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1.0 INTRODUCTION

1.1 Study Area and Background

The following Scoped Subwatershed Plan (Phase 1 - Overview and Background) has been prepared in conjunction with a Community Plan being completed for the Ayr Urban Area, in the Township of North Dumfries. The location of the Cedar Creek Subwatershed and the Ayr Community Plan area is shown in Figure 1. The Community Plan study area is located within the Cedar Creek, Nith River and Little Turnbull Creek Subwatersheds.

One of the key purposes of the Community Plan process is to identify the opportunities and constraints to development, and to develop appropriate management strategies to achieve environmental protection, restoration and enhancement. In recognition of this objective, the Regional Municipality of Waterloo (RMOW) Official Plan Policies require that a Scoped Subwatershed Plan should be undertaken, prior to an Official Plan Amendment (OPA) for the Ayr Community Plan. The Cedar Creek Subwatershed has been identified as a high priority for a Scoped Subwatershed Plan by the Grand River Conservation Authority (GRCA) and the RMOW.

The intent of this “scoped” subwatershed level of investigation is to provide a sufficient level of detail regarding the key biophysical attributes, functions, processes and linkages within the Cedar Creek subwatershed, as a “framework” for more detailed, field investigations (Comprehensive EIS) to be completed within the Ayr Community Plan study area. It is not the intent of this document to provide a comprehensive set of recommendations for the Cedar Creek Subwatershed, as a whole, but rather to provide a sufficient level of detail to ensure that development within the Ayr Community is compatible with the protection, enhancement and restoration of subwatershed level attributes and functions, as identified through this investigation.

The GIS mapping and overview subwatershed descriptions provided in this document will ultimately comprise the Phase 1 (i.e. Subwatershed Characterization) component of a larger Watershed Level investigation for Cedar Creek to be completed at some future date. The additional detailed information collected within the Ayr Community Plan study area will be included within the final report and will serve to further expand the information base for inclusion within a future watershed study.

The Comprehensive EIS (Phase 2) to be completed in conjunction with the Ayr Community Plan will demonstrate how the proposed land use plan and required infrastructure are compatible with the protection, enhancement and restoration objectives identified in Phase 1.

The Ayr Community Plan study area and associated subwatersheds (Cedar, Nith) contain the following key biophysical features, which were investigated as part of this study:

- \$ Cedar Creek and its associated cold water fishery, Provincially Significant Wetland and Regional Environmentally Significant Policy Area designations;
- \$ Nith River fishery and associated bottomland, valley slope and tableland habitat blocks;
- \$ groundwater recharge/discharge zones;
- \$ remnant forest blocks; and,
- \$ potential primary and secondary linkage connections.

As noted above, the results of the Phase 1 subwatershed characterization are intended to form a “framework” for the more detailed Phase 2 analysis, and refinement of opportunities and constraints to development within the Ayr Community Plan study area. A fundamental goal of the environmental inventory work completed within the Community Plan study area was to provide a defensible and implementable “natural heritage framework” that would form the basis for future urban land use planning and environmental policy formulation. The results of the combined Subwatershed and Community Plan level investigations will yield the following land use definitions for the Ayr Community:

- \$ those areas which should be retained and protected with no development intrusion (i.e., “Significant” Natural Areas);
- \$ those areas which can be sensitively integrated within an urban land use form;
- \$ those areas which should be restored and enhanced; and,
- \$ those areas which pose no or low constraint to development.

2.0 STUDY APPROACH

The key tasks completed as part of the Phase 1 - Overview and Background were as follows:

- \$ confirmation of work program and level of effort with GRCA;
- \$ compilation and review of existing background studies, reports, mapping, aerial photography and Natural Heritage System data bases (i.e. RMOW, GRCA, MNR, NHIC);
- \$ description, evaluation and mapping of terrestrial, wetland and aquatic habitat attributes and functions, including presence/absence of rare species and communities, corridor linkages, buffers/setbacks and potential enhancement/restoration areas;
- \$ description, evaluation and mapping of subwatershed level physiography, hydrological and hydrogeological features/functions;
- \$ identification of key watershed management issues and information gaps;
- \$ assessment of the sensitivity of natural features to development related impacts;
- \$ development of a preliminary “Natural Heritage Framework” that identifies various levels of constraint and opportunity to development;
- \$ mapping of the various watershed components and Natural Heritage System in an ArcInfo compatible GIS format (i.e. MapInfo Professional);
- \$ development of a series of preliminary environmental management recommendations for the protection and enhancement of the recommended Natural Heritage System;
- \$ recommendations for future technical studies to be completed through the next phases of land use planning, including a work program for the completion of a full subwatershed study for Cedar Creek; and,
- \$ documentation of findings in a Scoped Subwatershed Characterization Report.

The results of the above work program are documented below in Section 3.0.

3.0 EXISTING CONDITIONS

3.1 Cedar Creek Subwatershed Overview

The study area lies almost entirely within the Township of North Dumfries, with a small section of the northwest branch of Cedar Creek extending to the outskirts of the City of Kitchener, within the Regional Municipality of Waterloo in south central Ontario. The study area is bisected by the Cedar Creek subwatershed, which drains primarily agricultural lands and remnant natural woodlands and low lying wetlands south and west of the Cities of Kitchener and Cambridge respectively. The northern part of the study area is bisected by the Highway 401 corridor, which also defines the upper limits of the coldwater system within the study area. The prominent area of settlement within the study area is the village of Ayr, located at the confluence of Cedar Creek, and a meandering section of the Nith River. In contrast, the southeast portion of the study area contains a large network of natural areas, which extend eastward towards the Grand River, and comprise the highest concentration of Areas of Natural and Scientific Interest (ANSI), and municipally designated Environmentally Sensitive Policy Areas (ESPAs) in the Regional Municipality of Waterloo and the Grand River Watershed.

An overview of the natural heritage features and land use within the Cedar Creek Subwatershed is provided in Figure 2.

3.2 Physiography

The study area contains a mosaic of landforms, as a result of past glacial activity and drainage patterns.

The study area is situated within the physiographic area of the Waterloo Hills and Horseshoe Moraines as described by Chapman and Putnam (1984). The Waterloo Hills physiographic area encompasses the northern and western portion of the study area and is characterized by rolling, hummocky terrain of sandy or silty till, stratified drift deposits and ice contact gravel and sand in the form of kames and eskers. In low lying areas, the outwash sands predominate within the spillway flow paths. Surficial materials within this physiographic area are generally medium to fine textured sands that have developed into well drained members of the Dumfries, Fox, and Waterloo soil types. Glacial outwash and spillways are predominant in the more level, intervening areas. The most southerly portions of the Horseshoe Moraines encompasses part of the eastern portion of

the study area. This region consists largely of irregular, stony knolls, moraines and ridges, with gravelly terraces. Medium textured stony tills are found within this region, with soils comprised of well-drained Dumfries soil catena.

