CLYTHE CREEK
SUBWATERSHED OVERVIEW

Prepared for

Metrus Developments Inc.
Suite 2003, 1700 Langstaff Road
Concord, Ontario L4K 3S3

Prepared by

ECOLOGISTICS LIMITED
490 Dutton Drive, Suite A1
Waterloo, Ontario N2L 6H7

In Association with

Blackport and Associates
P.O. Box 28062
Parkdale Postal Outlet
Waterloo, Ontario N2L 6J8

25TH Anniversary
CELEBRATING 25 YEARS OF ENVIRONMENTAL EXCELLENCE

Updated April 1998

November 6, 1997

THE CITY OF
Guelph

PLANNING & BUSINESS DEVELOPMENT DEPARTMENT
PLANNING DIVISION
City Hall, 59 Carden Street
Guelph, Ontario, Canada N1H 3A1
Telephone: (519) 837-5616 Fax: (519) 837-5640

January 15th, 1998.

Mr. R. S. Hannah,
Planner.

Dear Scott:

Re: Clythe Creek Subwatershed Overview

At a meeting of the Environmental Advisory Committee, held on Wednesday, January 14th, 1998, the following resolution was passed:

"THAT the Environmental Advisory Committee recommend approval of the Clythe Creek Subwatershed Overview dated November 6th, 1997, as amended by submission dated January 1998, subject to:

a) Page 49 c (Recommendation #3), - second paragraph - reference the E.I.S.

b) Page 55, 1st line - use the words "potentially sensitive recharge/discharge area" in place of "significant groundwater" (be consistent with the wording).

c) Page 55 - bottom - save and except for standard mitigation techniques, etc.

d) Consider another step in the flowchart process.

..../2

e) Include a line on Figure 8 which represents the delineation of the corridor."

Yours truly,

Ruth Dempsey,
on behalf of the Environmental Advisory Committee.

rd

c.c. Mr. David Stephenson
Ecologistics Limited
490 Dutton Drive, Suite A1
Waterloo, ON N2L 6H7

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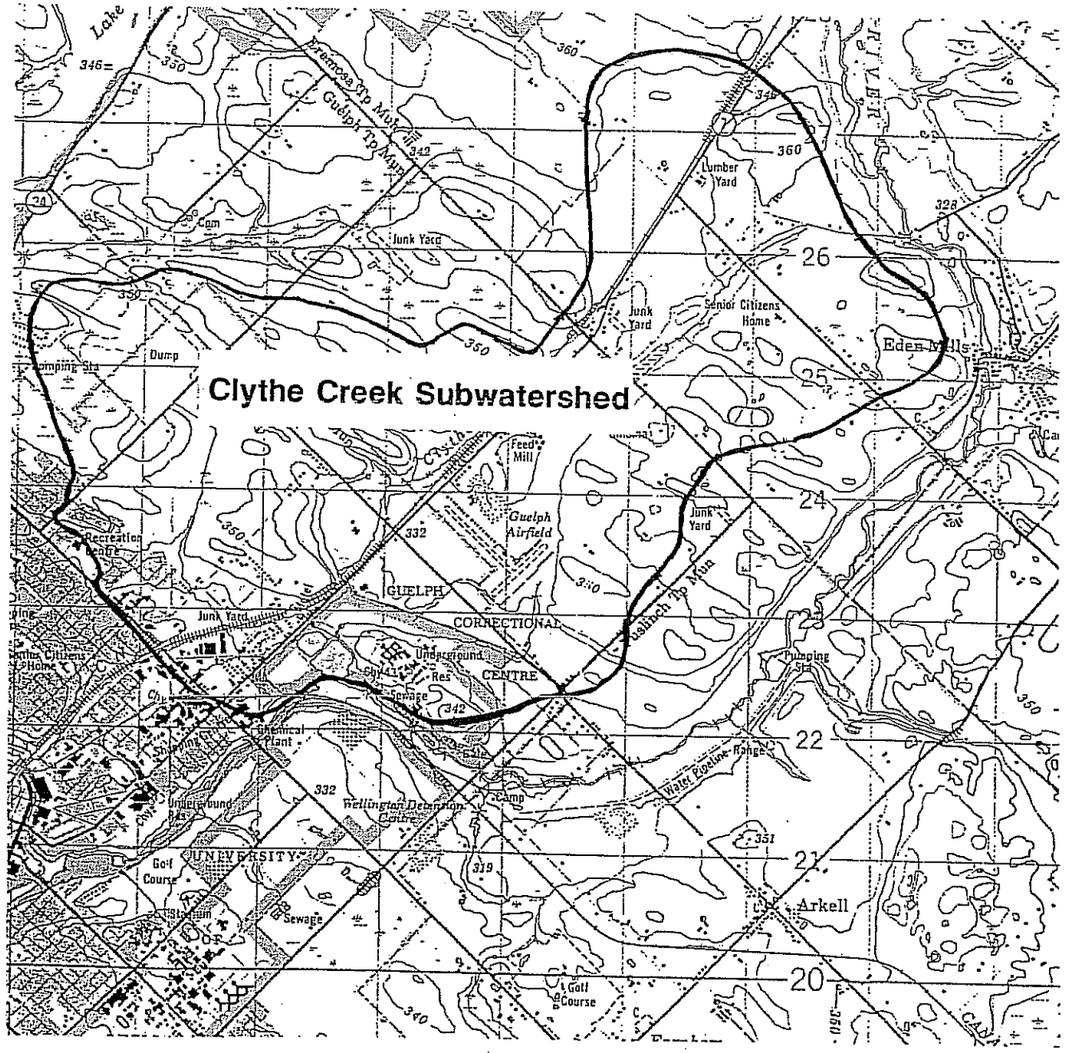
1.0 INTRODUCTION

1.1 Background

The Clythe Creek subwatershed drains a portion of the north east corner of the City of Guelph and adjacent township lands (see Figure 1). This area is currently experiencing a range of development pressures. Several studies on environmental, geotechnical and stormwater management issues have been completed in the vicinity of the Clythe Creek subwatershed and the Eastview Planning Area. A listing of these studies is included in Section 9 of this report. The City of Guelph Planning Department requires that for any development in this area, the proponent must consider the goals and objectives outlined in Policy 3.2.24 of the City of Guelph Official Plan. This policy provides specific guidance on issues related to groundwater recharge and stormwater management for development in the Clythe and Watson Creek drainage basins as follows:

"It is the policy of the City to encourage groundwater recharge and Storm Water Management Practices for storm water run-off in the design of new subdivisions in the area affected by the Eastview Secondary Plan. The following information may be required to be submitted in conjunction with the new subdivision applications submitted in the area affected by the Eastview Secondary Plan and shall specifically be required in the area listed in Policy 3.2.24.1:

a) *Detailed grading and drainage plans showing existing and proposed grades and drainage;*
b) *Geotechnical and hydrogeologic information to identify infiltration potential, to local and regional aquifers, of the site and surrounding area;*
c) *Detailed storm water management plans, including the manner in which storm water will be conveyed from the site and conducted to a receiving waterbody, and any storm water management techniques that may be required in accordance with the Approved Master Drainage Plan for the area;*



Map Source: NTS 1:50,000 Guelph 40 P/9

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Figure 1.

Key Plan

d) Erosion and sedimentation control measures to be employed both during and after construction, including their required maintenance. These plans should indicate a means whereby exposed soils, sediments and eroded materials will be retained on site during all phases of construction and should be in accordance with current Storm Water Management Practices;

e) The potential impacts of the proposed storm water management techniques on the water quality of the receiving waters in terms of, but not restricted to, water temperature, base flow and fisheries potential, including recommendations on how any potential impact will be mitigated;

f) The potential impacts in terms of quality and quantity of any proposed storm water management techniques on the regional aquifer and/or any municipal water sources connected to the affected aquifer;

g) Information required by Policy 3.2.24 (a) through (f) inclusive, shall be submitted to the satisfaction of the City, the Grand River Conservation Authority, the Ministry of the Environment and Energy and the Ministry of Natural Resources, prior to any plan of subdivision being considered for approval in this area.

3.2.24.1 Policy 3.2.24 shall apply to lands proposed for development within the Clythe and Watson Creek drainage shed as generally identified on Schedule "2".

Guelph Grange Hill Development Limited proposes to develop a 167 ha parcel of property in the eastern part of the City of Guelph for the purposes of providing opportunity for a variety of residential housing, support services, and some industrial facilities. The proponent retained the services of Ecologistics Limited to undertake environmental studies related to the proposed undertaking. Additional development proposals are underway in this area, including a development immediately upstream (east) of the Grange Hill lands. The Grand River Conservation Authority (GRCA) and the City of Guelph Planning Department (the City) outlined their expectations as to the level of detail to be included in such studies. There was a concern on the part of the agencies that a typical Environmental Impact Study (EIS) would focus too narrowly on site specific issues and that larger scale, subwatershed level analysis might not occur.

The City of Guelph requested that the proponent undertake a study that would examine issues at a broader subwatershed level, and would provide general guidelines to assist in the

protection of resources, including those which transcend the boundaries of site specific development proposals. The "ground rules" developed as part of the subwatershed level review would become instrumental in directing site specific EISs, and would assist in the analysis of future development. This report was produced to serve this purpose.

Prior to starting work on this project, meetings were held with the City of Guelph, Ministry of Natural Resources and the Grand River Conservation Authority to obtain input into the approach of this report as well as to collect background information on the study area (January 16, 1997). A draft table of contents was drawn up and presented to the City of Guelph Environmental and Ecological Advisory Committee (EEAC) on May 14, 1997. EEAC reviewed the table of contents and made some additions. This report is based on the revised table of contents.

1.2 Study Area

The study area includes Clythe Creek and two of its tributaries, Watson Creek and Hadati Creek. For the purposes of this report, the entire study area is referred to as the Clythe Creek subwatershed.

The study area for this report was based on the subwatershed limits for the Clythe Creek system (see Figure 1). This boundary was delineated using topography from 1:10,000 scale OBM mapping. Clythe Creek flows into the Eramosa River just south of Highway 7 (York Road) and east of Victoria Road.

The Clythe Creek subwatershed is approximately 21 km^2 in area. It is dominated by agricultural and built up lands. Woodlots in the study area are primarily small and isolated consisting of a mixture of deciduous species. Conifer plantations are fairly common. Clythe Creek is considered a cold water stream with a band of wetland vegetation found along its length. The abundance of groundwater, near or at the ground surface, in this watershed plays a key role in influencing the composition and distribution of vegetation in the watershed.

2.0 GOALS AND OBJECTIVES

The goals for the Clythe Creek subwatershed relate to the City's objectives for natural heritage features.

The City of Guelph's policies for natural heritage features are intended to identify and provide a level of protection for special or unique natural features in the City (City of Guelph 1997, Section 3.3).

The City defines natural heritage features as the following: Areas of Natural and Scientific Interest, Wetland Resource Areas, Forest Resources, Natural Corridors and Linkages, and Habitat of Vulnerable, Threatened and Endangered Species.

Objectives

a) *To recognize and identify existing natural features in the City that should be preserved.*

b) *To incorporate those recreational and educational opportunities that are unique to natural areas into the urban form and structure.*

c) *To preserve and protect land with unique or environmentally significant natural features and ecological functions.*

d) *To maintain and enhance natural river valleys, vistas, and other aesthetic qualities of the environment.*

e) *To protect wetlands, forested areas, and the habitat of rare species.*

f) *To promote the continued integrity and enhancement of natural features by interconnecting these features with natural corridors and linkages.*

Based on the City's objectives, the specific goals of this study are to provide direction to future land use decisions in the subwatershed to:

- maintain and enhance (where feasible) wetlands, watercourses, and terrestrial resources, and

- maintain and enhance hydrogeological characteristics of the area.

This will be achieved based on the following tasks:

- complete an overview of existing conditions in the Clythe Creek subwatershed including land use, soils and topography, groundwater resources, upland vegetation patterns, wetlands, wildlife, rare species and aquatic resources;

- document the significance of the natural resources in the study area based on the current status lists for plants, wildlife and birds and to determine the significance of the Clythe Creek wetland community,

- determine the sensitivity of the natural resources to the typical impacts associated with development, and

- based on the significance and sensitivity of the resources, establish guidelines for development in the subwatershed.

3.0 STUDY METHODOLOGY

3.1 Review of Background Information

A number of reports have been completed for the development of the Eastview Planning Area. These were reviewed for pertinent information on the biological resources in the Clythe Creek subwatershed. A list of documents is included in the reference section of this report.

Background information was also collected from the Grand River Conservation Authority who has conducted water quality sampling and aquatic habitat assessment in the study area as part of the Eramosa-Blue Springs Watershed Study, the Ontario Ministry of Natural Resources in Cambridge and the City of Guelph.

A review of published physiography, geology, aggregate resources and soils reports was conducted for the purpose of providing general information on soil characteristics within the study area.

Aerial photography for the subwatershed (1:8000, 1994) was collected and reviewed prior to the field survey. Vegetation units and land uses were mapped and described using these photos and then were refined and updated in the field.

The information on vegetation and land use in the study area was mapped onto 1:10 000 Ontario Base Maps. The maps produced for this report represent a compilation of data from our field surveys, review of other reports and wetland evaluation field maps from the OMNR. This presentation will differ from that in other reports but represents a composite.

3.2 Field Surveys

Field surveys of the study area were completed on May 1, June 4 and 17, July 28 and August 12, 1997 to map and describe land uses and biological resources. The surveys were a combination of field surveys and by touring all maintained roads within the study area and identifying the resources and land use. In areas where the adjacent lands were not visible from the road (ie: behind dense bush/trees/hedgerows or in areas of hummocky topography),

the features of the area were evaluated through a correlation of topographic maps, Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) Land Use System Mapping and aerial photographic interpretation.

3.3 Wetland Evaluation

Wetland communities had been delineated and described previously (Ecologistics Limited 1992b) and updated by the Ministry of Natural Resources (1994). This data was used in conjunction with field surveys, background information and air photo interpretation to create wetland mapping suitable for the completion of a wetland evaluation. The special features component of the third edition of the Ontario Wetland Evaluation System Southern Manual (1994) was used as a preliminary assessment of the potential of the wetlands in this subwatershed being provincially significant. A complete wetland evaluation was not conducted as part of this study.

4.0 FINDINGS

4.1 Regional Context

The Clythe Creek subwatershed is located in the northeast corner of the City of Guelph. The creek is a tributary to the Eramosa River. The subwatershed is located between the Eramosa River and the Guelph Northeast Wetland Complex. The study area is primarily agricultural land located in the Guelph Drumlin Field physiographic region. To the south and east is the Eramosa River valley. The river valley from downstream of Eden Mills upstream to north of Brisbane has been identified as an Environmentally Sensitive Area (Eagles *et al.* 1976). Upstream of Rockwood, the valley is also designated an Area of Natural and Scientific Interest (Klinkenberg 1984).

The Eramosa River valley system consists of wetland areas, a gorge with near vertical cliffs and meandering portions through loam soils. The river is characterised by high quality sections of braided stream, gravel terraces, rapids and limestone potholes. A high diversity of wetland vegetation including cedar swamp, alder thickets, deciduous swamp, wild rice marshes and cedar islands are found as well as upland deciduous forests, meadows and old fields. Rare species of flora and fauna are found including the vulnerable west Virginia white butterfly (MNR 1996, Klinkenberg 1984).

To the northwest of the Clythe Creek subwatershed is the provincially significant Guelph Northeast Wetland Complex (MNR 1989).

There are no environmentally sensitive areas in the Clythe Creek subwatershed.

4.2 Soils and Hydrogeology

A general overview of the soils within the study area was conducted through a review of the Soil Survey of Wellington County (Hoffman *et al.* 1963) and correlated with the Physiography of Southern Ontario (Chapman and Putnam 1984).

