MEDWAY CREEK COMMUNITY-BASED ENHANCEMENT STRATEGY

UPPER THAMES RIVER
CONSERVATION AUTHORITY

LONDON COMMUNITY
FOUNDATION

FRIENDS OF
MEDWAY
CREEK

Acknowledgements

A special thank you to the **Friends of Medway Creek** for their support of the *Medway Creek Community-based Enhancement Strategy*. The dedicated individuals who make up this committee are passionate about the future of this creek. Without them, there would be no one to help guide this strategy into the implementation phase.

The strategy was funded by the **London Community Foundation**. This foundation is very important to local communities and makes a difference in the future of our children.

The strategy was developed by the Friends of Medway Creek (Local Advisory Committee) and the Technical Advisory Committee (TAC).

The TAC members are:

- Municipalities of London, Lucan Biddulph, Middlesex Centre and Thames Centre
- Ontario Ministry of the Environment
- Ontario Ministry of Natural Resources
- University of Western Ontario
- Upper Thames River Conservation Authority

The principal sponsor of this report is the London Community Foundation.

Lastly, thank you to many other groups and individuals from all facets of the community who partnered with a project in the Medway Creek watershed under this strategy. These groups are listed in Appendix F.

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1.0 Introduction and Background

1.1 Medway Creek Watershed

The Medway Creek watershed covers 205 square kilometres along the western edge of the Upper Thames River basin in southwestern Ontario. The watershed includes portions of the municipalities of Middlesex Centre (65%), Lucan Biddulph (20%), City of London (10%) and Thames Centre (6%), as seen in **Map 1**.

The watershed is rich in natural and cultural resources. Most of the land is used for agriculture (83%), with the remainder in forest cover (11%) and urban land use (6%).

1.2 The Need for a Watershed Enhancement Strategy

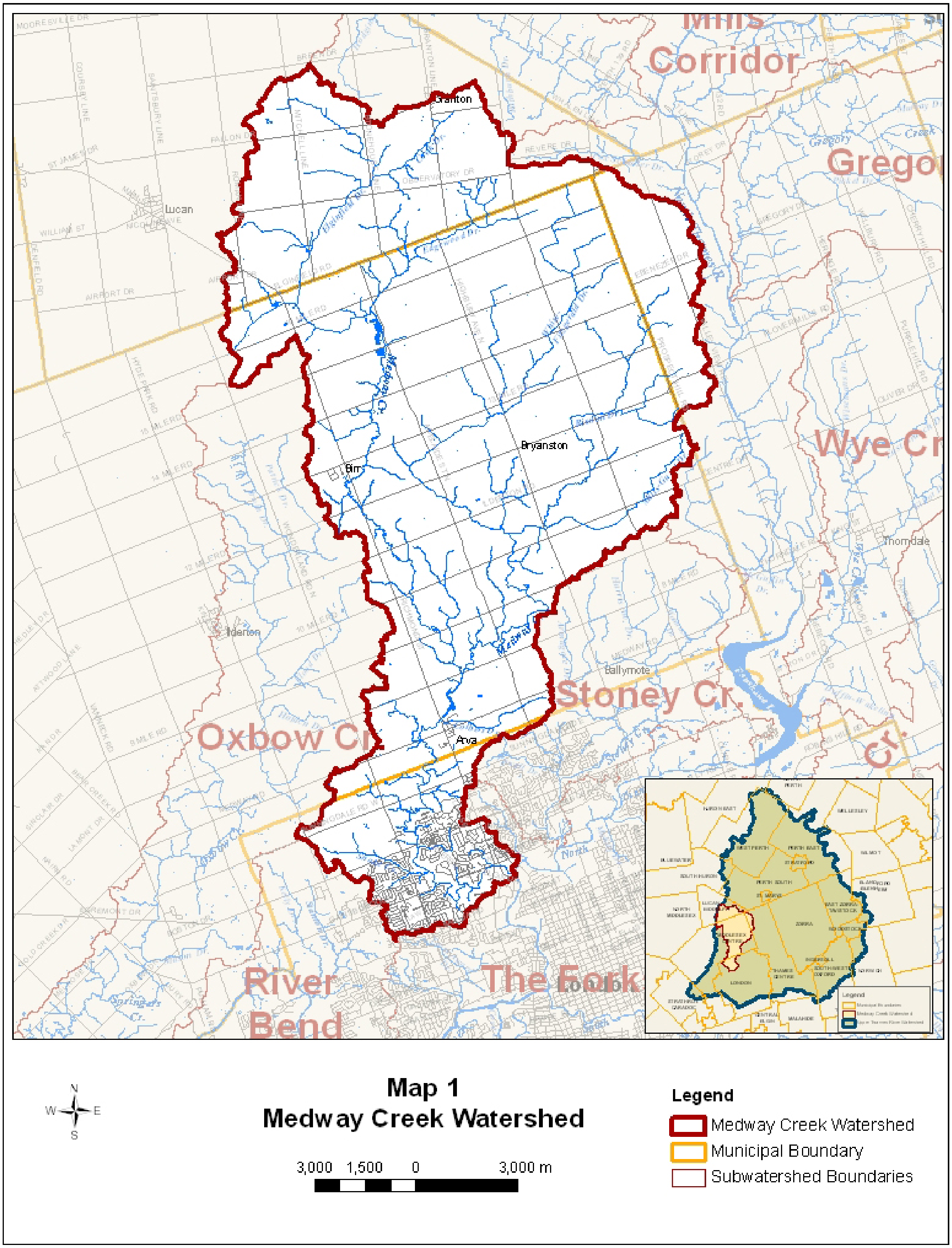
A number of agencies including the Upper Thames River Conservation Authority (UTRCA), the Middlesex Stewardship Council and, much more recently, Reforest London have been implementing various projects in the Medway Creek watershed area for years. These projects have generally been in response to demand from landowners.

In 2007, the UTRCA identified the Medway Creek watershed as a priority for environmental enhancement in the *2007 Upper Thames River Watershed Report Cards*. The report cards assessed surface water quality and forest health in 28 watersheds, and assigned letter grades. The Medway Creek watershed (Appendix G) received a C for water quality and a D for forest health, which were consistent with the watershed's scores in the UTRCA's 2001 report cards.

The report cards show the link between land-based activities and environmental quality. Providing information at this scale has facilitated groups working at the smaller watershed scale. Some long-time groups, such as the Upper Avon Conservation Club and the Friends of Stoney Creek, have demonstrated the success of this type of work. Other groups, such as the Friends of Dingman Creek and the Friends of Oxbow Creek, started as a result of the 2001 report cards.

The UTRCA was also aware of interest in the local community in undertaking environmental projects in the Medway watershed. The driving forces behind working at the watershed scale are local interest, knowledge of the watershed, and a desire for stewardship where one lives.

Map 1: Medway Creek Watershed



2.0 The Enhancement Strategy

2.1 Developing the Enhancement Strategy

The UTRCA initiated development of a community-based watershed strategy in early 2008. Watershed strategies build partnerships among community stakeholders to identify local environmental concerns, develop enhancement strategies to address these concerns, and initiate work to implement recommendations.

The first step was to create a Technical Advisory Team (TAC) to research the watershed and the community. The TAC included:

- watershed municipalities (Middlesex Centre, Lucan Biddulph, City of London and Thames Centre),
- University of Western Ontario,
- Ontario Ministries of Natural Resources and the Environment, and
- Upper Thames River Conservation Authority.

The TAC prepared a technical background summary that provides an overview of abiotic (non-living), biotic (living) and cultural aspects of the Medway Creek watershed. A public open house/meeting was held to share information, gather more input, and invite interested stakeholders to join a local advisory committee, which became the Friends of Medway Creek.

An enhancement strategy was prepared by the TAC and the Friends of Medway Creek in 2009. It is hoped that the strategy will provide an important reference tool for the Friends of Medway Creek and local municipalities, as well as a communications tool to use with the public.

Technical Background Summary

A technical background summary (see Section 3.0) was prepared in 2008 by the TAC. The technical summary provides an overview of abiotic (non-living), biotic (living) and cultural aspects of the Medway Creek watershed.

The research for the summary built on previous work for the 1995 City of London Subwatershed Studies (Group 1 – Medway, Stanton and Mud Creeks) undertaken by the UTRCA and the City of London, and the UTRCA's 2001 and 2007 Upper Thames River Watershed Report Cards.

Community Involvement

Active community-based work in the watershed began in early 2008 with the creation of a local advisory committee, the Friends of Medway Creek. The group's mission statement is:

> *Community members promoting the protection and improvement of the Medway Creek Watershed.*

The group's first task was to identify the community's issues, concerns and priorities for the watershed. The main objectives identified by the Friends were:

- Improve water quality and the health of the creek ecosystem
- Establish and maintain watercourse buffers
- Reduce and prevent erosion
- Enhance wetlands and swamps
- Increase agricultural involvement
- Remove unnecessary barriers along the creek
- Increase the amount of vegetative cover

In addition to the Friends, the Medway Creek community at large was involved with the strategy development through various means, including a community meeting, questionnaire, newsletters and presentations.

The Friends of Medway Creek has had and will continue to have a key role in implementing the strategy, including:

- liaising with landowners and helping to promote the strategy and enhancement activities
- identifying possible project locations and partners
- assisting with project funding proposals
- helping with enhancement projects
- helping to evaluate and update the enhancement strategy as needed

2.2 Target Areas

The Technical Advisory Committee recommended six criteria to identify potential project areas in the watershed (Table 1). These criteria are landscape features that should be targeted for enhancement activities.

Table 1. TAC Criteria to Identify Potential Project Sites

Criteria/ Landscape Feature	Goal	Possible Actions
Along watercourses	Create buffers to improve water quality and aquatic habitat	Plant trees and other vegetation
Between woodlots	Create wildlife corridors to improve wildlife habitat	Plant trees
In or around woodlots	Create forest interior habitat for interior species (especially birds)	Plant trees
Around wetlands	Create buffers to protect wetlands	Plant trees and other vegetation
High erosion areas	Reduce or prevent erosion to protect farmland and improve water quality and aquatic habitat	Plant trees and other vegetation
Areas of increased groundwater infiltration	Protect groundwater from contaminants	

These criteria were used to develop a map prioritizing areas for enhancement. Areas of the watershed were identified and scored as high, medium or low priority in relation to the number of criteria that overlapped in an area. This is shown on **Map 2: Areas for Restoration or Enhancement**. This is not to say that areas that are mapped as low or are not mapped have no value, indeed, work in these areas have an environmental benefit.

2.3 Implementation Activities

The goal of the enhancement strategy is to identify specific enhancement projects for the Medway Creek watershed that can be undertaken by the Friends of Medway Creek, the UTRCA, their partners and interested stakeholders.

The Friends of Medway Creek developed guidelines/suggestions for enhancement activities that anyone can undertake (Table 2).

Map 2: Medway Creek Watershed Areas for Restoration or Enhancement

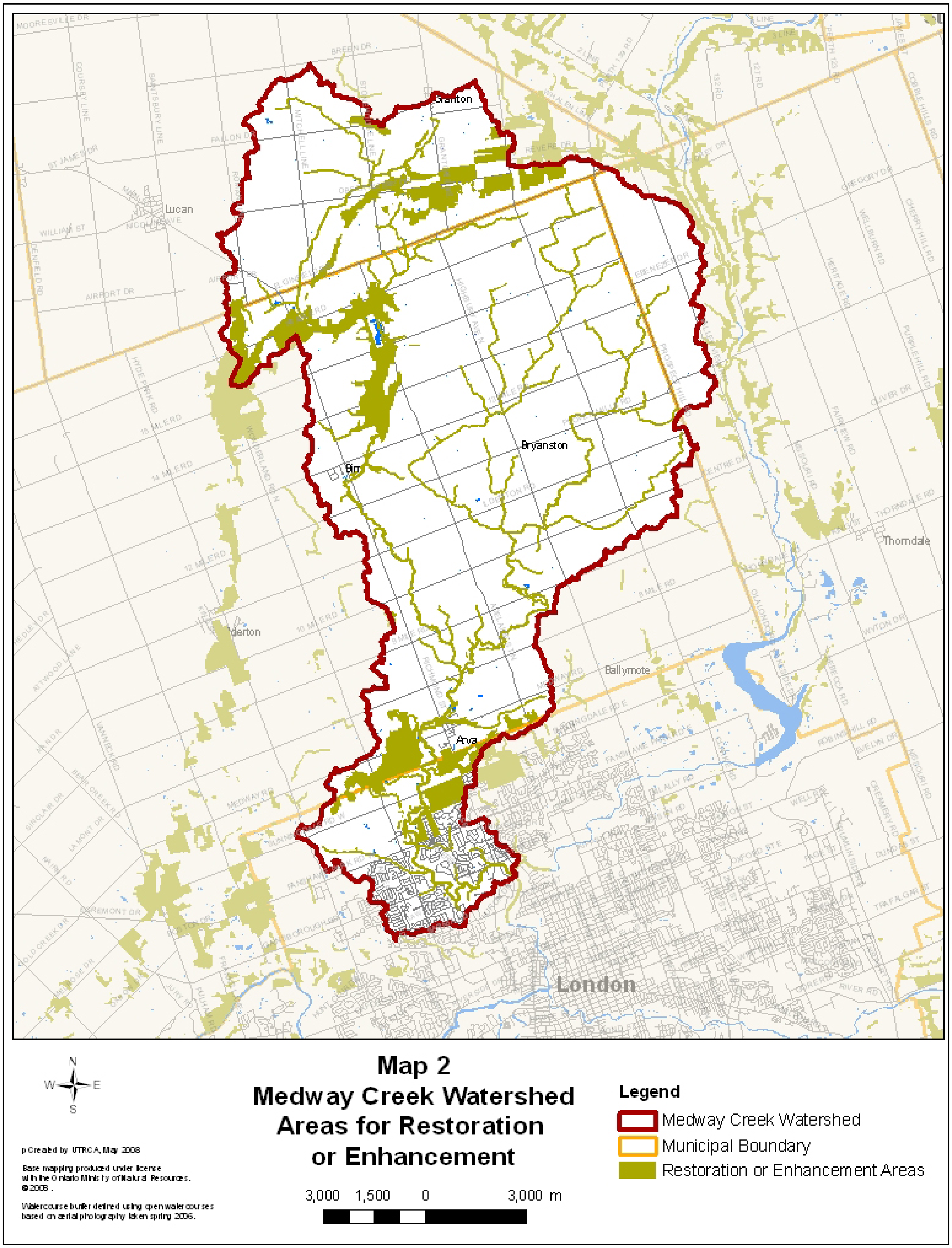


Table 2. Friends of Medway Creek Guidelines for Enhancement Activities

Key Opportunity Area	Related Current Initiatives	Action	Intended Outcome/ Products	Potential Partners
Water Quality *Rationale:* The Friends of Medway Creek identified the protection and improvement of water quality as the most important issue during the development of the Medway Creek Watershed Strategy. Medway Creek surface water quality received a 'C' grade in the 2007 UTRCA Watershed Report Card (App. G). This grade has remained steady from 2001. A declining benthic score was off-set by an improving *E. coli* score. Phosphorus remained steady.	*Clean Water Program (CWP):* The CWP is a collaborative effort between local municipalities to help improve and protect water quality in Oxford, Middlesex and Perth Counties. The program is delivered by local Conservation Authority staff and funded by the municipalities. Technical and financial assistance is provided for projects that improve and protect water quality. *Early Actions – Ontario Drinking Water Stewardship Fund:* Property owners closest to municipal wells and intakes can help protect drinking water sources through voluntary early-action stewardship projects under the Ontario Drinking Water Stewardship Program of the Ontario Ministry of the Environment (MOE). Eligible projects include decommissioning old/ abandoned wells, maintenance of existing wells, septic system inspections and upgrades, runoff and erosion protection, pollution prevention reviews for businesses, land conservation measures, and fuel storage management practices. *UTRCA Benthic Monitoring Program:* The UTRCA has been monitoring stream health through benthic sampling as a cooperative venture with the University of Western Ontario (UWO) since 1994. The program utilizes a slightly modified version of the Type II Rapid Assessment Protocol developed by the U.S. Environmental Protection Agency. Adjustments to the protocol (to accommodate local conditions) and direction of the sampling procedure have been provided by Dr. Robert Bailey of the UWO Biology Department. The Medway watershed benthic score declined between the 2001 and 2007 UTRCA Report Cards.	Develop a water monitoring program to supplement the water quality data from the single City of London surface water quality monitoring site on Windermere. Use results from surface water and benthic monitoring programs to identify pollution sources and develop remediation plans. Educate residents regarding Best Management Practices and potential funding opportunities. Potential water quality improvement can be linked to other opportunities as identified in this action plan: watercourse buffers, erosion control, wetlands and swamps, dams/ barriers and vegetative cover.	Improved fish habitat and potential rehabilitation for species at risk Reduced nutrient loading and *E.coli* levels in the creek Aesthetic appeal – less sediment and fewer algae blooms	City of London Fisheries and Oceans Canada Human Resources and Skills Development Canada – Job Creation Program Municipality of Middlesex Centre Ontario Ministry of the Environment Ontario Ministry of Natural Resources Private Landowners University of Western Ontario Upper Thames River Conservation Authority

Key Opportunity Area	Related Current Initiatives	Action	Intended Outcome/ Products	Potential Partners
Watercourse Buffers *Rationale:*: Many stream reaches, particularly in the upstream portion of Medway Creek, have been channelized and cleared of vegetation cover. Establishing watercourse buffers will address both water quality and vegetation cover.	*Watershed Buffer Restoration Project:* This project was initiated by the MNR in the Aylmer District in 2004. It was developed as a model, using a watershed approach, to identify key areas for protection and restoration within subwatersheds. Sites within the watershed are identified using parcel boundaries and prioritized based on water temperatures, corridor or gap filling potential to reduce fragmentation, size of parcel area with buffer, multiple properties to one landowner, and field ground truthing. The project is promoted to landowners by other local landowners or community members and projects are implemented by established programs (CAs, Stewardship Councils). *Drain Classification System:* The Municipal Drain Classification Project was a cooperative venture of the UTRCA, Fisheries and Oceans Canada, the Ontario Ministry of Natural Resources, local municipalities and Human Resources and Skills Development Canada. The project was designed to classify all municipal drains in order to expedite Fisheries Act Authorization for maintenance activities on drains lacking fish habitat or with resilient fish communities. Drains providing significant fish habitat or supporting sensitive fish populations were also identified and have been afforded additional protection. *Clean Water Program (CWP):* The CWP is a collaborative effort between local municipalities to help improve and protect water quality in Oxford, Middlesex and Perth Counties. The program is delivered by local Conservation Authority staff and funded by the municipalities. Technical and financial assistance is provided for projects that improve and protect water quality.	Create vegetative buffers where they are lacking, and enhance existing riparian vegetation. Contact the MNR for a map that identifies areas of potential buffer restoration. On areas where the watercourse is a drain, maintain one side for access to remove debris to facilitate clean-outs under the Drainage Act. Promote the CWP. Livestock Access Restriction to Watercourses is an eligible project. The grant rate (2009) is 50% of an installed fence or 100% of the cost of materials for a self-installed fence, to a maximum of $5,000.	Potential restoration of cold/cool water tributaries Increase shade and cover on creek to reduce temperature and evaporation Stabilize stream banks to prevent erosion Filter runoff from adjacent land Increase overall vegetative cover for the watershed	Ducks Unlimited Canada Middlesex Stewardship Council Ontario Ministry of Natural Resources Upper Thames River Conservation Authority