The Cedar Creek subwatershed is located in a major glacial spillway that historically conveyed the flows of the upper Grand River and Speed River to the Thames River, when the lower Grand River was blocked by a glacier (Karrow, 1963). This accounts for the distribution of soil textures and drainage regimes along the creek corridor. The lands immediately adjacent to Cedar Creek are broadly classified as peat/muck deposits, and are surrounded by kame and till moraines (Chapman and Putnam, 1984). The Cedar Creek subwatershed is underlain by dolostone bedrock of the Salina and Guelph formation, with overburden depths of greater than 100 m within kame and esker deposits, and decreasing to depths of about 16 m in the vicinity of the Grand River (Gore and Storrie Ltd, 1992).

3.3 Soils

Soils in the study are generally described as coarse and medium textured, having been formed from outwash and shallow lacustrine deposits or on stony till deposits. There are two principal types of soils that are found in the vicinity of Cedar Creek. These include the Burford-Fox soil associations within the upland areas, and organic soils within the lowlands surrounding Cedar Creek. Burford-Fox soils are classified as coarse and medium textured soils formed on outwash and shallow lacustrine deposits. These coarse and medium textured soils are generally very permeable, and consequently provide recharge to the baseflow of Cedar Creek and wetland areas. In contrast, organic soils within low lying areas along the Cedar Creek corridor exhibit poor drainage characteristics and have largely remained under natural vegetation.

Other soils found within the subwatershed include Brant-Waterloo soils which are moderately coarse-fine textured soils formed on lacustrine deposits, and Dumfries soils, which are medium textured soils formed on stony till deposits, and Freeport-Woolwich soils which are coarse and medium textured soils, overlying medium textured till deposits. These soil associations are most prevalent in the north east quadrant of the study area.

Due to coarse textured nature of the parent materials, most of the soil associations found in upland areas are predominantly well to moderately well drained. The majority of flat, well drained areas contain Class 1 and 2 agricultural lands, with major capability limitations resulting from topography, low fertility, and moisture holding capabilities.

Accordingly, lower capability lands are located primarily in the southeast portion of the watershed, which contain wetlands and remnant natural areas.

3.4 Land Use

Land uses within the study area are shown in Figure 2. The downstream end of the subwatershed is encompassed by the village of Ayr. The specially designated Ayr settlement area covers approximately 4.5 km² and defines the future expansion limits of the community. Other settlement areas include Reidsville, which is situated a few kilometers northeast of Ayr.

According to Figure 2, and site surveys, agriculture is the largest single land use in the Cedar Creek subwatershed. The major agricultural activity within the Cedar Creek subwatershed is mixed (rotational) and corn systems, with lesser areas in continuous row-crop and hay or grain crop systems. The fertility of coarse soils over time have been maintained through extensive use of fertilizers, manure application, and effective crop rotation management. Grain corn has been a popular crop within the Township of North Dumfries due to the Township soils' coarse texture and warmer temperatures (Gore and Storrie Ltd, 1992).

The major land use resource has been sand and gravel extraction from the surficial glacial (kame) deposits within the subwatershed. For the most part, the lower west and north east portions of the subwatershed area considered to have high potential for gravel extraction, while the remaining areas are considered to have medium potential for gravel extraction.

The Region of Waterloo has identified a major portion of the subwatershed as a mineral aggregate resource area (Region of Waterloo R.O.P.P., 1998). With the exception of a small area in the eastern side of Ayr, the boundaries of mineral aggregate resource area encompasses all of the areas designated by OMNR as having high and medium mineral resource potential (OMNR 1984, 1985). The Township of North Dumfries has implemented zoning by laws to allow for current licensing of extraction operations. The extent of the defined aggregate extraction area, active pit operations, and rehabilitated former pits are summarized in Figure 2a (to be completed). There are an estimated 35 licensed extraction properties within the study area, with other license applications likely being considered within the subwatershed study area. There is no documented information on petroleum resources or bedrock resource areas within the study area.

The long term effects of sand and gravel extraction is a major concern in the Cedar Creek subwatershed because of its potential to generate a variety of known environmental

impacts. The mining of aggregates is inherently a destructive activity involving the taking of a non-renewable resource. Known environmental impacts that have been attributed to sand and gravel extraction include the lowering of the groundwater table, and loss of groundwater recharge/discharge capability associated with permanent loss of the aggregate deposit. Impacts are generally believed to be greater if sand and gravel extraction occurs below the groundwater table, and the amount and extent of aggregate material removed.

Because the Cedar Creek system supports a cold water fishery that is dependent on groundwater contribution, potential negative impacts from unrestricted sand and gravel extraction include the loss of baseflow and localized upwelling conditions which are crucial to the long term sustainability of brook trout. Other potential impacts include thermal warming, and water contamination, depending on how the gravel pit operation is managed.

Rehabilitation plans for decommissioned gravel pits include naturalization and creation of fish habitat and parkland. In recent years, gravel pits have also been turned into golf courses, such as the recently built “Whistle Bare” golf course in the Blair Creek subwatershed. The long term effects of these rehabilitation plans should be closely monitored to ensure that hydrologic and water quality of the Cedar Creek system is not compromised.

Due to the rural nature of the surrounding lands, there are few developments within the outlying portions of the study area and these are confined to the industrial areas near Highway 401. Canadian Pacific Railway has a railway line that follows the course of Cedar Creek from its mid reaches at the Highway 401 to the village of Ayr. Union Gas and Interprovincial Pipeline Co. have pipelines that bear east-west along the subwatershed.

Finally, other land uses within the Cedar Creek subwatershed include woodlot management areas. These uses typically occur within plantations and Agreement forests in the vicinity of Alps Road and Wrigley Road, as shown in Figure 2. Some of these woodlands are owned by the Grand River Conservation Authority (GRCA) and the Region of Waterloo, and are open to the public for recreational and educational use. Further details on forest resources within the subwatershed are described in the following section.

