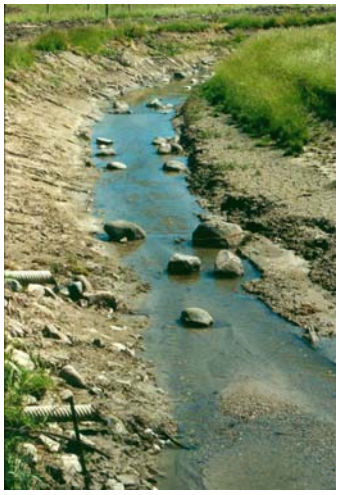
Cold water fish habitat management in the Nairn Creek sub-basin.



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Photographs on Front Cover (left to right):

Photograph of Nairn Creek looking downstream at Highway 7 in 1991 (source: Ontario Ministry of Natural Resources, Aylmer District). Photograph of Nairn Creek looking downstream at Highway 7 in 2002 (source: Ausable Bayfield Conservation Authority). Livestock access was restricted and trees were planted in 1991.

Executive Summary

The Ausable River's Nairn Creek has provided habitat for brook, brown and rainbow trout, fish species indicative of cold, clear, running waters. Past examination of this system has suggested that warm water temperatures and the introduction of fine sediment may limit available cold water habitat. Water temperatures and substrate were therefore, examined and summarized for watercourses in the Nairn Creek sub-basin. Factors that may influence water temperatures and potential habitat including sub-surface geology, forest cover, stream-side vegetation and drainage characteristics were evaluated. Information from recent (1999 and 2002) fish surveys were also summarized.

From 115 potential sites (i.e., watercourse and road intersections) in the Nairn Creek sub-basin, 76 sites were dry. At the sites with water, temperatures were typically warm (six sites of the 115 sites had cold water). Brook trout were found at five locations (one of the five sites was considered cold water) during the fish surveys. Except at one location on a Nairn Creek tributary (Duncrief Creek), numbers of brook trout were low (< 10 individuals). Dozens of brook trout were collected from one site on Duncrief Creek. Although this site had warm water temperatures, the important combination of continuous water flow, gravel-sized substrate and extensive in-stream cover (e.g., undercut banks, aquatic vegetation and stream-side shrubs) provided habitat for this temperature sensitive fish. Low water discharge and warm water temperatures may limit the brook trout population across the basin. However, the importance of in-stream cover should not be overlooked.

Recovery strategies for the brook trout of Nairn Creek include: protection and improvement for existing populations, research and monitoring and community education.

Acknowledgements

This sub-basin study was funded by the Ontario Ministry of Natural Resources (OMNR, Aylmer District and Middlesex Stewardship Committee) and the Ausable Bayfield Conservation Authority (ABCA). John Piraino from the ABCA produced the maps. Erin Dolmage, Billy Haklander, Patty Malone, Tracy Allison and John Schwindt provided field assistance. A special thank you to landowners, Steve Bowman, Mark Lowenstine and Gerald Lenders for allowing us to have access to their sections of the creek. Tom Prout and Kate Monk from the ABCA provided editorial comments. Dan Schaefer, Hal Schraeder and Pud Hunter from the OMNR, Aylmer District provided comments about the project design and review.

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1.0 Introduction

1.1 Background

In 2001, a Fish Habitat Management Plan was completed for the Ausable and Bayfield rivers (Veliz 2001). With input from the Ontario Ministry of Natural Resources (OMNR), Fisheries and Oceans, Canada (DFO) and local angler groups, sub-basins were prioritized for maintenance, protection and improvement based on angler interest, fish habitat and fish sensitivity. The Ausable River's Nairn Creek was listed as a priority one sub-basin due mainly to the presence of brook trout (*Salvelinus fontinalis*). This native fish species has particular water quality requirements such as constant water flow, cold temperatures, high dissolved oxygen concentrations, low suspended solid concentrations and clean substrate. The presence of this species in Nairn Creek reflects excellent stream health characteristics and conjures images of the archetypal babbling brook.

As early as 1956, the Ontario Department of Planning and Development recommended improvements to the Nairn Creek cold water fish habitat. Further examination of the water quality and fisheries in this sub-basin has been undertaken by the OMNR. For example, Nairn Creek was ranked fourth of 17 cold water streams in the Aylmer District and recommended for cold water rehabilitation in the Aylmer District Fish Management Plan (Hunter 1978, OMNR 1987). Ward (1983) found that brook trout in Nairn Creek were threatened by warm water temperatures, the introduction of silt substrate and intermittent water discharge. McPeck et al. (1991) made specific rehabilitation recommendations regarding in-stream clean ups and livestock access. Habitat improvements have also been undertaken in Nairn Creek. Riffle logs, stone barriers and rip-rap were installed and pools were dug in 1974, 1975 and 1976 (Stock et al. 1976).

By 2000, the population of brook trout in Nairn Creek was one of the most south-westerly populations in Ontario. Research completed as a part of the drain classification project revealed that water temperatures in locations that had historically provided brook trout habitat were warm and that brook trout were no longer found in the main Nairn Creek channel. An objective of the current study was to quantify the extent of cold water and gravel substrate habitat in the Nairn Creek sub-basin.

Natural features (i.e., geology and forest and wetland cover) and land use practices (i.e., drainage practices) in part, determine key migratory and resident trout habitat requirements (i.e., cold water and gravel substrate). Therefore, another study objective was to document the current extent of wetland and forest cover in the sub-basin.

Essentially all of the land in the Nairn Creek sub-basin is privately owned. Implementation of agricultural best management practices (BMPs) provide a first step towards implementing cold water fishery management. Therefore, another important study objective was to inform landowners about fish habitat and the sensitivity of some fish to certain land use practices.

1.2 Objectives

1. To document the sub-surface geology and the current extent of wetland, forest and stream side vegetation in the Nairn Creek sub-basin.
2. To document in-stream fish habitat characteristics such as water temperature and substrate size in the Nairn Creek sub-basin.
3. To quantify the historic and current brook trout fishery in the Nairn Creek sub-basin.
4. To inform local landowners about the importance and value of a brook trout fishery in the Nairn Creek and their opportunity to participate in the stewardship of this resource.
5. To prescribe necessary management activities (i.e., an Action Plan) to effect improvement in the status of brook trout in Nairn Creek.

1.3 Study Format

For the purposes of this study, habitat information relating to stream-side characteristics, stream flow, stream substrate and stream temperature were summarized from assessments conducted at 39 road/watercourse intersections across the sub-basin in 1999. More detailed water temperature and fish surveys were conducted at key locations in the sub-basin. An Action Plan is the final component of this study.

1.4 Study Area

Nairn Creek is a 129 km^2 sub-basin of the Ausable River system. The Nairn Creek sub-basin is located in Middlesex County, approximately 40 km northwest of the City of London, Ontario (Figure 1).

Nairn Creek is the official name of the tributary that discharges into Ausable River near the hamlet of Nairn, south of Ailsa Craig (Figure 1). The headwaters of this creek rise south of Lucan. Bear Creek, a main tributary of Nairn Creek, flows north and joins Nairn Creek just upstream of Nairn's confluence with the Ausable River. Another important Nairn Creek tributary is the Duncrief Creek. A section of this creek is also known as Lenders Drain. This tributary rises from springs east of Vanneck Road in the township of Middlesex Centre. In the upstream reaches, Nairn Creek is also known as the Denfield Creek, or the Stanley Creek Drain.

2.0 Methods

2.1 Sub-surface Geology and Forested and Wetland Areas

The sub-surface geology is derived from Ontario Ministry of Northern Development and Mines (1:50 000) mapping. Wetland and woodlot areas were determined from OMNR Ontario base mapping (1:10 000) (1985). Updated woodlot area information was

determined from 1999 aerial photography (1:15 000). Forest cover was compared between 1985 Ontario base map information and 1999 aerial photography.

2.2 Fish Habitat Surveys

To document in-stream fish habitat characteristics (the second objective) roadside fish habitat surveys were completed. Surveys were conducted at road/watercourse intersections in the Nairn Creek sub-basin in July and August of 1999. At the upstream side of the road, information regarding water flow, stream substrate, riparian vegetation and land use were recorded. (See Appendix A for an example of the habitat survey sheet).

Sites that were dry, or had been transformed from an open, tiled system to a closed, tiled system were not further evaluated with respect to substrate, vegetation and adjacent land use. Substrate was recorded as a per cent for the following categories: boulder, cobble, gravel, sand, silt, clay and bedrock. Dominant substrate for each site was determined for those sites that had substrate dominated ($\geq$ 45 %) by one category. Riparian width was estimated. Riparian vegetation and cover (i.e., in-stream structure that provide fish hiding areas such as large boulders, overhanging riparian vegetation) were characterized. Stream water temperatures were also recorded according to the protocol established by Stoneman and Jones (1996).

The transformation of open surface drains to closed and tiled drains was examined in the Nairn Creek sub-basin. The total length of open watercourses in 1975 was determined from the 1975 enlargements (1:5 000) of aerial photographs (1:20 000). The length of closed, tiled drains in 1999 was determined from the 1999 (1:15 000) aerial photographs. (The length of the watercourse that no longer appeared was assumed closed and tiled.) The amount of watercourse closed and tiled in 1999 is expressed as a per cent of the total length of open, surface drains (1975).

Onset Water Temperature Pro Loggers were installed during the summer of 2002 (June 25 to August 28) at three locations where brook trout have historically been located (Table 1 and Figure 1). The locations varied with respect to stream-side vegetation. The Lowenstine site was well shaded and downstream of an area with considerable forest cover. The Bowman site was in an open-canopied section. There was a 500 m open-canopied section of creek immediately upstream of this temperature data logger. The Lowenstine and Bowman site were located on the main Nairn Creek channel. The Lenders site on Duncrief Creek, was in a location with stream-side bushes and trees, shading was intermediate between the Lowenstine and Bowman site.