The overview of the study area revealed the complex nature of the soils hydrostratigraphy and topography. The study area is located within the Guelph Drumlin Field physiographic

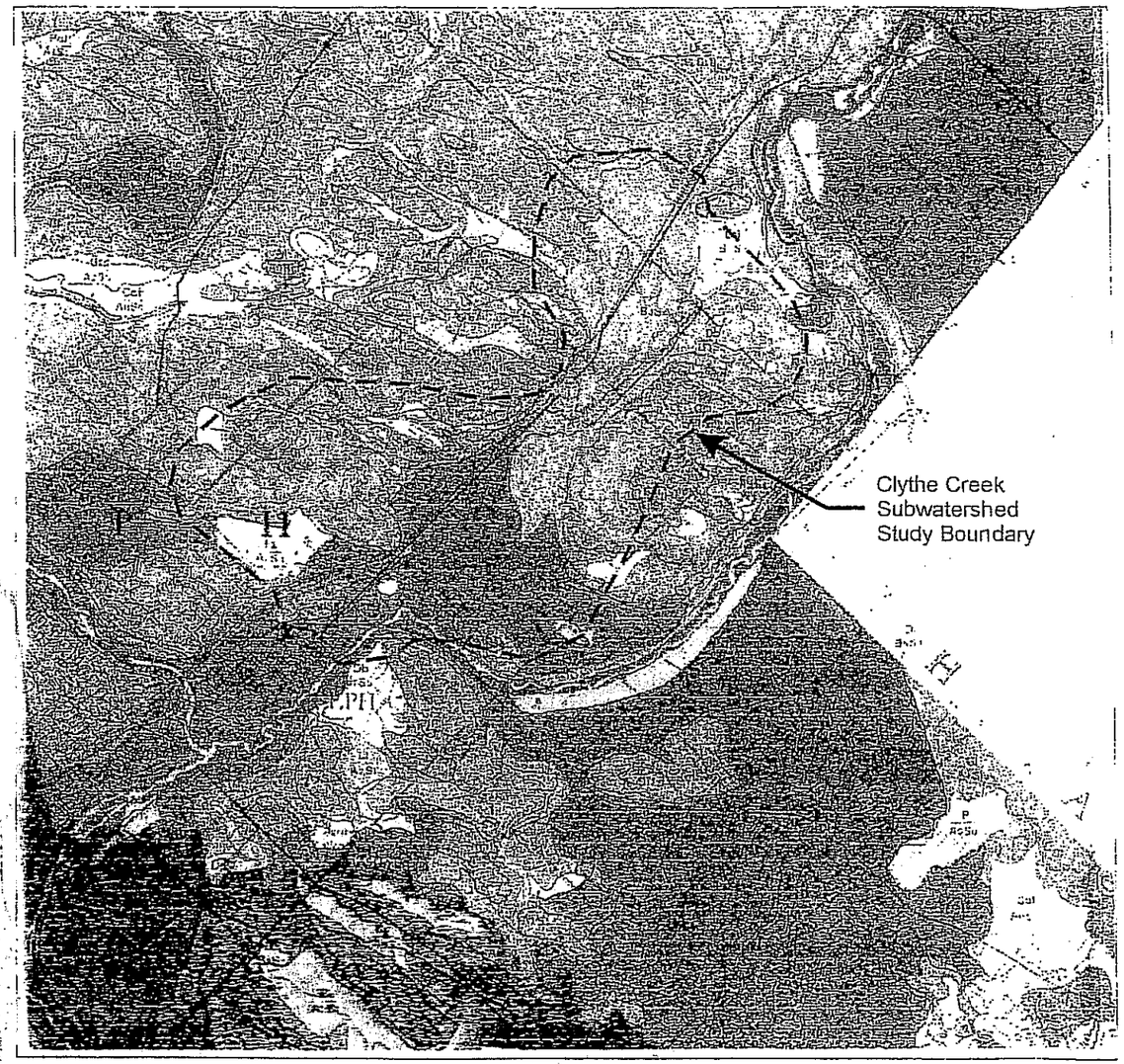
region. This physiographic region is characterized and named for the numerous drumlins that dominate the local area. Generally, the topography is a combination of small hills with gently sloping sides and low, level areas between the hills. The drumlins, and the plains in between, consist of a sandy to silty till. The lower areas are dominated by surface waters, either through small streams/creeks or marsh/wetland areas. The drumlins occur in groupings and generally tend in a west-northwest direction. The watercourse channels are infilled with deposits of sand and gravel. Several discontinuous eskers are found crossing the area (Braun Consulting Engineers and Jagger Hims Limited 1991).

Soils of the area range from till materials to vast sand and gravel deposits. The dominant soil series is the Guelph loam. The Guelph soil series is a loam till material. The soils in the study area are shown in Figure 2.

Within a hydrogeological context, the quaternary geology (Karrow 1968, See Figure 3), the overburden thickness (Vos 1969) and the bedrock topography (Karrow 1979) were reviewed to provide an overview of the groundwater flow system, the potential linkages to the surface water receptors and the potential for groundwater contamination and groundwater availability.

The quaternary geology map provides a general delineation of the surficial geological units. This information is used to assess the potential for precipitation to recharge and groundwater to discharge, depending, in a large part, on the permeability of the surficial unit. The overburden thickness can provide information on the potential for a layered overburden system and the potential for hydraulic connection to the bedrock.

The upper bedrock generally consists of the fractured Guelph Formation dolostone and has a relatively high permeability. Horizontal flow within the upper bedrock, and the subsequent potential for discharge to the local surface water features, will be controlled to a greater extent by the bedrock topography. The bedrock topography within and adjacent to the subwatershed likely presents groundwater flow within the upper bedrock which is generally directed toward, and along the main Clythe Creek channel. Portions of upper bedrock groundwater flow are likely directed into the subwatershed along the north-east and north-central boundaries and out of the subwatershed along the west and south-west boundaries. Groundwater flow directions are discussed in more detail in Section 6.0.



Basemap Source: Soil Map of Wellington County South Sheet 1:63360

Legend

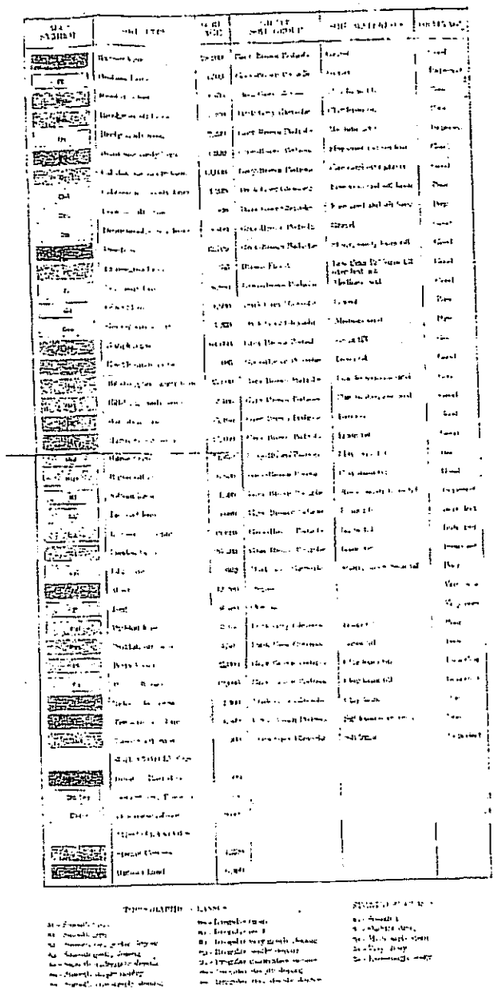


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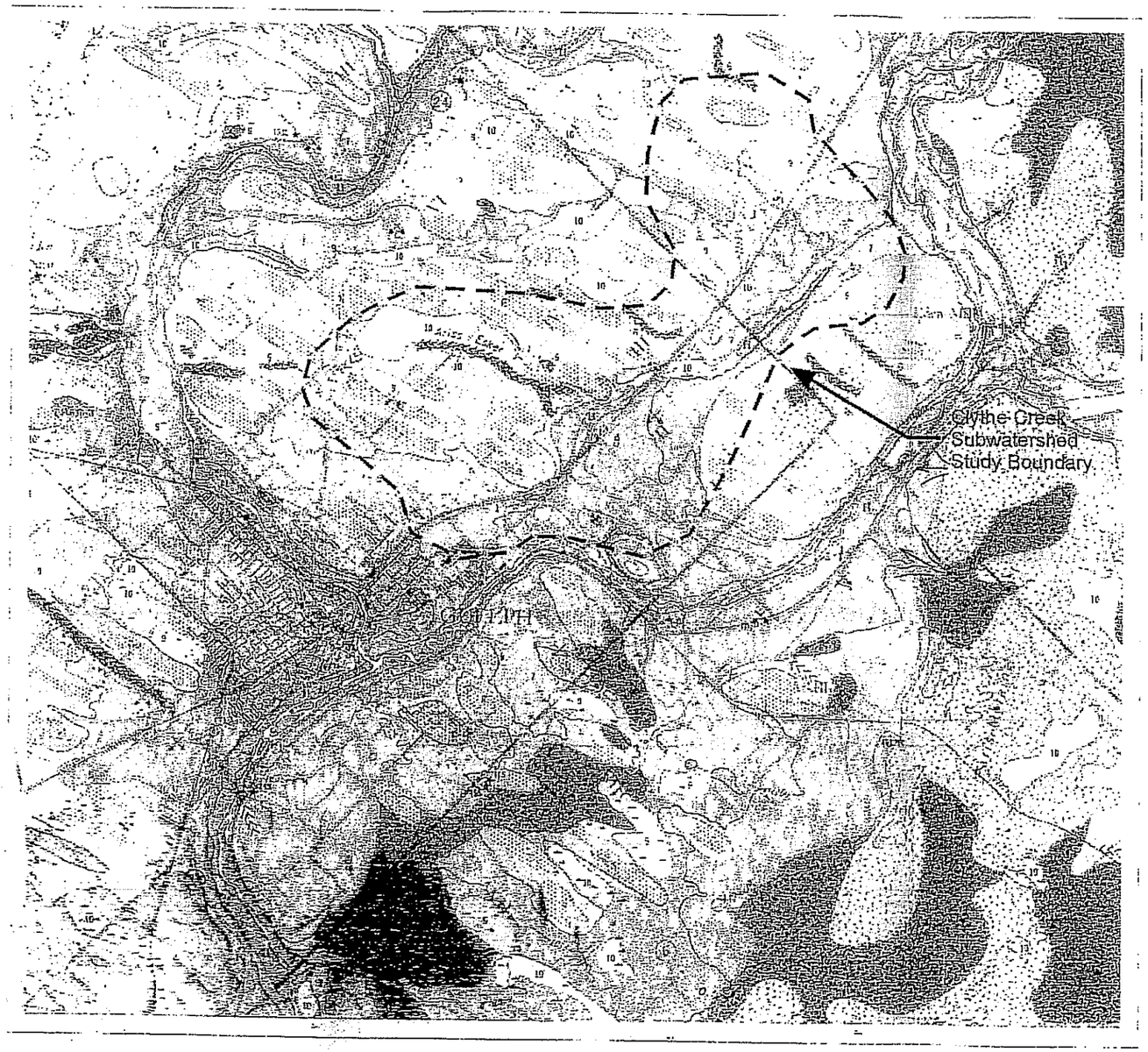
Figure 2.

Soils



Map Source: Map 2153 Pleistocene Geology of the Guelph Area

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CENOZOIC

PLEISTOCENE

RECENT

Modern alluvium: Gravel, sand, silt.

10 Swamps and bogs: Peat, muck, marl.

WISCONSINAN

Lacustrine: Sand and gravel

Pond deposits: Silt and clay

Outwash: gravel

Kames and eskers: Sand and gravel

WENTWORTH TILL: Soft or firm sandy till

Northern till: Clayey sandy till

Middle (?) Brown clay till

CATFISH CREEK TILL: Clay, silty, sandy till.

PALEOZOIC

SILURIAN

ALDERSHOT GROUP

Guelph Formation: Dolomite.
Amabel Formation: Dolomite.

Bedrock only is shown where overlain by thicker till and not shown separately.

Paleozoic formations are covered by thin, patchy till.

Deposits on bedrock are mapped where more than three feet or more in thickness. Thinner deposits are not shown.

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Figure 3.

Quaternary Geology

A large portion of the subwatershed is covered with a sandy till which originally was identified as the Wentworth Till and was re-identified as the Port Stanley Till. The extent of the silt and clay content of the till is a major factor in controlling the permeability and recharge rate. This till may be very sandy in some areas and can lead to reasonable recharge rates, especially in areas of hummocky topography where closed basins occur. The Port Stanley Till is the youngest till and in areas where the overburden thickness is significant it is generally underlain by older less permeable tills.

The younger outwash sands and gravels, and the kame and esker sands and gravels are commonly underlain by the lower permeability tills where the overburden thickness is greater. Where this occurs the majority of the recharging groundwater is expected to move through a more localized shallow groundwater flow system and discharge within, or immediately adjacent to the sand and gravel deposit. A lesser component of the recharging water will still migrate to depth, within the overburden and to the bedrock. In the south central area where outwash sands and gravels exist and the overburden thickness is thin there is a good potential for hydraulic connection to the upper fractured bedrock. In this case the permeable overburden and the upper bedrock may act as one hydrogeologic unit.

The contaminant susceptibility within a particular hydrogeologic setting will be dependent to a large degree on the permeability of the surficial unit and the hydraulic connection with the receiving aquifer. In the case of an esker or kame which is underlain by a less permeable till, the potential for local contamination within the esker is high, but the potential for contamination to the bedrock aquifer below the till is very low. Alternatively sands and gravels directly on bedrock, or bedrock at ground surface provides a significant pathway for groundwater contamination.

It is noteworthy that the main aquifer within the subwatershed is the underlying bedrock although there are overburden wells within the overburden that can provide sufficient quantities of water for domestic purposes. The bedrock aquifer resources for the subwatershed below the Guelph/Eramosa townline is discussed in detail in the Groundwater Resource Study, City of Guelph, Northeast Quadrant (Jagger Hims Ltd. 1995).

A conceptual understanding of the potential recharge and discharge areas and significance of hydraulic connection is important in assessing the potential impacts on groundwater levels from a reduction in recharge and groundwater withdrawal. Potentially sensitive

recharge/discharge areas are presented on a general scale based primarily on the permeability and thickness of overburden (Figure 4).