3.5 Forest Resources

The Cedar Creek subwatershed is situated in a transitional zone between the Deciduous Forest (or Carolinian) and the Great Lakes-St. Lawrence Forest Regions (Rowe, 1972) and therefore contains characteristic tree species that are commonly associated with both southern and northern climates and soil conditions. The typical forest associations within the Carolinian zone include trees that are more characteristic of southern regions of Ontario and northern United States and include uncommon species such as Black Oak (*Quercus velutina*), Pignut Hickory (*Carya glabra*), Sycamore (*Platanus occidentalis*), and Black Walnut (*Juglans nigra*) occurring in some parts of the study area. In contrast, the typical forest associations within the Great Lakes-St. Lawrence Forest Regions include Sugar Maple (*Acer saccharum*), American Beech (*Fagus grandifolia*), White Pine (*Pinus strobus*), White Ash (*Fraxinus americana*) and Red Oak (*Quercus rubra*) that are commonly found in central and eastern Ontario. The extent of woodlands within the study area is shown in Figure 3. Contiguous woodlands larger than 4 hectares are also shown, since these woodlands may be “Potentially Significant” in the Region of Waterloo.

The distribution pattern of tree species in the study area is related to soil drainage conditions found within a particular site location. Typically, the better-drained upland sites contain Sugar Maple (*Acer saccharum*) and American Beech (*Fagus grandifolia*), with lesser occurrences of Basswood (*Tilia americana*), White Ash (*Fraxinus americana*) Red and White Oak (*Quercus rubra*, *Q. alba*), and Black Cherry (*Prunus serotina*). Several occurrences of Northern Pin or Hill’s Oak (*Quercus ellipsoidalis*) are also found within the Cedar Creek subwatershed. Coniferous tree species that are associated with well to imperfectly drained sites include Eastern Hemlock (*Tsuga canadensis*), and White Pine (*Pinus strobus*).

The typical forest communities in imperfectly to poorly drained sites include Silver and Red maple (*Acer saccharinum*, *A. rubrum*), Bur Oak (*Quercus macrocarpa*), White Cedar (*Thuja occidentalis*), and Lowland Ashes (*Fraxinus nigra*, *F. pennsylvanica*). Other forest communities that occur within the Cedar Creek subwatershed include Tamarack (*Larix laricina*) and Black Spruce (*Picea mariana*) found within bogs, a short distance upstream of Ayr.

Disturbed and regenerating sites are characterized by successional species such as White Birch (*Betula papyrifera*), Trembling Aspen (*Populus tremuloides*), Balsam Poplar (*P. balsamifera*), White Elm (*Ulmus americana*), Hawthorns (*Crataegus spp.*), Dogwoods

(*Cornus spp.*), and Buckthorns (*Rhamnus spp.*). Common and Glossy Buckthorn (*Rhamnus cathartica* and *R. frangula* respectively) are invasive non-native species, which are extensively colonizing woodlands/wetlands. These species are threatening to crowd out native species in the sub-watershed and elsewhere in the Region of Waterloo.

The Forest Resource Inventory (FRI) of the Cedar Creek subwatershed indicates that the majority of forest resources in close proximity to Cedar Creek are considered to be low productivity upland and lowland cover types. High productivity or potentially high productivity upland forests are located on better-drained lands outside the Cedar Creek Spillway.

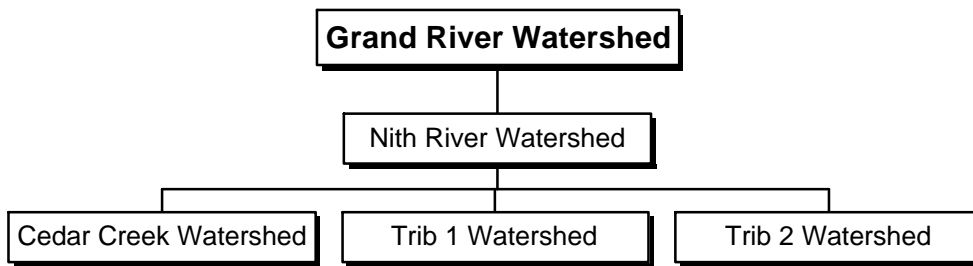
3.6 Wetland Resources

The Cedar Creek subwatershed contains an array of wetland types, ranging from deciduous swamps, bogs, and numerous shallow lakes and ponds. The extent of wetland habitat in the study area is shown in Figure 3. Many of these wetlands have been evaluated by the Ministry of Natural Resources and GRCA, and are known to contain special attributes (such as providing habitat for rare or unusual flora and fauna), and provide essential hydrological functions (water recharge, discharge, and storage) in the subwatershed. As a result, many of these wetlands are also designated as Provincially or Locally Significant, Areas of Natural and Scientific Interest (ANSIs), and Environmentally Sensitive Policy Areas (ESPAs). The role of these wetlands within the overall natural heritage framework is discussed in Section 4.

3.7 Aquatic Resources

The study area is located within the Grand River Watershed and the Nith River subwatershed. Within the study area (which falls within Nith River subwatershed), there are three smaller watersheds; Cedar Creek and two small tributaries of the Nith River. (Chart 1.) The Nith River drains into the Grand River that ultimately drains into Lake Erie. From a fisheries perspective, the Grand River and Lake Erie both exert an influence on the study area. Fish from Lake Erie (migratory fish, such as rainbow trout (*Oncorhynchus mykiss*)) are able to reach the Nith River within the study area through the Grand River migratory corridor.

Chart 1. Watershed Hierarchy



A summary description of the watershed hierarchy, as it pertains to hydrological pathways and fisheries resources, is provided below.

Grand River Watershed

The Grand River, located in south-central Ontario, extends 298 km from its headwaters north of Dundalk in Dufferin County to Port Maitland on Lake Erie. The watershed, comprising 6,500 km², is the largest inland river system in southern Ontario. Approximately 730,000 people inhabit this watershed.

The fish resources of the Grand River watershed are diverse, consisting of 80 confirmed and 18 probable/possible fish species. This represents 62% of all fish species found in Ontario. It is noteworthy that six fish species considered to be “Vulnerable” or “Threatened” in Canada are found in the watershed (*Grand River Fisheries Management Plan*, GRCA and MNR, 1998).

Nith River Watershed

The study area is located in lower section of watershed as defined by the Grand River Conservation Authority. The watershed drainage area of the entire Nith River is approximately 1,088 km².

The surface geology of this watershed is complex, with extensive kame moraines, sandplains and glacial spillways interspersed with sandy to sandy/silty till moraines, and a rolling topography. As a result of the geology, flow patterns in tributaries are complex due to the large amounts of groundwater influx. These groundwater influxes generate a higher, more stable baseflow, cooler temperatures, and provide opportunities to restore water quality. The fishery resource of the Lower Nith consists of a diverse warmwater fish community dominated by top predators (e.g. walleye, smallmouth bass and pike) and has a stable forage base. A seasonal coldwater fish community (i.e. migratory rainbow trout) also occurs in this system.