Key Opportunity Area	Related Current Initiatives	Action	Intended Outcome/ Products	Potential Partners
Erosion Control *Rationale:* Erosion control is the first step to prevent sediment transport in construction activities, land development, agriculture and any other activity that disturbs the soil. Erosion can be caused by both water and wind. Natural water erosion occurs in rivers and streams, particularly on the outside banks of a meander. Erosion control measures use some sort of physical barrier, such as vegetation or rock, to absorb the energy from the water or wind. Effective controls prevent water pollution and soil loss.	*Clean Water Program (CWP):* The CWP is a collaborative effort between local municipalities to help improve and protect water quality in Oxford, Middlesex and Perth Counties. The program is delivered by local Conservation Authority staff and funded by the municipalities. Technical and financial assistance is provided for projects that improve and protect water quality.	Identify candidate land parcels for fragile land retirement. Work with the community and landowners to retire and restore these lands. Promote the CWP. Erosion Control Structures is an eligible project. The grant rate (2009) is 50% up to maximum of $3,000. Inform landowners that UTRCA will perform free farm assessments and assist them with developing a farm management plan to address land use and erosion issues.	Reduce sediment Reduce phosphorus Improve habitat	Christian Farmers Federation Ontario Federation of Agriculture Ontario Ministry of Agriculture, Food and Rural Affairs Ontario Ministry of the Environment Soil and Crop Improvement Association Upper Thames River Conservation Authority

Key Opportunity Area	Related Current Initiatives	Action	Intended Outcome/ Products	Potential Partners
Wetlands and Swamps *Rationale:* Wetlands represent core areas for watershed restoration and enhancement. Wetlands include bogs, fens, swamps and marshes. There are four Provincially Significant Wetlands and many more regionally and locally significant natural heritage feature in the Medway Creek watershed.	*Healthy Headwaters Wetlands Initiative:* A partnership between the Ausable Bayfield CA, Middlesex Stewardship Council, Huron Stewardship Council, and Ducks Unlimited Canada to provide technical advice and assistance to landowners to complete wetland restoration projects in floodplain or riparian areas. Eligible projects include enhancing floodplain habitat, creating wetlands, creating conservation buffers, and installing fencing to exclude livestock. *Middlesex Natural Heritage Study:* This study provides information and a policy base to protect and rehabilitate the County's woodland and wetland features to fulfill the County's obligation under the Provincial Policy Statement for Natural Heritage. *Provincial Policy Statement for Natural Heritage:* The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and groundwater features. *Provincial Wetland Evaluation System:* This program, developed by the MNR, provides a process for assessing the importance of wetlands. Significant wetlands are protected by provincial policy and official plans. *Wetland Drain Restoration Project:* Developed by the MNR, the goals of this program are to restore wetland function, restore hydrology of drained wetlands without affecting upstream agriculture, build partnerships with landowners and conservation agencies, and provide opportunities for education and advancement. The program supports the restoration of a number of wetland functions: water quality improvement, groundwater recharge, flood attenuation, social/economic benefit, support of cold water fisheries, fish and wildlife habitat and special features.	Promote wetland creation or enhancement to store water during times of flood. Educate public, developers and government. Solicit developers' cooperation. Land Trust buy-up of sensitive lands.	Purify surface water run-off Provide wildlife habitat Provide recreation	County of Middlesex Ducks Unlimited Canada Thames Talbot Land Trust

Key Opportunity Area	Related Current Initiatives	Action	Intended Outcome/ Products	Potential Partners
Increase Agricultural Involvement *Rationale:* The land area within the Medway Creek watershed is 83% agriculture.	*Clean Water Program (CWP):* The CWP is a collaborative effort between local municipalities to help improve and protect water quality in Oxford, Middlesex and Perth Counties. The program is delivered by local Conservation Authority staff and funded by the municipalities. Technical and financial assistance is provided for projects that improve and protect water quality.	Gain cooperation of farmers and landowners. Apply for financial grants. Organize a tree planting project – target non-arable land that is unsuitable for agriculture.	Increase forest cover Reduce erosion and sediment run-off Involve more community members in the Medway Creek Enhancement Strategy Get more feedback and representation from the community	Christian Farmers Federation National Farmers Union Ontario Federation of Agriculture Ontario Ministry of Agriculture, Food and Rural Affairs Upper Thames River Conservation Authority
Dams/ Barriers *Rationale:* Dams and barriers disrupt a river's natural biology. Dams can change the natural course and flow, alter water temperatures and transform floodplains. Dams can also isolate populations of fish and wildlife in a river. The Medway Creek watershed has 24 man-made dams or barriers – more than any other watershed in the Upper Thames River catchment basin. Dam removal can be a highly effective river restoration tool to reverse impacts and restore rivers.		Identify the barriers that would have the greatest benefit if they were removed. Contact landowners – determine if barrier serves a purpose and communicate the benefits of removing the barrier. Seek financing for barrier projects and hire a contractor. Complete an inventory of aquatic resources. Assess the productive capacity of the fish populations. Assess the restoration potential for cold/cool water tributaries. Maintain/improve habitat, food productivity and spawning areas for species present.	No stagnant water Increase flow Reduce erosion Increased habitat for fish species – see some fish in the headwaters that haven't been previously seen	Fisheries and Oceans Canada Upper Thames River Conservation Authority

Key Opportunity Area	Related Current Initiatives	Action	Intended Outcome/ Products	Potential Partners
Vegetative Cover *Rationale:* Landscape ecology theory states that woodlots closest to the shape of a circle contain the maximum amount of forest interior. Maximizing forest interior, which is the protected area in the woodlot, will increase habitat for forest interior species and sensitive breeding birds. Woodlots with existing interior are a priority.	*City of London Guidelines for the Evaluation of Ecologically Significant Wetlands:* The goals of this program are to increase the representation of open space in the City; maintain and enhance the City's Natural Heritage System; provide linkages among open spaces throughout the City; and provide opportunities for passive recreation. These guidelines provide criteria for selecting and protecting significant woodlands. *Clean Water Program (CWP):* The CWP is a collaborative effort between local municipalities to help improve and protect water quality in Oxford, Middlesex and Perth Counties. The program is delivered by local Conservation Authority staff and funded by the municipalities. Technical and financial assistance is provided for projects that improve and protect water quality. *Communities for Nature:* The UTRCA works with corporations interested in supporting local environmental initiatives. Staff meets with local partners to identify sites that can be restored, and then coordinate community involvement in planting trees, shrubs, aquatic plants, wildflower meadows, and prairies. Projects range from small neighbourhood sites to large multi-year corporate and municipal initiatives. *Middlesex Natural Heritage Study:* This study provides information and a policy base to protect and rehabilitate the County's woodland and wetland features to fulfill the County's obligation under the Provincial Policy Statement for Natural Heritage. *Ontario Managed Forest Tax Incentive Program (MFTIP):* The MFTIP is a voluntary program available to landowners who own 4 ha or more of forest land, and who agree to prepare and follow a Managed Forest Plan for their property. Under the MFTIP, participating landowners have their property reassessed and classified as Managed Forest and taxed at 25% of the municipal tax rate set for residential properties.	Promote the CWP Program. Fragile Land Retirement is an eligible project. The grant rate (2009) is 50%, or up to 70% if landowner has an EFP, to a maximum of $2,000. The grant rate in the municipal Wellhead Protection Area around Birr is 70%. Schoolyard naturalizations. Plant trees around an existing woodlot. Plant trees and shrubs between woodlots to create wildlife corridors.	Increase forest cover Increase forest interior Increase breeding habitat for forest birds	City of London Elgin/Middlesex Woodlot Owner's Association Middlesex Stewardship Council Municipality of Middlesex Centre Upper Thames River Conservation Authority

3.0 Technical Background Summary

3.1 Abiotic Resources

Topography

Much of the Medway watershed is relatively flat to gently rolling. The watershed ranges in elevation from approximately 330 m on top of the Mitchell moraine in the northeast headwaters, to approximately 240 m where the Medway joins the North Thames River in London. The only areas where the local relief exceeds 10 to 15 m are along the upper reaches of Medway Creek and in a few prominent areas of hummocky moraine. The headwaters in Cook Drain are approximately 305 m in elevation; Edgewood Drain is approximately 325 m; and the White Fitzgerald and Risdon Drain is approximately 310 m.

The Medway is 214 km long. The most pronounced channel is found in the Elginfield area between Granton and Elginfield, where there is a broad valley covered with spillway material along the north side of the Mitchell moraine adjacent to Highway 7. The eastern boundary of the watershed is within 50 m of the North Thames River.

Bedrock

Devonian age fossiliferous limestone of the Dundee Formation underlies the area. The overburden, which overlies the deeper, older bedrock, ranges in thickness from 30 to 70 m. The overburden material varies from sand and gravel to clay and silt. Bedrock outcrops about 10 km northeast of the watershed in the Town of St. Marys.

Along the margin of the Dundee Formation contact with the older, deeper Lucas Formation (east of the study area in the St. Marys area), there is a rather dramatic change in groundwater conditions. Along this same contact, north of the watershed in the Staffa area, sinkhole topography is observed in association with the Dundee Formation. Sinkholes are a form of karst, which is a distinctive type of topography formed by the dissolution of carbonate rocks such as limestone by groundwater (Waterloo Hydrogeologic Inc. 2003). Sinkholes have not been documented in the Medway watershed, although this bedrock geology does impact the groundwater at depth and is discussed in the Groundwater Conditions section.

Physiography

Map 3 shows the physiographic regions of the Medway watershed (Chapman and Putnam 1984). The physiography consists of three primary regions: moraines (Arva and Mitchell moraines), the Stratford till plain (largest physiographic area), and spillways (predominantly along the river valley). These physiographic characteristics are related to the overburden glacial (Quaternary age) geology. Glacial sediments found within the Medway Creek valley are late Wisconsinan in age. In the Medway watershed, most of the features observed were deposited by the Lake Huron Lobe glacier during the period known as the Port Bruce Stadial (cold period) that occurred approximately 14,000 to15,000 years ago and deposited most of the sediments.

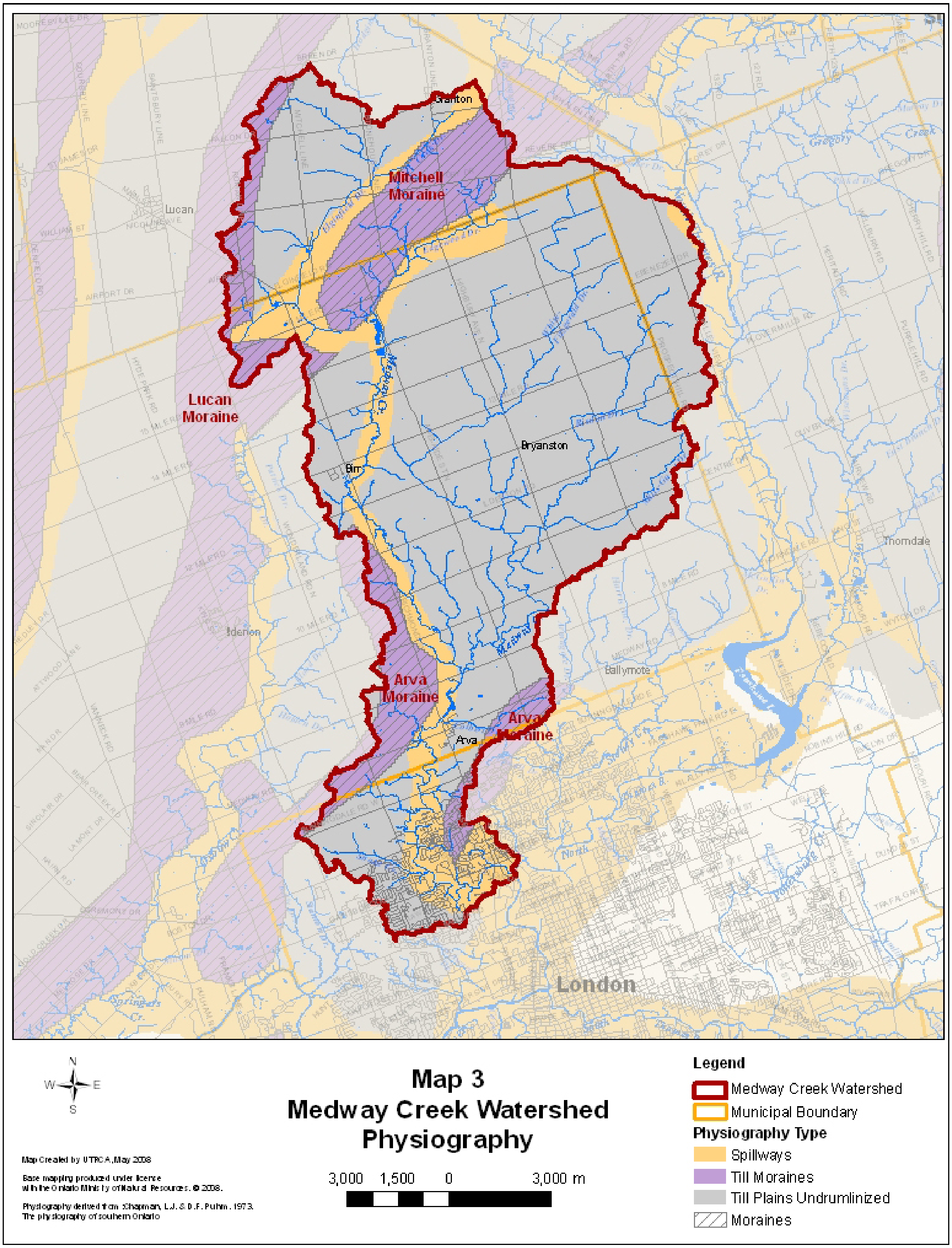
The Mitchell and Lucan moraines are particularly evident in the Elginfield area, where the Medway broke through the Mitchell moraine, just southeast of Elginfield.

The spillway material is comprised of silty sand and silty fine to very fine sand. In some localized areas, sand and gravel occur along the creek. The Stratford till plain is characterized by sandy silt till (Dillon Consulting 2007).

Soils

The surficial geology of the current landscape is the result of the actions of glaciers and their meltwater approximately 10,000 years ago (Marshall Macklin Monaghan 1994). This activity resulted in large till, sand and clay plains broken locally by terminal moraines and by the sand-covered valleys of the Thames River and its tributaries.

Map 3: Medway Creek Watershed Physiography



> "The Medway Creek Subwatershed is dominated by glacial deposits of the Huron Lobe particularly the sandy silt loam till of the Arva Moraine which is found throughout approximately 85% of this area. The Mitchell Moraine occurs near the northern border of the subwatershed and the Lucan Moraine forms the northwest edge of the subwatershed. The remaining 15% of the soil is predominantly lacustrine silty sand and clayey silt. The surficial geology in watercourses such as Medway Creek and areas adjacent to these watercourses is comprised of alluvium which is predominantly soil, sometimes containing organic remains with some sand and gravel." (Marshall Macklin Monaghan 1994).

The Medway Creek watershed soils consist of 33% clay loam, 32% silty loam, 20% silty clay loam, 6% bottomland, 6% urban (not mapped) and 3% coarse sand (**Map 4**).

Sediment Delivery

Potential soil loss is calculated through the Universal Soil Loss Equation to determine a value in tons/acre/year (tonnes/hectare/year). This equation is based on rainfall pattern, soil type, topography, crop system and management practices. Most of the Medway watershed is classified as having low erodibility (less than 3 tonnes/ha), with 5% classified as highly erodible (greater than 7 tonnes/ha of soil delivered to a watercourse per year). This information is depicted on **Map 5**.

Within the City of London, erosion sites have been documented on the outside of the meanders where the river channel meets the valley wall (e.g., along the Dead Horse Canyon in the Medway Valley Heritage Forest and the Fox Hollow/ Snake Creek ravine). Areas of high erodibility are concentrated into two regions. The first region is in the north of the watershed around Elginfield and south of Granton. Slopes in this area are significantly higher than those typically found in the Medway Creek watershed, and this area also coincides with a zone of lower agricultural capacity (Marshall Macklin Monaghan 1994). The second area is around Arva south of Eight Mile Road. Again, this region appears to have higher than average slopes. Erosion potential is greatest during spring runoff due to the large drainage area (Marshall Macklin Monaghan 1994).

Surface Hydrology

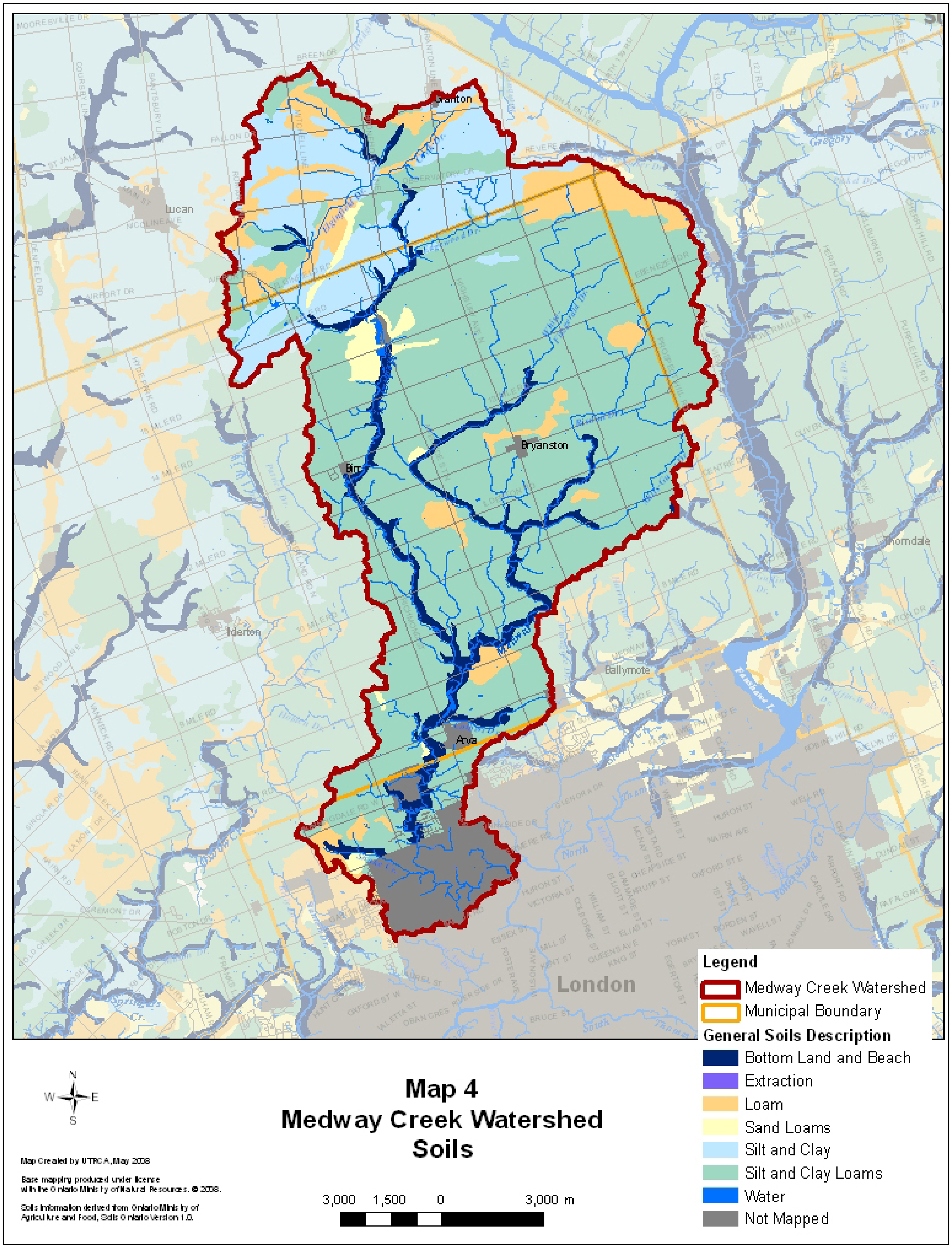
The headwaters of the 205 km^2 watershed begin around Granton in the Township of Lucan Biddulph. The Cook and Elginfield Drains flow around the Mitchell moraine in a southwest direction and through a spillway between the Mitchell and Lucan moraines. Another tributary, the Edgewood Drain, begins on the south side of the Mitchell moraine and flows southwest to meet the Elginfield Drain and the west branch of Medway Creek. This branch flows almost parallel to Highway #4 between the communities of Bryanston and Arva. Just south of Eight Mile Road, the west branch is joined by the east branch of the creek. Tributaries of the east branch include the White Fitzgerald Drain, Risdon Drain and Mills-Guest Drain. The confluence of Medway Creek with the North Thames River is southwest of the intersection of Richmond Street and Windermere Road in the University of Western Ontario campus in the City of London.