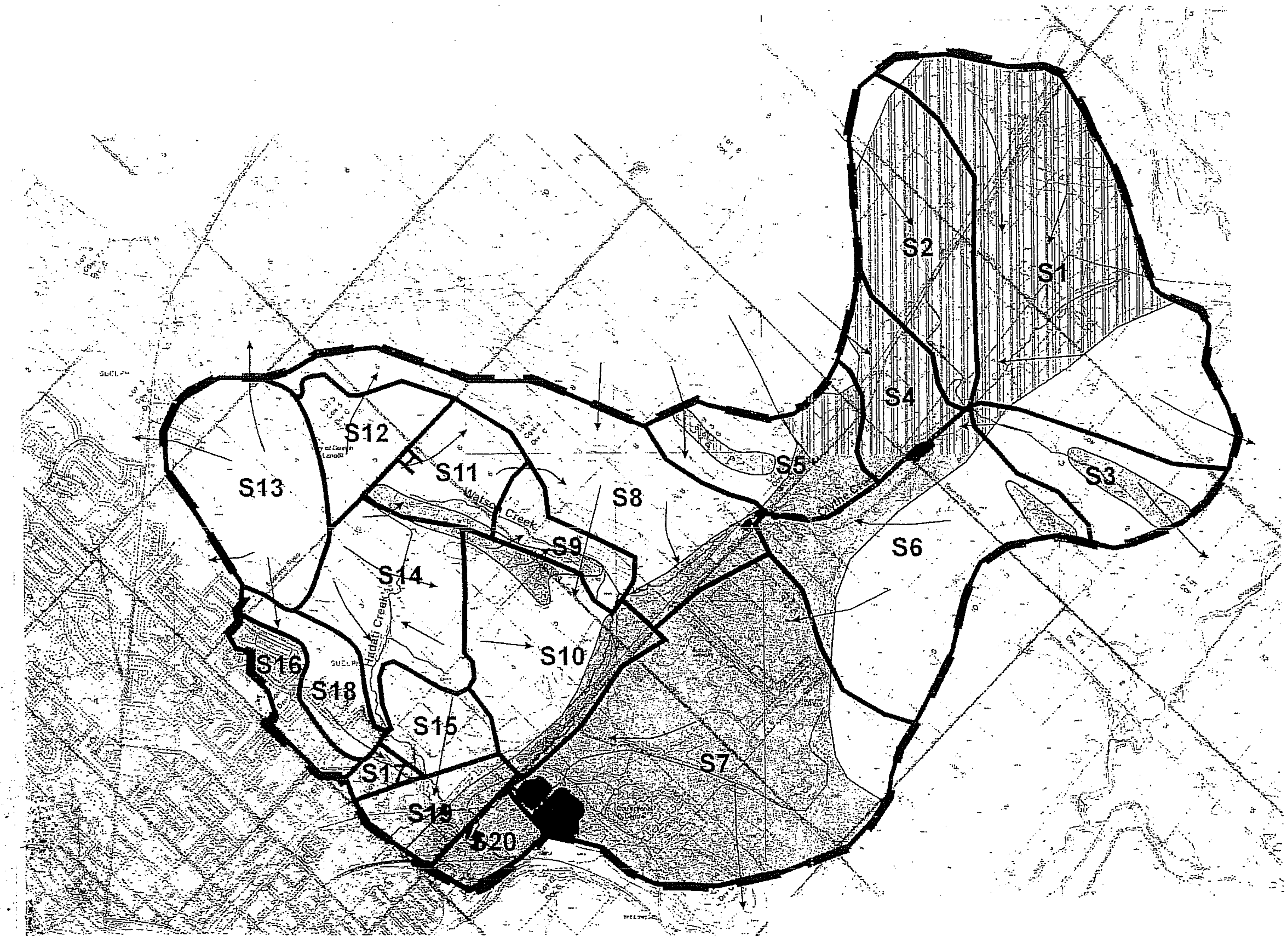
A preliminary quantification of recharge and discharge within the subwatershed was attempted based on spot stream flow data collected during December 1995 for the Blue Springs - Eramosa study. Spot flow measurements along Clythe Creek at the Guelph/Eramosa Townline and just downstream of Watson Road showed base flows of 17.7 l/sec and 101.0 l/sec respectively. The measurements provide a crude estimate of baseflow in the creek although it would be more appropriate to carry out a baseflow recession analysis from continuous stream flow data over a long period of time, but this data is not available. Based on the upstream catchment areas recharge rates of approximately 12 cm/year and 20 cm/year would be necessary to provide this baseflow. It is expected that the recharge rates within the permeable overburden are on the order of 20-30 cm/year and within the sandy till on the order of 15 cm/year. The analysis tends to confirm the approximate recharge and discharge for the Watson Road area. The upper reach recharge values appear low based on the baseflow measurement which is generally indicative of groundwater flow traversing the subcatchment boundaries without discharging directly in the upper reaches.

Detailed conceptual hydrogeological settings are presented for the subcatchment areas in Section 6.0.

4.3 Land Use

Figure 5 illustrates the general land use within the study area.

The land use within the study area is a mixture of agricultural and non-agricultural usage. Non-agricultural land uses were mapped during the surveys, including built up areas (consisting of industry, residential/housing, government facilities and waterbodies), pits and quarries, airports, landfill sites, disturbed areas, areas of construction, and recreational facilities. The majority of the non-agricultural usage is located in the western section of the watershed and is associated with the City of Guelph limits. These non-agricultural land uses include residential units, landfill, airport, government facilities and industrial lands. Much of the non-agricultural land use, in particular the residential units, are configured as linear development adjacent to some of the major roads.



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Subwatershed Boundary

Subcatchment Boundary

Potential Groundwater Flow Pathways

Potentially Sensitive Recharge/Discharge Areas

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Figure 4

Groundwater Characterization

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Subwatershed Boundary

LAND USE

Built-up Area
C Cultivated
D Disturbed Land
F/P Forage/Pasture
G Grain Crop - Wheat/Barley/Oats
I dle Land
PIT Aggregate Extraction
UC Under Construction Residential developme t under construction
Landfill Guelph City Landfill

Natural Area

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Figure 5.

Land Use

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4.4 Biological Resources

4.4.1 Vascular Plants

A list of vascular plant species found in the subwatershed was compiled from a number of sources which included field observations during this study and previous studies by Ecologistics Limited, as well as a review of background reports and field notes which were prepared by others. A listing of plant species reported from the Clythe Creek subwatershed is included in Appendix I of this report.

A total of 170 species of plants have been recorded in the subwatershed. This list should be considered a preliminary list requiring updating as additional studies occur. There were no nationally, provincially or regionally rare plants reported in the study area. Forty-nine non-native species (29%) were recorded in the study area. This fairly high percentage is indicative of anthropogenic landscapes which result in the removal of natural vegetation and introduction of non-native species.

4.4.2 Vegetation

There are a number of site specific studies which have been completed in the subwatershed which describe vegetation communities in specific areas in the study area. The following provides a general overview of vegetation communities found in the subwatershed. These descriptions represent a compilation of field reconnaissance surveys and a review of background reports.

Upland Terrestrial Resources

The majority of the study area is active or idle agricultural land. There are many small wooded areas and hedgerows found in the study area. These are located primarily along property boundaries and backs of lots.

Woodlots in the Eastview Planning area were mapped and described by Ecologistics Limited as part of the Eastview Secondary Plan. Woodlot types found here included deciduous

swamp, mixed swamp, coniferous swamp, upland hardwoods, floodplain forest, shrubby swale, upland shrubs, orchards and plantations (Cumming Cockburn 1991).

The vegetation in the northeast corner of the Eastview Planning area was mapped and described as part of the Watson Creek Wetland EIS conducted by Ecologistics Limited (1992) for Metrus Developments. The upland vegetation units found in this area include cedar dominated woods. immature cedar-buckthorn-poplar woods, cedar-buckthorn-cherry-sumac ridge, poplar-buckthorn, poplar stand, willow trees, small cedar trees, idle/old field, hedgerows and disturbed lands.

The vegetation communities which are described below are a compilation of data collected from the above reports as well as field observations and aerial photograph interpretation. Naturally vegetated upland areas have been classified as the following vegetation units and are mapped on Figure 6. These vegetation types represent approximately 218 ha, or 10% of the subwatershed area.

Old Field

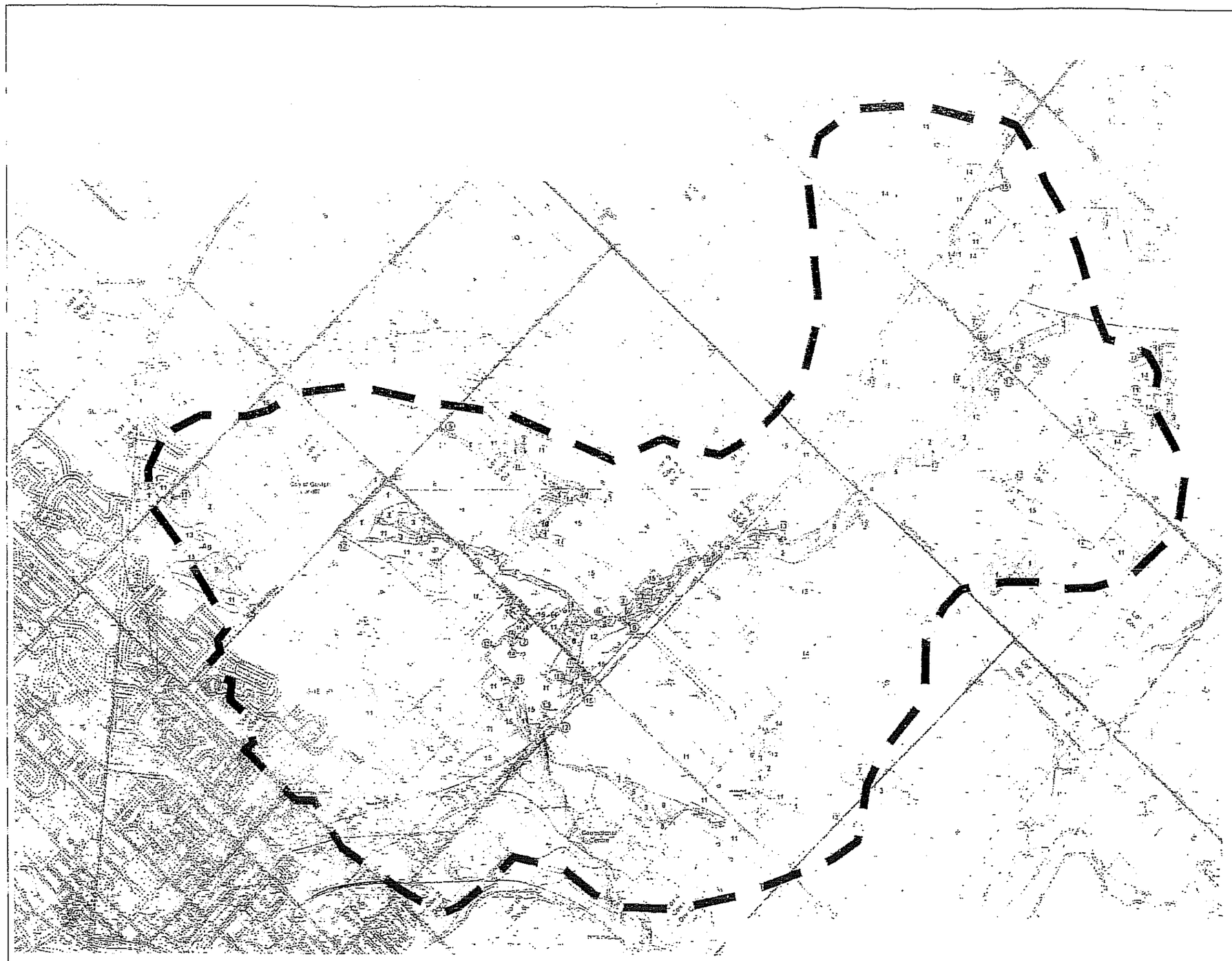
Almost half of the upland vegetation units in the subwatershed are dominated by old field community. These areas are typically agricultural lands which have been abandoned, roadsides or disturbed areas. Old field species include grasses, wild carrot, goldenrod, asters, clover and thistle.

Upland Scrub

These areas are dominated by an immature scrubby mixture of shrubs and small trees. Species found include hawthorn, poplar, willow, dogwood and ash. This type of community is found along the watercourse and late successional fields.

Cedar Dominated Woods

Much of the woods along the creek are dominated by white cedar. These areas total approximately 12.8 ha and consist of mixed age of stands and very densely spaced with a closed canopy. Little or no groundcover is typically found in these areas. These upland cedar areas often grade into cedar swamp communities along the creeks or other low lying areas.



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Subwatershed Boundary

VEGETATION UNITS

WETLAND COMMUNITIES:

1 Deciduous Swamp
2 Cedar Dominated Swamp
3 Tall Shrub Swamp
4 Alder/Aspen Swamp
5 Cattail Dominated Marsh
6 Reed Canary Grass Marsh
7 Wet Meadow
8 Dead Tree Swamp
9 Submergent Marsh
10 Seasonal Wetland

UPLAND COMMUNITIES:

11 Old Field
12 Scrub
13 Cedar Dominated Woods
14 Mixed Deciduous Woods
15 Coniferous Plantation

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Figure 6

Vegetation Communities

ecologistics limited

consultants in environmental management

Mixed Deciduous Woods

There are a number of small woodlots found in upland areas which are composed of a mixture of deciduous species. Sugar maple, white ash, American beech and others such as black cherry, ironwood and birch are characteristic of these stands, which total approximately 28.7 ha.

Conifer Plantations

The planting of conifers on idle agricultural land is fairly common in the study area with plantations of a variety of ages being found in the subwatershed. The total area of plantations in the subwatershed (approximately 48.7 ha) is greater than the combined total of other wooded stands. Plantations are mainly red pine, white pine and/or Scots pine.

4.4.3 Wetland Resources

The wetlands in the subwatershed consist of bands of vegetation along the watercourses as well as vegetation communities which have developed in the low lying areas between the ridges of the drumlins.

Wetlands in the study area have been described in previous reports (Ecologistics Limited 1992a, 1992b, 1993, 1997, Geomatics International Inc. 1994) and have also been mapped in detail by the Ministry of Natural Resources (1994).

The wetland communities which are described below and mapped on Figure 6 are the result of a compilation of the above sources of data, supplemented by reconnaissance level field surveys conducted as part of this study. A total of approximately 156 ha of wetland, consisting of 121 ha of swamp and 35 ha of marsh were found in the subwatershed. This represents approximately 7.4% of the subwatershed area.

Deciduous Swamp

Lowland wooded areas are characterized by tree species which are tolerant of high water levels in their environment. Species found here include red/silver maple, black ash, white elm and poplar as well as willow and dogwood. This wetland community type

totals approximately 44.4 ha in the area, and represents 28% of the wetlands in the subwatershed.

Cedar Dominated Swamp
Much of the wooded swamp areas along the creek are dominated by white cedar. This wetland community type is the most abundant in the subwatershed, totalling approximately 60.2 ha, or 38.6% of the wetlands in the study area. These areas are almost exclusively cedar and the trees form a dense canopy. Other species are less commonly found but include poplar, elm and dogwood.

Tall Shrub Swamp
Some flooded areas are vegetated with dense thickets of small trees and shrubs. Dogwood, elder, willow and buckthorn make up this community. Groundcover includes joe pye weed, aster, beggarticks and boneset.

Alder/Aspen Swamp
There is a pocket of swamp which is dominated by speckled alder, silver maple, elder and trembling aspen. This low shrub community is flooded by runoff from the adjacent road and railway.

Cattail Dominated Marsh
Cattail dominated marsh is found along the creek in areas of fluctuating water levels. Other species found in this community include jewelweed, boneset, sedges, nightshade and reed canary grass.

Narrow Emergent Marsh
Marsh dominated by narrow emergents, mainly reed canary grass, is found commonly throughout the study area. Bulrushes and sedges are also found here. This community is found in areas of seasonal flooding.

Wet Meadow
Several areas along the creek which are inundated in the spring support wet meadow vegetation. This type of community is characterized by joe pye weed, aster, sensitive fern, sedges, jewelweed, nightshade, boneset, sedges and horsetail.

Dead Tree Swamp

High water levels for prolonged periods of time have resulted in the death of trees in at least two locations in the subwatershed. These areas are characterized by standing dead trees, conifers and deciduous trees, tall shrubs and some herbaceous ground cover.

Submergent Marsh

Small areas of open water are found along the creek system as well as large ponds found adjacent to the correctional centre. These ponds contain submergent vegetation such as algae and pondweed.

Seasonal Wetland

There are some areas which are seasonally flooded, resulting in wetland conditions. These areas are primarily unvegetated but some tall shrubs such as willows and reed canary grass are also found in these areas.

Much of the wetland vegetation which was found along Hadati Creek (Ecologistics Limited 1992b, 1993) has been removed as the area is being developed into residential housing. This is shown on Figure 5 as Developed Lands.

4.4.4 Wildlife

Birds

A list of bird species for the watershed was compiled from field observations, species lists from other reports and a search of the Atlas of the Breeding Birds of Ontario. The Atlas is based on observations reported from a 10 km x 10 km square. Since some of the species listed from this square may be from outside of the subwatershed, this information should be used with caution only as a guideline of potential occurrence. This list has been included in this report in Appendix II.

A total of 57 species of birds have been reported in the study area. Most of these species are expected to breed in the study area.

One provincially threatened species has been reported in the study area; the least bittern (MNR 1994). The least bittern is found in freshwater marshes, marshy areas, ditches and

creeks. It makes its nest in standing vegetation such as cattails, bulrushes, common reed grasses and sedges. The least bittern is usually found in marshes greater than 2 to 5 ha, indicating that it is area sensitive.

The Atlas of the Breeding Birds of Ontario (Cadman *et al.* 1987) revealed that there are four significant species as defined by Sutherland (1994a) known from this study area in addition to the least bittern. They are as follows:

- red-shouldered hawk — provincially rare
- northern bobwhite — provincially threatened
- Henslow's sparrow — provincially endangered
- western meadowlark — no status

Red-shouldered hawk is listed as provincially rare which is defined as "any species of fauna or flora which is represented in Ontario by small but relatively stable populations, and/or which occurs sporadically or in a very restricted area of Ontario, or at the fringes of its range, and which should be monitored periodically for evidence of a possible decline". The red-shouldered hawk nests in heavily forested riparian areas, wet and mesic deciduous woodlands, flat floodplain forests and swamp woodlands. It is usually found in large, forested tracts, but nests have been found in woodlands as small as 4 ha (Austen *et al.* 1994). Possible habitat for the red-shouldered hawk may be found to the south of our study area along the Eramosa River.