The Nith River System also provides habitat for “Vulnerable and Special Concern” fish species, such as silver shiner, black redhorse and greenside darter (reference GRCA, 1998).

The Nith River flows through lands dominated by agriculture with very little forest cover. Water quality suffers from nutrient loading and high livestock populations. Extensive tile draining and thermal loading also contribute to poor water quality. As a result of the geology and current agricultural land uses, the Nith River suffers from high sediment loading, which affects the productivity of this system.

Through the study area the river has a well established vegetated riparian zone consisting of forested slopes/bottomlands and floodplain wetland pockets. Portions of the riparian zone have been impacted by urban development and lack a vegetated riparian zone. Cobbles, gravels, and sands dominate the bottom substrate throughout the study area.

Cedar Creek Watershed

The Cedar Creek watershed drains an area of approximately 54km². It originates in the Roseville Swamp and flows southwest for approximately 9 km to the town of Ayr before entering the Nith River (Figure 2). Roseville Swamp is a provincially significant wetland. Cedar Creek is classified as a Type 1 cold water stream community by the MNR and its mid-reaches contain critical fish habitat and waterfowl staging areas. Cedar Creek is considered one of the finest coldwater streams in the Waterloo Region.

Cedar Creek has been recognized as a cold water system that maintains an excellent fishery. A good riparian zone is present along the majority of the main channel consisting of the contiguous riparian forest cover and wetlands. The existing water quality is considered very good and the creek does not suffer from many of the land use practices typical of river and creek systems in the area. Water temperatures and sedimentation levels are both indicative of excellent water quality.

Substrates within Cedar Creek are dominated by gravels with many areas of groundwater discharge. This results in cold water temperatures even during summer low flow periods. Instream cover is excellent and stream morphology is diverse with pools, riffles and runs. Wetlands and smaller tributaries provide juvenile brook trout habitat while deeper pools in the main channel provide adult refugia during summer low flow periods.

The Jedburgh Pond and the Watson Pond are impoundments located in the core are of the Town of Ayr, providing a scenic focal point for recreational angling and waterfowl viewing opportunities within an urban and semi-urban park setting. These

impoundments lend character to the Town of Ayr, and are part of the settlement's early heritage. However as in most impoundments, there on-line features serve as barriers to fish movement throughout the system, as well as other impacts to fisheries and water quality resources that become more apparent over time. These effects will be discussed in Phase 2 of this study, which concentrates on the Ayr Secondary Plan study area.

The Jedburgh Pond covers an area of approximately 2.3 hectares. Much of its banks are forested with mature white cedar with exception of the Main Street allowance and the Jedburgh Dam. When the Jedburgh Dam was constructed in 1832, the creek widened and flooded the white cedars present along the old creek banks. Those flooded dead tree stumps are still present today and provide instream cover. The pond is shallow and the bottom substrate is dominated by soft sediments.

The Watson Pond is located within the downtown core of the Town of Ayr covering an area of 1.5 hectares. A park surrounds the pond on the west banks and commercial businesses are situated on the east bank. A boardwalk crosses over a narrow lobe of the pond and provides excellent overhead cover. The portion of the pond to the north of the boardwalk is shallow and is surrounded by a mixed cedar/trembling aspen tree cover. The bottom sediments are soft and support an emergent macrophyte community of water lilies, cattail and rushes. The portion of the pond south of the boardwalk is deeper (approximately 3m) with some tree cover along the eastern bank. The eastern bank is dominated by manicured lawn to the edge of the pond with little treed overhead cover. The bottom is composed of fine gravel and soft sediments with very little aquatic macrophyte cover present.

Tributaries to the Nith River Watershed (Coffin Creek and unnamed tributary)

The two tributaries are located in the south-east end of the Town of Ayr. Tributary 1 (north tributary) originates in a woodlot before flowing through town and into the Nith River. It is approximately 600m in length and supports cold water brook trout. Tributary 2 (south tributary) has been identified as a cool to warm water fishery originating in a residential area and is approximately 600m in length.

Fisheries Community Assemblages

The fish community descriptions of the riverine and pond systems within the study area were determined through background information accumulated from the MNR and GRCA as well as field sampling conducted by LGL Limited.

The Nith River has been classified as a warmwater fish community with a seasonal coldwater fish community (migratory rainbow trout). Sampling completed by the GRCA

and published in the 1997 *Fish Sampling In The Grand River* near the Town of Ayr show a total of 30 species have been identified within that reach of river. Fish listed as “Vulnerable and Threatened” found within the study area are the silver shiner (*Notropis photogenis*), black redhorse (*Moxostoma duquesnei*) and greenside darter (*Etheostoma blennioides*).

Cedar Creek is a Type 1 coldwater creek supporting a brook trout fishery. Fish inventory conducted by the GRCA in 1999 resulted in the capture of 18 species of fish within Cedar Creek. Fish listed as “Vulnerable” found within Cedar Creek is the greenside darter (*Etheostoma blennioides*).

The upper and mid reaches of Cedar Creek contain numerous seepages of upwelling groundwater and support self sustaining populations of brook trout (*Salvelinus fontinalis*). Brook trout were stocked since 1963 in the creek proper and continued into the 1970s in the downstream ponds (Brook trout were almost exclusively stocked with the exception of 500 Kamloops trout stocked in 1963). Spawning surveys conducted by the GRCA in 1988 and 1989 indicate that the mid reaches of Cedar Creek between Greenfield Road and Cedar Creek Road are heavily utilized by spawning brook trout, with the highest concentration of brook trout redds observed between Alps Road and Greenfield Road.

The lower reaches of the watershed support stocked salmonids and fish that are more tolerant of warmer water conditions in impounded areas. These include rainbow trout (*Oncorhynchus mykiss*) and white sucker (*Catostomus commersoni*), largemouth bass (*Micropterus salmoides*), mottled sculpin (*Cottus bairdi*), longnose dace (*Rhynchichthys cataractae*), blacknose dace (*Rhynchichthys atratulus*), greenside darter (*Etheostoma blennioides*) and pumpkinseed (*Lepomis gibbosus*).

Watson Pond (lower pond) has been stocked with a variety of trout on a regular basis starting in the early 1970s. Initial stocking programs involved brook trout but has been exclusively rainbow trout since 1993. The trout are stocked as part of a local fish derby that is held every year. A total of 7 fish species have been identified within the pond which includes mottled sculpin, white sucker, brook stickleback (*Culaea inconstans*), pumpkinseed, brook trout, largemouth bass and rainbow trout.