The loggers collected stream water temperature every 0.5 h. Except from July 15 to July 25, local air temperatures were collected from the Springbank Environmental Station (20 km from Denfield). Air temperatures were recorded from the Varna Environmental Station (50 km from Denfield) from July 15 to July 25, due to equipment malfunction at the Springbank station. Excluding dates between July 15 to July 25, average maximum daily air temperature was 27.22°C and 27.55°C at Varna and Springbank stations,

respectively. It was anticipated that the slight air temperature differences between stations would not compromise temperature results and conclusions.

Table 1: Location of water temperature data loggers at three sites in the Nairn Creek sub-basin in 2002.

Site	General Location	Latitude/Longitude
Lowenstine (Nairn Creek) (shade)	Middlesex Centre - Ward of London (Concession 15, Lot 30)	43°7'16" N 81°26' 44" W
Bowman (Nairn Creek) (sun)	Middlesex Centre - Ward of London (Concession 15, Lot 31)	43°7'18" N 81° 26' 58" W
Lenders (Duncrief Creek) (some shade)	Middlesex Centre - Ward of Lobo (Concession 10, Lot 18)	43°4'30" N 81°27' 58" W

On July 23, 2002 temperature was recorded in a spring-fed pond in the headwaters of Duncrief Creek at Jerry Giesen's farm (Figure 1). On August 1, 2002, random measurement of the substrate was completed at four locations and water temperatures collected at nine locations at the Bowman Farm (Table 1). On September 14, 2002 a portion of Nairn Creek downstream of the Bowman Farm was walked and in-stream cover was observed.

2.3 Fish Survey and Drain Classification

To determine fish species in the Nairn Creek sub-basin (the third objective), some locations were fished. Within the sub-basin, sites on drains that had a history of top level predator fish species occurrence were sampled with an electro-fisher in 1999. The historical information came from angler information and past surveys conducted by the OMNR in 1974 and Ward in 1983 (Figure 2).

Fish were also sampled June 28, 2002 from Nairn Creek at Bowman Farm (see Table 1 for location). A 35 m sampling station based on one-half of a meander (riffle, pool/ run, riffle sequence) was established. Seine nets placed at the upstream and downstream ends of the 35 m station prevented fish movement into or out of the sampling area. An electrofisher was used to sample the fish. Four passes were made at the station. Salmonids were counted and weighed with a Mars MS3 electronic scale. Non-salmonid fish species were counted. Following sampling, fish were released downstream of the station. On August 28, 2002 fish were also sampled from Nairn Creek in Carlisle.

The combined fish habitat and fish survey information was used to classify the drains in this sub-basin. It is important to note that the classification is subject to change depending on future stream condition.

2.4 Public Information

To inform landowners and the general public about the importance of brook trout (objective four), landowners were contacted. Landowner names and addresses were obtained from roll assessment maps located at the North Middlesex, Middlesex Centre and Lucan-Biddulph Municipal offices. A letter (Appendix B) was mailed to 569 property owners across the Nairn Creek sub-basin. The letter detailed the purpose of the current study and informed them of available grants to implement agricultural BMPs to improve water quality. The letter also invited landowners and interested public to a meeting on August 20, 2002.

2.5 Recovery Strategies

The format of the Nairn Creek Action Plan was taken from the Plan developed by the Redside Dace Recovery Team (2001).

3.0 Results

3.1 Sub-surface Geology and Forest and Wetland Areas

Much of the sub-surface geology in this sub-basin is tightly-bound Rannoch till (Figure 3). The poor infiltration capabilities of this till limit the number of groundwater discharge areas and therefore, limit the streams that have a continuous supply of water. However, there are extensive areas of sand deposits near the confluence of the Nairn, Bear and Ausable systems, that likely contribute water to these systems. An isolated gravel deposit in this sub-basin is the probable source of continuous cold groundwater for the Duncrief tributary and the Carpenter Drain (Concession 14, Lots 30 and 31 Ward of Lobo, North Middlesex).

Forest and wetland cover was approximately nine per cent of the basin. There has been an increase in overall per cent forest cover between 1985 and 1999 (Figure 4). Forest cover in 1984 was 10.32 km^2; in 1999 forest cover was 11.71 km^2.

3.2 Fish Habitat Surveys

From 115 potential sites (i.e., watercourse and road intersections inspected in 1999) in the Nairn Creek sub-basin, 76 sites were dry or closed drains and 12 had standing water (Table 2). Most of the dry sites were on first or second order streams. The intermittent nature of the tributaries may be a result of the impermeable soils, characteristic of the till plain geology and annual precipitation patterns. However, the lack of forest cover and wetlands may also in part, contribute to the low summer base flows. Drainage activities (i.e., systematic or random tiling of fields) in seepage areas and the removal of in-stream features (i.e., riffles, pools and meanders) during drain construction and maintenance may move water out of headwater areas quickly. The combination of natural conditions (i.e., little precipitation and impervious soils) and land use (i.e., drainage practices and lack of forest and wetland cover) ensure dry conditions in many of the tributaries of Nairn Creek.

Table 2: Summary of fish habitat characteristics at roadside/watercourse intersections for the Nairn Creek sub-basin. Data collected by Ausable Bayfield Conservation Authority and Fisheries and Oceans, Canada, 1999.

Attribute	Number of Sites	Average
Flow (115 sites)		
Strong	13	
Some	14	
Standing	12	
None	76	
Riparian Characteristics (39 sites)[a]		
width (m)		19
per cent shade		31
per cent trees		20
per cent shrubs		16
per cent herbaceous		77
In-stream Cover (39 sites)		
per cent of channel shaded		45
Land Use (39 sites)		
woodlot/wetland	5	
pasture	11	
crops	18	
residential	5	
Substrate (39 sites)		
Fine (clay or silt)	27	
Boulder or cobble	3	
Mixture	9	

[a] The sum of the tree, shrub and grass component does not equal 100 per cent. Grasses can underlie trees and therefore, increase the combined cover to > 100 per cent.

The transformation of open, surface drains to closed, tiled drains was evaluated for the Nairn Creek sub-basin. The length of the watercourse that no longer appeared in the 1999 aerial photography was assumed to be the length of the watercourse that was closed and tiled since 1975. The findings from this survey suggested that 14 per cent of open first or second order watercourses in this sub-basin were transformed to closed, tiled drains between 1975 and 1999.

Of the 115 road/watercourse intersections inspected in 1999, 39 sites had water and were therefore, further evaluated for fish habitat (Table 2). Stream-side vegetation was found at the upstream side of the road for all 39 sites. The dominant vegetation type was herbaceous material (grasses) (77 per cent). The estimated average width of the stream-side buffers at these road/watercourse intersections was 19 m. Although riparian buffer

strips were reported for all 39 sites, cattle access was noted at five sites on Nairn Creek and three locations on Bear Creek. Except one location on Bear Creek (a 'dry' location), all cattle had access on the downstream side of the road.

In-stream cover existed at the 39 sites with water and varied from five to 95 per cent of the channel. In-stream cover on a section of Nairn Creek was further observed on August 1, 2002 (upstream of Mill Lane) and September 13, 2002 (downstream of Mill Lane) near the Bowman Farm (Table 1). Downstream of Mill Lane, in-stream cover was excellent. The dominant stream-side vegetation was dogwood shrubs. These overhanging bushes covered approximately 10 to15 per cent of the wetted width of both sides of the stream for a total cover of 20 to 30 per cent of the stream. Immediately upstream of Mill Lane, a row of mature spruce and willow trees were found along most of the stream length. There was a 500 m section without trees or bushes. The dominant stream-side vegetation was grasses. Cattle have access to the creek above the Mill Lane bridge to the lot line between lot 30 and 31. (The landowner is in the process of restricting cattle access on this section of the creek.)

Fine sediment (i.e., clay and silt) was the dominant substrate at most (27) of the 39 sites (Table 2). Cobble or boulder was the dominant substrate at three locations. The remaining nine sites had a mixture of substrates, typically gravel and sand with silt and were not dominated ($\geq$ 45 per cent) by one type of substrate. Further investigation of substrate size at the Bowman Farm showed that the dominant substrate was cobble and boulder (Appendix C). However, silt and algae covered much of the cobble substrate in many areas of this section of Nairn Creek.

According to the protocol described by Stoneman and Jones (1996), remarkably few roadside/watercourse intersections in the Nairn Creek sub-basin were considered cold, or cool water (Figure 5). Two sites on the Carpenter Drain were considered cool or cold. The Carpenter drain provides cold water to Nairn Creek at Concession 15, Lot 30. Cold water (16°C) was recorded from this drain on August 1, 2002 (maximum air temperature was 32.2 °C). Stream water temperatures in Stumpf Drain (this drain crosses Highbury Ave. just south of Elginfield Rd.) were considered cold water. Cold water (15 °C) was recorded at the Giesen pond in the headwaters of the Duncrief Creek (maximum air temperature on July 23, 2002 was 23.1 °C). This site was not at a roadside/watercourse intersection and therefore, not a data point on Figure 5.

Stream water temperature at three sites (Bowman, Lowenstine and Lenders) that have historically supported brook trout were warm water, according to the protocol described by Stoneman and Jones (1996) (Figure 6). Average daily maximum temperatures at the Lowenstine site, the well-shaded site, were lower (21.8°C) than average daily maximum temperatures found at the sunny Bowman site (22.6°C).

3.3 Fish Survey

During 1999, 14 road/watercourse intersections were surveyed for fish. Most sampling occurred in the tributaries as a part of the drain classification survey. Fish communities across the sub-basin were dominated by minnows (See Figure 2 for site locations and Appendix D for species lists). Creek chub was an ubiquitous species; it was found at 13 sites. Blacknose dace and common sucker were also commonly found at 11 and nine sites, respectively. Site five on Bear Creek (near the Bear Creek and Nairn Creek confluence) had the highest number of species (16) and 13 species were found at site 114 (Vanneck Rd.) on Nairn Creek. These sites were on the main channel and therefore, might be expected to have a greater number of species compared to the tributary sites. Typically the tributary sites had three to six species. Interestingly, eight to ten species were found in sites on the Duncrief tributary. The greater number of species found at the Duncrief sites reflect the addition of cold water species (e.g., brook and rainbow trout and mottled sculpin) to the list of common minnows. Brown trout were not surveyed in 1999.