The northern bobwhite is listed as provincially threatened which is defined as "any indigenous species of fauna of flora which, on the basis of the best available scientific evidence, is indicated to be experiencing a definite non-cyclical decline throughout all or a major portion of its Ontario range, and which is likely to become an endangered species if the factors responsible for the decline continue unabated". The northern bobwhite was originally a bird of savanna/prairie edge habitats. Since the settlement of southern Ontario, the species has adapted to the agricultural landscape and typically occupies areas with grassland, cropland and bushy cover in close proximity to one another. Grasslands provide nesting cover, while thickets and shrubs provide shelter and food. This bird is not likely to occur naturally in our study area (Kirk personal communication 1997).

Henslow's sparrow is a provincially endangered species. This designation refers to "any species of fauna or flora which, on the basis of the best available scientific evidence, is indicated to be threatened with immediate extinction throughout all or a significant portion of its Ontario range." Henslow's sparrow is found in open habitats that contain tall dense grass and herbaceous vegetation with few of no woody shrubs and trees (e.g., upland weedy hayfields or pastures, wet meadows, and grassy fields). Henslow's sparrow benefited from the clearing of forests and creation of grasslands by early settlers. The loss of pastures and old fields to more intensive agriculture and development as well as disturbances to nesting colonies has lead to the decline in the population. Henslow's sparrow requires large areas of suitable habitat (at least 10 to 30 ha) because it is an area sensitive species. There are very few pairs of this species known to nest in the province and no substantial records exist in this area for approximately 18 years (Kirk personal communication 1997).

The western meadowlark is a significant species which has no designated special status (Austen *et al.* 1994). The species is considered to be uncommon in southern Ontario with a fairly stable population in northwestern Ontario. The western meadowlark is found in prairies and grasslands, agricultural fields, meadows or other similarly dry, open grassland areas. It prefers drier uplands rather than moist lowlands preferred by the eastern meadowlark. The western meadowlark's occurrence in this area is likely due to its adventive nature and the increase in suitable habitat (Kirk personal communication 1997).

Mammals

A total of 9 species of mammals have been reported from the study area. This list includes species which were observed during field surveys, as well as species documented in the study area from other reports. A search of the mammal atlas was also completed (Dobbyn 1994). A list of these species is included in this report in Appendix III.

One of the species reported from the study area in the Mammal Atlas, the smoky shrew (Dobbyn 1994), is provincially significant (Sutherland 1994b). The smoky shrew is found in birch and hemlock forests with a deep layer of leaf mold on the ground. No hemlock and birch forest habitat was found in the study area which suggests that the smoky shrew is unlikely to be found.

Reptiles and Amphibians

Twenty-one species of reptiles and amphibians have the potential for occurring in the study area. A list of herpetiles is found in this report in Appendix IV. This list was compiled through field surveys, review of background reports and information from the Ontario Herpetofaunal Summary (1985) and requires future verification. One provincially significant species, Jefferson's salamander (complex undetermined), was recorded in the study area in the Herpetofaunal Summary (Oldham 1994b).

The Jefferson salamander spends most of its life underground taking shelter beneath boards, logs and stones, however they may wander on rainy nights. Breeding occurs after spring rains when they congregate in numbers in woodland ponds and ditches. Habitat for this species is found in the study area and it is possible that it occurs here.

4.5 Aquatic Resources

The following is a general overview of aquatic resources in the Clythe Creek system. Information is organized by watershed; Clythe Creek, Watson Creek and Hadati Creek. Each creek is divided into reaches based on habitat characteristics. Typical characteristics such as width, depth, substrate and cover are also given for each reach in Table 1. the locations of the reaches are shown on Figure 6.

4.5.1 Clythe Creek

The Ministry of Natural Resources manages the Clythe Creek as a coldwater stream (Coulson personal communication 1997). It provides habitat for a range of fish species including brook stickleback, creek chub, blacknose dace, minnows, shiners and brook trout (GRCA 1995). A complete list of species is included in this report in Appendix V.

The upper reaches of the creek are fairly well vegetated and the creek channel is fairly natural. Dense cedar woods, swamp and marsh communities are found along the upstream portions of the creek. Towards Watson Road the creek is altered in several ways, there are ponds, open sections of creek, weirs and dams.

Table 1. Reach Characteristics for Clythe Creek (C), Hadati Creek (H), Watson Creek (W), and Un-named Tributaries (T).

REACH CHARACTERISTICS		Clythe Creek									
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Bankful Width	the width (m) of the channel at its fullest capacity	1.1	Not accessible	30	1.3	Ponded areas ~50 Channelled areas ~5	3	1.0	2.4	1 to 5	10 to 12
Depth of Channel	the depth (m) of the channel at its deepest point	0.10-0.12		<2	0.08-0.10	Ponded areas >2 Channelled areas ~0.25	0.25	0.09-0.10	0.24	0.5	0.5
Substrate Type	the characteristics of the material found on the streambed	Organic		Organic	Organic	Silt/organic	Organic	Gravel/organic	Silt/organic	Gravel and rubble, with thin organic layer	Silt/organic
Cover	the type and amount of vegetation found overhanging the stream	Dense jewelweed, cattails and occasional cedar		Mostly open water with cattails	Mainly cattails with scattered cedars	Herbaceous, lily pads around perimeter, red osier dogwood, cedars	Cattails, jewelweed, reed canary grass, areas of dense shrub	Herbaceous, open meadow, with small poplar/cedar stand	Dense shrub understor with willow trees	Mowed lawn	Dense shrub species, mixed herbaceous and occasional willow tree
Width of Riparian Zone	the width of the naturally vegetated areas adjacent to the creek	18-40	120	90	115	40	40-80	80	50	None	0-120
Channel Stability	channel and bank characteristics which indicate stability of channel including erosion, bank failure, etc.	stable		Stable	Stable, bank heights are low to nil	Stable	Stable	Stable	Stable, however some undercutting is evident	Stable	Generally stable but with some evidence of undercutting
Number of Bridge and Culvert Crossings	number of "breaks" in channel continuity from bridges, culverts, dams	1	0	0	0	3	1	0	0	13 Culverts, artificial water-falls and trickle-downs	3
Sinuosity	length of channel compared to linear distance from upstream to downstream limits of reach	1.32	1.09	1.33	1.14	1.1	1.27	1.25	1.08	1.43	1.3
Other Comments		Cool, clear water		Scattered stumps present	Open marsh, creek becomes braided through marsh	Overflow outlet in first pond, water very still, landscaped areas	Open marsh, channel is braided in areas	Meanders through ope meadow	Good shading, water is cool as it crosses under CNR berm	Occasional landscape tree, a few storm out-falls	Water very cloudy and slow flowing, lily pads & mergenis at confluence

Table 1(cont'd). Reach Characteristics for Clythe Creek (C), Hadati Creek (H), Watson Creek (W), and Un-named Tributaries (T).

REACH CHARACTERISTICS		Unnamed Tributaries			
		T1	T2	T3a	T3b
Bankful Width	the width (m) of the channel at its fullest capacity	Dry	Dry	Varying from 1 to 5	Not evident
Depth of Channel	the depth (m) of the channel at its deepest point			0.3	
Substrate Type	the characteristics of the material found on the streambed			Silt/organic	
Cover	the type and amount of vegetation found overhanging the stream			Landscaped trees and shrubs	
Width of Riparian Zone	the width of the naturally vegetated areas adjacent to the creek			None	
Channel Stability	channel and bank characteristics which indicate stability of channel including erosion, bank failure, etc.			Stable	
Number of Bridge and Culvert Crossings	number of "breaks" in channel continuity from bridges, culverts, dams			>5	
Sinuosity	length of channel compared to linear distance from upstream to downstream limits of reach				
Other Comments		Agricultural drainage feature	Agricultural drainage feature	Numerous dammed areas, piped sections and concrete channels (P21)	

Table 1(cont'd). Reach Characteristics for Clythe Creek (C), Hadati Creek (H), Watson Creek (W), and Un-named Tributaries (T).

REACH CHARACTERISTICS		Hadati Creek							Watson Creek			
		H1	H2	H3	H4	H5	H6	H7	W1	W2	W3	W4
Bankful Width	the width (m) of the channel at its fullest capacity	Dry	1	Dry	3 m concrete channel bed	Dry	3	1.8	Dry	Dry	Dry	Not accessible
Depth of Channel	the depth (m) of the channel at its deepest point		0.05		0.02 very little flow present		0.3	0.10-0.15				
Substrate Type	the characteristics of the material found on the streambed		Organic		Concrete	Silt and sand	Sand and silt	Sand/silt, algae growth				
Cover	the type and amount of vegetation found overhanging the stream	Grasses	Reed canary grass, Occasional shrub and some poplar		Grasses and weeds	None	None	Jewelweed, grasses, shrubs and occasional tree	Willow trees and shrub	Willow trees and shrub	Willow trees and shrub	
Width of Riparian Zone	the width of the naturally vegetated areas adjacent to the creek		Very little riparian area present	40 m riparian area left between houses	None	0-22	None	5		30	40	
Channel Stability	channel and bank characteristics which indicate stability of channel including erosion, bank failure, etc.	Stable	Stable	Unknown	Stable	Unknown	Low stability	Stable				
Number of Bridge and Culvert Crossings	number of "breaks" in channel continuity from bridges, culverts, dams	0	0	0	1	1	0	3	0	1	0	0
Sinuosity	length of channel compared to linear distance from upstream to downstream limits of reach		1.27	1.05	1.31	1.36	1	1.04		1.32	1.2	1.05
Other Comments		Road ditch along Eastview Road	Beaver pond at Eastview Rd, very little flow, dry down-stream	Runs through a newly developed residential area	This section has been channelized through new sub-division	Flow is blocked due to excavation for new subdivision	Excavated ditch whic drains subdivision to the north	Low to no water flow, a few piped sections, confluence with Clythe at HWY 7				Area of con-fluence very swampy

LEGEND

- Subwatershed Boundary
- Permanent Watercourses
- Intermittent Watercourses
- C1 ★ Reach (see text for description)
- S1 Subcatchment (see text for description)

PROJECT	DATE
769-03	November 1997
SCALE	DRWN/CHKD
1:29,000	MEG/DES

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Figure 7.

Aquatic Features
and
Subcatchments

ecologistics limited

consultants in environmental management

the CNR rail line and a driveway. This pond is smaller and is surrounded with trees and shrubs.

Downstream of the CNR crossing the creek flows through some open areas with a reduced natural riparian strip (40 to 80 m wide) and under Watson Road (Reach C6). Watson Creek joins Clythe Creek upstream of Watson Road. Herbaceous meadow vegetation dominates this portion of the creek and it is quite open with little cover. The channel is quite meandering with small dimensions. Organic material makes up the substrate.

Immediately downstream of Watson Road, the creek path appears to have been straightened (Reach C7). It runs through a abandoned agricultural field with little cover. The old field and small wooded stands provides a buffer of 40 to 80 m between the creek and active agricultural land and the CNR and Highway 7. Gravel and organic material make up the substrate.

A dense cedar stand is found downstream of Watson Road which provides good cover and cools the stream (Reach C8). Water temperature in this area was found to range from 14.5°C to 20°C in the months of July and August (GRCA 1995). Evidence of groundwater seepage is found here which supplements the baseflow and moderates water temperature. Summer flows in this area are around 0.006 m^3/s. The MNR has identified this area as an important invertebrate production area (Coulson personal communication 1997). Clythe Creek then flows under the CNR line and Highway 7.

Reach C9 of the creek has been altered significantly. It follows the south side of Highway 7 in a fairly straight path. The creek widens up to 5 m and is approximately 0.5 m deep. There are many culverts and dams along this portion. Cobbles line the bottom and mowed grass is found along the banks. Landscape trees provide occasional shady patches, but otherwise the creek is completely open in a park-like setting. Two large ponds and stormwater drains discharge into the creek here. Hadati Creek joins Clythe Creek just west of the intersection of Elizabeth Street and Highway 7.

Downstream of the confluence with Hadati Creek (Reach C10) the creek becomes wider and deeper with some ponded areas. It flows through a shrubby area with silver maple and willow trees alongside playing fields.

4.5.2 Watson Creek

Watson Creek is a tributary to Clythe Creek. It drains an area of approximately 103 ha (5%) of the Clythe Creek subwatershed. Watson Creek has a narrow riparian strip along part of its length and flows through an area which is pending residential development. It was divided into four reaches along its 2 km length. Watson Creek has its headwaters near a mixed swamp south of Eastview Road and the landfill and west of Watson Road (Reach W1). At one time the creek originated from the Guelph Northeast Wetland complex. The construction of the landfill resulted in flows to Watson Creek being diverted permanently to Hadati Creek (Ecologistics Limited 1992b). The creek flows through a disturbed gravel extraction area adjacent to the swamp. It then flows south east and under Watson Road and through some agricultural land (Reach W2). Cover along this portion of the creek is patchy, consisting of clumps of willows. These upper reaches of the creek are intermittent and were dry at the time of our field survey in August 1997. The five year flow in this area was calculated by Cosburn Patterson Wardman (1991) as 0.2 m^3/sec.

Reach W3 runs through active agricultural land. It has a buffer strip of deciduous secondary growth approximately 40 m wide. The creek then splits and flows through an open marsh and old field area (Reach W4) before joining Clythe Creek.

4.5.3 Hadati Creek

Hadati Creek is a tributary of Clythe Creek. It is approximately 3.3 km in length and was divided into seven reaches. The upstream drainage area of the creek is 390 ha or approximately 20% of the Clythe Creek subwatershed. Hadati Creek has been channelized along most of its length and runs through a developing residential area. Its upper reaches are located adjacent to the Guelph landfill.

Hadati Creek originates as a roadside ditch north of the landfill site. The creek is then piped for 400 m through the landfill (Cosburn Patterson Wardman 1991) where it emerges as a ditch along the north side of Eastview Road (Reach H1). The creek receives the diverted flows from the Guelph Northeast Wetland Complex which at one time flowed naturally into Watson Creek. This ditch was dry at the time of the 1997 field surveys and was overgrown with grasses. The ditch crosses under Eastview Road and flows south where it is ponded due to beaver activity (Reach H2). Very little flow was evident here. The five year flow for this

point was calculated to be 0.9 m^3/sec (Cosburn Patterson Wardman Limited 1991). Reed canary grass, poplars and shrubs lined the banks of this straightened section of creek. Downstream of the pond, the creek flows through a developing residential area (Reach H3). Much of the creek was dry and there is little vegetative cover. A field ditch tributary, which was also dry, joins the creek here. Reach H4 is a concrete lined straightened channel which continues downstream to Grange Road. The banks are dominated by mowed grass. Very little water was observed in the channel at the time of the field survey.

Downstream of Grange Road the channel is undergoing construction (Reach H5). A pool is formed just downstream of the road. This reach of creek has been excavated and the banks are bare soil. A small tributary joins the creek from the west and it also has been cleared of vegetation. The tributary meets Hadati Creek at the culvert under the CNR line where a small pool has formed.

Downstream of the rail line (Reach H6) the creek flows through an existing urbanized area. The channel is fairly straight with some natural vegetation such as jewelweed, grasses and shrubs. The riparian strip is very narrow and the creek receives flows from roadside ditches and from an urban area to the west. Downstream of Elizabeth Street five year flows increase to 7 m^3/sec (Cosburn Patterson Wardman Limited 1991). Hadati Creek joins Clythe Creek south of Highway 7.

4.5.4 Unnamed Tributary (T3)

An unnamed tributary flows from the south through the two large ponds by the Correctional Centre into Clythe Creek. Just upstream of the ponds, the creek varies in width from 1 to 5 m and is approximately 0.3 m deep. The substrate is organic material and silt and the channel is stable. There is no natural riparian strip, although a few landscape trees and shrubs are found along this reach. There are many dammed, piped and concrete lined sections along this reach. This tributary originates in a woodlot south of the Guelph Airport and is intermittent along most of its length. The stream bed was not evident at the crossing of Watson Road.