There is little information available on the Jedburgh Pond (upper pond) and recent field investigations did not provide much additional information. A 1977 MNR field survey of the pond reported brook trout within the pond. There is no recent data available to support that brook trout are still present in the pond. LGL Limited staff confirmed that

white sucker utilize the pond, but a full assessment was hampered due to the soft nature of the bottom substrate.

An overview of the aquatic habitat features within the study area is provided in Figure 4.

There is very little documented information available on two tributaries (Coffin Creek and unnamed tributary) flowing into the Nith River. LGL Limited completed a survey of the tributaries during the summer of 2000, and determined that the north tributary is a cold water stream that supports a brook trout fishery. A total of 7 species of fish were identified within the tributary, including brook trout and greenside darter. Flow in the south tributary was low at the time of LGL Limited field visit and no fish sampling was completed. The tributary originates in a residential neighbourhood and flows through a large stormwater management pond at which point very little flow was evident.

Restricted Use, Hazard and Floodplain Lands

The banks of stream systems and immediate adjacent lands, areas of organic soils, flooding and erosion susceptibility or of poor drainage are defined in the Official Plans as being hazard, restricted use, or floodplain lands. Accordingly, most of the riparian lands immediately along Cedar Creek and its tributaries are generally regulated by the Grand River Conservation Authority. The OMNR defines hazard lands as those which sustain a risk for occupants of loss of life or property damage if developed. Hazard lands within the study area are shown in Figure 5, and are subdivided into areas defined as Floodplain Limits, Conservation Lands, Poorly Drained Soils, and Steep Slopes.

3.8 Hydrology

Two tributaries of Cedar Creek drain lands from the northern portion of the watershed. The northwest tributary drains lands near the outskirts of the City of Kitchener from an elevation as high as 350 metres toward the southeast and across Highway 401. The northeast tributary drains lands west of Galt-Cambridge from an elevation up to 340 metres toward Highway 401 and the confluence with the northwest tributary. From the confluence near the highway, the north branch continues south to the Village of Ayr where it drains into the Nith River at an elevation of approximately 285 metres.

Another tributary from the east drains lands in the southeastern portion of the watershed toward its confluence with the north branch near Greenfield Road just northeast of Ayr. The distance from the northwest watershed boundary to the Nith River, roughly along the route of the northwest and north tributaries, is 14 kilometres. The distance from the southeast watershed boundary to the Nith River is approximately 11 kilometres.

Within the Village of Ayr, Cedar Creek encompasses two bodies of water. Jedburgh Pond has a surface area of approximately 2.3 hectares and is located east of Main Street. Watson Pond has a surface area of approximately 1.5 hectares and is located immediately downstream of Jedburgh Pond between Main Street and Northumberland Street and a short distance from the Nith River. Both ponds are maintained with outlet weir structures located at Northumberland Street and Main Street. Two tributaries of Cedar Creek are located to the north of the main channel and east of the limit of existing development. A coldwater tributary of the Nith River is located south of Cedar Creek and extends up to the Hilltop Estates. A second tributary of the Nith River is located south of Greenfield Road and west of Regional Road 50.

The future development areas in Ayr are tributary to Cedar Creek and its two tributaries as well as the Nith River and tributaries. The industrial zoned area north of the CPR and the potential residential areas north of Cedar Creek drain to the two tributaries of Cedar Creek, while the residential area between the creek and Wrigley Road is directly tributary to Cedar Creek. Areas south of Wrigley Road and Hilltop Drive drain to the Nith River along with potential development areas on the west side of the community area.

3.8.1 Groundwater Recharge/Discharge

Information regarding groundwater recharge and discharge was obtained from the Grand River Conservation Authority Hydrogeological Study and associated 1:50,000 scale map sheets for Cambridge (February, 2000). Within the Cedar Creek watershed, the depth to the water table reaches as high as 40 to 50 metres, however, the depth is less than 25 metres in the majority of the area and 15 metres or less in the Village of Ayr. The Cedar Creek watershed encompasses predominantly weak to medium downward hydraulic gradients (20 metres or less between the water table surface and the potentiometric surface). However, large areas of weak to medium upward gradients are found along the north branch of Cedar Creek and at the eastern limit of the watershed. Potential groundwater discharge areas have been identified along the southeast tributary, particularly in the headwaters. Additional locations were identified along the north and northeast tributaries including an area within the Village of Ayr and along the lower portion of the northwest tributary.

Dry weather flow measurements were taken along Cedar Creek and the two small tributaries in the Village of Ayr as well as along the two small tributaries of the Nith River in order to characterize the areas of groundwater discharge within the Ayr Community Plan boundary. The measurements were taken on September 7, 2000 and are

presented in Table 1. A total of 11 measurement stations were identified for the characterization. As shown, no flow was found at five of the stations including: Stations 2 and 4 along the tributary of Cedar Creek at the eastern limit of the community area; Station 6 along the second tributary of Cedar Creek draining lands from the north and crossing Greenfield Road and the CPR; and Stations 10 and 11 along the tributary of the Nith River just south of Greenfield Road, west of Regional Road 50.

Flow was measured further down along the second tributary of Cedar Creek at Station 7 indicating groundwater discharge along this reach. Flow was also measured at Station 9 along the tributary draining the Hilltop Estates, indicating groundwater discharge. This tributary was previously identified as a coldwater tributary. Along Cedar Creek, the flow increased from Greenfield Road at Station 1 to Stations 3 and 5, upstream and downstream of the eastern tributary indicating groundwater discharge along this reach. In addition, considering the flow input to Cedar Creek from the second tributary, the flow measured at Station 8 downstream of the Jedburgh Pond indicates groundwater discharge along Cedar Creek between Stations 5 and 8.

Station	Location	Baseflow (cms)
1	Cedar Creek at Greenfield Road	0.26
2	Eastern Tributary at Greenfield Road	0.00
3	Cedar Creek u/s of Eastern Tributary	0.29
4	Eastern Tributary at Cedar Creek	0.00
5	Cedar Creek d/s of Eastern Tributary	0.31
6	2nd Tributary at CPR	0.00
7	2nd Tributary at Jedburgh Pond	0.014
8	Cedar Creek at Main Street	0.43
9	Hilltop Estates Tributary at Swan Street	0.008
10	Nith Tributary south of Greenfield Road	0.00
11	Nith Tributary south of Greenfield Road	0.00

Flows measured September 7, 2000

The Grand River Conservation Authority has additional flow measurements for Cedar Creek which will be used for calibration of the Cedar Creek hydrologic model.