In 1999, brook trout were sampled from two tributary systems, Carpenter Drain and Duncrief Creek. Two brook trout were found in the Carpenter Drain. This tributary flows into Nairn Creek near the Bowman Farm (Concession 14, Lots 29 and 30). A greater number (>10) of brook trout were found in two locations on Duncrief Creek (site 113 - Vanneck Rd. and site 125 - Charlton Rd.). Dozens of brook trout are reported from site 125 (John Schwindt, personal communication August 12, 2002). Only one brook trout was sampled at site 135 (Hedley Dr.) on Duncrief Creek. Brook trout were not found in the main Nairn Creek channel in the 1999 survey.

Surveys conducted in 2002 yielded three brook trout in the main Nairn Creek channel at the Bowman Farm on Mill Lane (see Table 1 for coordinates and Figure 1; see Appendix E for weights and Ward 1983 data). Brook trout were not found in Carlisle in August 2002. Brown trout were not surveyed in 2002. In summary, between 1999 and 2002, brook trout were found at five locations in the Nairn Creek sub-basin: Nairn Creek near Mill Lane, Carpenter Drain and three locations in Duncrief Creek.

3.4 Drain Classification

There were 76 drains, or drain extensions in the Nairn Creek sub-basin. The majority of the drains (53) have been transformed to closed, tiled systems (see Figure 8). Eight of the remaining open drains were dry in 1999. Six drains were found to have cold water or the history of cold water fish species and four of the drains were considered warm water with bait fish. Five drains were not classified.

3.5 Public Information

On August 20, 2002, 35 landowners attended a public meeting. The dialogue that followed the presentations about brook trout habitat and stewardship grants, indicated that the attendees were informed about their local creek and interested in its health (see Appendix F for notes taken during the meeting). Two farmers have initiated actions with

the Clean Waters Project in Middlesex County to plant trees and fence livestock. Some landowners and anglers suggest that cattle access is not the main problem for trout in Nairn Creek. These landowners suggest that 40 to 50 years ago there were more cattle grazing on pasture and more trout.

4.0 Synthesis

The sub-surface geology map indicated that there is a gravel lens that likely provides a continuous source of water to sections of Nairn Creek. Notably Carpenter Drain and Duncrief Creek have continuous summer cold or cool water discharge. In the dry summer of 2002, reduced base-flow was noted in tributaries and the main Ausable River channel. However, reduced flows were not noted in the Duncrief Creek, Carpenter Drain, or Nairn Creek downstream of Carpenter's Drain. The groundwater discharge provides the Nairn system with a continuous source of cool/cold water. Carpenter Drain, the Giesen pond in the headwaters of the Duncrief Creek, Watson Drain No. 2 and Stumpf Drain also have cool/cold water temperatures.

Across the Nairn Creek sub-basin, the fish communities reflect the discharge and temperature regime established by groundwater discharge areas. The isolated nature of these groundwater discharge areas means that many of the tributaries in this sub-basin are intermittent and respond to precipitation patterns and temperatures in the higher order tributaries are typically warm. As a result, warm water minnows dominated fish communities across much of the basin. Occurrence of cold water fish species (e.g., brook and rainbow trout) was localized. In 1999, four locations in two tributaries (Carpenter Drain and Duncrief Creek) supported brook trout. Rainbow trout were found in the main Nairn Creek channel at Vanneck Rd. and in two locations in Duncrief Creek. Brown trout were not surveyed in 1999 and 2002. Cold water species were not reported from Watson Drain No. 2 or Stumpf Drain. Stumpf Drain is isolated from the main channel as the downstream portion of this watercourse is dry. Watson Drain No. 2 had marginal cold water temperatures and silt substrate.

The absence of brook trout from the main Nairn Creek channel in the 1999 survey (ABCA drain classification survey, 1999 to 2001) in part, prompted this study. The site at Bowman's Farm (Mill Lane) had 13 brook trout in 1982 (Ward 1983) and was therefore, sampled in 2002. A small population of brook trout (a total catch of three individuals in a 35 m section) was found at the Bowman Farm. In 2002, brook trout were not found further downstream in Carlisle. Brook trout were last sampled from Carlisle in 1974 (OMNR files 1974). Upstream of Mill Lane, brook trout have not been sampled since the 1974 survey (OMNR files 1974). Results from this study indicate that the brook trout population (three fish) is very marginal in the main Nairn Creek channel. Furthermore, the current distribution and abundance of the brook trout population in the main channel is reduced compared to population estimates from 1982 (Ward 1983) and 1974 (OMNR files 1974) (see Figure 7). Two tributaries, Carpenter Drain and in particular, Duncrief Creek provide much of the habitat required for brook trout in the Nairn Creek system.

Habitat factors that contribute to the success of brook trout populations include cold stream water temperatures, cover, gravel substrate, and pools, with cold stream temperatures being most important (Stoneman and Jones 2000). Stoneman and Jones (2000) suggested that stream temperatures > 17 to 22°C will not support high trout biomass. The maximum temperature for

brook trout habitat is about 24°C (Meisner 1990). In the summer of 2002, stream temperatures recorded at three locations in Nairn Creek with brook trout were all considered warm water. The average maximum daily temperatures at the three sites with brook trout ranged from 21.8° C to 22.5°C. Furthermore, the maximum temperatures at the three sites from June 25 to August 28 was > 25°C. Temperatures recorded at these three locations in the Nairn Creek system were at the maximum temperature borderline for brook trout. Thus, one important explanation of the low brook trout population numbers in Nairn Creek and its tributaries is the relatively high summer water temperatures.

Warm stream water temperatures is not the lone explanation for the reduced brook trout population in the Nairn Creek system. Although, warm water temperatures were recorded throughout the Duncrief system, there were differences in the number of brook trout sampled at the different locations. Sites 125 and 113 had considerably more brook trout (> 10) than site 135 (1 brook trout). The most obvious difference between the locations was in-stream cover and stream-side vegetation. Site 135 had less in-stream cover and stream-side vegetation than site 125 (40 and 75 per cent cover, respectively and zero and 30 per cent bushes for stream-side vegetation, respectively). Cover is important for salmonids as it provides areas to hide. Stream-side vegetation also provides hiding areas and material for aquatic invertebrates, an important food resource.

Stream-side vegetation may also maintain cool water temperatures (Barton et al. 1985). In the current study, the average maximum daily temperature at the Lowenstine site (21.8°C), a well shaded site was cooler than at the Bowman site (22.6°C), an open-canopied site. However, the Lowenstine site was also upstream of the Bowman site and therefore, closer to Carpenter Drain (the cold water source). Further investigation of temperatures in shaded versus open sites is warranted to test the hypothesis that stream-side vegetation maintains cold water conditions in the Nairn Creek system.

Substrate is another important determinant of brook trout habitat. Substrate in the Nairn Creek immediately downstream of the cold water source (the Carpenter Drain), was dominated by cobble (see Appendix C). Stoneman and Jones (2000) suggested that gravel is the substrate preferred by brook trout. Gravel substrate is found in the tributaries, Duncrief Creek and Carpenter Drain. The tributaries may provide the right combination of potentially cold water temperatures and gravel-sized substrate. The lack of flowing water in many of the tributaries may in part, limit the availability of habitat with the appropriate sized substrate in the Nairn Creek system.

Temperatures across the basin and in sections that support brook trout were warmer than might be expected. However, brook trout were found in five locations (Bowman Farm near Mill Lane - Nairn Creek, Carpenter Drain, and three locations on Duncrief Creek). The differences in the number of brook trout found in the different locations within the Nairn Creek system suggest that habitat conditions such as in-stream cover and gravel substrate were important determinants of brook trout success in the Nairn Creek system.

5.0 Action Plan

Brook trout are a rare species in aquatic systems south and west of London, Ontario. Biologist John Schwindt from the Upper Thames River Conservation Authority, completed fish surveys for much of south-western Ontario. He found brook trout in only one location south and west of London. The population of brook trout in Nairn Creek is therefore, one of the most southerly populations in Ontario and needs resources from provincial and federal agencies to ensure protection and improvement. The findings from the current study indicate that the brook trout population in Nairn Creek is on the verge of being eliminated. The population in the Duncrief tributary appears to be self-sustaining. A management plan is required to provide a framework for improvements for these populations.

I Recovery Goal

To increase the distribution and abundance of the brook trout population in the Nairn Creek sub-basin.

II Recovery Objectives

A. Secure and protect the current geographical distribution and abundance of brook trout through habitat protection.

B. Expand the 2002 known brook trout range by three times (Figure 9) by 2020.

III Recovery Strategies

The following strategies will be used to meet objectives A and B:

A. Improve riparian quality
B. Increase forest cover
C. Remove obstructions to flow
D. Research and monitoring
E. Communication and Outreach
F. Inform Planning/Regulatory Staff/Management

Specific tactics related to these strategies are described below. The following recommendations are for agency (ABCA, OMNR and DFO) review and implementation. A timeline is provided in section 5.1.

Tactics:

A. Improve riparian quality

1. **Plant trees.** Establish a 10 year goal of a five km vegetated buffer along the cold and potentially cold water branches of the Nairn Creek

2. Continue to inform and work with landowners to **restrict livestock access** in Nairn Creek and its tributaries. Financial incentives that are currently being offered may not convince all landowners of the benefits of restricting livestock from watercourses. Agencies

responsible for enforcing sections 35 (2) and 36 (3) of the Federal Fisheries Act (i.e., DFO and Environment Canada) should visit non-complying landowners in 2003 and 2004 and provide them with a time-line to restrict livestock.