5.0 SIGNIFICANCE AND SENSITIVITY

This section of the report is a summary of natural resource significance from Section 4.0, supplemented with general comments on species and habitat sensitivities to changes in site conditions.

5.1 Vascular Plants

There were no provincially or regionally rare species of plants reported in the study area or documented in the background information.

5.2 Vegetation

5.2.1 Upland

The majority of the upland areas in the subwatershed have been cleared of natural vegetation. Upland wooded areas in the study area are generally small and isolated from other natural areas such as wetlands and watercourses. Upland forest communities range in size from 0.8 to 7.2 ha. Mixed deciduous upland woods are fairly scarce representing approximately 1.4% of the subwatershed and are often supplemented with coniferous plantations. Plantations are fairly common in the subwatershed and include plantings of young saplings up to mature stands of white and red pine. Old field and shrub dominated uplands are commonly found adjacent to wooded areas, disturbed lands and marginal farmland.

There are locations where upland woods are connected to other natural areas outside of the subwatershed (see Figure 6). Upland woods extend east from the headwaters of the creek to join the woods along the Eramosa River.

The upland wooded areas adjacent to the wetlands in the study area have a potentially important role in maintaining the wetlands. These wooded areas provide sheltered conditions for the interior of the wetland. The removal of these trees may cause windthrow of the typically shallowly rooted cedars and other trees located in the organic soils of the wooded portions of the wetlands.

The mature upland cedar woods in the study area contain trees which are accustomed to growth in the sheltered microclimate found in the interior of mature woodlots. These trees are sensitive to changes in growth conditions resulting from forest clearing or disruption of forest edges. Stable forest edges provide a buffer for the interior portions of the woods. Removal or disruption of stable edges may expose the woodlot interior to drying winds and sun as well as windthrow. Loss of the sheltered interior conditions may result in a decrease in regeneration of tree seedlings and spring flora. Invasion of edge and open field plant species may further reduce regeneration of forest species.

5.2.2 Wetlands

The Hadati-Clythe Wetland Complex was evaluated by Ecologistics Limited (1992) using the Ministry of Natural Resources Wetland Evaluation System (1992). This system ranks wetlands into classes ranging from 1 (highest) to 7 (lowest), based on the presence of biological, social, hydrological and special features. The 1992 Wetland Policy describes Class 1, 2 and 3 wetlands as provincially significant. The evaluation of the Hadati-Clythe Creek Wetland Complex determined that the wetland was a Class 5, non-provincially significant wetland.

Using the information compiled in this report, and calculating the special features component of the 1994 version of the wetland evaluation system (which scored >200) these wetlands are considered to be provincially significant. A complete wetland evaluation would need to be completed and reviewed by the OMNR to formalize the provincial significance of this wetland.

Groundwater linkages are discussed in detail in Section 6.0.

The wetlands in the study area have undergone considerable human impact. Impacts include:

- wetlands which naturally drain to Watson Creek are now directed to Hadati Creek, increasing flows,
- natural constriction at southwest corner of Eastview area creates a dam effect, and
- channelization of the creek below Eastview Road has decreased the water storage capacity of these areas.

The wooded swamp portions of the wetlands are particularly sensitive to changes in site conditions. Clearing or disruptions to the wooded edge can potentially result in windthrow of the shallowly rooted trees as well as opening the interior of the wetland to the effects of wind, sun and invasive species. Any changes to the water regime can result in mortality of trees. Trees which are found in swamps are accustomed to the wet soils and the particular groundwater/surface water interactions which are found there. They are not tolerant of draining, which results in desiccation or flooding, which drowns the trees. This can be seen occurring along stretches of Hadati Creek where increased flows have drowned portions of the wooded swamp communities which once existed here (Ecologistics Limited 1992b, 1993).

Marsh communities such as cattail or reed marshes are fairly tolerant of fluctuations in water levels. These areas can withstand some periods of drying out or flooding.

5.2.3 Wildlife

Detailed surveys of wildlife in the subwatershed are required. The following sections are based on the compilation of wildlife species reports from background reports in conjunction with assessment of habitat potential.

Birds

The woodlots in the study area are mainly small isolated features which offer habitat for birds which are not sensitive to edge conditions and are commonly found in open fields, hedgerows and small wooded areas. The observation of the least bittern is an exception to this. This bird is an area sensitive marsh species. The marshes along the upper portions of Clythe Creek provide potential habitat for this species.

A number of birds which were observed in the study area or that are known from the area through the Breeding Bird Atlas are known as forest interior or interior-edge species. Interior-edge species can breed either in the forest edge, usually defined as the area within 100 metres of the outer treed edge, or in the interior, the area more than 100 metres in from the edge. This includes the red-eyed vireo, common yellowthroat, northern cardinal, gray catbird and blue jay. Forest interior species breed primarily in the interior and therefore require a larger woodlot than interior-edge birds (Cadman 1997). Forest interior birds which

were found in the study area include white breasted nuthatch, hairy woodpecker, scarlet tanager and veery.

Other rare species of birds which have been documented in the area in the background information which was discussed previously are the red-shouldered hawk, northern bobwhite, Henslow's sparrow and western meadowlark. None of these species are expected to be found in the study area except the red-shouldered hawk which may be found along the Eramosa River or in larger woodlots in or near the study area.

The red-shouldered hawk and the least bittern are both sensitive to loss in area of habitat. Disturbances such as clearing, intrusions into woodlots and forest edge disruption could all interfere with red-shouldered hawk nesting. The wetland habitat required by the least bittern will be sensitive to changes in water quantity and quality. Clearing and filling of wetlands may disturb this species.

Mammals

There were no significant mammals observed during our study. The smokey shrew, which is considered provincially significant, was documented in this area through the Atlas of the Mammals of Ontario (Dobbyn 1994). This species is not likely to be found in our study area.

Amphibians and Reptiles

There were no significant species of herpetiles observed during our study. One provincially significant species, Jefferson salamander, has been documented in the study area (Oldham 1985) through the Ontario Herpetofaunal Summary. Habitat for this species is found in the study area. The wet forests this species requires are sensitive to impacts from development including clearing, regrading, filling and changes in the water table.

5.2.4 Aquatic Resources

The Clythe Creek system is regarded as having coldwater fisheries potential and ultimately could provide habitat for coldwater species of fish including brook trout and brown trout. These species are found in the Eramosa River and could potentially inhabit Clythe Creek.

The dense vegetation along portions of the creek and groundwater inputs moderate the temperature of the creek to some degree. The goundwater inputs are discussed in more detail in Section 6.0. However, several ponds found on-line and others located off-line of the creek have the impact of warming the waters. Flows are also disrupted by these ponds and other obstructions such as culverts, weirs and dams.

The creek is also impacted by runoff from the surrounding lands. This includes runoff from agricultural lands, roads, stormwater from residential areas and industries. The lack of adequate buffers along the field tributaries, Hadati, Watson and Clythe Creeks allow for potentially polluted waters to enter the main creek easily and quickly.

6.0 SUBCATCHMENT OVERVIEW

The Clythe Creek subwatershed was divided into twenty subcatchments based on topography and the watershed delineation by Cosburn Patterson Wardman Limited (1991) (see Figure 7). The general character of each subcatchment is described in table format (see Table 2).

6.1 Subwatershed Descriptions

The generalized groundwater flow directions and hydrogeologic sensitivity are presented in Figure 4.

Subcatchments S1, S2, S3, S4, S5 and S6

The headwater area of Clythe Creek includes subcatchments S1 to S6. These subcatchments have similar characteristics including smooth gentle slopes, land use dominated by agriculture, soils of mainly fine sand over gravel/loam till and low forest cover (approximately 3 to 18%). Subcatchments S1, S4, S5 and S6 all drain directly into Clythe Creek, while subcatchments S2 and S3 drain via agricultural ditches into Clythe Creek.

There are some small upland woodlots found in this area which contribute to the natural cover in these subcatchments. A small portion of the woods in subcatchment S1 are part of a larger woodlot which extends outside of the subwatershed and down to the Eramosa River. Another portion of upland woods found in subcatchment S5 extend to the north and are connected to the Guelph Northeast Wetland Complex. These woodlands may provide important links for wildlife between the study area and natural areas in the surrounding landscape.

The creek in this area has a well developed riparian strip along most of its length. Dense cedar and large marshes provide cover for the creek except at a ponded area located upstream of the Township Line.

The wetlands associated with the creek appear to be supported by groundwater which intercepts the land surface along the low-lying areas of the creek valley. Surface runoff also

Table 2. Clythe Creek Subcatchment Characteristics.

	Area (sq km)	Land Use	Topography	Soil Type	Drainage	Forest Cover
S1	3.2	Agriculture	Smooth & irregular gentle to moderate slope	fine sand over gravel/gravel	Clythe Creek head-waters Reaches C1, C2	16%
S2	1.3	Agriculture	Smooth, gentle to moderate slope	Fine sand over gravel/loam till	Unnamed Tributary to Clythe Creek Reach T2	3%
S3	0.8	Agriculture	Smooth, gentle slope	Fine sand over gravel/loam till	Unnamed Tributary of Clythe Creek Reach T1	18%
S4	0.57	Agriculture	Smooth, very gentle slope	Fine sand over gravel	Clythe Creek Reaches C2, C3, C4	5%
S5	0.9	Agriculture	Smooth, very gentle to moderate slope	Fine sand over gravel/loam till	Clythe Creek Reaches C4, C5	13%
S6	2	Agriculture, some scrubland areas	Smooth, very gentle to gentle slope	Loam till/fine sand over gravel	Clythe Creek Reaches C2, C3, C4, C5	3%
S7	3.5	Guelph Airport and Airfield, Correctional Center, commerical	Smooth, very gentle slope	Gravel, some fine sand over gravel	Unnamed Tributary to Correctional Center ponds, Reach T3a,b	13%
S8	1.7	Agricultural, sloping area with small pine plantation, connects to S9	Smooth, very gentle to moderate slope	Loam till, some gravel	Clythe Creek Reach C6	44%
S9	0.35	Agriculture, sloping area with small pine plantation, connects to S8	Smooth/irregular, moderate slope	Gravel	Watson Creek Reaches W2, W3, W4	15%
S10	1.2	Residential Development	Smooth, moderate slope	Loam/till gravel	Clythe Creek Reaches C6, C7, C8, C9	70%
S11	0.5	Some agriculture, wetland area, connects to S12 across Eastview Rd.	Smooth basin to moderate slope	Organic/ loam till	Watson Creek Reach W1	49%
S12	0.52	Agriculture, landfill site, wetland area connecting to S11 across Eastview	Smooth basin	Organic with some loam till	Hadati Creek Reach H1	6%
S13	1.2	Guelph Northeast Wetland Complex, landfill site	Smooth basin to moderate slope	Organic with some medium sand	Hadati Creek drainage ditch to Reach H2	12%
S14	1	Industrial/commercial, heavy residential develop-ment, little agriculture	Smooth, moderate slope	Loam till	Hadati Creek Reaches H2, H3, H4	7%
S15	0.4	Residential, little agriculture	Smooth, very gentle to moderate slope	Gravel/medium sand	Hadati Creek Storm sewers to Reach H5	31%
S16	0.27	Heavy residential and commercial	Smooth, gentle to moderate slope	Loam till/ medium sand	Hadati Creek Storm sewers to Reach H6	0%
S17	0.1	Residential development area	Smooth, gentle to moderate slope	Loam till/ medium sand	Hadati Creek Reach H6	3%
S18	0.38	Heavy residential, little agriculture	Smooth, gentle to moderate slope	Loam till/ medium snad	Hadati Creek Storm sewers to Reach H6	0%
S19	0.38	Heavy commercial, industrial and residential	Smooth basin	Formerly organic	Hadati Creek Reach H7	0%
S20	0.23	Royal City Jaycee's Bicentennial Park, wetland area	Smooth, very gently sloping	Gravel	Clythe Creek Reach C10	0%

provides input to the creek, but in the form of seasonal flows. The cattail marshes provide potential habitat for the provincially threatened least bittern.

The headwaters of the creek are important for maintaining the quality and quantity of downstream flows. Although these reaches do not provide habitat for coldwater fish species themselves, they contribute to downstream habitat quality. Breaks in the natural vegetation along the creek corridor are relatively few, consisting of a road crossing and private residence lawn at Regional Road 29, a road crossing at Township Line and an artificial pond located upstream of Highway 7.

Subcatchments S1 and S2 consist of permeable fractured bedrock outcropping, or significant deposits of outwash sand and gravel overlying fractured bedrock. This setting provides for high recharge and potential discharge to Clythe Creek. The bedrock topography will direct flow to the southwest as well as bring in a small component from outside the subwatershed. Within subcatchments S3 and S6, and to a lesser extent S2, there are varied thicknesses of till with the surficial till being the Port Stanley sandy till. The sandy nature of the till and hummocky topography potentially allows for more infiltration in this unit than generally expected for a till.

The sand and gravel eskers will provide for sensitive local, shallow recharge and discharge systems as these permeable units will be underlain by the lower permeability tills. There will likely be a component of groundwater flow directed eastward out of subcatchment S3 towards the Eramosa River due to the bedrock topography. Within subcatchment S6 groundwater flow will likely move west and southwest through the overburden and within the upper fractured bedrock. Subcatchment S4 is similar to S3 in that there will be high recharge in the permeable sands and gravel and outcropping fractured bedrock, with groundwater flow following the bedrock topography to the southeast, and a component of groundwater flow coming in from outside the subwatershed to the west. Within subcatchment S5 the easterly portion consists of permeable sands and gravels at surface and high recharge is expected. To the west the overburden consists of sandy tills underlain by thicker lower permeability till units. The sands and gravels of the esker will provide for local groundwater recharge and discharge. Groundwater flow in the upper bedrock will generally follow the bedrock topography to the east.

become more steep towards Clythe Creek along the side slopes of drumlins which characterize the area.

Wetlands are found in a narrow band along the creek as well as a willow and cedar swamp which extend along a valley towards the north.

S10 consists mainly of the sandy till at ground surface. Again the recharge is more limited in this setting because of the lack of hummocky topography. The overall bedrock topography indicates the possible convergence of significant groundwater flow in the upper bedrock which appears to be represented by groundwater discharge along Clythe Creek where the bedrock outcrops. This is potentially the most sensitive groundwater/surface water linkage within the subwatershed.

Subcatchment S11

Subcatchment S11 forms the headwaters of Watson Creek. Historically, Watson Creek received flows from land to the north of this subcatchment. However, construction of the landfill and piping of flows to Hadati Creek changed this and reduced the amount of area draining into this portion of the creek by approximately one third to one half.

The land in this subcatchment is primarily agricultural. A large wetland in the southwest corner of the Watson-Eastview intersection provides input to the creek. Deep organic soils are associated with this wetland. This wetland consists of deciduous swamp with some pockets of marsh and cedar swamp. The Ariss Esker to the west forms the boundary between this subcatchment and Hadati Creek. Slopes associated with this esker vary up to 20%. Some excavation of the ridge has occurred resulting in ponded areas and disturbed soils.

The sands and gravels of the Ariss Esker will likely provide a component of local recharge and discharge to the upper reach of Watson Creek. The groundwater recharge/discharge function of the wetland is not known but given the elevated topography it is potentially a recharge wetland.

Subcatchments S12 to S20

Subcatchments S12 to S19 are all associated with Hadati Creek. S12 and S13 form the headwaters of the creek. Dominant features in this area are the landfill and portions of the provincially significant Guelph Northeast Wetland Complex. The wetland is characterized by deciduous and coniferous swamp communities. Deep organic soils are associated with the wetland. During the construction of the landfill, flows from the wetland complex were diverted from Watson Creek and piped under the landfill to Hadati Creek, increasing the flows to this system. The presence of the landfill and provincially significant wetland preclude much development in this area.

The hydrogeological setting for S12 is similar to S11. Within S13 the permeable surficial sands and gravels in the south will give rise to high recharge. The topography and the existence of lower permeability tills underlying the sands and gravels will direct the shallow overburden flow to towards S16 and S18. Deeper overburden and bedrock flow is likely divided to the east, into S14, and to the west, out of the subwatershed.