The large rural basin north of the City has experienced historic straightening and channelizing of first and second order streams. Of the 214 km-long watercourse, 30% is a natural watercourse, 49% is channelized (tiled) and 21% is buried (closed tile).

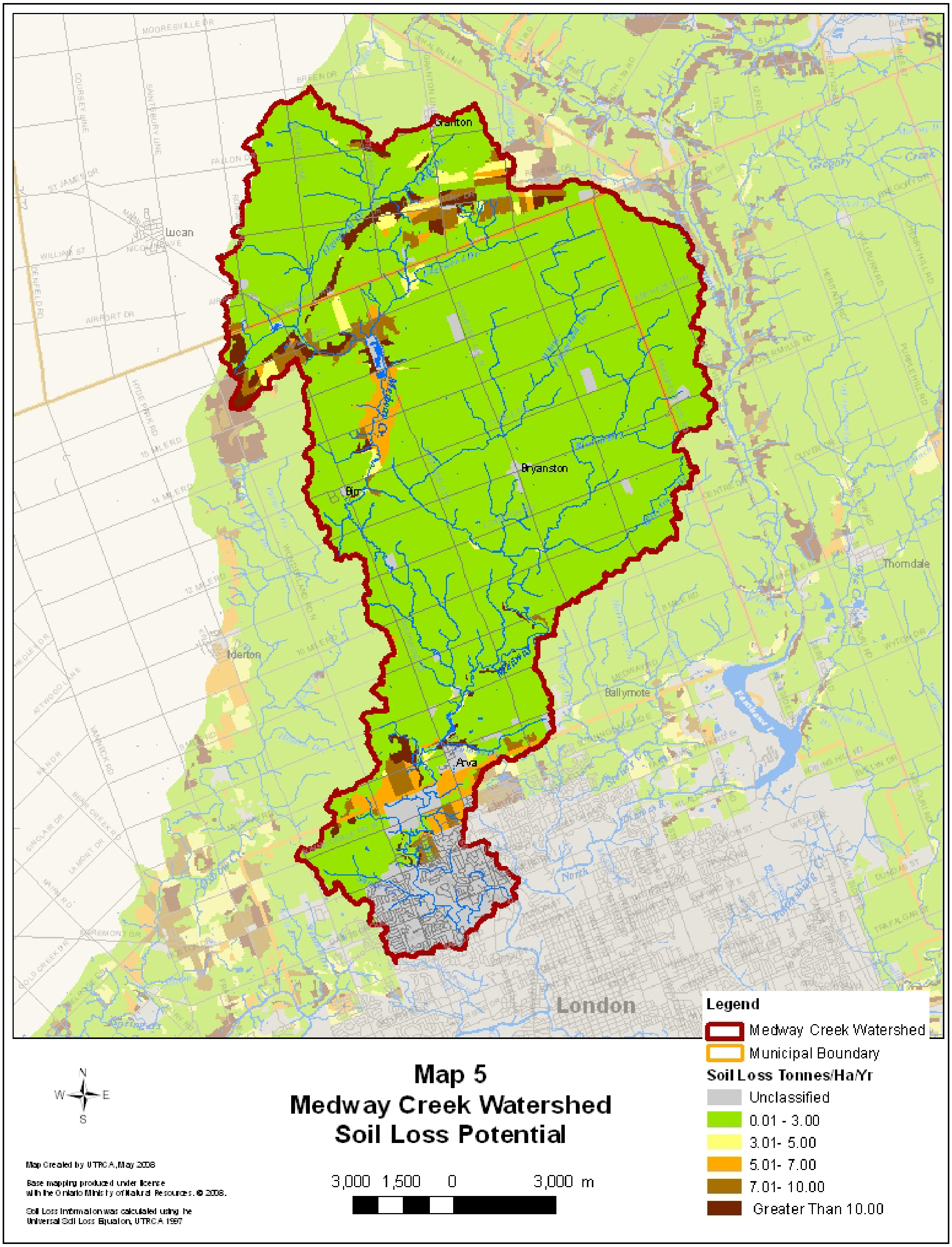
Several urban subwatersheds have been defined in the Medway Creek Urban Hydrology Study (1990) for the City of London. These subwatersheds are Ryersie Road, Rollingwood, Gainsborough Road, Fox Hollow, Highland Estates and Sunningdale. There has been significant erosion along the Gainsborough Drain downstream of the Gainsborough right-of-way (UTRCA 1990) and some less severe erosion in the Fox Hollow subwatershed between Wonderland and Medway Creek.

Stormwater control measures for new development are required by the City to reduce the effects of urban development on water quality, erosion and flooding. The UTRCA also requests similar stormwater control practices for any new development outside of the City.

Map 4: Medway Creek Watershed Soils



Map 5: Medway Creek Watershed Soil Loss Potential



The Water Survey of Canada operates a hydrometric gauge of the creek immediately upstream of Western Road in London, and the UTRCA has maintained an hourly rainfall gauge at the same location since 1984. The mean annual flow is 2.7 cubic metres per second. Medway Creek contributes 6.5% of the flow to the Thames River measured downstream of London. Stream data collected by UWO researchers along Medway Creek from the streamflow gauge indicates that the western branch of the creek has higher yields during low flows compared the eastern branch, and peak flows from urban areas occur earlier than peak flows from upstream areas. For the entire watercourse, 57% has permanent flow and 43% has intermittent flow. Local residents acknowledge that the west watercourse north of Fourteen Mile Road is intermittent in the summer months, which concurs with flow measurements taken through the UTRCA Low Water Response Program during some recent dry summers. The southern half of the basin is a “gaining stream” with groundwater discharge. The largest seep of groundwater in the watershed occurs around the Arva Dam (Marshall Macklin Monaghan 1994).

Groundwater Conditions

Groundwater can be found filling the spaces between the grains of sand and gravel, in rock crevices and in fractures. Groundwater flows slowly through water-bearing zones or formations, known as aquifers, at different rates. It is not confined to channels or depressions in the same way that surface water is concentrated in streams and lakes. Groundwater exists almost everywhere underground (Figure 1) yet has a close connection with surface water bodies and circulates as part of the hydrologic cycle. Groundwater represents one of the safest and cleanest forms of water supply. Understanding how and where groundwater moves through the watershed and the factors that control this movement will help to protect and manage this resource.

Groundwater moves from recharge areas (where precipitation percolates into the ground) to discharge areas where water appears above the ground in seeps, streams and lakes. Recharge occurs throughout the Medway Creek watershed in all areas. Groundwater flows at different rates according to the nature of the aquifer, but the highest water levels mimic the topography and are associated with the moraines. Aquifers occur at various depths in the overburden and in the bedrock in Medway Creek watershed (Dillon Consulting in association with Golder Associates 2004). Most of the aquifers of importance in the Medway watershed are unconsolidated porous media such as sand and gravel.

Groundwater characteristics such as recharge and discharge areas are often controlled by the physiography and topography. Overall the general groundwater flow is from the northeast to the southwest and the groundwater drainage area or “groundwater watershed” is much larger than the Medway Creek in most cases. The flow of Medway Creek has little influence on the groundwater flow in the deeper, more extensive aquifers. Localized shallow aquifers are in communications with streams, the flow of which is controlled by groundwater during dry periods.

The location and extent of overburden and bedrock aquifers and their water bearing capacities vary throughout the watershed. Aquifers are often found at shallow depths adjacent to the river in the spillway. In the higher, moraine areas, the more productive, confined aquifers are located deep within the overburden; however, there are also local, less extensive aquifers at shallow depths that are also important for natural habitat. In some parts of the watershed, groundwater is only found in the deeper, bedrock aquifer.

The highest groundwater elevations occur along the Mitchell and Lucan moraines in the area around Birr. Lower water elevations are usually observed in the bedrock aquifers.

There is an anomalous area northwest of Birr where shallow wells are not available and only a deep aquifer is present. This deep aquifer is associated with the Dundee Formation/ Lucas Formation and water moves along the fractures of the rock.

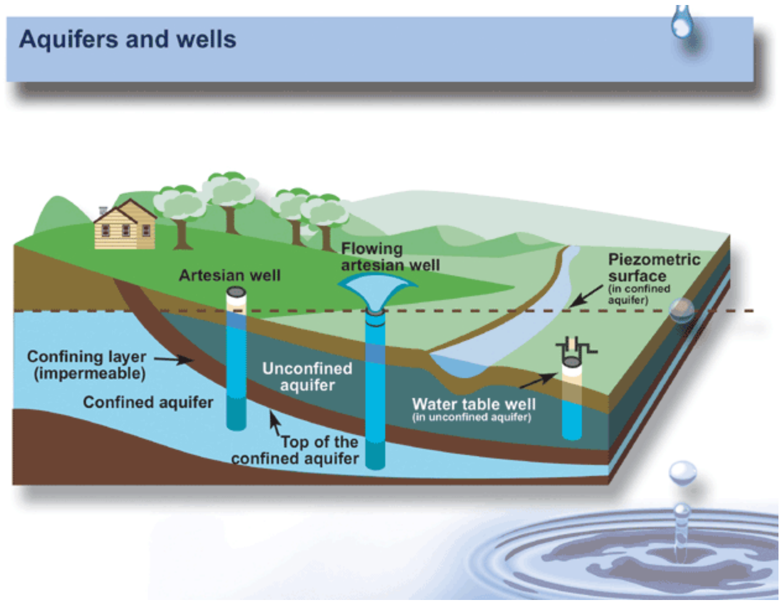


Figure 1. Diagram of aquifers and wells

Environment Canada Fact Sheet 5: Groundwater - Nature's Hidden Treasure.

The following quote from the London Township Archives illustrates how well depths vary:

> Those who have been associated with the well drilling business will confirm that the level of the water table varies throughout the London Township. Leroy Parsons, owner of L. Parsons Well Drilling Ltd., described the unique presence of a thin layer of sand which exists along Hwy. 4 at Birr…. Some properties immediately north of Birr, along Concession 13, required wells which were drilled to a depth of 200 feet or more. It was not uncommon to find records of 380-400 foot wells in the most northern sections of the township (London Township Archives - A Rich Heritage 1796-1997, Vol. 1).

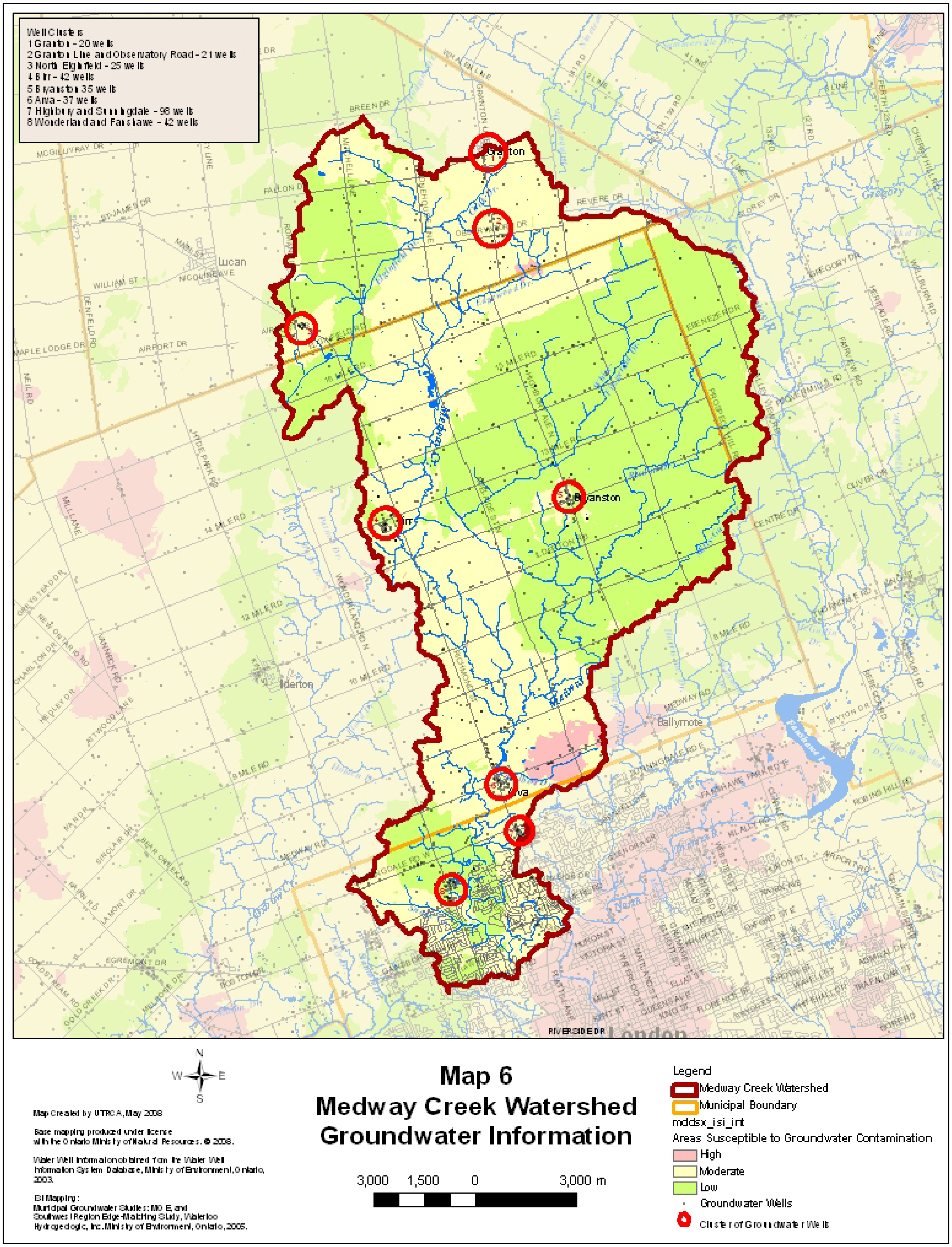
The first phase of the subdivision (18 lots) in the Village of Birr is supplied by one communal well (**Map 6**) that was developed in 1975. The well taps a sand and gravel aquifer 48 m below surface that is approximately 6 m thick. The overlying sandy silt to clay till material acts as an extensive confining layer that protects the well. The second phase of the development relies on individual wells, many of which also tap the same deep aquifer; however, there are shallow wells too.

The UTRCA does not have any groundwater monitoring wells in the Medway subwatershed at this time. However, water quality and quantity analysis for the Village of Birr is available. The village's water supply is maintained by the Municipality of Middlesex Centre and water quality data was summarized by Dillon (2007) for the period of sampling for water quality for the years 2003 to 2005. No water quantity issues were identified. Although the summary provided by Dillon (2007) was not exhaustive, no health related parameters exceeded the Ontario Drinking Water Quality Standards. Birr's water supply is hard, high in iron and has naturally occurring elevated fluoride levels.

Surface Water Quality

The City of London has been sampling Medway Creek once a month since 1978. The creek is sampled at the Western Road bridge, upstream of the confluence with the North Thames River. The samples are analysed by the City's Greenway Pollution Control Centre Laboratory for 12 water chemistry parameters: temperature, dissolved oxygen (in mg/L and percent saturation), pH, total coliforms, *Escherichia coli*, total phosphorus, total ammonia, nitrate, nitrite, conductivity, suspended solids, and chloride. This report summarizes data collected through this monitoring program.

Map 6: Medway Creek Watershed Groundwater Information



Summary of Parameters and Results

Total Phosphorus

Fate and Behaviour

While phosphorus is an essential nutrient for plant and animal life, excess phosphorus loading can result in significant increases in plant growth. Phosphorus is not directly toxic to aquatic life but elevated concentrations can lead to undesirable changes in a watercourse. These changes include reduced oxygen levels, reduced biodiversity, and toxic algae blooms that can be a health risk in recreational water and drinking water sources.

Sources

Potential phosphorus sources include commercial fertilizers, animal waste, domestic and industrial wastewater, including soaps and cleaning products and faulty septic systems. Phosphorus binds to soil and is readily transported to streams with eroding soil.

Standards

Ontario's interim Provincial Water Quality Objective is 30 micrograms/L total phosphorus to prevent the nuisance growth of algae. There is no Ontario Drinking Water Standard. Current scientific evidence is insufficient to develop a firm phosphorus objective at this time, but 0.03 mg/L should be considered a general guideline that should be supplemented by site-specific study. Algae blooms and excessive plant growth should be eliminated at total phosphorus (TP) concentrations below 0.03 mg/L and can be a relevant assessment of TP.

Monitoring Results

Total phosphorus has been monitored in Medway Creek since 1979. Over this time period, total phosphorus has been consistently above the provincial guideline. In some instances, phosphorus has been as much as nine times the guideline.

Figure 2 shows phosphorus levels declining since the 1980s and remaining steady over the past 15 years at elevated levels of approximately five times the provincial objective.