B. Increase forest cover

1. **Plant trees**. A basin should have 30 per cent forest cover for ecosystem health (Environment Canada et al. 1998). This sub-basin (with 10 per cent coverage) needs considerable reforestation efforts.

C. Remove obstructions to flow

1. Some landowners believe that beavers are responsible for the reduction in brook and brown trout populations. Reduced velocities were noted upstream of beaver dams on the Nairn Creek channel. The dams may restrict trout movement in the Nairn system. Further examination of the interaction between beaver and trout would also illustrate to landowners that their concerns are being considered. (The ABCA and OMNR should immediately encourage landowners to **remove beavers and beaver dams** from the Nairn system.)

D. Research and monitoring

1. A brook trout population and fish habitat survey should be undertaken every seven to ten years to document the continued existence of brook trout in the Nairn Creek system. However, stream temperature should be monitored annually. The ABCA with MNR and DFO support, should survey the brook population and fish habitat in 2010.

2. A database that captures information pertaining to tree planting through the ABCA should be initiated. This database should have geographical information (i.e., location) and information about tree species and numbers. This would provide the ABCA with current information about forest cover. The ABCA should immediately establish a **tree planting database**.

3. Maintain the drain classification database. For example, drain maintenance activities should be recorded for all drains. Likewise, additional watercourse temperature, fish habitat and fish survey data should be updated. The ABCA should continue to **update the drain classification database**.

4. Land use types in the Nairn Creek sub-basin should be updated from the 1985 Ontario Base Map information. The ABCA and OMNR should initiate a pilot project to **compare 1985 with 2002 land use information**.

5. An important research project that would determine potential wetland rehabilitation areas in Nairn Creek is recommended. The implementation of Geographic Information

Systems (GIS) to overlay sub-surface geology and soils maps would help to determine candidate wetland areas. The ABCA and OMNR should cooperate on a GIS program to **identify candidate wetland restoration areas** in Middlesex County.

6. Determine the key factors associated with agricultural activities that increase water temperature in streams draining agricultural lands. The ABCA with OMNR and DFO support, should conduct **a literature review about factors that determine watercourse temperatures in lands draining agricultural areas**.

7. Further investigation of water temperatures in shaded compared to non-shaded areas of the Nairn Creek is warranted to test the hypothesis that stream-side vegetation maintains cold water conditions. The temperature survey in 2002 was conducted in three sites. A sun-shade comparison was completed on the same stream. Ideally (for scientific rigour), a sun-shade comparison should be conducted for three streams, for a total of six locations. One pair of thermistors should be placed in Nairn Creek (at the Lowenstine and Bowman locations), one pair of thermistors should be placed in the Carpenter Drain (east and west branch on Fifteen Mile Rd.) and the final pair should be placed in the Duncrief Creek (site 125 and site 135). The ABCA with OMNR and DFO support, should **conduct temperature comparisons** in the Nairn Creek sub-basin.

8. The water temperatures in the Nairn Creek system were warmer than was expected for brook trout habitat. One potential explanation is that groundwater close to the discharge areas is being warmed. Two potential warming practices include gravel extraction and off-line ponds. Further examination of these practices, particularly the effects of these practices on water temperatures on nearby surface water systems, is an important project that might help to explain warm water temperatures in the Nairn Creek system. The ABCA with OMNR and DFO support, should **conduct a literature review about the effects of off-line ponds and gravel extraction on surface waters**.

9. The ABCA and Ontario Ministry of the Environment (MOE) should establish a groundwater monitoring well in the Nairn Creek sub-basin. **Groundwater temperature and volume should be monitored at this new station starting in 2003**.

10. The transformation of open, surface drains to closed, tiled drains has occurred in this sub-basin. Between 1975 and 1999, 14 per cent of the open drains were transformed to closed drains. From Figure 8, it appears that much of the first and second order streams have been tiled (perhaps the closure occurred prior to 1975). There has been no examination of the potential effects on fish habitat of this practice. For Nairn Creek, the practice may cool downstream water temperatures. Conversely, the loss of habitat in these tributaries (particularly if these tributaries had gravel bottoms) should be recognized. In 2003, the ABCA with OMNR and DFO support, should **conduct a literature review about the potential effects of the transformation of open, surface drains to closed, tiled drains**.

11. **Quantify systematic and random field tiled areas in this sub-basin**. The amount of sub-surface drainage may affect the hydrology and the nutrient concentrations in the receiving creek.

E. Communication and Outreach

1. Local landowners need to be recognized for their contributions in maintaining the existing population of brook trout in the Nairn Creek sub-basin, particularly for their participation in tree planting. Between 1985 and 1999, forest cover has increased by 1 km^2 in the Nairn Creek sub-basin. Examination of wood-lot cover from the aerial photography (1999) indicates that forest corridors beside streams in some areas have been preserved. The ABCA, OMNR and DFO should produce a pamphlet to congratulate the landowners on past achievements and encourage them to plant a five km stream buffer in ten years. All agencies involved with the fisheries management in Nairn Creek (i.e., ABCA, MNR and DFO) should produce a landowner brochure to encourage stewardship in establishing stream buffers along the creek. **Produce a brochure** that establishes a ten year goal of a five km buffer along the cold water, or potentially cold water sections of Nairn Creek and its tributaries.

2. Findings from the drain class fish habitat/roadside survey suggests there is good acceptance of leaving vegetation beside streams. Typically, landowners leave herbaceous material (grasses). The leaving of this grass buffer strip is an encouraging sign. Further investigation may be required to determine if the landowner is leaving the area to regenerate, or is mainly interested in grass cover. One landowner was concerned about shallow tree roots that might rob his crops of moisture and nutrients. Perhaps, the planting of bushes and tap root trees (i.e., oak and cherry) would provide some of the shade and cover required by the trout and alleviate the potential for crop yield reductions. Thus, a phone or mail survey conducted in the Nairn Creek area might **determine factors that prevent landowners from planting trees in riparian areas**. The ABCA with OMNR and DFO support should conduct a mail or phone survey of landowners along the Nairn Creek to determine factors that prevent landowners from planting treed buffer strips.

3. When another financial incentive program, such as the Healthy Futures for Ontario Agriculture Program becomes available, **a special mail-out to the landowners in the Nairn Creek basin** should be considered. A description of a sub-basin might be incorporated. During this study, some people did not think that information about Nairn Creek at the Public Meeting would pertain to them as they did not live directly beside the creek.

4. **A display about the Nairn Creek study** and information pertaining to landowner grants should be organized at local events such as the 2003 Gala Days in Ailsa Craig.

F. Inform Planning/Regulatory Staff/Management

1. The Middlesex County Official Plan is currently being reviewed. Agencies that have the opportunity to comment on the Plan (i.e., the ABCA and MNR) should ensure that **sensitive brook trout habitat highlighted on Figure 9 is recognized**.

2. **Review of proposals for development and works in water** that are in, or adjacent to, the sensitive areas highlighted (Figure 9) must consider the potential for sediment deposition and the addition of warm water to Nairn Creek. Agencies such as the ABCA, MNR and DFO reviewing work in water projects must immediately adopt a policy that would prevent the addition of warm water and fine sediment to Nairn Creek.

3. The transformation of open, surface drains to closed, tiled drains in the Duncrief system is not recommended as these tributaries may provide the gravel substrate required for brook trout habitat. Agencies such as the ABCA, have the opportunity to review drainage applications. During review of the drain applications, **no additional feet of drain should be transformed from open, surface drain to closed, tiled drain**.

4. There were four ponds in the headwaters of Duncrief Creek on the Giesen property in July, 2002. Water control structures that draw cold water from the bottom of the ponds might be encouraged in future dialogue with this landowner, or other landowners that construct ponds in the Nairn Creek sub-basin. This policy should be implemented by the ABCA, MNR and DFO over the long-term.

5. Drain maintenance activities may result in changes to riparian vegetation, substrate composition and width: depth ratios. There are sections of the Nairn Creek system that are sensitive to these activities (See Figure 8, Class A and D). The municipal drain class authorization system delivered by the ABCA with support from the DFO was designed to minimize effects of drain maintenance. The success of this program will depend on: ongoing dialogue with Drainage Superintendents, adherence to timing restrictions and maintenance activities that are as infrequent and minimal as possible. A meeting to describe the findings of this report with DFO and the appropriate Drainage Superintendents (i.e., North Middlesex, Middlesex Centre and Lucan-Biddulph) should be scheduled.

6. Water taking permits are required if the user takes > 50 000 litres per day. In drought conditions, more users may take water from the Nairn system as this system has continuous summer discharge. **The MOE should review the number of users and the amount of water that is removed for this sub-basin**.

5.1 Timeline

The following schedule documents implementation dates of specific tactics detailed in section 5.0.