Subcatchments S14, S15, 17 and S18 are currently undergoing residential development. The creek is the main natural feature, although it has undergone severe changes along much of its length. Very little natural vegetation is anticipated to remain. Portions of the creek have been channelized within a concrete and riprap drainage way. Topography in the Hadati Creek drainage basin is smooth and gently sloping to flat. The gradient of the creek is 1 to 2% increasing to 3.5% below Grange Road, and 5.7% below the railway tracks (Cumming Cockburn Limited 1991).

Subcatchments S17 and S19 are already developed as are portions of S18. These areas are composed of a mixture of residential, commercial and industrial developments. Numerous roads and the CNR rail cross through this area. There is very little natural vegetation and the creek has been channelized and buried in sections. Storm runoff from urban areas to the north and west provides pulses of flow which are of poor quality.

Within S14 the surficial sandy till will allow for recharge and the topography appears to provide a shallow overburden pathway for groundwater discharge to Hadati Creek. Deeper overburden and upper bedrock flows are expected to move south to S15 and east to S10. Throughout S15-S18 the sandy till can provide recharge in the less developed areas. A

component of shallow overburden flow may be directed towards Hadati Creek with a larger component in the bedrock likely flowing towards the lower reach of Clythe Creek or Eramosa River.

S20 is located along the final reach of Clythe Creek before it empties into the Eramosa River south of Highway 7. Playing fields and some undeveloped lands are found. The CNR rail runs through this subcatchment.

Within S19 and S20 there will be high recharge and discharge within the thin permeable sands and gravels. Discharge will likely occur to both Clythe Creek and the Eramosa River.

6.2 Summary

Subcatchments were used in this study to identify areas in which potentially contain several sensitive features in combination. Although many features span the boundaries of the subcatchments, these areas should be considered in future impact, or stormwater management studies.

The combination of wetlands, high quality creek conditions and groundwater conditions in subcatchments S8, S9 and S10 suggest that these areas are high priority areas. Any development proposed in these areas would be subject to detailed studies of these features. Aquatic habitat, water quality, groundwater and wetland studies should be completed to fully document existing resources and determine the sensitivity of these resources to the specific potential impacts of the proposed development. Based on these studies, appropriate setbacks from the wetlands, watercourses and sensitive groundwater areas should be determined. Special consideration should be given to stormwater management practices which will protect the wetlands, creeks and groundwater.

The other subcatchments in the subwatershed (S1 to S7, S11 to S20) are anticipated to be less sensitive, but still require environmental studies. Subcatchment S11 has undergone extensive alteration of the natural resources including reduced flows in Watson Creek and aggregate extraction of the drumlins. However, the presence of the Eastview-Watson swamp and the headwaters of Watson Creek create more sensitive conditions.

Subcatchments S1 to S7 are dominated by agricultural lands, and S12 to S20 are already developed or are undergoing development. In these areas, efforts should be made to retain existing vegetation and to enhance natural areas. The Hadati Creek system has been altered significantly and is undergoing development. It has already been significantly degraded and studies on the sensitivity of this creek would be redundant. Efforts toward restoring and rehabilitating the creek should be considered.

The Clythe Creek and its wetlands are the most significant resources in these areas. Suitable setbacks from Clythe Creek and its wetlands should be determined. Any combinations of upland/wetland habitat should be maintained for wildlife habitat as well as any linkages between the Clythe Creek subwatershed and the Eramosa River valley or the Guelph Northeast wetland complex.

6.0 SUBWATERSHED LEVEL RECOMMENDATIONS

6.1 Overview

This section summarizes the key recommendations for achieving the subwatershed goals of maintaining and enhancing terrestrial, wetland and aquatic resources as well as hydrological and hydrogeological characteristics of the Clythe Creek subwatershed. Many of these recommendations arise from text presented in Section 4.0. Specific recommendations are provided below. Guidelines for the implementation of these recommendations are provided in Section 6.2.

Recommendation #1 - Woodlot Preservation/Enhancement

a) *Upland wooded areas are to be retained where possible (including plantations)*

The clearing of land for agriculture, in the past, has impacted the Clythe Creek subwatershed. This activity has reduced the amount of forest cover in the subwatershed and the availability of wildlife habitat. Natural vegetation is now found in narrow lowland corridors along the valley of Clythe Creek and its tributaries. Some small upland woods and hedgerows are found scattered along the backs of farms and lot boundaries. Some areas of old field and successional vegetation are situated on lands that were found to have unsuitable conditions for agriculture. Conifer plantations of pines and spruces have been planted in some of these areas. Upland wooded habitats are important for many species of wildlife and birds. These areas should be retained where possible. A combination of upland, wetland and water features provides diverse habitat and are more significant to wildlife than isolated pine plantations, for example.

The percentage of woodland in the landscape of Wellington County is approximately 18.2 percent (Riley and Mohr 1994). In areas where forest cover is less than 15 to 25 percent, it is important to retain the remaining forests as representatives of the original forests and to help conserve diversity (Riley and Mohr 1994). The cover of natural woodland in this subwatershed is approximately 2 percent with an additional 2.3 percent of plantation. The restoration of natural areas is recommended to increase woodland cover.

The lack of natural vegetation in the subwatershed is expected to have contributed to the degradation of wetlands and aquatic habitat in the creeks. Runoff from agricultural lands, roads, residential areas and industries has a potential impact on the quality of the water and also on the timing of flows. Stormwater runoff can produce flashy flows with high volumes of water passing through the system and into Clythe Creek in a short period of time. These high flows can cause erosion of the banks, flooding and damage to aquatic habitat and man-made structures. Upland vegetation and the wetlands along the creek are important for absorbing rainfall and surface runoff and enhancing infiltration.

Recommendation #2 - Natural Areas/Wildlife

a) *The restoration of natural areas is recommended to increase woodland cover. Planting trees and other native plants to establish and enhance existing natural areas is recommended to increase wildlife habitat and create linkages for wildlife movement (between habitats within the subwatershed as well as to habitats outside the subwatershed)*

b) *Detailed plant and wildlife surveys are recommended as part of subsequent (EIS) studies*

Opportunities for enhancement of natural vegetation areas should be examined. Planting trees and other native plants to establish and enhance existing natural areas is recommended to increase wildlife habitat and create linkages for wildlife movement. Limited wildlife surveys have been completed in the subwatershed to date. Linkages between habitats within the subwatershed to habitats outside the subwatershed will enhance wildlife habitats.

Recommendation #3 - Wetlands and Other Sensitive Habitats

a) *A complete evaluation of the wetlands, using the MNR Wetland Evaluation System, should be conducted*

b) *The wetlands are to be maintained*

c) *Appropriate width buffers of natural vegetation are to be retained or created along the wetlands, creeks and tributaries for the protection of sensitive habitats.*

The wetlands in the subwatershed are ranked as provincially significant. Wetland vegetation and organic soils along the creek also slow the water and control its release. The wetlands are to be maintained under provincial policy. Appropriate width buffers of natural vegetation are important along the wetlands, creeks and tributaries for the protection of sensitive wetlands and habitats. The dimensions and characteristics of these buffers are to be determined on a site-specific basis.

Recommendation #4 - Preservation and Enhancement of Aquatic Habitat

a) *The removal of existing online ponds is recommended.*

b) *The use of dry ponds, or wet ponds with modified (subsurface) discharges, for stormwater management will help to maintain lower water temperatures that are important to re-establish a coldwater fishery.*

c) *The preservation and augmentation of tree cover along the creeks is recommended to moderate temperatures.*

d) *The use of natural channel design techniques and bioengineering methods is encouraged to increase the habitat potential of the creek for fish and invertebrate populations while providing suitable channel design and erosion control during development projects.*

It is important to realize the high quality habitat potential of the Clythe Creek system. The removal of existing ponds and the use of dry ponds for stormwater management will help to maintain lower water temperatures that are important to re-establish a coldwater fishery. The preservation and augmentation of tree cover along the creeks will help to moderate temperatures. Maintaining groundwater inputs to the creeks is probably the most important factor in preserving the aquatic habitat in this system

although other potentially limiting factors must be considered. The use of natural channel design techniques and bioengineering methods will also increase the habitat potential of the creek for fish and invertebrate populations while providing suitable channel design and erosion control during development projects.

Recommendation #5 - Groundwater

a) *Groundwater inputs to the creeks must be maintained to preserve the aquatic habitat in this system*

b) *The emulation of existing groundwater recharge is recommended throughout the watershed, particularly within the potentially sensitive areas.*

c) *Groundwater withdrawals need to be reviewed from the perspective of reductions in water levels within the groundwater flow system providing discharge water to the creeks and wetlands. An assessment of this linkage, for existing and future groundwater takings, is necessary to maintain the aquatic and terrestrial function.*

d) *Groundwater quality degradation from road salting, fertilizer, septic systems, spills etc. is more likely within the sensitive groundwater areas and is to be controlled.*

Groundwater protection throughout a substantial portion of the subwatershed is necessary to maintain the quantity and quality of recharge for both the permeable surficial units and the bedrock aquifer. The groundwater function of these units is significant from both a surface water discharge linkage, as pointed out above, and anthropogenic use of groundwater from the major bedrock aquifer system. The emulation of existing groundwater recharge should be promoted throughout the watershed, particularly within the potentially sensitive areas shown on Figure 4. In addition, groundwater withdrawal can reduce water levels within the groundwater flow system that in turn can impact discharge to the creeks and wetlands. An assessment of this linkage, for existing and future groundwater takings, is necessary to maintain the aquatic and terrestrial function. Groundwater quality degradation from

road salting, fertilizer, septic systems, spills etc. is more likely within the same area shown on Figure 4, and needs to be controlled.

6.2 Guidelines for Implementing Subwatershed Level Recommendations

Most of the subwatershed level recommendations provided in Section 6.1 are encouraged by existing municipal and provincial guidelines, policies and official plans. In order to co-ordinate the implementation of the recommendations within the Clythe Creek subwatershed the following implementation requirements are provided. These implementation recommendations are anticipated to be organized into the following:

- Creek Management Corridor,
- Sensitive Groundwater Recharge and Discharge Areas,
- Implementation Process (including study triggers).

6.2.1 Creek Management Corridor

The layout of the remnant natural habitats within the subwatershed was found to be associated with the main creek channels and floodplains of the Clythe and Watson Creeks. A number of other habitats are found at a distance from these creek corridors, for example the wetlands in subcatchment S8. These habitats include the creek, the provincially significant wetlands and associated woodlots. *Given the configuration of habitats it is recommended that the management of these features be approached in an integrated manner.* This suggests that A Creek Management Corridor approach be used in this subwatershed. Effective management of these features generally requires the use of some type of "adjacent lands" zone around each feature. The current guidelines for Natural Heritage Features (MNR 1997) provide guidance as to the adjacent lands zone for these features.

The Creek Management Corridor is recommended to consist of the following features and their associated adjacent lands zone:

- creek channel (30 m adjacent lands zone),
- wetlands (120 m adjacent lands zone),

- significant upland woods (50 m adjacent lands zone), and
- adjacent steep valley slopes (and appropriate slope stability setbacks).

Based on the current City OP, as well as discussions with City planning staff, the current mechanism used in the City for triggering, scoping, and reviewing environmental studies was considered. The mapping (Schedule 2) appended to the OP delineates natural heritage features in the City. In cases where undertakings are proposed in the vicinity of natural heritage features, discussions with City staff, EAC and pertinent agencies are conducted to prepare a work plan and table of contents for an Environmental Impact Study (EIS).

Schedule 2 in the City OP identifies a number of the significant natural resources that form the basis of the Creek Management Corridor. Some differences in the size of the various features are noted, and the lack of information on significant woodlots in the OP mapping is noted. Due to this, *it is recommended that the mapping provided in this report be used as a guide for identifying natural heritage features.*

In the Hanlon Creek area, a comprehensive EIS has been completed, and therefore the adjacent lands zone has been delineated and EIS requirements are described in detail. By comparison, a comprehensive EIS was not prepared as part of the current study, and therefore *it is recommended that inclusion of standard adjacent lands zones around each component of the creek corridor be included as part of the Creek Management Corridor to ensure protection of sensitive resources.*

The approximate boundary of the Creek Management Corridor is the outer-most composite boundary of the above-noted features, and is shown at a large scale on Figures 6 and 8. In addition to the habitats along the creek corridor, a number of other significant natural areas are highlighted on Figure 8. Although not immediately associated with the central creek corridor, for the purposes of this report and simplicity, these features will be treated as part of the corridor. Future land use decisions in the subwatershed *are recommended to focus on maintaining the features that are within the Creek Management Corridor and increasing connectivity between the components within the corridor, as well as linkages to natural areas outside the subwatershed* (such as habitats along the Eramosa River to the east and south, and the Guelph Northeast Wetland Complex to the north).

6.2.2 Potentially Sensitive Recharge/Discharge Areas

Although many of the natural features within the subwatershed are physically located adjacent to the creek corridor, many of these features are driven by hydrogeological processes that extend well back from the creek and associated habitats. Therefore any analysis of potential impacts or land use changes in the subwatershed, must also assess undertakings against the sensitive recharge/discharge areas.

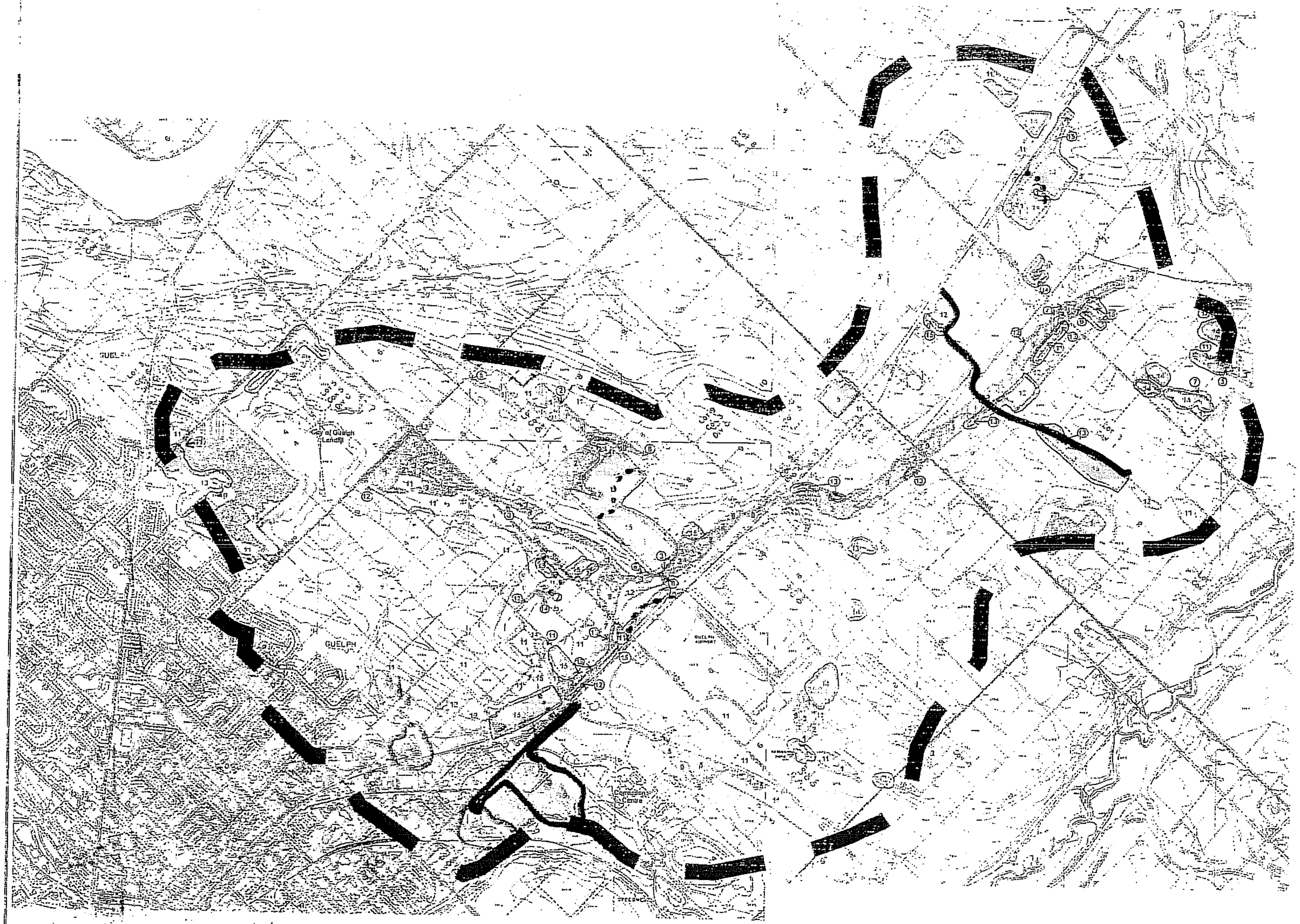
Based on the hydrogeological characterization described in Section 4.2, areas of potentially sensitive recharge and discharge have been identified. These areas are shown on Figures 4 and 7. No mapping of significant groundwater areas is provided in the City OP, except for the Arkell Springs Water Resource Protection Area. The role of groundwater in the subwatershed, especially linkages to surface water features such as the creeks and wetlands is a significant component of the ecosystem in this area. The zones of sensitive recharge and discharge are a reflection of the permeability and thickness of the overburden and therefore do not necessarily correspond to the bounds of the Creek Management Corridor described above.