3.8.2 Water Balance

Water balance information for the Cedar Creek watershed for both the soil/land use combinations (termed response units) and the overall balance was obtained from the Grand River Conservation Authority and is presented in Tables 2 and 3.

Unit	Precip	Evapo-transpiration	Infiltration	Runoff	Baseflow	Percent of Watershed
Impervious	906	229	0	730	0	1.9
Wetland	906	240	23	354	23	5.0
Clay Till Low	906	414	401	342	9	0.0
Clay Till High	906	316	335	192	43	0.2
Silt Till Low	906	452	468	260	33	0.0
Silt Till High	906	369	458	131	109	0.0
Sand Till Low	906	574	625	204	76	9.4
SandGravel Low	906	621	805	77	185	67.9
SandGravel High	906	607	875	7	270	15.6

Notes: All values in mm/year
 Low represents a land use of row crop, High represents forest cover
 Infiltration represents the total volume entering the ground
 (including that lost to transpiration)

As shown, almost 70% of the watershed consists of row crop on sand and gravel soils. Another 15% consists of forest on sand and gravel soils. These units result in the highest total infiltration rates (including that lost to transpiration) of 805 and 875 mm/year, respectively.

The overall water balance below was calculated by combining the information from the response units, using the Cedar Creek percentages, into one grouping. It should be noted that this overall water balance does not account for effects due to disconnected drainage or hummocky topography, which will result in increased infiltration.

Precipitation	Evapo-transpiration	Runoff	Baseflow	Delta
906.5	624.2	84.6	173.4	24.3

Note: Delta represents the volume that “leaks” through the watershed and drains to the underlying aquifer (deep groundwater recharge)

The soil types in the future development areas consist of coarse and medium textured soils including the Brant, Caledon, Dumfries, Fox, St. Jacobs, and Burford series (The Soils of Waterloo County, 1971). These soils have medium to high infiltration potential. Thus, this will be an important consideration in the development of storm water management criteria.

3.8.3 Existing Storm Water Management Facilities

There are three storm water management facilities within the Village of Ayr. One is an extended detention/infiltration facility located northwest of the intersection of Hilltop Drive and Hunt Street. This facility serves Phase I of the Hilltop Estates development and outlets to the coldwater tributary that runs north of Mitchell Street and crosses Swan Street prior to discharging to the Nith River. A Phase II/III facility is proposed to be located southeast of Ayr Road and Hilltop Drive.

Another existing facility is a wetland type pond located southeast of the intersection of Swan Street and the south leg of Mitchell Street. This pond receives runoff from a sewer along Mitchell Street as well as a sewer from the south. The pond outlets across Swan Street prior to discharging to the Nith River. Visible flow was observed in the outlet during a site visit in August of 2001 following a dry period.

The third facility is a small dry pond located east of Main Street near Hall Street. This facility outlets to the south under a driveway and into a woodlot area north of Jedburgh Pond.

Storm Water Management Criteria for Future Development

Storm water management criteria are required to minimize the impacts of future development on the hydrologic regime and surface water features. The criteria must address storm water quality and quantity control as well as erosion control once the conditions of the development area and downstream features are fully understood. Thus, specific criteria shall be established upon completion of the Cedar Creek hydrologic model and the Cedar Creek Two-Zone floodplain assessment. The following general criteria shall be considered:

- \$ control of peak flows such that downstream flood risk and erosion potential are not increased;
- \$ control of runoff volumes in consideration of the existing hydrologic regime and such that downstream erosion potential is not increased;

- \$ control of water quality prior to discharge to existing watercourses in accordance with the Ministry of the Environment Level I protection of receiving watercourses for Cedar Creek and the Nith River;
- \$ control of contaminant discharge by detaining the “first flush” runoff generated by a 25 mm storm;
- \$ maintenance of groundwater recharge through provision of infiltration facilities and/or practices that promote infiltration;
- \$ control of thermal impacts of storm water runoff;
- \$ protection of significant environmental features from impacts of storm water management facilities;
- \$ incorporation of a natural and aesthetically pleasing landscaping plan into the design of storm water management facilities; and,
- \$ protection of the function of existing storm sewers, culverts and other drainage elements as well as existing storm water management facilities.

Storm Water Management BMPs

A screening of best management practices (BMPs) will follow the establishment of specific storm water management criteria for the future development areas. Such practices include: “at source” controls such as reduction of lot grading, rear yard retention of runoff, and dry wells for down spouts; conveyance controls such as infiltration trenches and enhanced grassed swales; and “end of pipe” controls such as extended detention dry ponds, wet ponds, and wetlands, and infiltration basins. The selection of the BMPs will depend on the conditions of the development area including topography and infiltration potential as well as downstream conditions.

4.0 NATURAL HERITAGE SYSTEM OVERVIEW & FRAMEWORK

The following section provides an overview of the key environmental attributes and functions discussed in the previous sections. It forms the basis for a preliminary “natural heritage system” and the establishment of opportunities and constraints to development within the Ayr Community. The natural heritage framework of the Cedar Creek Subwatershed is provided in Figure 7. It represents a composite “layering” of the various constraint themes/layers discussed in Section 3.0. A preliminary assessment of primary/secondary linkage connections and potential core forest habitat is provided in Figure 6. Criteria used in the development of the natural heritage framework was derived from the principles shown in Section 5 of the Natural Heritage Training Manual Version 1 issued by the Ministry of Natural Resources (1977).

The establishment of appropriate environmental protection, enhancement and restoration measures will be established through the Phase 2 (Comprehensive EIS) study for the Ayr Community Plan. By refining the various management measures to ensure environmentally sustainable growth in Ayr, broader subwatershed level management measures and guidelines will be established. It is the intent that this level of detail will be provided in the final Phase 1 (Overview & Background) report, including terms of reference for follow-up studies.

An overview of the various natural heritage features within the study area is provided below.

Designated Natural Areas

The mixture of vegetation communities with both northern and southern vegetation affinities, combined with the area’s unique physiography has contributed to the development of a wide variety of life and earth science features that are considered unique within the Waterloo Region. These natural areas and forests also provide habitat for many wildlife species. The Cedar Creek subwatershed contains areas that are considered to be Areas of Natural and Scientific Interest (ANSI) by the Ministry of Natural Resources, and Environmentally Sensitive Policy Areas (ESPA) by the Region of Waterloo. Many of these areas are also recognized by the International Biological Programme (IBP). The designated natural heritage features in the Cedar Creek subwatershed are shown in Figure 2, and are summarized as follows:

ANSIs

ANSIs contain natural landscapes or features that are considered to contain significant representations of life and earth science interests which are valuable in terms of natural heritage, education, or scientific study. Provincial and regional levels of significance are recognized relative to the ANSI character and extent of representation. All of the ANSIs within the study area are also designated as ESPAs in the Region of Waterloo Official Plan.