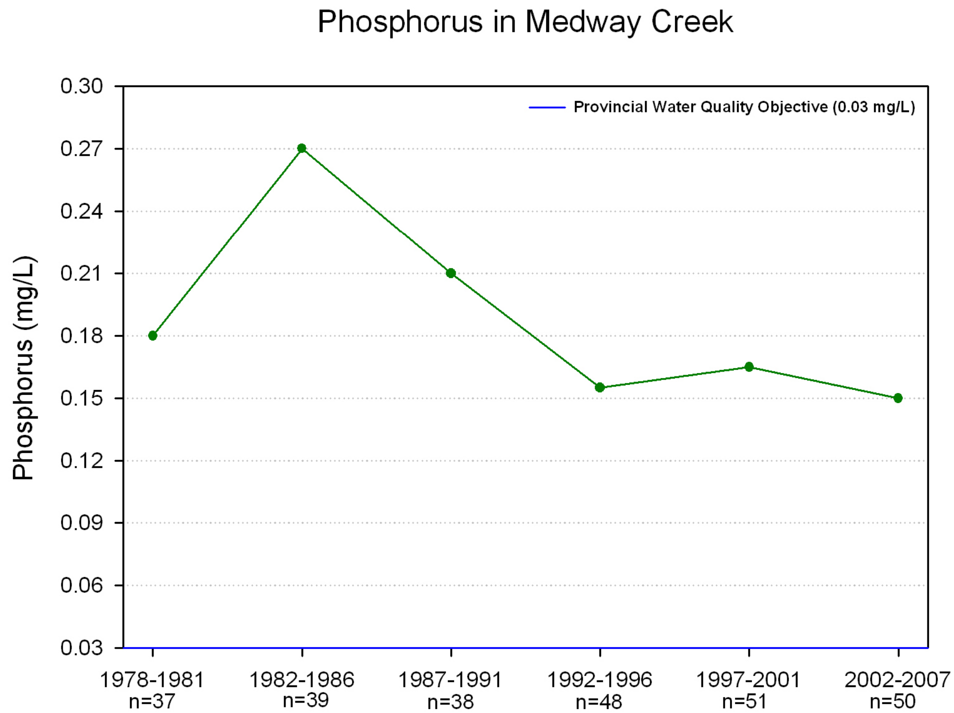


Figure 2. Phosphorus levels in Medway Creek

75th percentiles showing phosphorous levels in 5 year time blocks.

Nitrate

Fate and Behaviour

Nitrate is a nutrient that does not adsorb to sediment and that moves readily through surface runoff to streams and through soil into groundwater. Elevated levels in a watercourse can be toxic to aquatic organisms, especially amphibians. A condition called blue baby syndrome can result from young children drinking water with elevated nitrates.

Sources

Nitrate sources include animal waste, commercial fertilizers, municipal waste water, septic systems, and atmospheric deposition.

Standards

The Ontario Drinking Water Standard for nitrate is a maximum acceptable concentration of 10 mg/L. The Province does not have an objective for aquatic life but the Canadian Environmental Quality Guideline to protect aquatic life is 2.93 mg/L.

Monitoring Results

Nitrate levels have been monitored in Medway Creek since 1997. Figure 3 shows concentrations of nitrates routinely exceeding the Canadian guideline (CCME) for the protection of aquatic life over the monitoring period. Nitrates have decreased somewhat in Medway Creek in recent years.

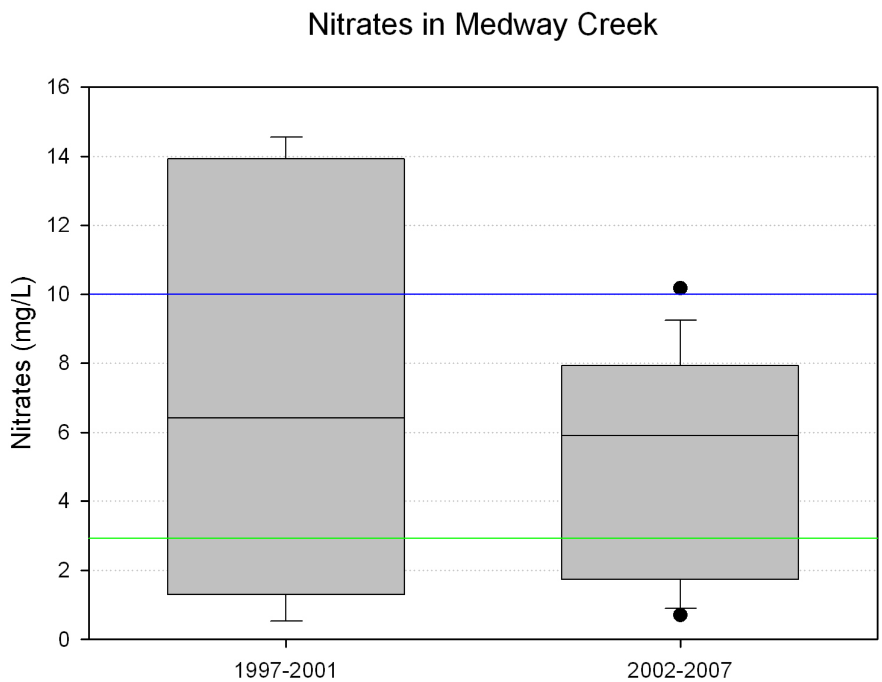


Figure 3. Nitrate concentrations in Medway Creek

Boxplot graph presenting 50% of the data within the gray box (the 25th to 75th percentiles), the 10th and 90th percentiles are the end of the "whiskers", and the 5th and 95th percentiles are the black dots.

Chloride

Fate and Behaviour

Chloride moves easily with water and persists in the river system. Nearly all chloride added to the environment will eventually migrate to surface water or groundwater. Chloride can be toxic to aquatic organisms at high concentrations, and affects growth and reproduction at lower concentrations.

Sources

The highest loadings of chloride are typically associated with the application and storage of road salt (e.g., calcium chloride). Urban streams tend to have the highest chloride concentrations.

Standards

The Ontario Drinking Water Standard (aesthetic objective) is 250 mg/L. Ontario does not have a Provincial Water Quality Objective for aquatic life. An Environment Canada/Health Canada assessment report (2001) documents toxicity for sensitive aquatic species at 210 mg/L. Acute toxicity for aquatic organisms is approximately 1500 mg/L.

Monitoring Results

In 2004, chloride monitoring was initiated as part of the City of London's surface water quality monitoring program. Figure 4 shows chloride concentrations well below recommended guideline levels since monitoring began.

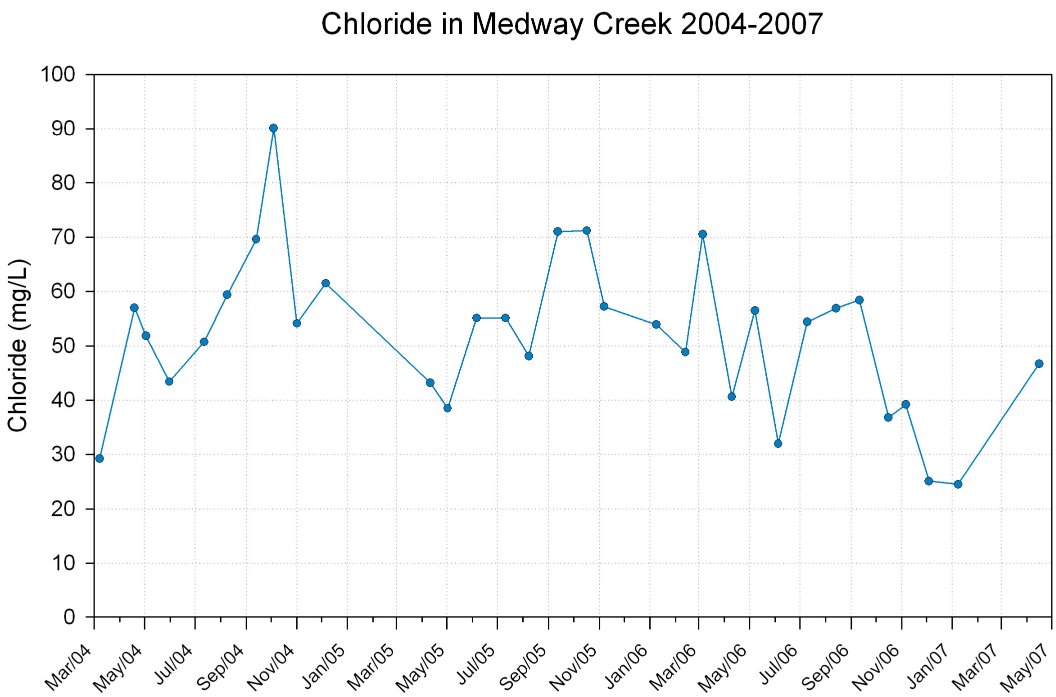


Figure 4. Chloride levels in Medway Creek

Suspended Solids

Fate and Behaviour

Suspended solids consist of silt, clay, and fine particles of organic and inorganic matter. These particles are significant carriers of phosphorus, metals, and other hazardous contaminants. Suspended solids can be detrimental to aquatic organisms including fish (cover spawning beds, damage gills, etc.). Oxygen levels in the stream can be impaired by organic solids from sources such as wastewater treatment plants and storm sewers.

Sources

Soil erosion is the most common source of suspended solids to a watercourse. Erosion from cultivated land, construction/development sites and eroded stream banks can all contribute sediment to surface water. Natural erosion of streambeds and banks are also sources.

Standards

There are no established standards for suspended solids, although standards are built into the Provincial Water Quality Objective for turbidity. Turbid water is undesirable for water supplies, healthy aquatic life, recreation and aesthetics. Suspended solids can also transport quantities of trace contaminants.

Monitoring Results

Suspended solids have been monitored in Medway Creek since 1992. The values have remained fairly steady throughout the past 15 years (Figure 5).

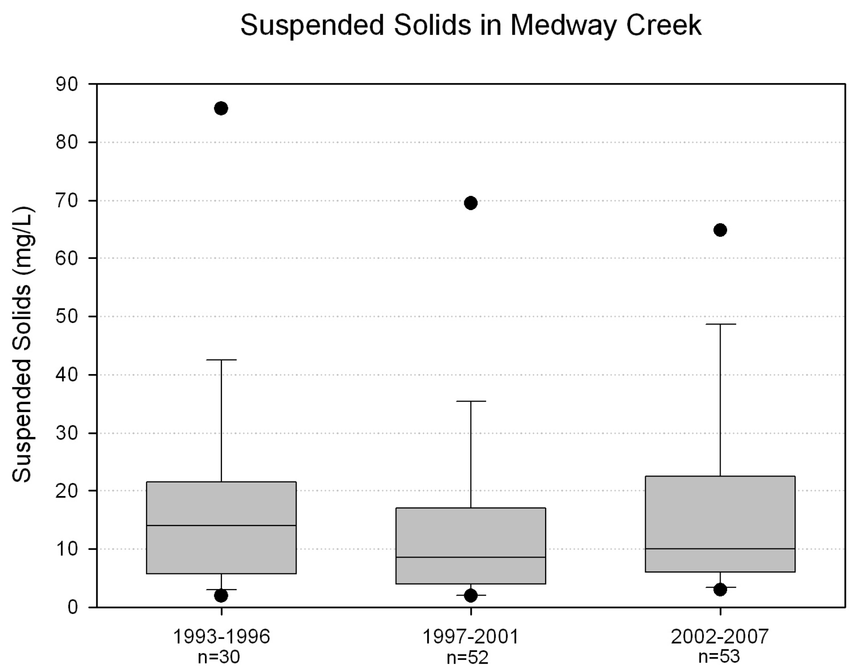


Figure 5. Suspended solids levels in Medway Creek

Bacteria
Fate and Behaviour
E. coli is a member of the total coliform group of bacteria and is the only member that is found exclusively in the feces of humans and other animals. Its presence in water indicates not only recent fecal contamination of the water but also the possible presence of intestinal disease-causing bacteria, viruses, and protozoa. Bacteria in surface water can also contaminate groundwater, putting drinking water sources at risk. Total coliforms include fecal coliform bacteria (such as *E .coli*) as well as other types of coliform bacteria that are naturally found in the soil.

Sources
E. coli and other fecal bacteria are found in the feces of humans and animals. Potential sources of fecal bacteria include runoff from biosolids/sewage or livestock waste application, faulty private septic systems, inadequate manure storage, wildlife, and urban storm water runoff.

Standards
The Provincial Water Quality Objective for recreational waters is 100 *E. coli*/100 mL. The Ontario Drinking Water Standard for bacteria states that there should be no bacteria present in a drinking water supply.

Monitoring Results:
Bacteria, specifically *E. coli* and total coliforms, have been monitored in Medway Creek since 1978. Bacteria levels in surface water tend to fluctuate widely and monthly sampling gives a minimal assessment of bacteria in a creek. Based on this data, *E. coli* is consistently above the recreational guideline of 100 *E. coli*/100 mL, although levels have dropped over in the past 20 years (Figure 6). Figure 7 suggests an increasing trend in total coliform levels.

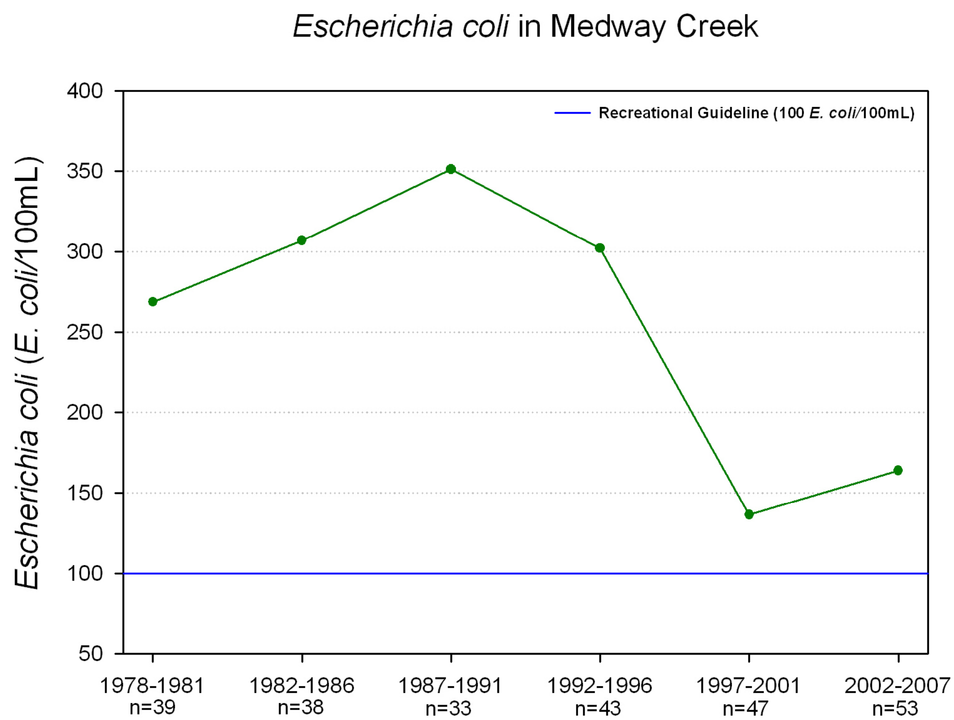


Figure 6. *E. coli* concentrations in Medway Creek

Geometric mean of data over 5 year blocks of time.

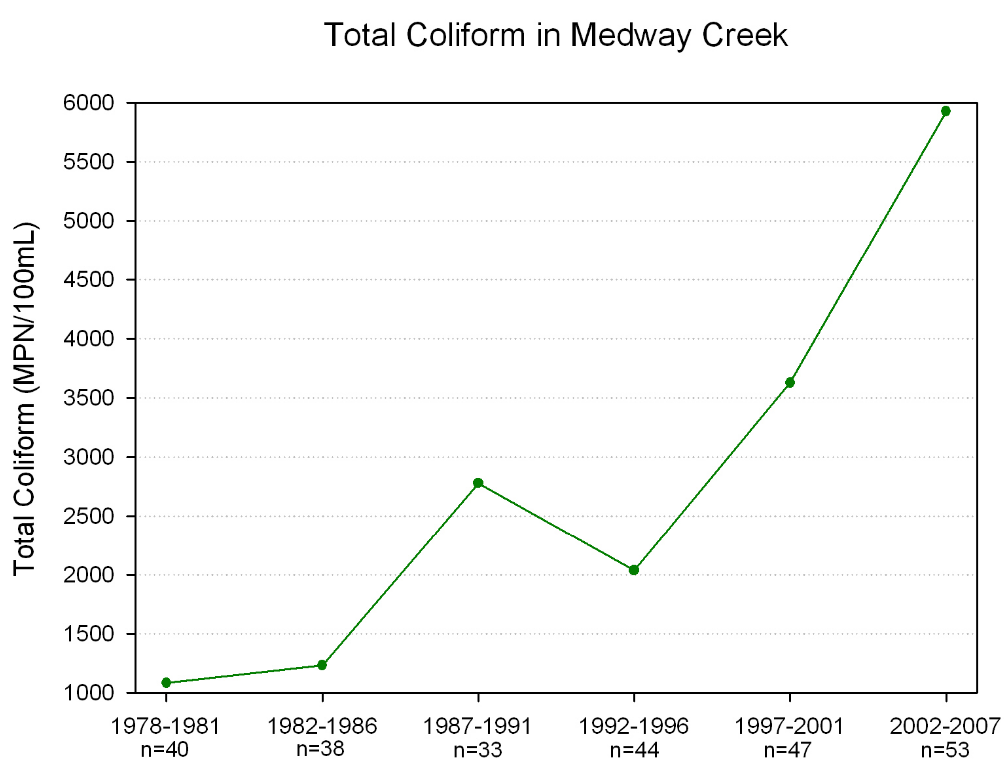


Figure 7. Total coliform concentrations in Medway Creek

Geometric mean of data over 5 year blocks of time.

3.2 Biotic Resources

3.2.1 Aquatic Ecosystem

Aquatic Natural Heritage

The aquatic portion of the Technical Background Summary provides an assessment of the current aquatic habitat conditions and information on benthic water quality and fisheries within the Medway Creek watershed. While this study focuses on the aquatic natural heritage features found within the watershed, these aquatic features influence the downstream portion of the North Thames River and, subsequently, the receiving waters of the Thames River and Lake St. Clair.

For the purpose of the Medway strategy, aquatic natural heritage features were limited to watercourses including streams, rivers, creeks, swales, and open surface drains, and their respective riparian areas or floodways. A watercourse may be defined as an identifiable depression in the ground in which a flow of water regularly or continuously occurs (Government of Ontario 1990). Some watercourses may dry up or contain pools of standing water during the drier periods of the year, particularly during periods of drought.

Watercourses are complex systems influenced by the surrounding lands such as the floodplain, the substrate (rocks, cobble, clay, sand, and silt), the channel itself, water flow, water temperature, and many other factors. Combined, all of these factors determine the type of aquatic community that is present.

The habitat that a watercourse provides includes the water, river bottom (substrate), surrounding land, in-stream vegetation, and overhanging vegetation. This habitat supports all the life stages of aquatic species and some of the life stages of semi-aquatic species. Watercourses provide habitat for feeding, cover to escape predation, areas to reproduce, and migration routes. Watercourses also provide food, water, and travel corridors for many terrestrial species.

An aquatic community can provide an indication of the current conditions in a certain location or reach of watercourse, and the potential for future improved/ restored conditions. Some aquatic species are specialists found in specific habitats, while other aquatic species are generalists that can be found in a variety of habitats. In addition, some species have known tolerances to contaminants. Due to these characteristics, some aquatic species of plants, fish, mussels, insects and invertebrates are excellent indicators of ecosystem health, and help to identify areas in need of conservation, protection and preservation, and areas in need of restoration or rehabilitation.