6.2.3 Recommended Implementation Process

Based on the recommended Creek Management Corridor and the Potentially Sensitive Recharge/Discharge Areas discussed above, a sequence of events or studies is required, as described below, to ensure adequate and consistent treatment of the features within the subwatershed. This sequence is shown in Figure 9.

6.2.3.1 Step 1 - Trigger Decision

In most cases a trigger is identified that simply consists of a geographic zone in which any undertaking falling within that zone must go through the review process. When a proposal comes forth that is inside the trigger zone; the review process is invoked. When the proposal is outside the trigger zone, the process is avoided (although other permitting requirements may apply to the undertaking).



LEGEND

- Subwatershed Boundary

VEGETATION UNITS

- WETLAND COMMUNITIES:
- UPLAND COMMUNITIES:

ADJACENT LANDS:

- Woodland 50m
- Wetland 120m
- Watercourses 30m

PROJECT	DATE
1769-03	November 1997
SCALE	**DRWN/CHKD**
1:29,000	MEG/DES

N

Figure 8.

Delineation of Creek Management Corridors

ecologistics limited

consultants in environmental management

For this process, it is recommended that the Creek Management Corridor and significant groundwater be used as the trigger zone (Step 1 - Figure 9)

In the Clythe Creek subwatershed, the adjacent lands zones have been included in the Creek Management Corridor. This recognizes the inherent uncertainty in delineating and mapping significant habitats. The standard 120 m trigger distance used for wetlands in the Provincial Policy Statement was applied to the wetlands within the subwatershed (see Figure 6) and was found to be the main determinant of the bounds of the management corridor. It should also be noted that the some of the lands along the north of the subwatershed also fall within the adjacent lands zone for the Guelph Northeast Wetland Complex.

Based on a review of the Creek Management Corridor and Sensitive Recharge/Discharge mapping as well as any other resource mapping (and associated support information), the applicant identifies whether the proposal falls into an area that:

- is within the Creek Management Corridor,
- is within the Potentially Sensitive Recharge/Discharge Areas, or
- is outside the above.

A key task for the applicant and the City to determine whether the proposal falls within a sensitive zone. The scale of the mapping that is provided in this report is to be viewed as approximate only. The delineation of the sensitive areas must be done to a greater detail in conjunction with discussions with municipal staff. The onus is also on the applicant at this point to provide some details as to the presence of any sensitive zones or description of resources in the area. Municipal staff's responsibility would be to review the application, perhaps conduct a site visit, and agree/disagree with the suggested presence or absence of the sensitive zone, and the review path.

If municipal staff accept the undertaking as falling outside sensitive zones, approval (perhaps with some modifications or conditions) may be granted with little or no reporting.

6.2.3.2 Step 2 - Preparation of Issues Summary Report

This step will focus on characterizing the undertaking and determining whether additional detailed studies are required. This step is envisioned to be a "scoping" exercise that identifies potential features of concern, spatial and temporal study bounds.

In other jurisdictions, this decision is typically accomplished via some form of "waiver report", or under the provincial EIS guidelines an "Issues Summary Report", which documents key aspects of the proposed undertaking as well as natural and other issues of potential concern. It is recommended that all proposed undertakings in the sensitive zones must go through this step.

Municipal staff may deem the undertaking to be of a minor nature and approval may be granted based on the waiver report. In other cases detailed studies may be required depending on the level of detail or the character of the undertaking, thus invoking detailed studies.

This step is a documentation step. Essential information on:

- the nature of the proposal, and
- the location of the proposal, especially with respect to sensitive features/lands .

This information is documented in a short report. This report should include maps of the proposed undertaking as well as the delineation of sensitive zone(s), and photographs of the area.

In some cases this report can be completed simply by the applicant. In some cases, proponents may wish to obtain assistance from professionals with expertise in planning, engineering, environment, etc.

6.2.3.3 Step 3 - Municipal Review and Decision

The Issues Summary report is submitted for review to the municipalities.

This step represents a key decision point in the process with respect to the level of detail, and need for, additional documentation or study by the applicant. A key determinant of this is the level of detail and character of the environmental features underlying the sensitive zone. Based on the character of the sensitive resources within the subwatershed, there are two possible outcomes of the municipal review of the issues summary report.

a) minor proposals that actually occur within a sensitive zone but are not envisioned to result in a significant impact to the resources of concern, and
b) proposed undertakings that are within a sensitive zone and are deemed to be of a significant nature and potentially resulting in negative impacts to the resource(s).

It is important to discriminate between these possible review decisions both in terms of efficiency as well as cost. More detailed reviews will be required for those proposals that fall within the second category. Fairly straightforward reviews would be required in the first case, and detailed studies and costs are generally not warranted.

6.2.3.4 Step 4 - Preparation of An Environmental Impact Study (EIS)

In cases where municipal staff or the applicant identifies that a detailed review is warranted (based on the Issues Summary report), an EIS-type approach is recommended. There are numerous recent documents prepared by the OMNR that guide the preparation and review of EISs (see Reference section for a listing of these documents). These should be used in the subwatershed. The scope of these EISs will need to be tailored to the proposal and the resources deemed to be at risk. An initial scoping meeting between the applicant and municipal and other agency staff may be warranted.

Development proposals within the subwatershed must be evaluated against the significant biological and hydrological features. This will be done through an Environmental Impact Study (EIS) which:

- delineates and characterizes the significant features which comprise the corridor on a site-specific basis,

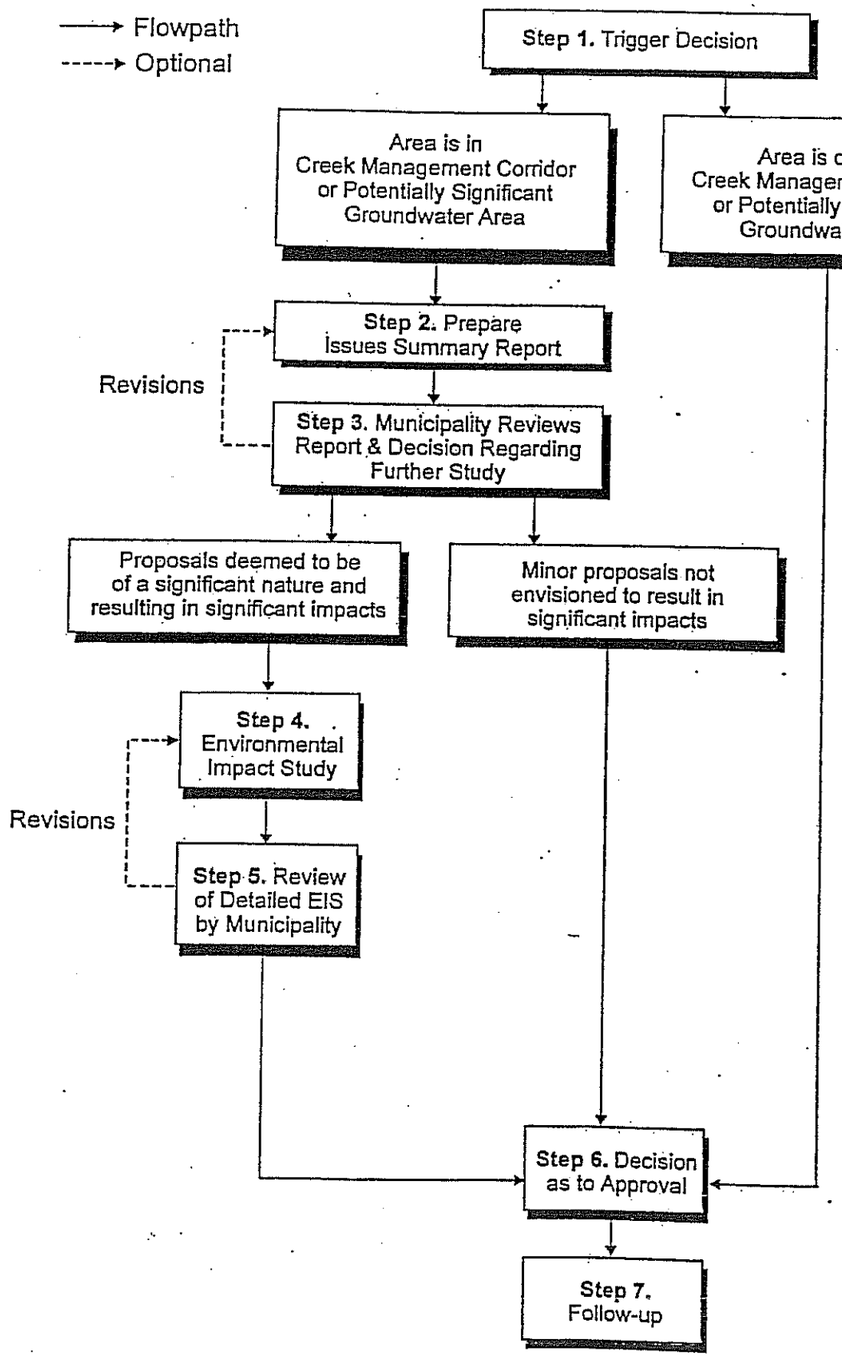
8.0 CONCLUSIONS

The Clythe Creek subwatershed contains a number of natural features which are of significance from a regional and local perspective. The wetland communities within the creek corridor provide habitat features deemed to be of provincial significance based on the MNR Wetland Evaluation System. The creek itself once supported a coldwater fish community and could once again support such a community if riparian corridors and groundwater inputs are maintained and rehabilitated. The groundwater features of the watershed are significant, both in terms of the linkages to the ecological function of the creek and associated wetlands and also with respect to the importance of the aquifers for regional groundwater supply.

Considerable pressure from a variety of land uses has already impacted on the sensitive resources in the area. This development pressure is expected to continue within the subwatershed.

The municipalities with jurisdiction over the Clythe Creek subwatershed will continue to be called upon to review development proposals within the subwatershed. A process is required whereby these agencies can ensure protection of the valued natural environment components by applying a consistent set of requirements to each development proposals. This report constitutes a recommended methodology for achieving these requirements.

Figure 9. RECOMMENDED CLYTHE CREEK SUBWATERSHED ENVIRONMENTAL REVIEW PROCESS



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APPENDIX I

VASCULAR PLANTS REPORTED FROM THE STUDY AREA

VASCULAR PLANTS REPORTED FROM THE STUDY AREA

(Including Ecologistics Limited site surveys on
May 1, June 4 and 17, July 28 and August 12, 1997)

	EQUISETACEAE	HORSETAIL FAMILY
	Equisetum arvense	Field Horsetail
	Equisetum hyemale	Scouring-rush
	Equisetum palustre	Marsh Horsetail
	OSMUNDACEAE	ROYAL FERN FAMILY
	Osmunda regalis	American Royal Fern
	ASPLENIACEAE	SPLEENWORT FAMILY
	Athyrium filix-femina	Northeastern Lady Fern
	Cystopteris bulbifera	Bulblet Fern
	Dryopteris carthusiana	Spinulose Wood Fern
	Matteuccia struthiopteris	American Ostrich Fern
	Onoclea sensibilis	Sensitive Fern
	Polystichum acrostichoides	Christmas Fern
	PINACEAE	PINE FAMILY
	Abies balsamea	Balsam Fir
	Larix larcina	Tamarack
+	*Picea abies*	Norway Spruce
	Picea glauca	White Spruce
	Pinus resinosa	Red Pine
+	*Pinus sylvestris*	Scots Pine
	Tsuga canadensis	Eastern Hemlock
	CUPRESSACEAE	CYPRESS FAMILY
	Juniperus virginiana	Red Cedar
	Thuja occidentalis	White Cedar
	TYPHACEAE	CATTAIL FAMILY
	Typha angustifolia	Narrow-leaved Cattail
	Typha latifolia	Common Cattail
	ZOSTERACEAE	PONDWEED FAMILY
	Potamogeton sp.	Pondweed sp.
	ALISMATACEAE	WATER-PLANTAIN FAMILY
	Sagittaria latifolia	Common Arrowhead

	POACEAE	GRASS FAMILY
+	*Agropyron repens*	Quack Grass
+	*Bromus inermis*	Smooth Brome Grass
	Calamagrostis canadensis	Canada Blue-joint
+	*Elymus repens*	Quack Grass
	Glyceria striata	Fowl Manna Grass
	Leersia oryzoides	Cut Grass
	Phalaris arundinacea	Reed Canary Grass
+	*Phleum pratense*	Timothy
	Phragmites communis	Common Reed
	Poa spp.	Grass
	Poa alsodes	Woodland Poa
+	*Poa compressa*	Canada Blue Grass
+	*Poa pratensis*	Kentucky Blue Grass
+	*Setaria viridis*	Green Foxtail
+	*Zea mays*	Corn
	CYPERACEAE	SEDGE FAMILY
	Carex spp.	Sedge
	Carex aquatilis	Water Sedge
	Carex convoluta	Sedge
	Carex flava	Yellow Sedge
	Carex gracillima	Graceful Sedge
	Carex hystercina	Porcupine Sedge
	Carex pedunculata	Peduncled Sedge
	Carex retrorsa	Retrorse Sedge
	Carex stipata	Awl-fruited Sedge
	Carex stricta	Stiff Sedge
	Scirpus atrovirens	Dark Green Bulrush
	ARACEAE	ARUM FAMILY
	Arisaema triphyllum	Jack-in-the-pulpit
	LEMNACEAE	DUCKWEED FAMILY
	Lemna minor	Common Duckweed
	JUNCACEAE	RUSH FAMILY
	Juncus effusus	Soft Rush
	LILIACEAE	LILY FAMILY
	Trillium erectum	Purple Trillium, Stinking Benjamin
	SALICACEAE	WILLOW FAMILY
	Populus balsamifera	Balsam Poplar
	Populus grandidentata	Large-toothed Aspen
	Populus tremuloides	Trembling Aspen
	Populus spp.	Poplar
+	*Salix alba*	White Willow

	Salix bebbiana	Beaked Willow, Bebb's Willow
+	*Salix fragilis*	Crack Willow
	Salix spp.	Willow
	JUGLANDACEAE	WALNUT FAMILY
	Juglans nigra	Black Walnut
	BETULACEAE	BIRCH FAMILY
	Alnus rugosa	Speckled Alder
	Betula alleghaniensis	Yellow Birch
	Betula papyrifera	White Birch
	Betula spp.	Birch
	Ostrya virginiana	Ironwood
	FAGACEAE	BEECH FAMILY
	Fagus grandifolia	American Beech
	Quercus alba	White Oak
	Quercus macrocarpa	Bur Oak
	Quercus rubra	Red Oak
	ULMACEAE	ELM FAMILY
	Ulmus americana	White Elm
	URTICACEAE	NETTLE FAMILY
+	*Urtica dioica*	European Stinging Nettle
	POLYGONACEAE	BUCKWHEAT FAMILY
	Polygonum amphibium	Water Smartweed
+	*Rumex crispus*	Curly Dock
	Rumex orbiculatus	Great Water Dock
	CARYOPHYLLACEAE	PINK FAMILY
+	*Silene vulgaris*	Bladder Campion
	RANUNCULACEAE	CROWFOOT FAMILY
	Anemone canadensis	Canada Anemone
	Caltha palustris	Marsh-marigold
	Ranunculus spp.	Buttercup
+	*Ranunculus acris*	Tall Buttercup
	Thalictrum dioicum	Early Meadow Rue
	BRASSICACEAE	MUSTARD FAMILY
+	*Brassica nigra*	Black Mustard
	GROSSULARIACEAE	GOOSEBERRY FAMILY
	Ribes cynosbati	Prickly Gooseberry