Within the Cedar Creek subwatershed, McCrone Lake is considered to be regional Life Science ANSI and contains two lakes surrounded by a Tamarack-Sphagnum bog, calcareous meadow, a fen complex and an upland forest community containing Maple, Beech, and Hickory.

Alps Woods is a large, upland forest of White Oak, Pignut Hickory, Basswood, Hard Maple, and Black Cherry. This forest is also known as the Dryden Tract and is recognized as a provincial Life Science ANSI, a regional Earth Science ANSI (Cottrell kame moraine), and an IBP site. The Alps Woods is located on the rolling topography of the Cottrell kame moraine, which is resulted in the formation of a rich variety of understory vegetation from the wide variety of microhabitats. The Alps Woods is the only site in the Waterloo Region that contains abundant specimens of the rare Yellow Mandarin (*Disporum langinosum*).

Hungry Hills Regional Life Science ANSI encompasses the Dryden Tract forest and is noted for its biological diversity. This ANSI contains a large kame area and a provincially significant wetland complex. Significant species that have been recorded in the Hungry Hills ANSI include the rare Blandings Turtle (*Emydoidea blandingi*).

The Cottrell Lake Kame is the only a regional Earth Science ANSI within the study area. Kames are rough and hummocky landforms formed within a deposit of partly sorted glacial debris at the edge of retreating ice lobes. The Cottrell Lake kame is large and extends in a southeast direction at the eastern portion of the study area and is deemed to be of high to medium potential for mineral resources and the north portion of this kame is under active aggregate extractive use.

Roseville Swamp is a regional Life Science ANSI (which is also an IBP Site) which forms the headwaters of Cedar Creek. It is situated along the eastern edge of the gently rolling Waterloo Sand Hills as part of an old spillway bed.

Cranberry Bog (also known as Grass Lake or Paris Bog), is an early successional sphagnum bog that is a provincial Life Science ANSI. The bog is also a provincially significant wetland, and contains various species of sundew (*Drosera spp.*). The bog is surrounded by upland maple-pine-oak woods and prairie relics and is known as an important wildlife and waterfowl area. Cranberry Bog is also designated as an IBP site.

Sudden Tract contains a large expanse of upland forest situated within an area of morainic hills. Sudden Tract is a regional Life Science ANSI and a provincially significant wetland. The upland forest communities are interspersed with many lower lying areas and small lakes that are considered significant botanical sites and contain Orchids (*Platanthera spp.*). The low lying areas form a wetland complex and also contain a network of hiking trails. The Sudden Tract also contains areas of Carolinian forest and a notable diversity of salamanders.

Little Turnbull Lake Regional Life Science ANSI contains bog and swamp habitat and is known to support a significant water storage function. This wetland is reputed to be an excellent waterfowl nesting site.

Bannister and Wrigley Lakes are two small lakes that provide nesting areas for marsh birds and a staging area for migratory waterfowl. Because of these functions, this area is known as a regional Life Science ANSI, a provincially significant wetland, and an IBP Site.

Finally, a portion of Dean's Lake Regional Life Science ANSI is present within the southeastern part of the study area. This area is under both public and private ownership and contains a clean sand bottom lake surrounded by upland oak-hickory Carolinian forest, interspersed by smaller moist areas. Wetlands are present within this area, that are known to provide significant water storage and recharge functions.

ESPAs

ESPAs are areas of natural and scientific interest designated under municipal planning policies are deemed to be of local significance. Although all of the ANSIs are also ESPAs, additional areas with the ESPA designation include the following:

Cedar Creek ESPA- the Cedar Creek area contains provincially significant wetlands, waterfowl staging areas, and critical fish habitat with spawning populations of brook trout.

Reid's Lake (Lester's Lake) ESPA- Reid's Lake contains a provincially significant wetland and contributes significant water storage and recharge functions to the Cedar Creek watershed. This ESPA is also designated as an IBP site.

Barrie Tract ESPA- Barrie Tract is a wooded area along the north part of the Cedar Creek subwatershed. This ESPA is significant because of its well managed Carolinian woodlots and understory of southern botanical affinities.

Milroy Lake ESPA (Veich's Lake)- Milroy Lake is a small deep lake and surrounding bog which is designated as a Class 5 (non-provincially significant) wetland. This ESPA provides water storage and recharge functions and waterfowl habitat. The Millroy Lake ESPA has been reported to contain an array of rare plant species.

Turnbull Lake Basin ESPA- Turnbull Lake is a large wetland near the southwest boundary of the study area. This wetland is a headwater area for Charlie Creek and is known to provide a natural water storage and water recharge function.

There are also two ESPAs located within the Ayr Community Plan Study area. This includes **Greenfield Swamp ESPA**, which is also a provincially significant wetland comprised of a swamp and a marsh formed along an oxbow of the Nith River. The second is **Ayr Forest ESPA** which is a floodplain forest along the banks of the Nith River at the southern end of Ayr.

Provincially Significant Wetlands (PSWs)

The existing ANSIs and ESPAs either wholly or partially include all of the provincially classified wetlands found in the Cedar Creek subwatershed. PSWs within the study area include Roseville Swamp, Greenfield Swamp, McRone Lake, Cranberry Bog, Sudden Bog, Sudden Tract, Cedar Creek, Hungry Hills, Bannister and Wrigley Lakes, Turnbull Lake Basin, Little Turnbull Lake, and Reid's Lake.

Significant Flora and Fauna

The Cedar Creek subwatershed sustains a diverse native flora and fauna, due to its topographical variety and its location at the divide between the Carolinian and Great Lakes-St. Lawrence Life Zones. Although past land clearing for agriculture and more recent urban growth have fragmented and in some cases degraded wildlife habitat, most significant natural areas have been afforded a measure of protection through the designation as Environmentally Sensitive Policy Areas and Provincially Significant Wetlands as well as the Regional Tree By-Law. The Regional Tree-by-law prevents the

unauthorized clearance of woodlands and established a minimum standard of sustainable forestry in the Region of Waterloo's woodlands.