A watercourse can transport food, sediment, nutrients, and debris. The species living within the aquatic environment are the first affected by an adverse impact such as impaired water quality. In many cases, monitoring of aquatic species measures the extent of contamination and the state of the water conditions, for extended periods of time. It is important to have baseline surveys and consistent monitoring programs in place to ensure the accurate reporting of current conditions. Continuous monitoring provides insight into changing conditions or trends, and additional monitoring is required to target information gaps.

Background Data Collection and Maintenance

Aquatic information pertinent to watercourses in the Medway Creek subwatershed was gathered from the following sources: Environment Canada (EC), Fisheries and Oceans Canada (DFO), Ontario Ministry of Natural Resources (OMNR), Royal Ontario Museum (ROM), and Upper Thames River Conservation Authority (UTRCA). The information is maintained in Microsoft Access databases, and is transferable to a Geographical Information Systems (GIS) application.

Field Data Collection

The UTRCA has routinely sampled fish, fish habitat, and benthic water quality at specific locations in the Medway Creek watershed. Staff followed standardized provincial protocols, including the Ontario Stream Assessment Protocol (OSAP), the Ontario Benthos Biomonitoring Network (OBBN), and the Municipal Drain Classification Project (MDC). The MDC and OBBN directed the qualitative assessment of the aquatic habitat conditions. The OBBN protocol also determines the collection of the benthic water quality information, while OSAP guides the fish community sampling.

Results and Findings

The aquatic information collected provides baseline data and a current picture of the aquatic environment found within the Medway Creek watershed.

Benthic Monitoring

Benthic refers to benthic macroinvertebrates (BMI) which are insects and other macroscopic organisms that lack a backbone, and live at or near the bottom of watercourses (rivers) and waterbodies (lakes). They include the larval and/or adult stages of freshwater worms, beetles, caddisflies, crustaceans, damselflies, dragonflies, leeches, mayflies, and stoneflies. BMI are useful indicators of water quality because they are abundant in most stream sediments and have well known tolerances to pollution and habitat disturbances. Additionally, they provide a long term assessment of water and habitat quality because they are relatively sedentary, spend all or most of their lives in water, and many have life spans of a year or more. Benthic organisms are relatively easy to sample and identify for analysis and monitoring purposes.

Benthic samples collected by the UTRCA within the Medway Creek watershed since 1997 are summarized in Table 3, and the sampling locations are illustrated in **Map 7**. Benthic samples are compared using biotic indices, which are values assigned to benthic invertebrate taxa indicating their pollution sensitivity and tolerance on a scale from 0 to 10. Lower numbers indicate pollution sensitivity and high numbers indicate pollution tolerance. The Family Biotic Index (FBI) is the weighted average of the biotic index and number of benthic macroinvertebrates in each taxon in the sample. Appendix A contains the detailed analysis of the benthic sampling results.

The UTRCA has conducted benthic sampling as a cooperative project with the University of Western Ontario (UWO) throughout the upper Thames River watershed. The sampling methodology follows a version of the US Environmental Protection Agency (EPA) rapid bioassessment protocol as modified by Dr. Robert Bailey (UWO). Dr. Bailey and John Schwindt (UTRCA) were involved with the development of the provincial OBBN protocol, which incorporated Dr. Bailey's methods.

UTRCA benthic samples are taken at the same locations as the Provincial Water Quality Monitoring Network sites, from reference reaches, and at representative sites along watercourses to provide adequate information for assessment purposes. Benthic sampling also targets areas where monitoring activities can track changes occurring on the landscape such as urban development and in-stream habitat improvements.

The results of the benthic sampling within the Medway Creek watershed range from very poor to good quality water and habitat conditions. These results are fairly typical of urban developed, industrialized, and intense agricultural areas, and indicate that significant habitat and water quality improvements could occur in the watershed. Further investigation would be required to pinpoint sources of habitat and water quality impairment and to suggest possible solutions to rehabilitate the habitat and water quality. A continuous monitoring program would track any changes occurring with water and habitat quality as well as indicate trends within the watershed.

Map 7: Medway Creek Watershed Watercourse Monitoring

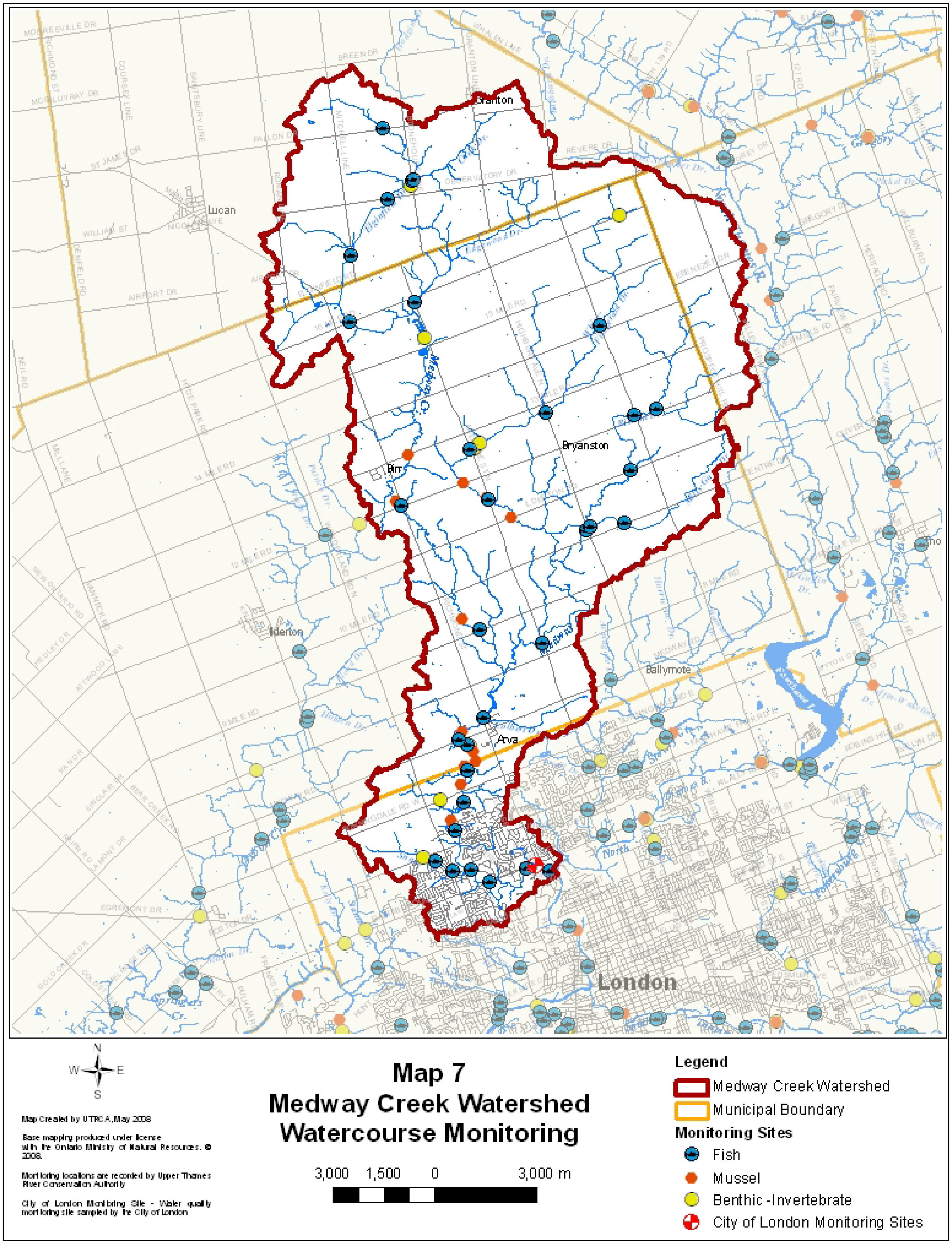


Table 3. Medway Creek Benthic Water Quality Sampling Summary

Stream Name	Location	Date	Family Biotic Index (FBI) Value	
Medway Creek	South of Windermere Road and west of Western Road, at UWO	5/27/1997	5.051	Fair
		5/29/1998	5.455	Fair
		6/3/1998	5.448	Fair
		5/20/1999	5.731	Fair
		6/30/1999	5.751	Fairly Poor
		6/26/2000	5.518	Fair
		6/7/2001	5.610	Fair
		6/10/2002	6.591	Poor
		6/21/2002	5.621	Fair
		6/21/2002	6.139	Fairly Poor
		6/2/2003	6.240	Fairly Poor
		6/14/2004	5.962	Fairly Poor
		5/16/2005	5.938	Fairly Poor
		6/6/2005	5.770	Fairly Poor
		5/29/2006	5.448	Fair
		5/31/2007	5.917	Fairly Poor
	9 Mile Road	6/23/1997	6.115	Fairly Poor
		5/26/1998	6.017	Fairly Poor
		6/11/1999	5.837	Fairly Poor
		10/4/2000	5.016	Fair
		3/12/2001	5.204	Fair
		6/20/2001	5.116	Fair
		10/3/2001	5.115	Fair
		6/17/2002	6.624	Poor
		10/28/2002	5.596	Fair
		6/2/2003	5.659	Fair
		6/2/2003	6.264	Fairly Poor
		10/27/2003	5.413	Fair
		6/14/2004	5.488	Fair
		10/6/2004	4.786	Good
		5/16/2005	4.769	Good
		10/3/2005	5.081	Fair
		5/29/2006	5.210	Fair
		9/28/2006	4.606	Good
		5/28/2007	5.389	Fair
	At Malloy Plant	6/15/1999	6.380	Fairly Poor
	Near outlet at UWO	7/24/2003	4.806	Good
	North of Fanshawe Park Road	10/25/2004	5.071	Fair

Stream Name	Location	Date	Family Biotic Index (FBI) Value	
	Downstream of Sunningdale Road	7/19/2005	5.590	Fair
		10/17/2005	5.630	Fair
	Sunningdale upstream of golf course	7/19/2005	5.393	Fair
		10/17/2005	5.064	Fair
	South of Medway Road	10/27/2004	5.460	Fair
		5/28/2007	6.701	Poor
		10/2/2007	5.625	Fair
	12 Mile Road	5/28/2007	5.701	Fair
	South of Medway Road	10/27/2004	5.460	Fair
		5/28/2007	6.701	Poor
	Fox Hollow	6/11/1999	7.427	Very Poor
		6/20/2000	6.860	Poor
		10/3/2001	7.5625	Very Poor
	Off Sunningdale Road	6/11/1999	6.788	Poor
	East Tributary at Adelaide Street	7/1/1998	5.957	Fairly Poor
		3/12/2001	5.466	Fair
Elginfield Drain	Biddulph	5/25/2000	6.776	Poor
	Upstream of Stonehouse Road	6/19/2003	6.629	Poor
		10/16/2003	6.842	Poor
McClary Dr	Medway Road, roadside	6/30/2003	5.873	Fairly Poor
		10/16/2003	5.712	Fair
Mills Drain	Highbury Road	6/20/2003	7.145	Poor
		10/16/2003	7.610	Very Poor
Snake Creek	Fox Hollow	6/11/1999	6.341	Fairly Poor
		6/20/2000	6.439	Fairly Poor
		11/5/2002	4.860	Good
		10/17/2005	5.995	Fairly Poor
White Fitzgerald Drain	Adelaide Street east of Birr	6/23/1997	6.468	Fairly Poor
		6/24/1998	6.666	Poor
		6/15/1999	6.682	Poor
	Adelaide Street east of Birr	6/23/1997	5.909	Fairly Poor
		6/24/1998	6.511	Poor
		6/15/1999	6.308	Fairly Poor
	Off Prospect Hill Road	6/15/1999	7.876	Very Poor

The water quality ranges for the FBI values are as follows:

<4.25 = Excellent

4.25-5.00 = Good

5.00-5.75 = Fair

5.75-6.50 = Fairly Poor

6.50-7.50 = Poor

>7.50 = Very Poor

Fisheries Monitoring

In the federal Fisheries Act, fish are defined as including parts of fish; shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals; and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals (Department of Justice 2006). In the scope of this document, fish species are discussed further in this section, crustaceans fall into the category of benthic macroinvertebrates, and shellfish are considered mussels, which are a separate subsection of fisheries monitoring in this report.

Fish

Fish are vertebrates that live in water, breath through gills and swim with fins. Most fish are able to survive in various habitat and water quality conditions; however, several species of fish have very specific habitat and water quality requirements as well as food preferences. Some species of fish are considered to be sedentary, spending their time under the cover of rocks or overhanging vegetation, even though all are capable of moving throughout the water column and traveling large distances in a watercourse. Due to specific habitat requirements, varying water quality tolerances, and the ability to accumulate substances such as toxins, fish are excellent indicators of ecosystem health, especially those species susceptible to pollution and intolerant of habitat alterations. Generally speaking, a diverse fish community indicates a relatively healthy aquatic environment. Fish also play a crucial role in the aquatic food chain, by providing food for humans, fish, and other wildlife.

To date, approximately 94 species of fish have been recorded the Thames River and its tributaries, which is more than half of the 165 fish species found in Ontario. Currently, 13 species found in the Thames River watershed have Species at Risk (SAR) status.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses species for their consideration for legal protection and recovery (or management) under the federal Species at Risk Act (SARA). The designations under SARA are listed in Table 4.

Table 4. COSEWIC Species At Risk Designations

SARA Designation	Definition
Extinct	A wildlife species that no longer exists
Extirpated	A wildlife species no longer existing in the wild in Canada, but that exists elsewhere
Endangered	A wildlife species facing imminent extirpation or extinction
Threatened	A wildlife species likely to become endangered if limiting factors are not reversed
Special Concern	A wildlife species that may become a threatened or endangered species because of a combination of biological characteristics and identified threats
Not At Risk	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient	A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.

References: www.sararegistry.gc.ca/species/schedules_e.cfm?id=1
www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm?stype=species&index=1&cosid=&common=&scientific=&population=&taxid=3&locid=0&desid=0&schid=0&desid2=0&
www.cosewic.gc.ca/eng/sct0/rpt/rpt_csar_e.pdf
www.cosewic.gc.ca/eng/sct5/index_e.cfm
(current to September 2009)

Species at Risk in Ontario (SARO) are designated by the Ontario Ministry of Natural Resources (OMNR) in accordance with the provincial Endangered Species Act (ESA 2007) through the Committee on the Status of Species at Risk in Ontario (COSSARO). The provincial designations are listed in Table 5.

Table 5. Provincial Species At Risk Designations

SARO Designation	Definition
Extirpated	A species that no longer exists in the wild in Ontario but still occurs elsewhere.
Endangered (Regulated)	A species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's Endangered Species Act (ESA)
Endangered (Not Regulated)	A species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's ESA.
Threatened	A species that is at risk of becoming endangered in Ontario if limiting factors are not reversed.
Special Concern	A species with characteristics that make it sensitive to human activities or natural events.

Reference: www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/STEL01_131230.html
www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/276722.html and
www.e-laws.gov.on.ca/html/regs/english/elaws_regs_080230_e.htm
www.mnr.gov.on.ca/276841.pdf
(current to September 2009)

Since 1936, 45 species of fish have been found in fish samples collected throughout the Medway Creek watershed. Table 6 lists the species of fish found. **Map 7** illustrates the fish sampling locations and Appendix B contains the fish report for each sample collected.

The fish species found within Medway Creek indicate a warmwater habitat, which is typically expected of larger watercourses the size of the Medway and the North Thames River. Several species of minnows and darters were well distributed throughout the watershed. Redhorse species, sunfish and game fish such as Largemouth Bass, Smallmouth Bass, Yellow Perch, and Northern Pike were located in Medway and tributaries that outlet into it. Three species at risk were found in the subwatershed. The Black Redhorse and Silver Shiner have federal designation as SAR, while currently the provincial SAR list also includes the Greenside Darter.

All of the fish listed in the table are native and indigenous to the area, with the exception of the common carp and rainbow trout. Migrant fish are species that travel a significant distance in order to carry out a component of their life cycle such as spawning. Sensitive species have specific habitat requirements. Coker and Portt (2005) classified these species such that any alterations to their habitat could prove to be detrimental to the species.

Table 6. Medway Creek Fish Species Summary

Common Name	Scientific Name	COSEWIC Status	SARO Status	Native	Coldwater	Sensitive	Target	Migrant
Black Bullhead	*Ameiurus melas*			✓				
Black Crappie	*Pomoxis*			✓		✓	✓	
Black Redhorse	*Moxostoma duquesnei*	Threatened	Threatened	✓		✓	✓	
Blacknose Dace	*Rhinichthys atratulus*			✓				
Blackside Darter	*Percina maculata*			✓				
Bluntnose Minnow	*Pimephales notatus*			✓				
Brassy Minnow	*Hybognathus*			✓				
Brook Stickleback	*Culaea inconstans*			✓				
Central Mudminnow	*Umbra limi*			✓				
Central Stoneroller	*Campostoma anomalum*			✓				
Common Carp	*Cyprinus carpio*							
Common Shiner	*Luxilus cornutus*			✓				
Creek Chub	*Semotilus*			✓				
Fantail Darter	*Etheostoma flabellare*			✓				
Fathead Minnow	*Pimephales promelas*			✓				
Golden Redhorse	*Moxostoma erythrurum*			✓		✓	✓	
Green Sunfish	*Lepomis cyanellus*			✓				
Greenside Darter	*Etheostoma blennioides*	Not at Risk	Not at Risk	✓		✓		
Hornyhead Chub	*Nocomis biguttatus*			✓				
Johnny Darter	*Etheostoma nigrum*			✓				
Largemouth Bass	*Micropterus salmoides*			✓		✓	✓	
Least Darter	*Etheostoma microperca*			✓				
Longear Sunfish	*Lepomis megalotis*			✓				
Longnose Dace	*Rhinichthys cataractae*			✓				
Mimic Shiner	*Notropis volucellus*			✓				
Northern Hog Sucker	*Hypentelium nigricans*			✓				
Northern Pike	*Esox lucius*			✓		✓	✓	✓
Northern Redbelly	*Phoxinus eos*			✓				
Pumpkinseed	*Lepomis gibbosus*			✓				
Quillback	*Carpiodes cyprinus*			✓				✓
Rainbow Darter	*Etheostoma caeruleum*			✓				
Rainbow Trout	*Oncorhynchus mykiss*				✓	✓	✓	✓
Redfin Shiner	*Lythrurus umbratilis*			✓				
River Chub	*Nocomis micropogon*			✓				
Rock Bass	*Ambloplites rupestris*			✓		✓	✓	
Rosyface Shiner	*Notropis rubellus*			✓				

Common Name	Scientific Name	COSEWIC Status	SARO Status	Native	Coldwater	Sensitive	Target	Migrant
Shorthead Redhorse	*Moxostoma*			✓		✓	✓	✓
Silver Redhorse	*Moxostoma anisurum*			✓		✓	✓	✓
Silver Shiner	*Notropis photogenis*	Special Concern	Special Concern	✓		✓		
Smallmouth Bass	*Micropterus dolomieu*			✓		✓	✓	
Spotfin Shiner	*Cyprinella spiloptera*			✓				
Stonecat	*Noturus flavus*			✓				
Striped Shiner	*Luxilus chrysocephalus*			✓				
White Sucker	*Catostomus*			✓				✓
Yellow Perch	*Perca flavescens*			✓		✓	✓	✓

Coldwater: Life history information was reviewed in "Morphological and Ecological Characteristics of Canadian Freshwater Fishes" to identify species habitat, including thermal 'preferences.' These species are found in coldwater habitats, defined as having water temperatures of less than 19°C.
Target: Indicates if the species is a sportfish and considered a top level predator or a species requiring the same habitat as a top level predator. Generally speaking, any species that is targeted for angling purposes would be a sportfish.