	ROSACEAE	ROSE FAMILY
	Agrimonia gryposepala	Agrimony
	Amelanchier arborea	Juneberry, Serviceberry
	Crataegus spp.	Hawthorn
	Fragaria virginiana	Common Strawberry
	Geum spp.	Avens
+	*Malus domestica*	Apple
	Potentilla simplex	Common or Old-field Cinquefoil
	Prunus virginiana	Chokecherry
	Rosa sp.	Rose
	Rubus idaeus	Red Raspberry
	Rubus occidentalis	Black Raspberry
	Spiraea alba	Meadowsweet
	FABACEAE	PEA FAMILY
+	*Lotus corniculatus*	Bird-foot Trefoil
+	*Medicago lupulina*	Black Medic
+	*Trifolium pratense*	Red Clover
+	*Vicia sativa*	Common Vetch
	GERANIACEAE	GERANIUM FAMILY
+	*Geranium robertianum*	Herb Robert
	ANACARDIACEAE	CASHEW FAMILY
	Rhus radicans	Poison-ivy
	Rhus typhina	Staghorn Sumac
	ACERACEAE	MAPLE FAMILY
	Acer negundo	Manitoba Maple
	Acer rubrum	Red Maple
	Acer saccharinum	Silver Maple
	Acer saccharum	Sugar Maple
	BALSAMINACEAE	TOUCH-ME-NOT FAMILY
	Impatiens capensis	Spotted Jewelweed
	RHAMNACEAE	BUCKTHORN FAMILY
+	*Rhamnus cathartica*	Common Buckthorn
	VITACEAE	GRAPE FAMILY
	Parthenocissus inserta	Virginia Creeper
	Vitis riparia	Riverbank Grape
	TILIACEAE	LINDEN FAMILY
	Tilia americana	Basswood
	VIOLACEAE	VIOLET FAMILY
	Viola papilionacea	Stemless Blue Violet

	ONAGRACEAE	EVENING-PRIMROSE FAMILY
	Circaea quadrisulcata	Enchanter's Nightshade
	Epilobium spp.	Willowherb
	Oenothera parviflora	Small-flowered Evening-primrose
	APIACEAE	CARROT FAMILY
	Angelica atropurpurea	Angelica
	Cicuta bulbifera	Bulbous Water-hemlock
+	*Daucus carota*	Wild Carrot, Queen Anne's Lace
	Sium suave	Water Parsnip
	CORNACEAE	DOGWOOD FAMILY
	Cornus foemina	Grey Dogwood
	Cornus stolonifera	Red-osier Dogwood
	ERICACEAE	HEATH FAMILY
	Vaccinium corymbosum	Highbush Blueberry
	OLEACEAE	OLIVE FAMILY
	Fraxinus americana	White Ash
	Fraxinus nigra	Black Ash
+	*Syringa vulgaris*	Common Lilac
	ASCLEPIADACEAE	MILKWEED FAMILY
	Asclepias incarnata	Swamp Milkweed
	Asclepias syriaca	Common Milkweed
	CONVOLVULACEAE	MORNING GLORY FAMILY
+	*Convolvulus arvensis*	Field Bindweed
	BORAGINACEAE	BORAGE FAMILY
+	*Echium vulgare*	Blueweed, Viper's-bugloss
	LAMIACEAE	MINT FAMILY
+	*Glechoma hederacea*	Ground-ivy
+	*Leonurus cardiaca*	Motherwort
	Lycopus uniflorus	Northern Water-harehound
	Mentha arvensis	Field or Common Mint
	Prunella vulgaris	Heal-all
	SOLANACEAE	NIGHTSHADE FAMILY
+	*Solanum dulcamara*	Bittersweet
	Solanum nigrum	Black Nightshade
	SCROPHULARIACEAE	FIGWORT FAMILY
+	*Verbascum thapsus*	Common Mullein

	PLANTAGINACEAE	PLANTAIN FAMILY
+	*Plantago lanceolata*	English Plantain
+	*Plantago major*	Broad-leaved Plantain
	RUBIACEAE	MADDER FAMILY
+	*Galium spp.*	Bedstraw
+	*Galium mollugo*	Bedstraw
	CAPRIFOLIACEAE	HONEYSUCKLE FAMILY
+	*Lonicera tatarica*	Tartarian Honeysuckle
	Sambucus canadensis	Common Elder
	Sambucus pubens	Red-berried Elder
	Triosteum aurantiacum	Orange Fruited Horse Gentian
+	*Viburnum opulus*	Guelder-rose
	Viburnum trilobum	Highbush-cranberry
	DIPSACACEAE	TEASEL FAMILY
+	*Dipsacus sylvestris*	Teasel
	ASTERACEAE	ASTER FAMILY
+	*Achillea millefolium*	Yarrow
+	*Arctium minus*	Common Burdock
	Artemisia vulgaris	Common Mugwort
	Aster sp.	Aster
	Aster ericoides	Heath Aster
	Aster novae-angliae	New England Aster
	Bidens spp.	Beggarticks
+	*Chrysanthemum leucanthemum*	Ox-eye Daisy
+	*Cirsium arvense*	Canada Thistle
+	*Cirsium vulgare*	Bull Thistle
	Erigeron annuus	Annual Fleabane
	Erigeron philadelphicus	Philadelphia Fleabane
	Eupatorium maculatum	Spotted Joe-Pye-Weed
	Eupatorium perfoliatum	Boneset
+	*Hieracium pratense*	King Devil Hawkweed
	Solidago canadensis	Canada Goldenrod
	Solidago flexicaulis	Zig-zag Goldenrod
	Solidago nemoralis	Gray Goldenrod
	Solidago spp.	Goldenrod
+	*Sonchus oleraceus*	Annual Sow-Thistle
+	*Taraxacum officinale*	Dandelion
+	*Tragopogon pratensis*	Meadow Goat's-beard
+	*Tussilago farfara*	Sweet Coltsfoot
	Xanthium strumarium	Cocklebur

170 Species Observed
\+ 49 Non-Native Species

APPENDIX II

BIRDS REPORTED FROM THE STUDY AREA

BIRDS REPORTED FROM THE STUDY AREA

#	Pied-billed Grebe	*Podilymbus podiceps*
#	American Bittern	*Botaurus lentiginosus*
# T	Least Bittern	*Ixobrychus exilis*
#	Great Blue Heron	*Ardea herodias*
*	Green-backed Heron	*Butorides striatus*
#	Canada Goose	*Branta canadensis*
*	Wood Duck	*Aix sponsa*
#	American Black Duck	*Anas rubripes*
#	Mallard	*Anas platyrhynchos*
*	Blue-winged Teal	*Anas discors*
*	American Wigeon	*Anas americana*
*	Hooded Merganser	*Lophoddytes cucullatus*
#	Turkey Vulture	*Cathartes aura*
#	Northern Harrier	*Circus cyaneus*
#	Sharp-shinned Hawk	*Accipiter striatus*
*	Northern Goshawk	*Accipiter gentilis*
* R	Red-shouldered Hawk	*Buteo lineatus*
*	Broad-winged Hawk	*Buteo platypterus*
#	Red-tailed Hawk	*Buteo jamaicensis*
#	American Kestrel	*Falco sparverius*
*	Ring-necked Pheasant	*Phasianus colchicus*
#	Ruffed Grouse	*Bonasa umbellus*
* T	Northern Bobwhite	*Colinus virginianus*
*	Virginia Rail	*Rallus limicola*
*	Sora	*Porzana carolina*
#	Killdeer	*Charadrius vociferus*
*	Spotted Sandpiper	*Actitis macularia*
*	Upland Sandpiper	*Bartramia longicauda*
*	Common Snipe	*Gallinago gallinago*
*	American Woodcock	*Scolopax minor*
#	Ring-billed Gull	*Larus delawarensis*
#	Herring Gull	*Larus argentatus*
#	Rock Dove	*Columba livia*
#	Mourning Dove	*Zenaida macroura*
#	Black-billed Cuckoo	*Coccyzus erythropthalmus*
*	Eastern Screech-Owl	*Otus asio*
#	Great Horned Owl	*Bubo virginianus*
*	Common Nighthawk	*Chordeiles minor*
*	Chimney Swift	*Chaetura pelagica*
*	Ruby-throated Hummingbird	*Archilochus colubris*
#	Belted Kingfisher	*Ceryle alcyon*
*	Red-headed Woodpecker	*Melanerpes erythrocephalus*
#	Downy Woodpecker	*Picoides pubescens*
* #	Hairy Woodpecker	*Picoides villosus*

#	Northern Flicker	*Colaptes auratus*
*	Pileated Woodpecker	*Dryocopus pileatus*
*	Eastern Wood-Peewee	*Contopus virens*
*	Alder Flycatcher	*Empidonax alnorum*
* #	Willow Flycatcher	*Empidonax traillii*
*	Least Flycatcher	*Empidonax minimus*
*	Eastern Phoebe	*Sayornis phoebe*
*	Great Crested Flycatcher	*Myiarchus crinitus*
#	Eastern Kingbird	*Tyrannus tyrannus*
*	Horned Lark	*Eremophila alpestris*
*	Purple Martin	*Progne subis*
#	Northern Rough-winged	*Stelgidopteryx serripennis*
#	Tree Swallow	*Tachycineta bicolor*
*	Bank Swallow	*Riparia riparia*
*	Cliff Swallow	*Hirundo pyrrhonota*
* #	Barn Swallow	*Hirundo rustica*
#	Blue Jay	*Cyanocitta cristata*
#	American Crow	*Corvus brachyrhynchos*
#	Black-capped Chickadee	*Parus atricapillus*
*	Red-breasted Nuthatch	*Sitta canadensis*
#	White-breasted Nuthatch	*Sitta carolinensis*
*	Brown Creeper	*Certhia americana*
* #	House Wren	*Troglodytes aedon*
*	Winter Wren	*Troglodytes troglodytes*
*	Sedge Wren	*Cistothorus platensis*
*	Marsh Wren	*Cistothorus palustris*
*	Golden-crowned Kinglet	*Regulus satrapa*
*	Blue-gray Gnatcatcher	*Polioptila caerulea*
*	Eastern Bluebird	*Sialia sialias*
*	Veery	*Catharus fuscescens*
*	Wood Thrush	*Hylocichla mustelina*
#	Gray Catbird	*Dumetella carolinensis*
#	Brown Thrasher	*Toxostoma rufum*
#	Cedar Waxwing	*Bombycilla cedrorum*
#	European Starling	*Sturnus vulgaris*
*	Warbling Vireo	*Vireo gilvus*
* #	Red-eyed Vireo	*Vireo olivaceus*
*	Nashville Warbler	*Vermivora ruficapilla*
#	Yellow Warbler	*Dendroica petechia*
*	Chestnut-sided Warbler	*Dendroica pensylvanica*
*	Black-throated Green Warbler	*Dendroica virens*
*	Pine Warbler	*Dendroica pinus*
*	Black-and-White Warbler	*Mniotilta varia*
*	American Redstart	*Setopohaga ruticilla*
*	Ovenbird	*Seiurus aurocapillus*
*	Northern Waterthrush	*Seiurus noveboracensis*
*	Mourning Warbler	*Oporornis philadephia*
#	Common Yellowthroat	*Geothlypis trichas*

*	Canada Warbler	*Wilsonia canadensis*
*	Scarlet Tanager	*Piranga olivacea*
#	Northern Cardinal	*Cardinalis cardinalis*
#	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
#	Indigo Bunting	*Passerina cyanea*
*	Rufous-sided Towhee	*Pipilo erythrophthalmus*
#	American Tree Sparrow	*Spizella arborea*
#	Chipping Sparrow	*Spizella passerina*
*	Clay-colored Sparrow	*Spizella pallida*
#	Field Sparrow	*Spizella pusilla*
*	Vesper Sparrow	*Pooecetes gramineus*
#	Savannah Sparrow	*Passerculus sandwichensis*
*	Grasshopper Sparrow	*Ammodramus savannarum*
* E	Henslow's Sparrow	*Ammodramus henslowii*
#	Song Sparrow	*Melospiza melodia*
#	Swamp Sparrow	*Melospiza georgiana*
* #	White-throated Sparrow	*Zonotrichia albicollis*
*	Bobolink	*Dolichonyx oryzivorus*
#	Red-winged Blackbird	*Agelaius phoeniceus*
*	Eastern Meadowlark	*Sturnella magna*
#	Western Meadowlark	*Sturnella neglecta*
#	Common Grackle	*Quiscalus quiscula*
*	Brown-headed Cowbird	*Molothrus ater*
*	Northern Oriole	*Icterus galbula*
*	Purple Finch	*Carpodacus purpureus*
#	House Finch	*Carpodacus mexicanus*
*	Pine Siskin	*Carduelis pinus*
#	American Goldfinch	*Carduelis tristis*
#	House Sparrow	*Passer domesticus*

121	Species Noted
#	57 Species Observed (Ecologistics Limited May 1, June 4 and 17, July 28 and August 12, 1997)
*	68 Species - Atlas of the Breeding Birds of Ontario
T	(2) Species Threatened
R	(1) Species Rare
E	(1) Species Endangered

APPENDIX III

MAMMALS REPORTED FROM THE STUDY AREA

FISH REPORTED FROM THE STUDY AREA

Ministry of Natural Resources 1994 and
Grand River Conservation Authority 1995

SALMONINAE	SALMON, TROUT SUBFAMILY
Salvelinus fontinalis	Brook Trout
UMBRIDAE	MUDMINNOWS
Umbra limi	Central Mudminnow
CYPRINIDAE	CARPS AND MINNOWS
Luxilus cornutus	Common Shiner
Notropis heterolepis	Blacknose Shiner
Phoxinus cos	Northern Redbelly Dace
Phoxinus neogaeus	Finescale Dace
Pimephales promelas	Fathead Minnow
Rhinichthys atratulus	Blacknose Dace
Semotilus atromaculatus	Creek Chub
CATOSTOMIDAE	SUCKERS
Catastomus commersoni	White Sucker
Hypentelium nigricans	Northern Hog Sucker
GASTEROSTEIDAE	STICKLEBACKS
Culaea inconstans	Brook Stickleback
COTTIDAE	SCULPINS
Cottus bairdi	Mottled Sculpin
PERCIDAE	PERCHES
Etheostoma flabellare	Fantail Darter

REPTILES AND AMPHIBIANS REPORTED FROM THE STUDY AREA

*	Yellow-spotted Salamander	*Ambystoma maculatum*
* ^	Jefferson Salamander (undetermined)	*Ambystoma (jeffersonianum complex)*
*	Eastern Redback Salamander	*Plethodon cinereus*
*	Four-toed Salamander	*Hemidactylium scutatum*
*	American Toad	*Bufo americanus*
*	Spring Peeper	*Hyla crucifer*
*	Tetraploid Gray Treefrog	*Hyla versicolog*
*	Striped Chorus Frog	*Pseudacris triseriata*
*	Wood Frog	*Rana sylvatica*
* #	Northern Leopard Frog	*Rana pipiens*
*	Pickerel Frog	*Rana palustris*
* #	Green Frog	*Rana clamitans*
* #	Common Snapping Turtle	*Chelydra serpentina*
*	Painted Turtle	*Chrysemys picta*
*	Eastern Ribbon Snake	*Thamnophis sauritus*
*	Common Garter Snake	*Thamnophis sirtalis*
*	Northern Water Snake	*Nerodia sipedon*
*	Northern Redbelly Snake	*Storeria o. occipitomaculata*
*	Brown Snake	*Storeria dekayi*
*	Smooth Green Snake	*Opheodrys vernalis*
*	Eastern Milk Snake	*Lampropeltis t. triangulum*

* 21 Species – Ontario Herpetofaunal Summary 1985
\# 3 Species Observed (Ecologistics Limited May 1, June 4 and 17, July 28 and August 12, 1997
^ 1 Species Provincially Significant