Tactics	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
plant trees										
restrict livestock access										
remove beavers and beaver dams										
survey fish										
establish tree planting data base										
evaluate candidate wetland (s)										
temperature study of agricultural lands										
monitor temperature in surface and ground water										
study drain transformation										

Tactics	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
quantify tiled areas										
produce a brochure										
determine factors that prevent landowners from planting trees										
mail-out	As necessary to attract landowners to various incentive grants.									
local displays										
Official Plan Review										
review water taking permits										

6.0 Bibliography and Literature Cited

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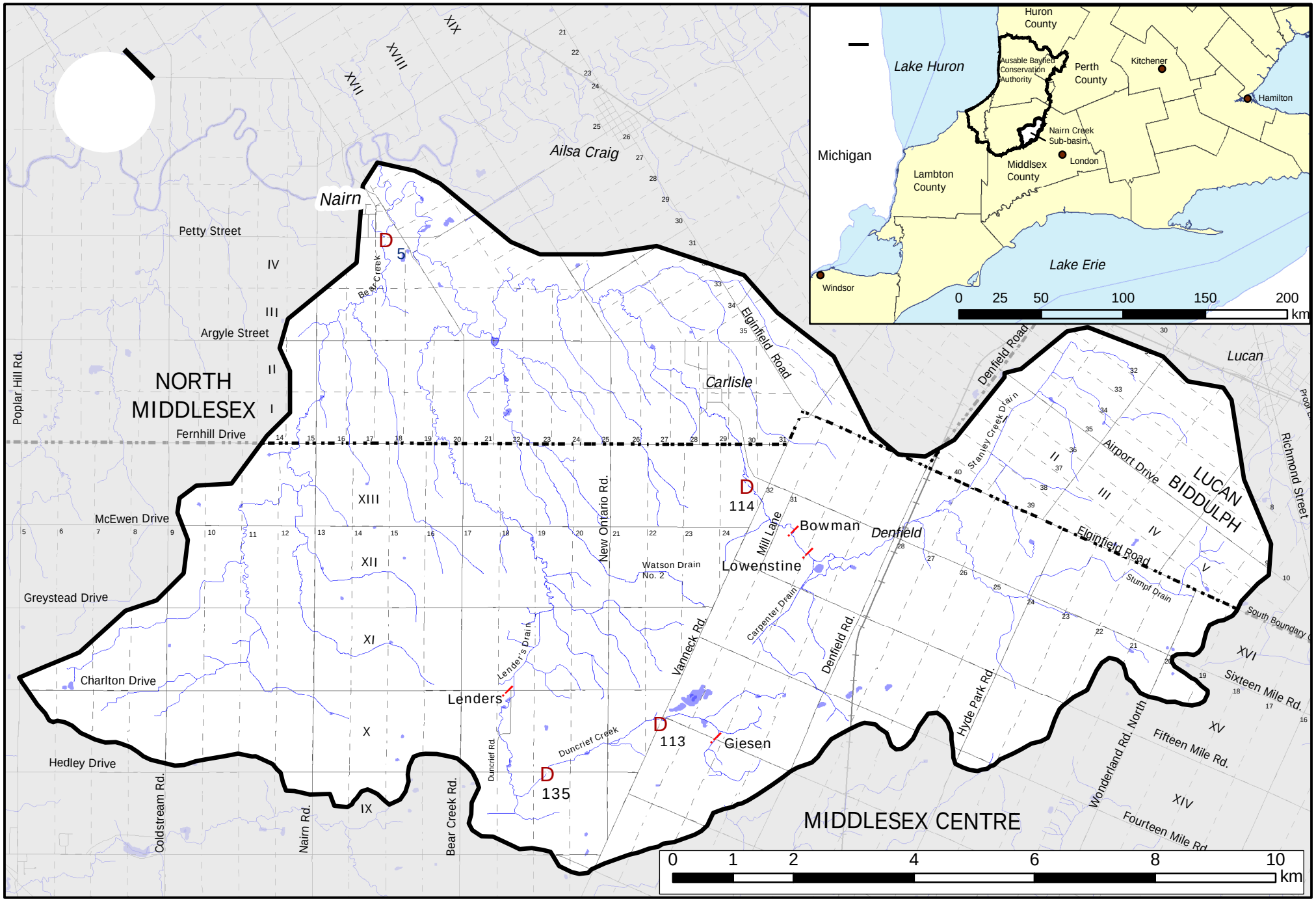

Figure 1: The Nairn Creek sub-basin with roads, fishing and temperature sites mentioned in the text identified. Map of southwestern Ontario and the Ausable Bayfield Conservation Authority jurisdiction and Nairn Creek sub-basin highlighted in the inset.

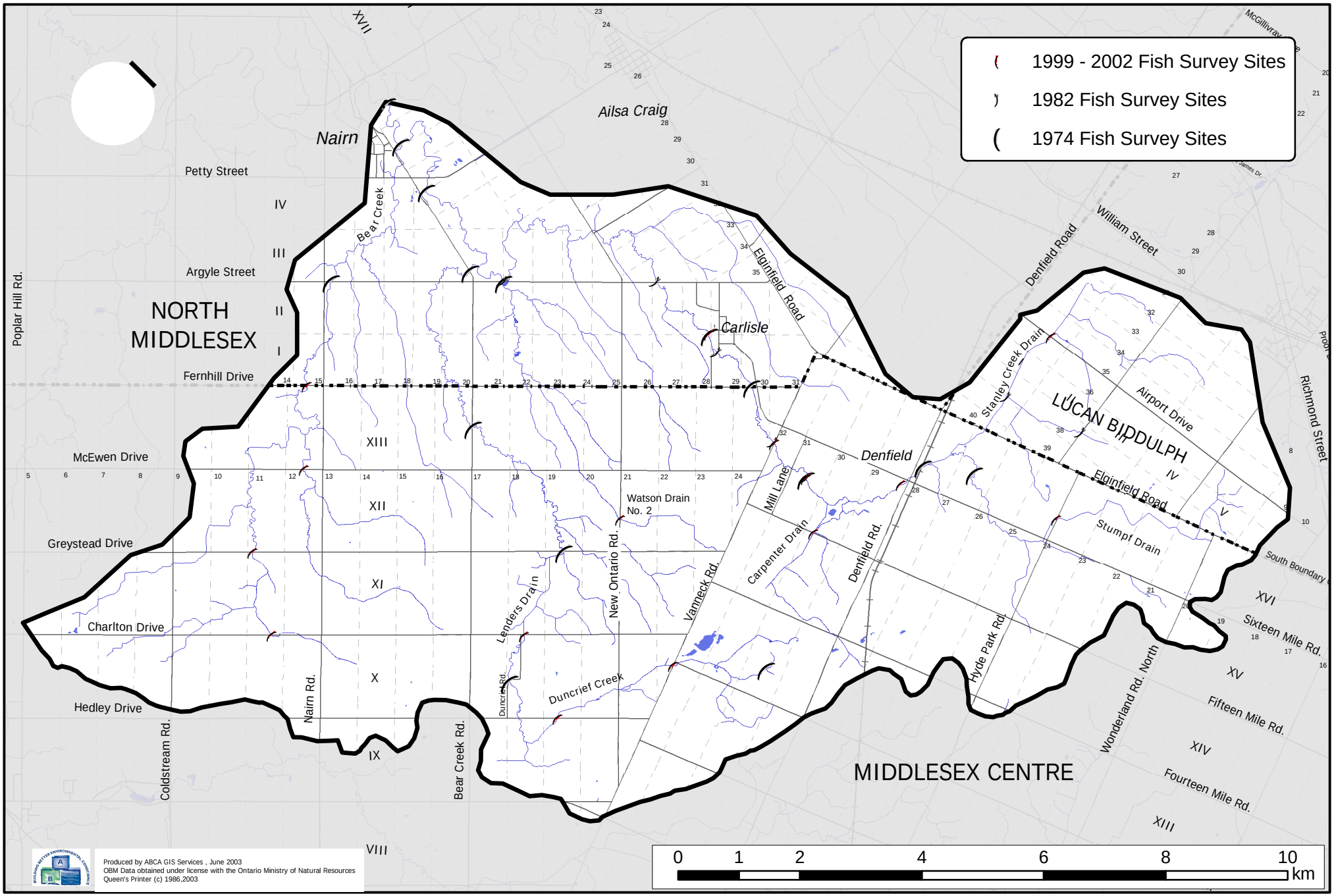

Figure 2 : Location of fish distribution survey sites in 1974 (Ontario Ministry of Natural Resources), 1982 (Ward) and 1999 to 2002 (Ausable Bayfield Conservation Authority and Fisheries and Oceans, Canada).