Mussels

Freshwater mussels or molluscs are soft-bodied organisms that secrete a calcareous substance that surrounds the soft body and hardens into a shell, to protect the mussel from predation and adverse conditions (Metcalfe-Smith 2005). Mussels serve as natural filters as they feed on algae, bacteria and organic matter. Mussels have a muscular foot that allows them to burrow into softer sediments and move about. Freshwater mussels are sensitive to environmental pollution and habitat alterations, which make them excellent indicators of ecosystem health (Morris 2004).

To date, 34 of 41 of Ontario's species of freshwater mussels have been recorded in the Thames River watershed. Sampling for mussels in Medway Creek has occurred since 1935. Environment Canada (EC) has collected mussel information since the early 1980s, while Fisheries and Oceans Canada (DFO), the University of Guelph (UoG) and UTRCA have gathered more recent mussel data in the watershed. To date, 15 species of mussels have been recorded in the Medway watershed. The Kidneyshell, Rainbow and Wavy-rayed Lampmussel are the three Species at Risk (SAR) located in the Medway. Table 7 lists the mussel species found in the watershed. **Map 7** shows the mussel sampling stations.

All mussel species are negatively affected by drought, pollutants, sedimentation, urbanization, agricultural practices, dams and barriers, poor water quality, predation (by muskrats and raccoons), loss of habitat, and recreational activities (Thames River Recovery Team 2004; Morris 2004; Metcalfe-Smith *et al.* 2000). A diverse community of mussels indicates a healthy aquatic environment. Further sampling of the mussel populations in the watershed could provide a clearer indication of the mussel community.

Table 7. Medway Creek Mussel Species Summary

Common Name	Scientific Name	COSEWIC Status	SARO Status	Native
Creek Heelsplitter	*Lasmigona compressa*			✓
Creeper	*Strophitus undulatus*			✓
Cylindrical Floater (papershell)	*Anodontoides ferussacianus*			✓
Elktoe	*Alasmidonta marginata*			✓
Fat Mucket	*Lampsilis siliquoidea*			✓
Fluted Shell	*Lasmigona costata*			✓
Giant Floater	*Pyganodon grandis*			✓
Kidneyshell	*Ptychobranchus fasciolaris*	Endangered	Endangered	✓
Mucket	*Actinonaias ligamentina*			✓
Plain Pocketbook	*Lampsilis cardium*			✓
Rainbow	*Villosa iris*	Endangered	Threatened	✓
Slippershell Mussel	*Alasmidonta viridis*			✓
Spike	*Elliptio dilatata*			✓
Wabash Pigtoe	*Fusconaia flava*			✓
Wavy-rayed Lampmussel	*Lampsilis fasciola*	Endangered	Endangered	✓

3.2.2 Terrestrial Ecosystem

Forest Zones

Figure 8 illustrates the forest regions in Southern Ontario. The Medway Creek watershed spans two forest zones, namely the Carolinian or Deciduous Forest Region to the south, and the Mixed or Great Lakes-St. Lawrence Forest Region to the north. The two zones do not meet at a precise location, but instead they mix over many kilometres in both directions. As a result, plants and animals of both northern (e.g., Paper Birch) and southern affinity (e.g., Black Walnut) can be found in this area.

Detailed botanical inventory work carried out in the Medway Valley Heritage Forest between Fanshawe Park Road and Windermere Road in the 1980s (Bowles 1986) recorded 386 species of vascular plants. Ten were considered nationally, provincially or regionally rare (see Tables 4 and 5 for definitions). About 20% of the species were introduced or non-native. Species representing the Carolinian Forest Region included Black Walnut, Sycamore, Witch Hazel, Black Maple, Prickly Gooseberry and Running Strawberry Bush.

Vegetation Cover Characteristics

The dominant climax forest community in this region is Maple-Beech (Sugar Maple-American Beech). Other common forest trees include Black Cherry, ash, hickory, oak, and poplar. Hardwood trees dominate, but some conifers can be found. White Pine is found on higher, drier ground, and Hemlock and Eastern White Cedar grow in cool, moist locations.

Along the watercourses, trees tolerant of fluctuating water levels can be found including Sycamore, willow, and Manitoba Maple. Ninebark and dogwood are common shrubs in floodplains.

In the deciduous forests, the spring flora is rich with ephemeral herbs that develop and flower before leaves emerge on the shrubs and trees. Common and beautiful species include trillium, Solomon's Seal, False Solomon's Seal and Trout Lily.

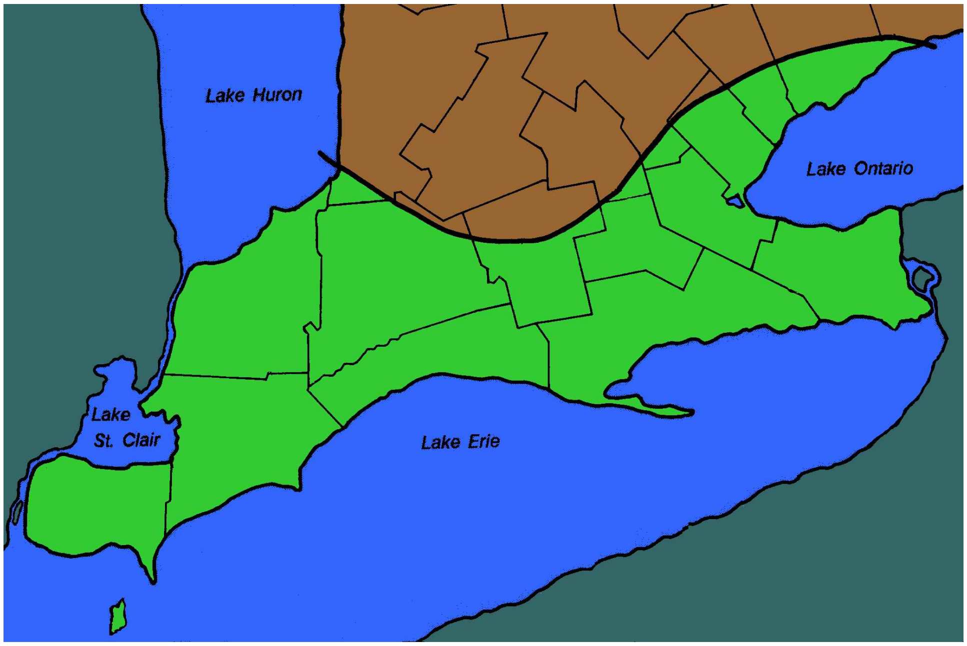


Figure 8. The forest regions of southern Ontario

The Carolinian life zone or deciduous forest zone (green) meets the Great Lakes-St. Lawrence or mixed forest zone (brown) north of London. (Source: Carolinian Canada Coalition)

Significant Natural Areas and Sites

Several sites within the Medway watershed have been recognized or designated as environmentally significant (Table 8). Most of these lands are in private ownership, except portions of the Medway Valley Heritage Forest. **Map 8** shows the locations of these areas.

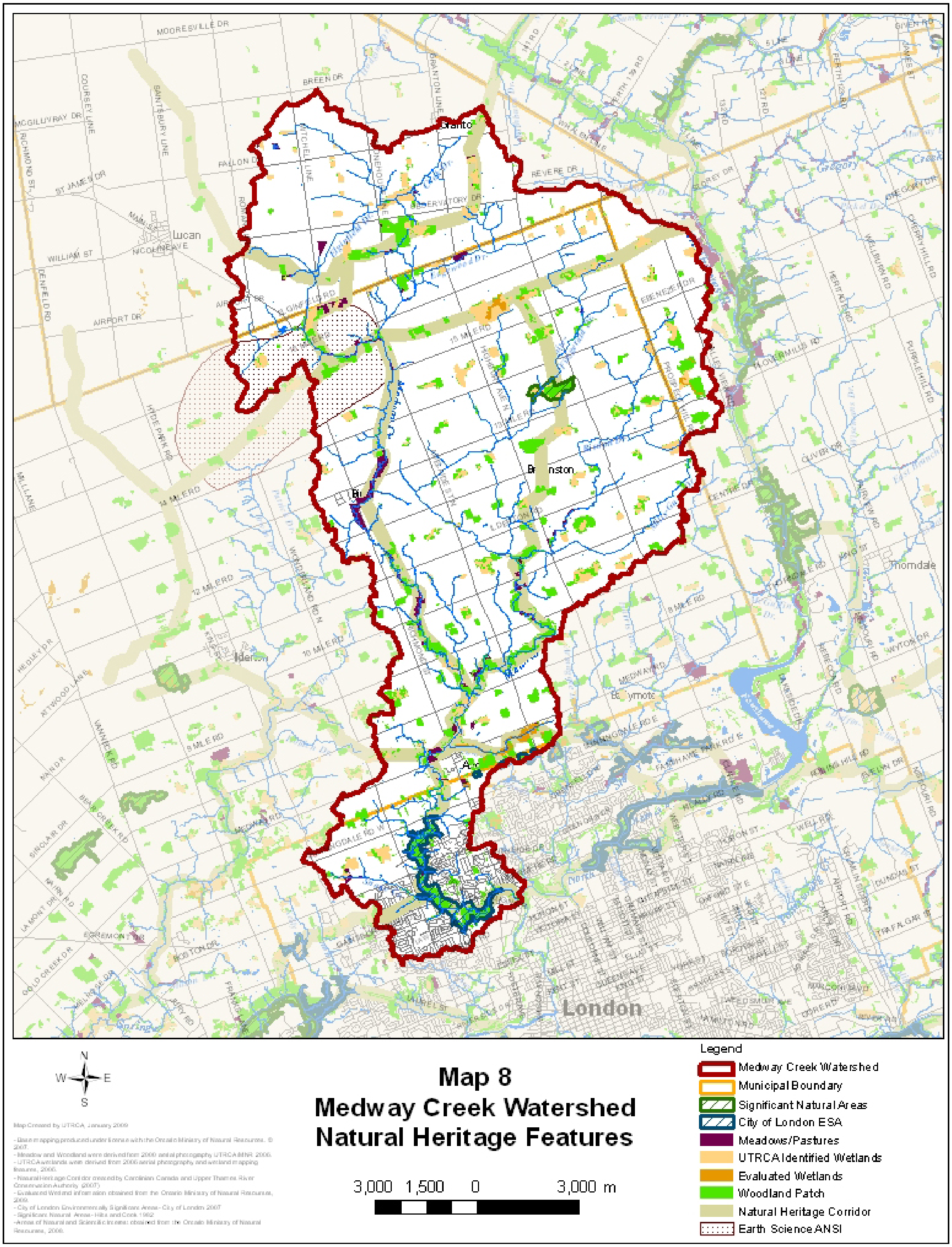
Table 8. List of Significant Natural Areas in the Medway Creek Watershed

Name	Designation (Agency designating)	Size (ha)
Arva Moraine Wetland Complex	Evaluated Wetland (OMNR)	41
Elginfield Swamp	Evaluated Wetland (OMNR)	2
Maple Grove Swamp	Evaluated Wetland (OMNR)	16
Valleyview Wetland	Evaluated Wetland (OMNR)	6
Arva ESA	Significant Natural Area (City of London/ County of Middlesex)	76
DeVizes Woodlot	Significant Natural Area (County of Middlesex)	47
Medway Valley Heritage Forest Environmentally Significant Area	Environmentally Significant Area (City of London)	130
Elginfield Area Moraine	Earth Science Area of Natural and Scientific Interest (OMNR)	1068
	TOTAL	**1310**

The Ministry of Natural Resource's Aylmer District initiated the Watershed Buffer Restoration Project, which will identify key areas for protection and restoration within subwatersheds (Appendix D).

Furthermore, the Aylmer District have been working on the Wetland Drain Restoration Project since 1996 with the hopes of restoring wetland functions within a watershed and providing benefits to society as well as many other benefits (Appendix E).

Map 8: Medway Creek Watershed Natural Heritage Features



Terrestrial Species at Risk or of Special Concern

Several rare species have been recorded within the Medway watershed (Table 9). Species are designated federally by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) and provincially by COSSARO (Committee on the Status of Species At Risk in Ontario). An "at-risk" species means its population numbers are very low, often due to lack of habitat or being located at the edge of its range. See Tables 4 and 5 for definitions.

Mammals and Reptiles

The Flying Squirrel

The Southern Flying Squirrel (formerly a species of special concern provincially and nationally; delisted in March 2006) was observed in the Medway Valley Heritage Forest ESA in 2007.

Queen Snake

The Queen Snake is the only species of water snake found in Canada. This snake is rarely seen, even in known locales. The Queen Snake has never been considered abundant in Ontario and has been recorded only occasionally in 28 locations since 1858. Some of these areas have not had documented sightings since the late 1800s, and only about 16 areas have had sightings since 1979.

In 1994, the Natural Heritage Information Centre ranked the Queen Snake as S2 which means it is very rare in Ontario, with five to 20 occurrences province-wide. In 1999, COSEWIC designated the Queen Snake as "Threatened."

A Queen Snake was first recorded in the Medway Creek watershed in the 1950s, and last seen in 1999. There have been numerous, unsuccessful surveys since that time.

Eastern Hog-nosed Snake

The Eastern Hog-nosed Snake is a thick-bodied, medium-sized snake reaching a length of approximately 50-115 cm. The flat head and characteristic upturned snout are unique to this species. The Canadian population is limited to southern Ontario, where it is found in sandy dune areas, mixed hardwood and pine forests, and forest/grassland boundaries (edge habitat).

In 2001, COSEWIC designated the hog-nosed as "Threatened." Very little information has been collected on this species in Canada. A decrease in public sightings and the loss of natural habitat indicate a diminishing population. Estimates on the size of the population cannot be produced until more information is gathered.

The last observed Eastern Hog-nosed Snake in the Medway Creek watershed was recorded in 1965.

Blanding's Turtle

The Blanding's Turtle prefers lake wetlands, bogs, swamps and ponds with soft substrate, abundant aquatic vegetation and basking areas. This species may become very terrestrial for parts of its active season, and is often encountered in farm fields and along roads.

The last observed Blanding's Turtle in the Medway Creek watershed was recorded in 1923.

Plant Species At Risk

The plant species listed in Table 9 are mostly found in the Medway Creek Environmental Significant Area or other known natural areas, as these tend to be the sites studied or inventoried in the past. Some of the plant species have never been abundant in this region as they are Carolinian species at the northern edge of their range.

Table 9. Terrestrial and Aquatic Species at Risk in the Medway Creek Watershed

Common Name	Scientific Name	COSEWIC Status	SARO Status
VASCULAR PLANTS			
Green Dragon	*Arisaeme dracontium*	Special Concern	Special Concern
Purple Twayblade	*Lipari liliifolia*	Endangered	Endangered
False Rue-anemone	*Enemion biternatum*	Special Concern	Threatened
FISH			
Black Redhorse	*Moxostoma duquesnei*	Threatened	Threatened
Silver Shiner	*Notropis photogenis*	Special Concern	Special Concern
MUSSELS			
Kidneyshell	*Ptychobranchus fasciolaris*	Endangered	Endangered
Rainbow	*Villosa iris*	Endangered	Threatened
Wavy-rayed Lampmussel	*Lampsilis fasciola*	Endangered	Endangered
REPTILES			
Blanding's Turtle	*Emydoidea blandingii*	Threatened	Threatened
Snapping Turtle	*Chelydra serpentine*	Special Concern	Special Concern
Eastern Hog-nosed Snake	*Heterodon platirhinos*	Threatened	Threatened
Queen Snake	*Regina septemvittata*	Threatened	Threatened
MAMMALS			
Woodland Vole	*Microtus pinetorum*	Special Concern	Special Concern

Notes: See Tables 4 and 5 for status definitions.

Grading Forest Conditions

There is only 9.8% forest cover in the Medway Valley (2007 UTR Watershed Report Cards, Appendix G). This amount of forest cover is slightly lower than the average for the Upper Thames watershed, which is at 11.4%. Meadow and other vegetation cover types add an additional 1.4% for a total of 11.2% natural cover. This amount is considered too low for sustainability. It is believed there should be 25-30% forest and other natural cover in southern Ontario’s landscape to sustain native plants and animals (Environment Canada 2004).

The amount of forest interior is also low at 1.0%, indicating most woodlots are too small and/or narrow to support area-sensitive birds such as Scarlet Tanager and Ovenbird. Forest interior refers to the protected core found inside a woodlot that some bird species require to nest and breed successfully. The outer 100 m perimeter of a woodlot is considered “edge” habitat and prone to high predation, sun and wind damage and alien species invasion.

The 2007 Upper Thames River Watershed Report Cards (Appendix G) rank forest conditions in the Medway watershed as a D when grades for forest cover (D) and forest interior (F) are combined. D is also the average grade across the Upper Thames basin. This grade is not unexpected due to the highly developed nature of the landscape. Very few large woodlots remain.

Woodlot Size

There are about 300 woodlots in the Medway basin, and only 8% of these are over 30 ha in size (Table 10). The vast majority (78%) are under 10 ha in size, and likely do not contain any forest interior.

Table 10. Woodlot Size in the Medway Creek Watershed

Size Category	Number of Woodlots	% of Woodlots
<10 ha	235	78
10 – 30 ha	45	14
> 30 ha	24	8

Vegetation Cover Types

Most of the natural vegetation cover consists of deciduous forest/woodland (77%). Another 11% is meadow/grassland habitat. There are smaller amounts of mixed (deciduous/coniferous) forest habitat (4%) as well as plantation (3%) which is usually coniferous trees (see Table 11).

Table 11. Vegetative Cover Types Found Within the Medway Creek Watershed

Types	Ha	% of Cover
Deciduous Woodland	1837	77
Mixed (coniferous-deciduous) Woodland	92	4
Plantation (coniferous)	69	3
Hedgerow	74	3
Tree Nursery, Orchards	32	1
Urban Woods <0.5 ha	14	1
Meadow	254	11
TOTAL COVER	2371	100%

Wetland Cover

Wetland cover makes up 1.1% of the watershed or 11.1% of the natural vegetation cover. The majority of wetlands in this region are deciduous swamps or wooded wetlands dominated by soft maple and willow. Most of southern Ontario's wetlands were drained and filled during European settlement and with the advent of land drainage. The OMNR has initiated two pilot programs in Ontario called the Watershed Buffer Restoration Project (WBRP) and the Wetland Drain Restoration Project (WDRP) to help increase wetland and riparian cover within subwatersheds. Further details on these programs are found in Appendices C and D, respectively.

3.3 Cultural Features

Archaeology

Over 400 settlement sites, dating back 11,000 years, have been discovered in and around the City of London. Some of these sites are from First Nations while some more recent sites are from European pioneers (Finlayson 1990).