The Natural Heritage Information Centre (NHIC) database provides a list of locations within the study area where flora and faunal species that are provincially ranked as "Vulnerable, Threatened, or Endangered". These occurrences are listed in the databases as 1 km by 1 km blocks to provide a measure of protection for the species. The identification of Endangered or Threatened Species in an area may trigger Policy 4.2.1 of the Region of Waterloo Official Policies Plan which could result in the designation of the significant portion of the habitat of the species as an Environmental Preservation Area. Examination of the NHIC database reveals the following occurrences of Vulnerable, Threatened, and Endangered Species in the Cedar Creek subwatershed:

- 1 Endangered and 1 Vulnerable Species in the vicinity of Alps Woods ANSI;
- 3 Vulnerable and 2 Threatened Species in the area of Sudden Bog ANSI;
- 2 Vulnerable Species in the vicinity of Sudden Tract and Miller Lake ANSI;
- 1 rare vegetation community and 1 Threatened Species within the lower portion of the Cedar Creek watershed and the Town of Ayr.

The natural areas of North Dumfries Township sustain many rare and significant plants. Many of these rare plants are mentioned in the natural area descriptions of ANSI and ESPA reports. Other rare species that are known to occur within and in the surrounding areas of the subwatershed include American Ginseng (*Panax quinquefolius*), and Downy False Foxglove (*Aureolaria virginica*).

In addition to the common species, several significant species have been reported to occur within the subwatershed and the surrounding natural areas. These would include a number of bird species such as red shouldered hawk (*Buteo lineatus*), hooded warbler (*Wilsonia citrina*), long eared owls (*Asio otus*) Louisiana Waterthrush, (*Seiurus motacilla*), Cerulean Warbler (*Dendroica cerulea*) and the Carolina wren (*Thyrothorus ludovicianus*) (Cambridge OMNR, 1992). The wetlands and open marsh areas associated with the designated ANSIs, ESPAs, and PSWs may attract black tern (*Chlidonias niger*), black duck (*Anas rubripes*), and possibly the least bittern (*Ixobrychus exilis*).

Cambridge District MNR have identified the potential for Four Toed Salamander (*Hemidactyllum scutatum*) and the Queen Snake (*Regina septemvittata*) to be present

within the general area of the Cambridge district. The Four Toed Salamander has been previously observed in the Sudden Tract, and the Queen Snake has been reported in the vicinity of the Grand River in the past.

Many of the mammals common to southern Ontario are expected to be present within the subwatershed study area. These species include, among others, white tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), red fox (*Vulpes fulva*), porcupine (*Erethizon dorsatum*), muskrat (*Ondatra zibethicus*), grey squirrel (*Sciurus carolinensis*), coyote (*Canis latrans*), beaver (*Castor Canadensis*), Virginia opossum (*Didelphis virginiana*), hoary bat (*Lasiurus cinereus*), European Hare (*Lepus europaeus*), woodchuck (*Marmota monax*), striped skunk (*Mephitis mephitis*), ermine (*Mustela erminea*), long-tailed weasel (*Mustela frenata*), mink (*Mustela vison*), small-footed bat (*Myotis leibii*), little brown bat (*Myotis lucifugus*), Northern long-eared bat (*Myotis septentrionalis*), Eastern cottontail (*Sylvilagus floridanus*), Eastern chipmunk (*Tamias striatus*), red squirrel (*Tamiasciurus hudsonicus*), red fox (*Vulpes vulpes*) and rabbits (*Sylvilagus spp.*), etc. associated with rural landscapes.

Potentially Significant Woodlands

The Provincial Policy Statement has established a minimum area of 4 hectares for potentially significant woodlands in the Waterloo Region. In the Cedar Creek subwatershed, there are numerous woodlands that meet this minimum size criteria (Figure 3). These woodlands are considered to be “Potentially Significant”, until further evaluation by the Region of Waterloo confirms these woodlands as “Significant Woodlands” under the Provincial Policy Statement.

Linear Features

Highway 40, and the CNR/CPR rail system, and natural gas transmission corridors are found within the Cedar Creek subwatershed study area.. All of these anthropogenic features attract and support movement of selected wildlife species, therein serving as wildlife movement corridors. Internal to the site are numerous hedgerows, wooded swales and watercourse valleys, and local roads; these features connect with off-site areas. Highway 401 presents a significant and formidable barrier to ground-based wildlife movement into or out of the site.

Summary of Watershed Functions and Attributes

In summary, the Cedar Creek subwatershed contains the following functions and attributes:

- \$ The study area contains many glacial mineral deposits and aggregate resources that are conducive to mining activity. These are protected by the Aggregate Resources Act. The Regional Official Policies Plan does not permit aggregate extraction within Environmental Preservation Areas or ESPAs.
- \$ Prime Agricultural lands exist throughout the area as result of flat, well-drained soils
- \$ Cedar Creek contains a Type 1 cold water trout fishery that is self sustaining, due to the presence of upwelling groundwater discharge conditions.
- \$ The downstream river systems of Nith and Grand River contains both diverse resident and migratory populations of fish. Linkages exist within these river systems through hydrological and existing riparian corridors. The village of Ayr is the located at the confluence of the Nith River and Cedar Creek.
- \$ The area's climate, topography, and geology both provide an outstanding array of habitats and allows for the existence of Carolinian and boreal plant and animal species. For this reason, the area contains the highest concentration of ESPA's and ANSI's throughout Waterloo Region.
- \$ The area contains many wetlands that provide a recharge or discharge function. Many of these wetlands are provincially significant and provide outstanding waterfowl habitat.
- \$ The natural features within the Cedar Creek Subwatershed are well linked providing strong inter-subwatershed and intra-subwatershed connections.

5.0 SUMMARY AND CONCLUSIONS

The following report has presented an overview of the biophysical attributes and functions of the Cedar Creek Subwatershed. This overview is largely based on background data/mapping sources with selective ground-truthing. A preliminary natural heritage framework has been identified, which forms the basis for a more detailed review within the Ayr Community Plan area.

Specific recommendations regarding the protection, enhancement and restoration of the key subwatershed features and functions, will be developed through the Phase 2 (Comprehensive EIS) study process. Through the refinement of opportunities and constraints to development within the Ayr Community, a set of specific recommendations will be established regarding:

- \$ stormwater and groundwater management;
- \$ riparian corridor management and enhancement;
- \$ stream and wetland buffering;
- \$ natural feature buffering;
- \$ enhancement/restoration;
- \$ trail location and management;
- \$ edge management; and,
- \$ storm pond and natural area landscaping guidelines.

A terms of reference for future studies (i.e. site specific EIS or EIR) and a larger Watershed level investigation will be developed in consultation with the Region/GRCA and will be provided as an addendum to the final Phase 1 report.