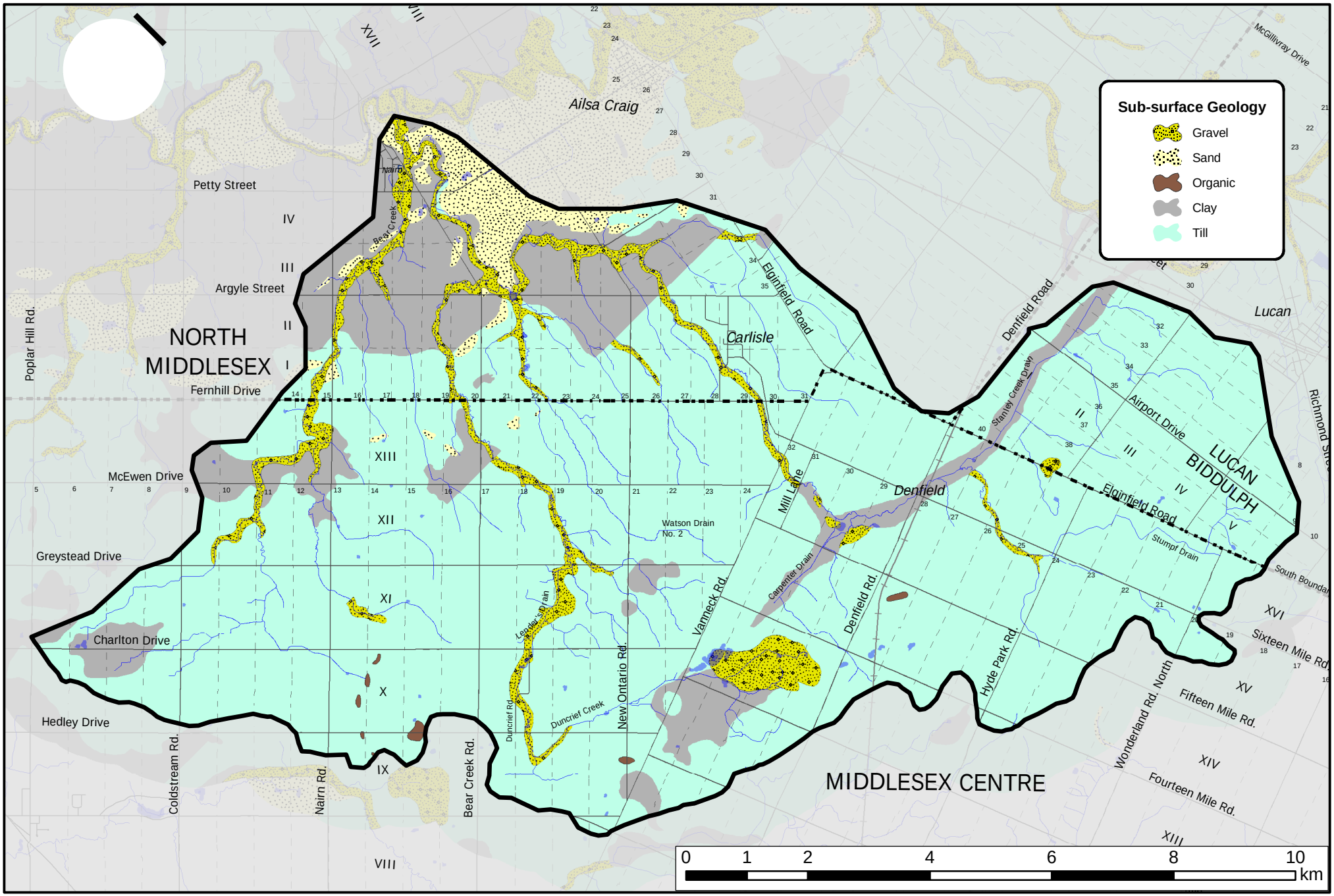

Figure 3: Sub-surface geology in the Nairn Creek sub-basin (Ontario Ministry of Mines and Development 1: 50 000 quaternary geology).

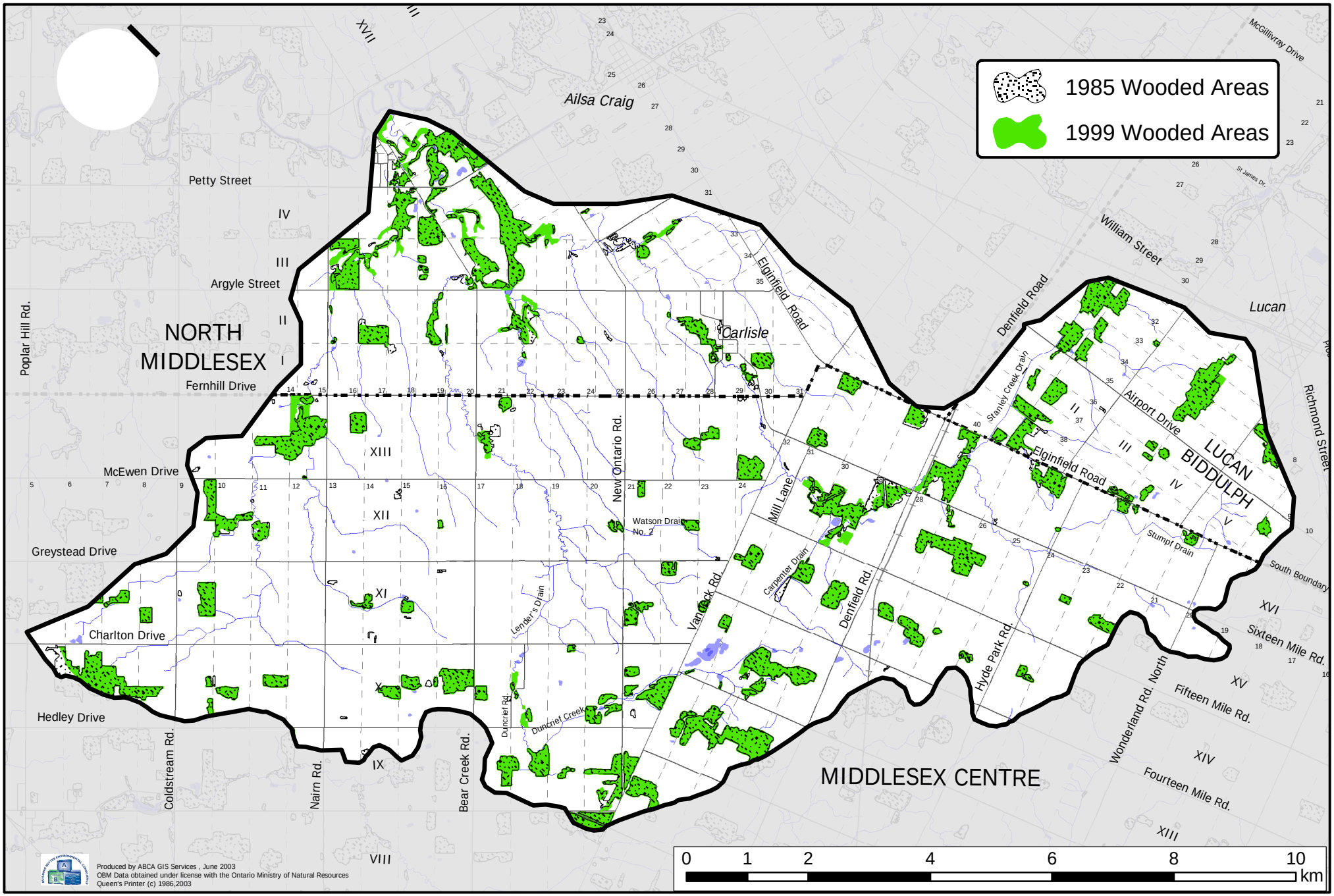

Figure 4: Forest cover in the Nairn Creek sub-basin in 1984 (Ontario Ministry of Natural Resources) and 1999 (1: 15 000 aerial photographs Ausable Bayfield Conservation Authority).

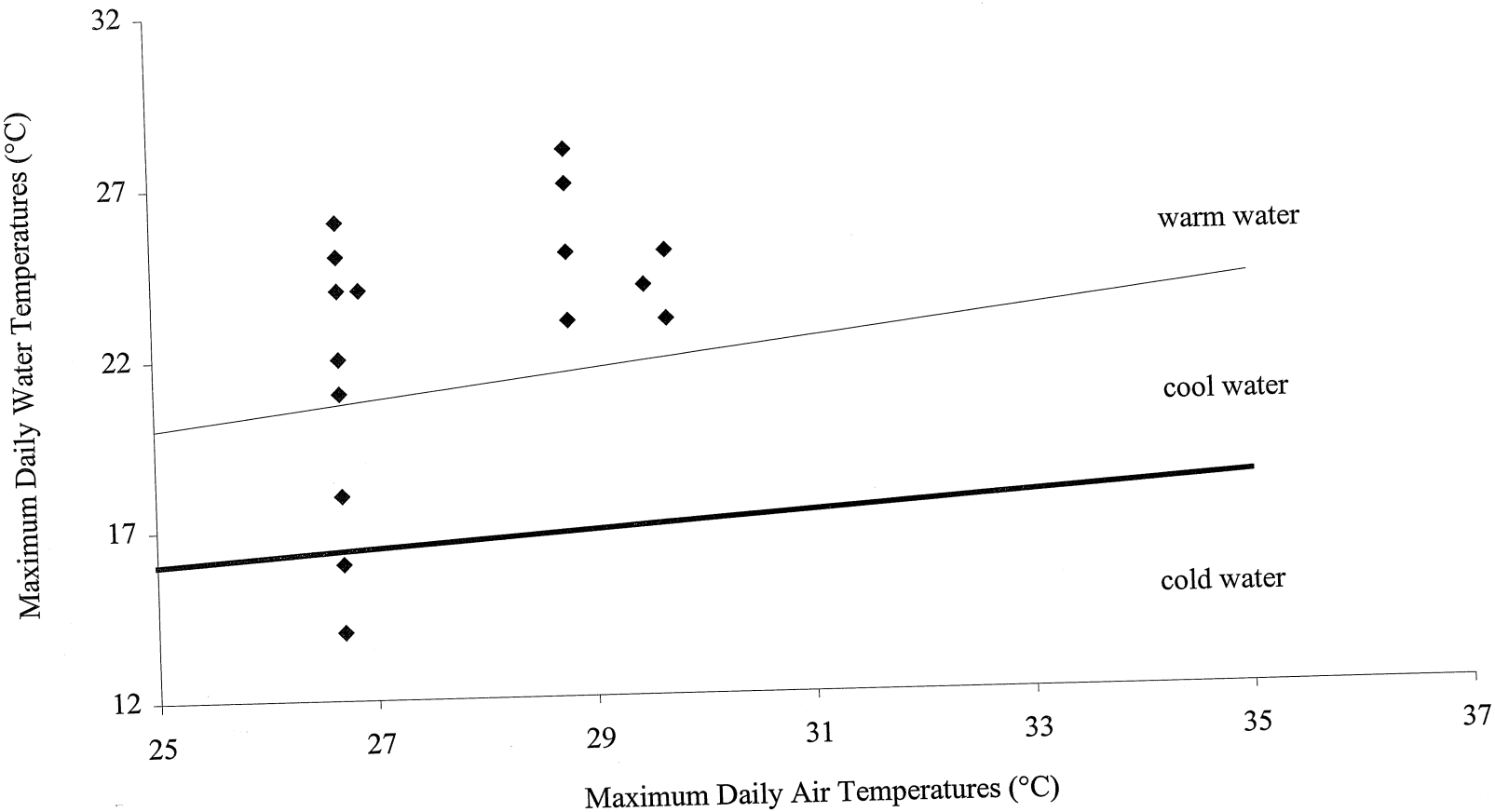

Figure 5: Maximum daily air and water temperatures at 16 road/watercourse intersections across the Nairn Creek sub-basin. Sites below the top line are considered cool/coldwater. Data points appear aligned because water temperatures were collected on five days when maximum air temperature exceeded 25°C. Temperatures were collected in 2000 (Ausable Bayfield Conservation Authority).