After the glaciers retreated and the tundra-like environment appeared, the ancestors of the First Nations appeared in southern Ontario in 9,000 B.C. Over time, the First Nations developed new tools and refined others and the population grew. At the time of the Middle Woodland Period (300 B.C. to 800 A.D.) bands occupied most of the major river drainages in the area. During the summer, bands lived in large groups at prime fishing locations along the Thames River, especially around rapids, which indicates that spawning fish were taken in great numbers. During the fall and winter, the large groups would disperse into smaller units and move inland. It was also during this period that corn was introduced, although it was not until the Late Woodland Period (800 A.D. to 1400 A.D.) that the “three sisters” emerged as staples: corn, beans and squash (Finlayson *et al.* 1990).

The Lake Woodland Period saw a division of labour occur as emphasis was placed on agriculture. Men would hunt, fish, build and sit on council while the women would farm, harvest, tan hides, make pottery and rear the children. At this time, small villages of 1 hectare or less, built around longhouses, were occupied for long periods of time. After 1300 A.D. a broad homogenous culture known as Middleport spread across southern Ontario. It is not known why this was so, only that there is a change in the archaeological record. One hypothesis is that the Pickering group from southeastern Ontario conquered the local Glen Meyer group. At the end of this period, villages grew to be as large as 3.2 hectares with extremely large longhouses (Finlayson *et al.* 1990).

The period between 1400 A.D. and 1500 A.D. is known as the Prehistoric Neutral Period. Villages decreased in size to 2 hectares with smaller longhouses, but had multiple palisades for fortification, which may indicate that warfare was on the increase. The prehistoric Iroquoians grew crops in fields near their villages. These fields were up to 4 kilometres away from the village, so most of the population would move to cabins by the fields for the spring through to the fall. Longhouses were also constructed close to the agricultural fields (Finlayson *et al.* 1990).

Although the Forks of the Thames would have been an ideal spot for a community, the major villages were located along smaller creeks and streams and were 7 to 10 kilometres apart, perhaps indicating defined territories (Finlayson *et al.* 1990). One of the villages is known as the Lawson Site (the land was donated by Colonel Tom Lawson in the 1960s) and is the land upon which the Museum of Ontario Archaeology is built (1600 Attawandaron Road, London). The site, with a 4 km radius, was very strategic; it was located on a plateau overlooking the steep slopes of two ravines at the confluence of Snake Creek and Medway Creek. Up to 2,000 people may have lived in the 40 longhouses on this 2-ha site (London Township 2001). Plots of land were cleared to grow beans, squash and corn, and several cabin sites were found and excavated. Two such sites were located northwest of the intersection of Fanshawe Road and Richmond Street and another was located at the southwest corner of Sunningdale Road and Adelaide Street (London Township 2001). Strangely, the period ends with the total abandonment of London. One theory is that the group chose to move east to join their kin in the Brantford area. However, relations with other groups deteriorated as a result of the fur trade, and the Neutrals were defeated and dispersed by the New York State Iroquois in the 1650s.

Hundreds of sites in the lower reaches of the Medway Creek have been recorded as having some artifacts of Native or European settlement. The two main reasons for these finds are the proximity to the Thames River and high rate of development occurring in north London. Many of these finds are appearing through the archaeology assessments that developers are required to undertake prior to any construction. The number of identified sites decreases moving northward towards the upper reaches of Medway, mainly due to the lack of exploration in the area (Pearce interview 2008).

Settlement

Settlement in southern Ontario did not begin in earnest until 1783 when the Treaty of Versailles was signed. A large number of British loyalists emigrated from the newly formed United States to the British colony, and more arrived when George III declared that British loyalists would be given land and provisions for the first year. Many of the new citizens were farmers, tradesmen or ex-military. Lieutenant Governor John Graves Simcoe realized that transportation routes were needed to encourage settlers to arrive. However, southern Ontario was still sparsely populated when America declared war in 1812. The colony managed to hold out and the Treaty of Ghent was signed in 1814.

Medway Creek was originally called St. Martin's Creek by the European settlers. It was renamed Medway, after the River Medway in Kent, England, which has the largest watershed in southern England and empties into the Thames estuary on the eastern coast.

City of London

The City of London portion of the watershed is a relatively small geographic area that comprises the downstream 10% of the catchment, or 20 ha. However, this portion makes up a large majority (89%) of the human population of the watershed. Historically, the watershed has been urbanizing from south to north, matching the growth of the city in this same direction.

The City of London was officially first settled between 1801 and 1804 by Peter Hagerman and became a village in 1826. Originally, the London area was chosen as the site for the capital of Upper Canada by Lieutenant Government Simcoe. This choice was rejected, but London became an administrative seat for the area west of the capital at the time, York (Toronto). The town of London was also part of the Talbot Settlement, named after Colonel Thomas Talbot who oversaw the land surveying and built the first administrative buildings.

The most recent annexation of lands in 1993 from the north (formerly London and Lobo Townships) required the creation of Fox Hollow and Sunningdale Area Plans to guide and manage urban development. These area plans were directed by the Medway Creek Subwatershed Study, completed in 1996. Another planning document, a Conservation Master Plan was completed for the Medway Valley Heritage Forest Environmentally Significant Area within the city.

The area includes single family and multi family residential neighbourhoods with some of the most scenic vistas of the Medway Valley Heritage Forest and surrounding creek corridor. Neighbourhoods such as Whitehills, Orchard Park and Windermere have developed around the University of Western Ontario and such notable creek-bank properties as the Elsie Perrin Williams Estate and the Museum of Ontario Archeology. These neighbourhoods also contribute to the challenges associated with property stewardship, such as parkland encroachment, non-native plants, property runoff and the potential impacts of swimming pools (approximately 1,000), which could be a potential source of chlorine to the Thames River. Commercial plazas and recreational amenities such as the London Aquatic Centre are also located in this portion of the watershed.

Future Development in the City of London

The Medway Creek watershed portion of the City of London is entirely contained in an area planned for development in the next 20 years. This development limit, known as the Urban Growth Boundary, extends to the north boundary of the City and contains much of the regional plans called Fox Hollow and Sunningdale Community Plans. These community plans are further divided into overall plans of subdivisions. Community plans are the regional planning documents that have taken the results from the Medway Subwatershed Study (1995) and translated the data into development design that respects the natural environment while considering such aspects as infrastructure, soft and hard servicing, road alignment and development type and density. These parameters all are incorporated into plans of subdivisions which are typically in the order of 200 lots each. At each scale of planning (community plans and subdivision plans) some refinement and clarifications occur. Approval of these subdivisions is completed by City Staff; however, the appeal mechanism for applicants is provided through the Ontario Municipal Board.

Urban development requires infrastructure such as sewage collection and treatment. Treatment does not take place, nor is it planned within the City portion of the subwatershed. Instead, sanitary sewer lines collect and transport sewage to pollution control plants outside the Medway Creek watershed. Three pumping stations within the watershed assist with transporting sewage in addition to sewage from the hamlet of Arva in the adjacent municipality. These pumping stations are (from upstream to downstream in the valley) Sunningdale, Pitcairn, and Medway Pumping Stations. Until recently, Whitehills Pumping Station, near the intersection of Wonderland Road with Snake Creek, was also in operation; however, the Snake Creek Sanitary Sewer improvements have now made that station unnecessary and it was decommissioned in the spring of 2008.

The Medway Creek valley has been the site of a main trunk sewer line since the late 1970s when the original project was completed. A further extension north of this sewer now exists north of Fanshawe Road and is proposed to continue as a further extension as far as Sunningdale Road. This infrastructure will service these newly developed lands. Projects of this type are completed after a Class Environmental Assessment (Class EA) is done to provide options, discuss advantages and disadvantages, and determine best courses of action. Balancing the needs of infrastructure, natural environment, public open space and trails continues to be a challenge in such developing areas of the City. The Class EA reports that summarize this process were completed in 1981, 1999 and 2004.

London Township

London Township is a former municipality that was amalgamated in 1998 with Lobo and Delaware Townships to become the Municipality of Middlesex Centre. Some of the archaeological sites discovered in London Township are the locations of pioneer homesteads. Communities often developed around mills, schools, stores, roads or railroads. Some of these communities were annexed as part of the City of London, such as Masonville, Ealing, Gore and Pottersville, while other communities no longer exist (London Township 2001). Hamlets that still exist in the former London Township portion of the Medway Creek watershed are Arva, Birr and Bryanston.

Arva

Arva, originally called Sifton's or St. John's, is located at the corner of Medway Road and Highway 4 (also called Richmond Street and originally called Proof Line). In the 1850s, most of the buildings were owned by Joseph Sifton who was a wagon maker, storekeeper, tavern owner and eventually postmaster (London Township 2001). Sifton's later became known as St. Johns's after the local Anglican church, St. John the Divine. This church is one of the oldest parish churches in southwestern Ontario and is still in use. In the 1880s the settlement was given its current name of Arva, after the post office name for the settlement (London Township 2001). Arva had a population of 200 citizens by 1857 and was a growing business community. Today, Arva has an estimated population of 525.

Arva Flour Mill

Arva's most historically important business, the Arva Flour Mill, was built in 1819. The mill, on the east side of the Richmond Street (formerly Proof Line), north of Medway Road, is one of only two small working mills left in Canada. Some of its frame was salvaged from a woolen mill that stood several hundred yards farther along Medway Creek. The mill used the power of the Medway Creek to turn its waterwheel, but when the creek dried up in the summer, a steam engine and, later, electricity were used to run the mill. Between 1842 and 1917, the mill had five different owners. In 1917 the mill was purchased by Clarence Scott and Hugh Templeman. The mill was then acquired by Clarence Scott's son, Harold, in 1961. Harold sold the mill to his son-in-law, Bill Matthews, in 1981. Still using water power from Medway Creek, Bill's children work at the mill and continue the family-run operation.

Underground Railroad
In the 19th century, Arva was a critical rest stop for the Underground Railroad. This informal network of secret routes and safe houses was used by 19th century black slaves in the United States to escape to free states (or as far north as Canada) with the aid of abolitionists sympathetic to their cause. The term is also applied to the abolitionists who aided the fugitives. The Underground Railroad was at its height between 1810 and 1850 (Wikipedia 2008).

Birr

Birr, once known as Bobtown, is located at the intersection of Highway 4 (Richmond Street, formerly Proof Line) and Thirteen Mile Road. John Griffiths, a weaver, renamed the community Birr after his home in County Offaly, Ireland. Birr means "watery place" in Irish (London Township 2001). Despite its small size, Birr has maintained itself and supported various private businesses throughout the years. McIntosh House, a hotel, was built in approximately 1860. The original hotel burned in a fire in 1928, but was rebuilt and then changed into general store on the bottom with a community hall on the second floor during the Depression, and then apartments on the second floor during the Second World War. The general store continues today as Legg's Historic General Store (London Township 2001).

Bryanston

Bryanston is located at the intersection of Highbury Avenue and Twelve Mile Road. Originally the hamlet was named Goodwood after the English home of the first settlers in the area. At one time, the community boasted three hotels, two sawmills, a flour mill, a chopping mill, two general stores, a cheese factory, a brick factory, a liquor store, and a carriage and wagon shop. When the post office was registered in 1863 and a duplication of the name Goodwood was discovered, the name changed to Bryanston (London Township 2001). At the end of the 19th century, the Sutherland and Innes Stave Company of Wallaceburg leased a sawmill on the southeast corner of the hamlet. This operation employed 35 men, most of whom stayed in the nearby hotels and boarding houses. The operation severely depleted the local elm tree population.

Biddulph Township

The Township of Biddulph is a former municipality that was amalgamated in 1999 with the Village of Lucan to form the Township of Lucan Biddulph. The name Biddulph was taken from John Biddulph, one of the first directors of the Canada Company, a large, private, British land development company (Wikipedia 2008). Many of the first settlers in the area were Irish immigrants, particularly from the County of Tipperary. In the 1880s, the area earned notoriety with the murder of five members of the Donnelly family. Within the township, the village of Elginfield and a portion of the village of Granton are in the Medway Creek watershed.

Elginfield

The hamlet of Elginfield is located approximately 16 km north of the City of London at the intersection of Richmond Street and Elginfield Road (also called Highway #7). The hamlet was first known as Ryan's Corners after William Hodgins Ryan (London Township 2001). The hamlet's name changed to Elginfield in 1849 after the governor of the Province of Canada, James Bruce, Eighth Earl of Elgin (London Township 2001). In 1857, records show the population of Elginfield was 50; by 1889 the population had jumped to 300 (London Township 2001). Today, there are a few businesses in the area including a restaurant, automotive repair, RV centre, and a gas station.

Granton

The Village of Granton is located on the northern border of the Medway Creek watershed. Originally, the old Main Line of the Grand Trunk Railway, now called the Canadian National, ran through the village. The village earned its name through a combination of the railway superintendent's birthplace in Granton, Scotland, and because the Grant family was among the first settlers and was instrumental in bringing the railway to the village. Despite this, the town made an application to change the name to 'Beaver' but neither the railway company nor the post office department would comply (Pioneers to the Present 2001).

Transportation

Pioneer families in London and Biddulph Townships struggled to establish an orderly network of roads due to obstacles such as steep grades, thickets and swamps. The introduction of corduroy roads offered a practical solution. Roads were covered by readily available logs, laid crosswise along the route. When widening Highway #4 north of Birr in the later 1960s, construction crews unearthed several massive logs wedged tightly together, about three feet below the road grade (London Township 2001).

Until 1922, statute labour was used to keep the roads in good condition. Roadmasters were appointed by the townships and managed the ratepayers who were assigned so many days per year depending on the property assessment. Any defaulters for statute labour were charged fines (Biddulph Township 2001).

Highway #4

Highway #4, previously known as Proof Line Road, and now know as Richmond Street or London Road, was once a toll road owned by Joint Stock Companies. This toll road included the Richmond Street extension north of Huron Street in the late 1800s, with a toll booth originally at Huron Street and then at Tower Lane (Arva) until 1904.

The village of Birr had a hotel in the late 1800s because the afternoon stage coaches running between London and Lucan would stop overnight in Birr, which was the approximate half-way point, and resume travel the next day (Wikipedia 2008).

It was reported that the typical charges at the tollgates were 10 cents for a single horse, 20 cents for a team, and five cents per head for cattle. When the Township of London bought the road from the Joint Stock Companies, the collection of tolls was ceased. Shortly after this announcement a huge celebration was held in Arva where the locals torched the tollgates (London Township 2001). The Township owned the road until 1906 when it was taken over by the County. Since 1920, the road has been under the jurisdiction of the Ministry of Transportation Ontario (formerly the Department of Highways of Ontario) (London Township 2001). Originally created to link London with Goderich, Highway 4 now links London with places as far north as Owen Sound and Tobermory.

Highway #7

Like Highway #4, Highway #7 was also owned and maintained by first the Township and then the County until it was assumed by the Department of Highways in 1920. This highway was a major road that connected Toronto with Sarnia and Port Huron.

Highway #23

Highway# #23 has been an important roadway for Biddulph Township and connects Whalen Corners with Elginfield. Originally known as Swamp Road, the road was renamed to Mitchell Line because it continues to Mitchell and Listowel in Perth County.

Drinking Water Supply

Groundwater is a source of drinking water for a large area of the Medway Creek watershed. There is one municipal well in the community of Birr. Most of the properties in the watershed outside of the City of London have private wells. The community of Arva receives surface water from Lake Huron through the Lake Huron Primary Water Supply System. The City of London is also supplied by surface water from both Lake Huron and Lake Erie. Drinking water protection plans are currently being developed to protect municipal sources of drinking water, which includes the Birr well system (groundwater) and the intakes for the Lake Huron Primary Water Supply System and Elgin Water Supply System (surface water).

Birr

The Birr drinking water system (system number 220005492) is comprised of one drilled well, which is rated at 88 m^3/day and has a maximum allowable taking per day of 73 m^3/day under Permit to Take Water #1355-72EQ43. The system presently serves 18 lots with an estimated population of 63 residences (2007 Annual Report 2008).

Those who have been associated with the well drilling business will confirm that the level of the water table varies throughout the former London Township. Leroy Parsons, owner of L. Parsons Well Drilling Ltd., described the unique presence of a thin layer of sand along Highway #4 (Richmond Street) at Birr. The water supply for the first phase of a residential subdivision there was drawn from a 60-foot deep communal well derived from an aquifer. Those living in the second phase of the same subdivision had individual wells. Some properties immediately north of Birr, along Concession 13, required wells that were drilled to a depth of 200 feet or more. It was not uncommon to find records of 380-400 foot wells in the most northern sections of the township (London Township 2001).

Lake Huron Water Supply

In 1961, the City of London expanded with the sizeable annexation of some township lands. At this time, a study of the water supply and its distribution was of paramount importance. Other municipalities were struggling with poor quality or insufficient water supplies and the London Public Utilities Commission (PUC) was facing increasing opposition from farmers over continued exploratory drilling on their properties. The London PUC eventually accepted a proposal by the Ontario Water Resources Commission, later known as the Ontario Clean Water Agency, to pursue the construction of a water treatment facility at Grand Bend, with the treated water to be transported via pipeline to a reservoir at Arva (London Township 2001). The plant has a treatment capacity of 340 million litres per day and currently serves approximately 325,000 people (City of London website).

Local distribution of Lake Huron water in the former London Township has been limited to Arva and Ilderton, and the community of Denfield. Consequently, landowners still depend on private wells for their water supply (London Township 2001).

Dams and Barriers

Dams and barriers found in watercourses are also known as impoundments because they back up water behind them. Generally, dams were built to store water for livestock and other domestic uses such as irrigation or fire fighting, more water on the landscape, to prevent flooding, and to generate power for mills. The design of dams and other structures such as road, lane and train crossings, culverts, and weirs, creates barriers. There are also other naturally occurring structures that create barriers such as velocity (fast flowing), gradient (steep slope), woody debris, and natural formations of bedrock (waterfalls), and of course beavers also build dams. Chemical and thermal differences within the water column/body may also create a barrier.

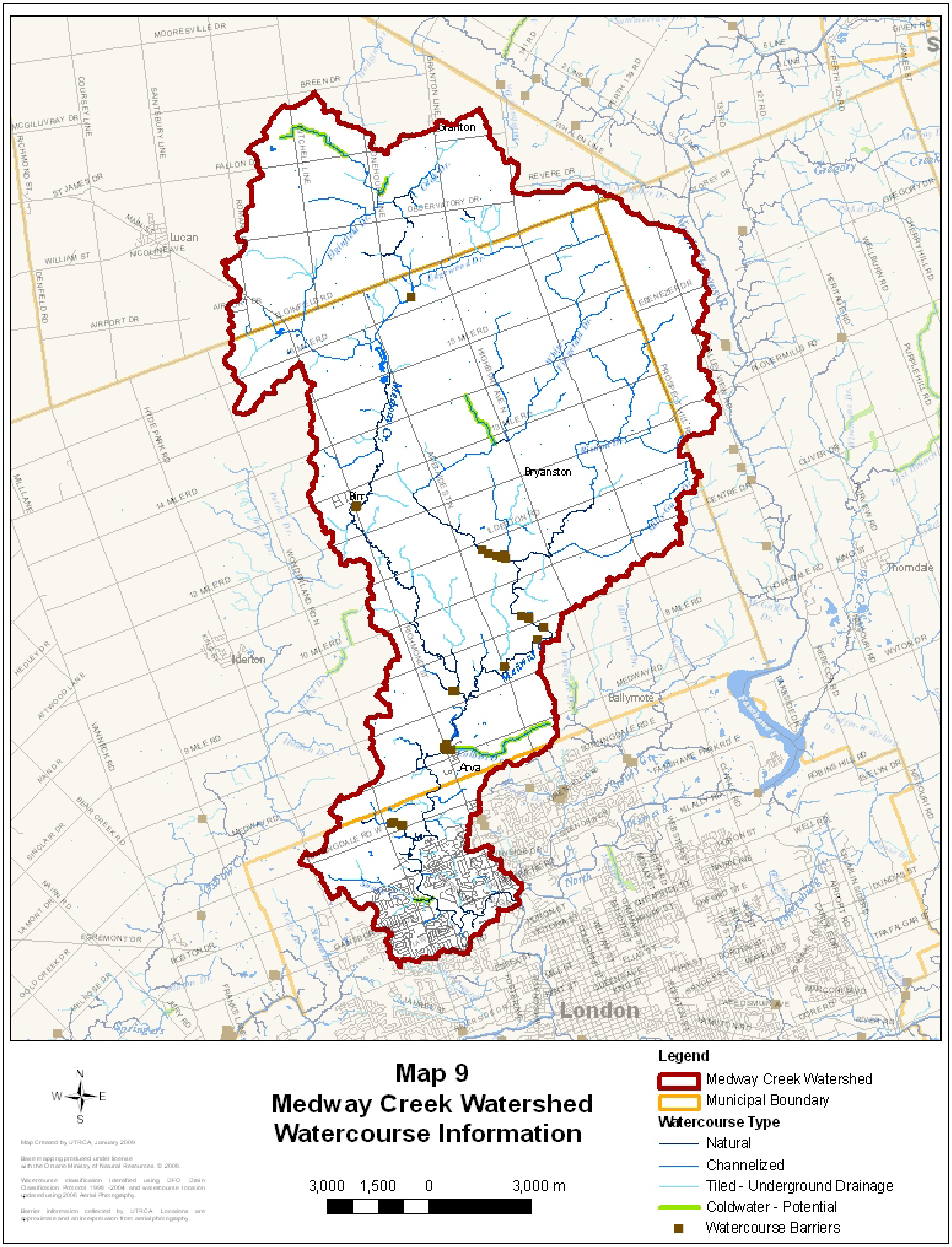
Many dams and reservoirs are highly valued by their local communities for their recreational and aesthetic uses as well as their historical significance. Other structures are important for their role in flood control or flow augmentation. Incidental benefits of dams and reservoirs include fish and wildlife habitat, recreational activities such as fishing, canoeing and swimming, and cultural values. While it may seem that increasing water storage capacity would provide a positive result, dams and barriers also have negative impacts on riverine systems. These impacts include barring migration of fish and wildlife, altering the river channel to a lake-like habitat, increasing soil deposition upstream of the dam, accelerating erosion downstream of the dam/barrier, altering water quantity and quality, escalating eutrophication (excess nutrients that cause excessive algae growth and a resulting lack of oxygen), as well as causing wildlife mortality.

Man-made dams have traditionally been managed and maintained as multi-use facilities. Starting in the late 1990s, dams reaching the end of their lifespan were evaluated to consider whether it was worthwhile to replace them or to just decommission them. Some of the reasoning for dam decommissioning or removal considers whether the dam serves a purpose, the cost of rehabilitation or maintenance, and the restoration of the fish and wildlife community as well as the riverine state.

When considering the fate of any dam, it is important to complete studies and provide the best option for the structure. Normally the options include maintaining the status quo, doing nothing, rehabilitating the structure (usually by modifying the structure and providing mitigation for fish and wildlife movement) or removing the structure. Since most dams have a historical or cultural value to the local community, a process to engage the public is required to mediate any issues or concerns, and to aid in deciding upon the best solution for the structure. It is important to note that all instream dam and barrier alterations require permits and approvals from several regulatory agencies prior to works commencing, which means that these agencies would also be involved throughout the process.

Based on a dam and barrier inventory that was completed in 2001 by the UTRCA, 24 barriers have been identified in the Medway Creek watershed (**Map 9**). None of the dams identified serve to control floods, nor were they designed for that purpose. Some of the recognizable dams include the Arva Flour Mill Dam, the Arva Mill Duck Pond and the St. John's Estate Dam. Appendix C lists the dams and barriers that have been identified in the watershed and describes the type of barrier and the purpose of the structure. All of the dams and barriers in this watershed are characterized as being run of the river, which means that they initially block the water column, but once the water is backed up behind the structure, the water will continue to flow over the dam.

Map 9: Medway Creek Watershed Watercourse Information



Recreation and Education

Medway Valley Environmental Significant Area (ESA)

The Medway Valley Environmental Significant Area (ESA) is also known as the Medway Valley Heritage Forest. This area is owned by the City of London, the UTRCA and private landowners. It was officially designated as a Natural Area in the 1989 City of London Official Plan (Naturally Elgin, no date).

The 82 hectares (203 acres) Medway Valley ESA consists of upland forest and valley slopes. Some of its more unusual habitats are a Black Walnut savannah and a small, wet floodplain meadow. Old orchards and pastures are succeeding to forest with species such as hawthorn, Grey Dogwood, apple, elm, Basswood, Black Locust, Manitoba Maple and aspen (Naturally Elgin website).

In the middle of the 19^{th} century, a gristmill was built on William Turville's property approximately one mile west of the confluence of the Medway with the Thames River. In 1877 the Elsie Perrin Williams estate was built, and the development of walkways and bike paths, river crossings and a picnic area introduced people to the natural features of the valley (Naturally Elgin website).

The valley today has significantly more forest cover than it did 100 years ago. At the end of the 19^{th} century, significant deforestion had occurred to make room for agriculture. In the 1950s, a property at the end of Windermere Road was purchased by local residents and put into public ownership so that the forest could naturally regenerate (Naturally Elgin website).

Today, the Medway ESA is used by a great number of people who enjoy walking, hiking, nature appreciation, bird watching, cross-country skiing/snowshoeing (managed trails only), jogging, limited fishing, biking (specific designated areas only), and walking dogs on leash . For those people who enjoy picnics and easy family outings there are picnic tables and walking trails located on the Perrin Williams Estate, which is operated by Heritage London.

Weldon Park

In the mid-1960s Weldon Park was set aside on the southern limits of Arva and east of Highway #4. In Canada's Centennial year (1967), Col. Douglas B. Weldon donated 15 ha and $1,500 to create the park named in his honour. The site contains sport fields and facilities, a short walking trail and ponds (London Township 2001).

Agriculture

Land use in the Medway Creek watershed is dominated by agriculture (83%). Only 11% of the watershed is forested, and 6% is urban.

The following summary is based on a Statistics Canada 2006 survey. Two hundred farms participated in the survey, representing a total land base of 18,232 ha or approximately 89% of the watershed. These farms have reported total gross farm receipts of approximately $44,000,000.

The farm types that participated in the Statistics Canada survey were:

- **Livestock**
  - Swine
  - Poultry
  - Cattle both beef and dairy
  - Other livestock (e.g. horses)

- **Cash Crop**
  - Corn
  - Grain
  - Soybeans
  - Berries and grapes
  - Vegetables
  - Trees, fruits and nuts

- **Other**
  - Natural pastures
  - Tame or seeded pastures

Conservation Practices

Farms that implement sound conservation practices wherever possible will reduce runoff (water, sediment, etc.) to surface water and minimize soil losses by wind. Conservation practices improve soil health by increasing the organic levels, soil structure, and soil water holding capacity, and can also increase crop yields.

In the Medway Creek watershed, 169 farms (85%) implemented the following soil conservation practices:

- Crop rotation
- Rotation grazing
- Winter cover crops
- Plowing down green crops
- Buffer zones around water bodies
- Windbreaks or shelter belts (natural or planted)

Tillage Practices

The traditional role of tillage systems was to provide weed control and prepare a seedbed that will give good crop stands and high yields. More recently, tillage and cropping systems have been changed to accomplish the same goals while reducing soil erosion through less intensive or no cultivation. High fuel costs and shortage of labour may also encourage farmers to use reduced tillage systems.

The switch to a different tillage system must be based on the system's compatibility with the farm's soil types, slopes, drainage, moisture regime and temperature. Farm operators must consider the tillage system's effect on erosion control, timeliness, potential for controlling weeds, insects and diseases, and profitability. No one tillage system is best for Ontario conditions because of the variability in soils, crops and climate. In fact, the tillage system may rotate depending on the crop being grown. Ontario farmers tend to use conventional tillage, mulch tillage and no-tillage systems.

Conventional Tillage Systems
Conventional tillage is any tillage system that attempts to bury most of the previous crop residue, leaving less than 30% of the soil surface covered with residue after planting. Usually the moldboard plow is used in conjunction with a variety of other tillage implements. The principal advantages of the moldboard system are that machinery is familiar, widely available and adaptable to a wide range of soil conditions. Moldboard plowing increases soil porosity, and allows for good air exchange, root proliferation and water infiltration. The increased soil porosity can be lost with excessive secondary tillage or in soils with poor structural stability. Many livestock producers view the moldboard plow as the most effective way to incorporate manure and break up sod fields. The disadvantage of the moldboard system is the high cost of equipment, fuel and labour associated with seedbed preparation. Another disadvantage of the moldboard system is that with little or no residue cover, there is a high risk for soil erosion by wind and water.

Mulch Tillage Systems
Mulch tillage systems are designed to leave more than 30% of crop residue on the soil surface and offer more protection from soil erosion by wind and water than does the moldboard plow. The chisel plow has been the most widely adopted mulch tillage tool in Ontario. Other terms used to describe this system are reduced tillage, minimum till or conservation tillage.

No-Till Systems
No-till systems provide the greatest opportunity to leave protective crop residues on the soil surface to reduce soil erosion by wind and water. This system also has the greatest potential for reducing tillage costs, offset somewhat by the need to control weeds in almost all cases with a preplant "burndown" herbicide application. The term "no-till" refers to any system that confines all tillage and seeding operations to one pass of the planting equipment, regardless of the amount of in-row soil disturbance.

The success of no-till systems is often dependent on a range of factors other than the equipment design. Two of these factors -- soil drainage and crop rotation -- have a significant influence on the performance of all no-till systems.

In the Medway Creek watershed, 165 farms prepared 14,412 ha of land for yearly seeding (Table 12).

Table 12. Medway Creek Watershed Tillage Practices and Area Used

Tillage Practice	Description	Area
Conventional Tillage	Tillage incorporating most of the crop residue into soil	6,200 ha
Mulch Tillage	Tillage retaining most of the crop residue on the surface	2,742 ha
No-Till	No-till seeding or zero-till seeding	5,470 ha
	TOTAL AREA	14,412 ha

Farms Producing and/or Using Livestock Manure

Properly managing the nutrients from manure is essential to optimizing economic benefit to the farmer and minimizing impacts on the environment.

The value of manure in crop production is often underestimated. Manure contains all of the nutrients required by crops, but not necessarily in the proportions needed for specific soil and crop conditions. In addition to nitrogen, phosphorus and potash, manure contains many secondary nutrients and micronutrients. Manure supplies vital organic matter that helps maintain soil structure, reduce soil erosion, and increase soil moisture holding capacity. Manure application is one of the few ways to increase the organic matter within farmed soils.

Three manure application methods are used on farmlands: surface application, surface application and incorporation, and direct injection.

Surface application
Surface application involves manure applied onto the surface of a field. The field may or may not have a living crop and the manure can be either in a solid or liquid form.

Incorporation (surface applied and incorporated and direct injected)
Incorporation involves the mixing of nutrients into the soil surface by some form of tillage. Tillage should have a minimum depth of soil disturbance of 10 cm and, for optimum nutrient retention, should occur during or immediately after application. Direct injection of a liquid material into the soil is considered to be a form of incorporation.

The main purposes for incorporation or injection of manure are to reduce odours, minimize surface runoff and improve nutrient and pathogen retention. Shallow incorporation and the mixing of these materials with the crop residue will also promote the decomposition of the residue.

In Medway Creek watershed, approximately 60% of the farms surveyed generated manure or used manure (Table 13). The types of manure applied included liquid, solid and composted manure. The manure was reported to be applied to field crops, hay and/or pasture.

Table 13. Medway Creek Watershed Manure Application and Associated Land Base

Application Method	Land Area
Surface applied	992 ha
Surface applied and incorporated and direct injection into the field	2414 ha

Best Management Practices

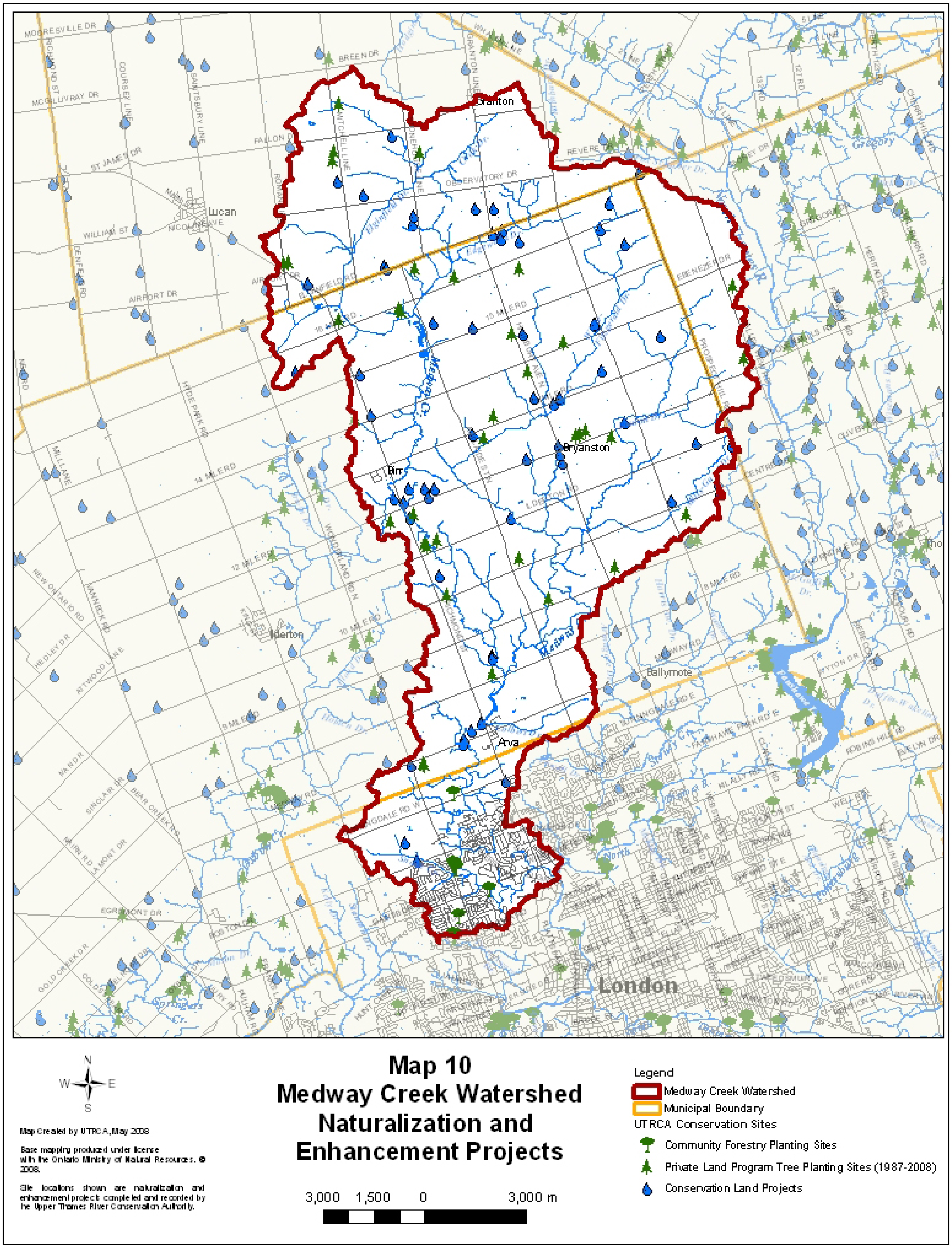
Farming is a business with many risks: the weather, finances, and market uncertainties. Today, we also realize that certain farming practices may create environmental risks that affect water quality. Producers experience some of the resulting problems themselves in the form of lower crop yields, soil losses and water pollution. Both rural and urban neighbours may be affected. For those affected, practical and workable solutions exist in detail in Ontario's Best Management Practice Program (BMP). The BMP addresses solutions for various soil, water and habitat concerns.

Many landowners within the Medway Creek watershed have participated in an UTRCA program to enhance their lands (**Map 10**). There are environmental cost-share programs available to assist farmers through the Environmental Farm Plan.

Environmental Farm Plan

Environmental Farm Plans (EFP) are assessments voluntarily prepared by farm families to increase their environmental awareness in up to 23 different areas on their farm. Through the EFP local workshop process, farmers highlight their farm's environmental strengths, identify areas of environmental concern, and set realistic action plans with timetables to improve environmental conditions. Environmental cost-share programs are available to assist in the implementation of projects.

Map 10: Medway Creek Watershed Naturalization and Enhancement Projects



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Acronyms

ANSI: Area of Natural and Scientific Interest

BMI: Benthic macroinvertebrates

BMP: Best Management Practice

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

DFO: Department of Fisheries and Oceans Canada

EC: Environment Canada

EFP: Environmental Farm Plan

EPA: Environmental Protection Agency

ESA: Environmentally Significant Area

FBI: Family Biotic Index

GIS: Geographic Information System

MDC: Municipal Drain Classification Project

OMNR: Ontario Ministry of Natural Resources

OMOE: Ontario Ministry of the Environment

OBBN: Ontario Benthos Biomonitoring Network

OSAP: Ontario Stream Assessment Protocol

PWQMN: Provincial Water Quality Monitoring Network

ROM: Royal Ontario Museum

SAR: Species at Risk

SARA: Species at Risk Act

SARO: Species at Risk in Ontario

UTRCA: Upper Thames River Conservation Authority

UWO: University of Western Ontario

Glossary

Barrier: The term barrier implies barring passage or movement and in this case, the barrier is to fish and/or aquatic wildlife movement or migration. Barrier construction can be virtually anything including large woody debris, perched or orphaned culverts, concrete steps, steep slopes or gradients, excessively fast or high velocity flow, or even chemical or thermal in nature (anything that would bar fish passage including dams).

Benthic: Relating to the bottom of a waterbody (e.g., the ocean floor)

Dam: Structure as barrier for the purpose of holding back water, creating reservoir for flood control or to increase water level.

Macroinvertebrate: An organism that does not have a backbone and us visible to the naked eye. Aquatic macroinvertebrates including insects, crustaceans and worms. Their abundance and diversity have been used as an indicator of ecosystem health and local biodiversity.

Tributary: Drains, creeks, streams or other watercourses that flow into the main waterway.

Vertebrate: An animal without a backbone.

Watershed: The land drained by a watercourse and its tributaries.

Wetland: Lands that are seasonally or permanently covered by water, or areas where the groundwater is close to the surface. Wetlands have many environmental benefits including reducing floods, improving water quality and providing wildlife habitat.