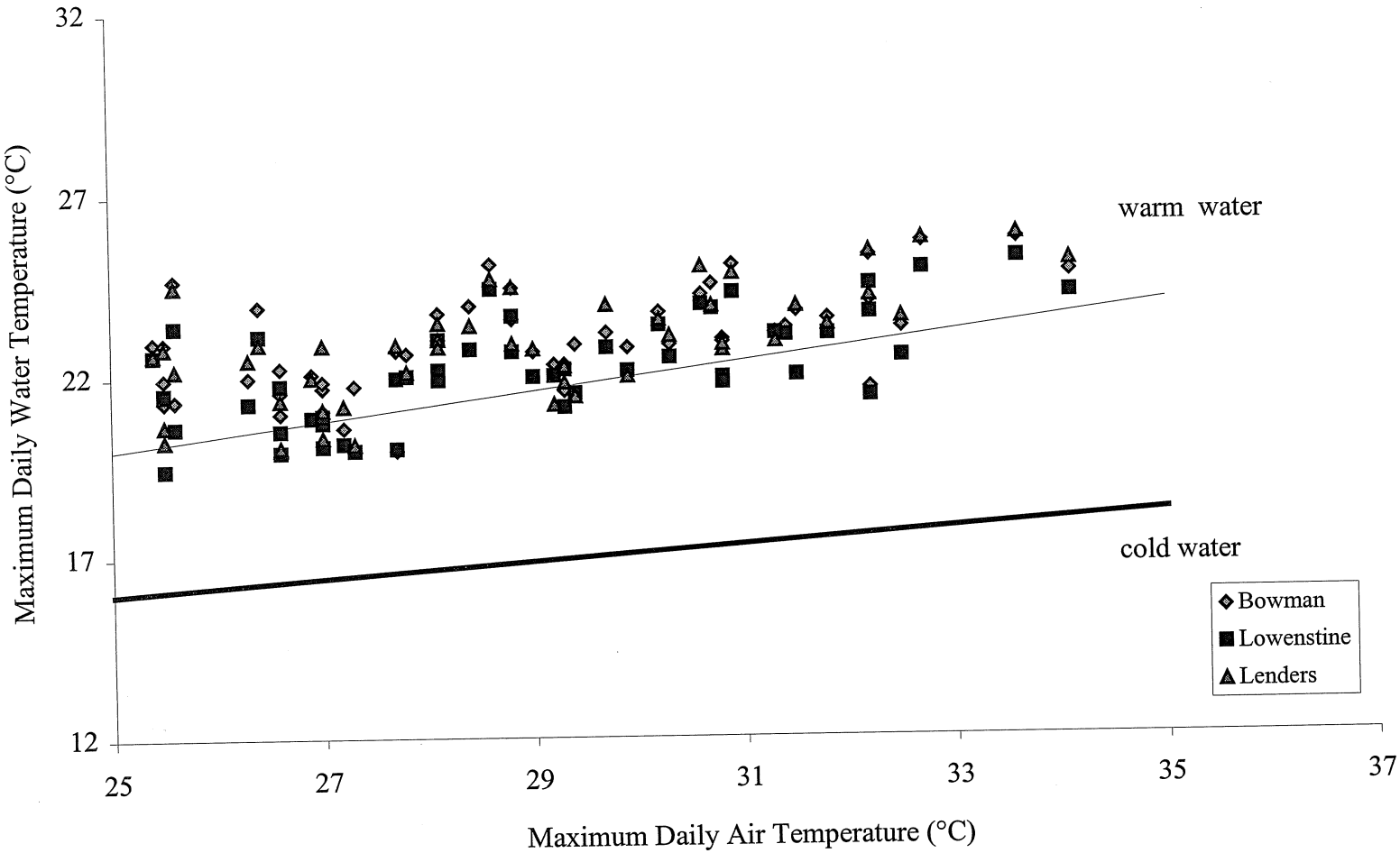

Figure 6: Maximum daily air (> 25 °C) and water temperatures at three sites in the Nairn Creek sub-basin (Bowman, Lowenstine and Lenders). Temperatures were collected from June 25 to August 28, 2002.

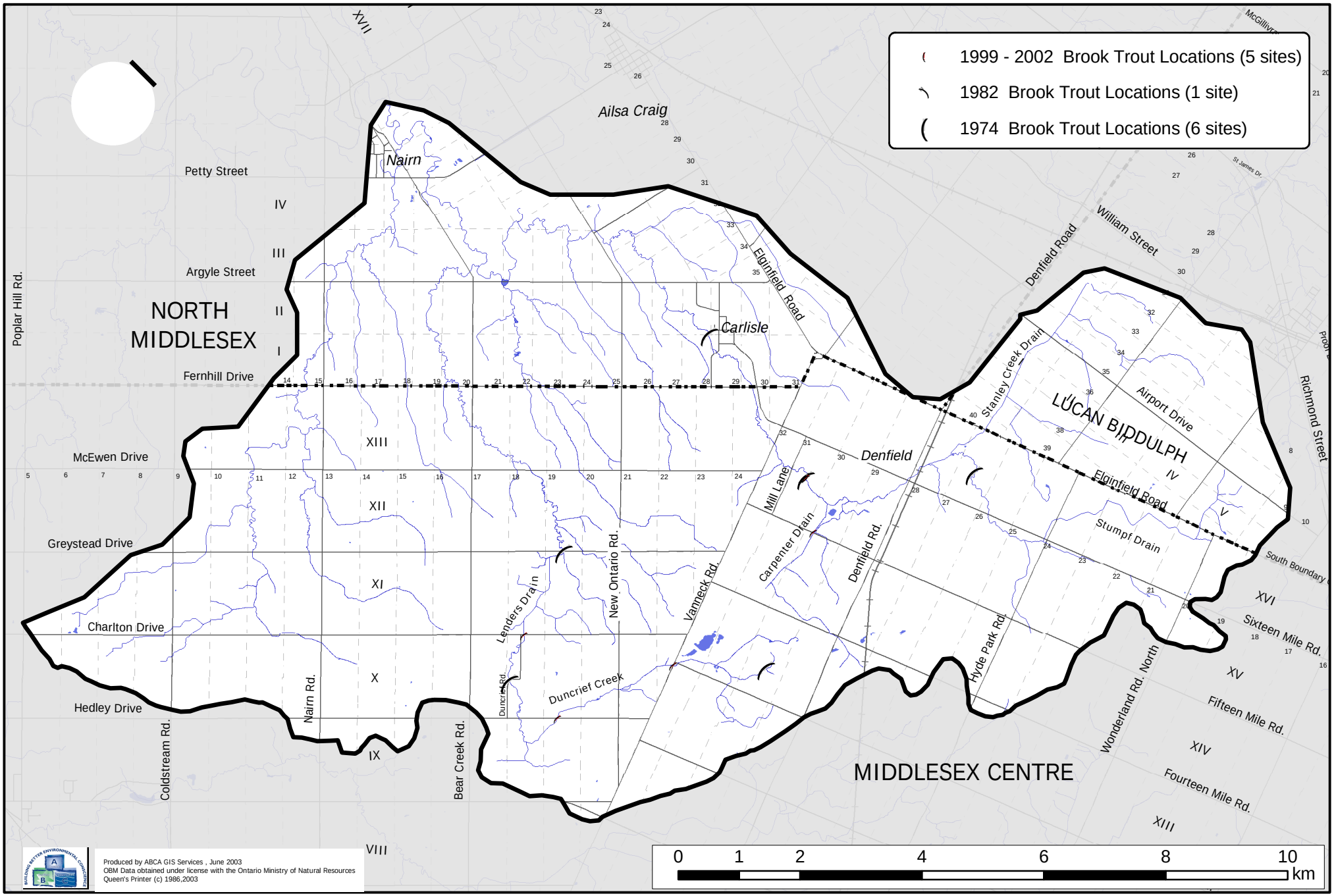

Figure 7: Location of brook trout in distribution surveys conducted in 1974 (Ontario Ministry of Natural Resources), 1982 (Ward) and 1999 to 2002 (Ausable Bayfield Conservation Authority and Fisheries and Oceans Canada).

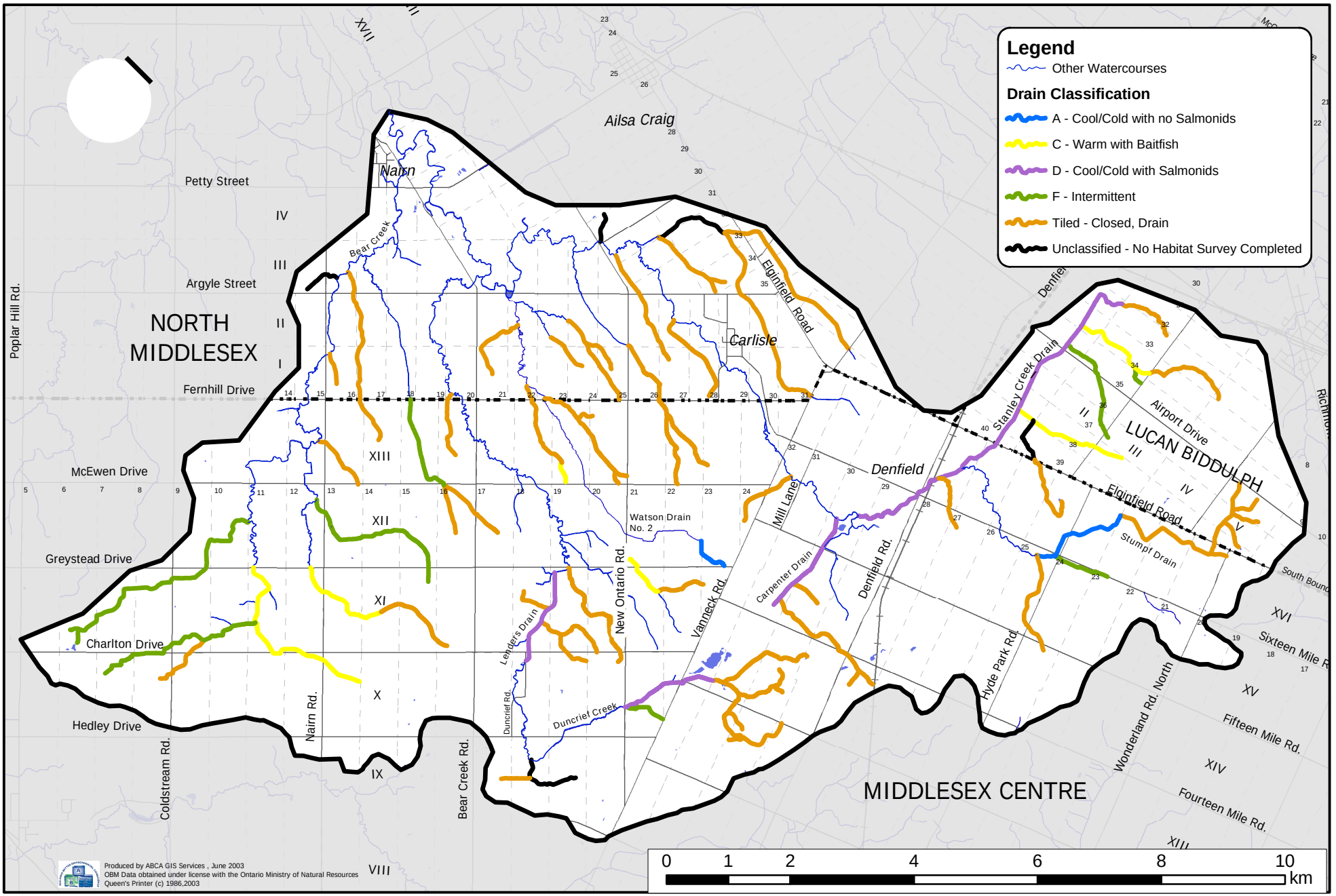

Figure 8 : Drain classification for watercourses in the Nairn Creek sub-basin (Ausable Bayfield Conservation Authority and Fisheries and Oceans, Canada 2002). Drain classification is based on fish distribution and habitat characteristics that are subject to change.

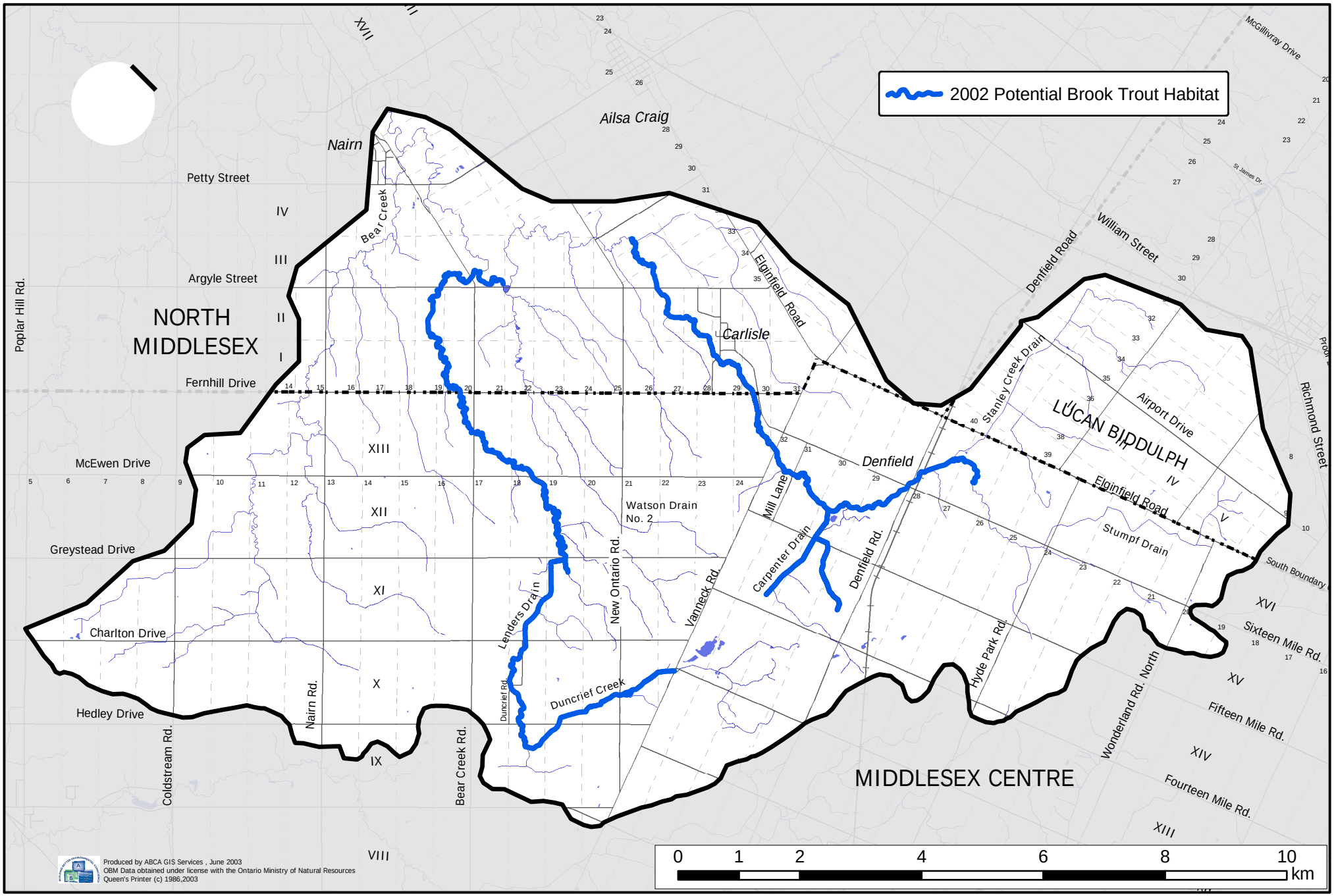

Figure 9 : Potential range of multi-year brook trout populations in the Nairn Creek sub-basin.

Appendices

Appendix A: Fish habitat survey sheet

CA/DFO Habitat Assessment

Siteno _____ Initials _____ Photo# _____ Date _____ Time _____

Name/Location _____

Flow Present ☐ Quantity _____ Turbidity Clear ☐

Absent ☐ Quality _____ Turbid ☐

Channel Natural ☐ Width _____ Opaque ☐

Ditched ☐ Depth _____ Erosion None ☐

Tiled ☐ Bridge ☐ or Culvert ☐ Little ☐

Pool % _____ Riffle% _____ Run% _____ Some ☐

Substrate Boulder _____ % Silt _____ % CPOM _____ % Lots ☐

Cobble _____ % Clay _____ % FPOM _____ %

Gravel _____ % Bedrock _____ % Debris _____ %

Sand _____ % 100%

Aquatic Vegetation Amount _____ % of channel

Emergent _____

Submgent _____

Algae _____

Riparian Vegetation Width _____ Shade _____ % of Channel

Trees _____ % Shrubs _____ % Herbs _____ %

Cover Amount _____ % of channel Type _____

Fish Present ☐ Description _____

Absent ☐ _____

Landuse _____

Temperature Air _____ Mean temp for Day _____

Water Minimum _____ Maximum _____

Comments (Barriers, Pollution, etc.) _____

_____

_____

Landowner ☐

Appendix B: Letter to rate payers in the Nairn Creek sub-basin

July 15, 2002
File: W.7.16.1

John Smith
6 Smith Drive, RR 1
Ailsa Craig, ON
N0M 1A0

Dear John Smith:

Re: Nairn Creek Fish Study

In 2001, a fish habitat management plan was completed for the Ausable and Bayfield rivers. At that time, we noted that Nairn Creek supported a fish species that has very stringent water quality requirements such as constant water flow, cold temperatures, high dissolved oxygen and low suspended solid concentrations. The presence of the native brook trout (*Salvelinus fontinalis*) in the Nairn Creek sub-basin reflects excellent water quality which is in part, the result of good land stewardship practices employed by landowners in the Nairn Creek watershed.

As a landowner in the Nairn Creek sub-basin (please find a map on the back of this letter), you are being contacted for two reasons. Primarily, we wish to let you know that we will be conducting further investigation of temperature and stream bottom characteristics in some reaches of Nairn Creek. Secondly, we wish to take the opportunity to inform you that certain land use practices such as stream-side tree cover and the protection of wetlands may improve habitat for brook trout. Some landowners within the Nairn Creek sub-basin are currently receiving financial assistance to employ best management practices and improve water quality. Improved water quality benefits not only the landowner but may also help to enhance conditions for the rare and ecologically valuable brook trout.

We are planning a Public Meeting on August 20 at 7:30 to provide additional information regarding the study and current incentive programs. The meeting will be at the Ailsa Craig Community Centre. In the meantime, we encourage you to contact me for more information about the fish habitat study, or Kate Monk, the Stewardship Co-ordinator, for more information regarding financial incentives for the implementation of various projects. Thank you for taking the time to read this letter.

Yours truly,

AUSABLE BAYFIELD CONSERVATION AUTHORITY

Mari Veliz, Biologist

Appendix C: Substrate characteristics

Table C1: Substrate size according to the Wentworth Scale (after Allan 1995) and substrate size found at the Bowman Farm (August 1, 2002).

Size Category	Particle Diameter (range in mm)	Particle Diameter at the Bowman Farm (mm)
Boulder	>256	**site 1:** 420
Cobble	64-256	**site 1:** 210, 70 **site 2:** 170, 230, 210 **site 3:** 120, 80, 70 **site 4:** 130 ,80, 70
Pebble	16-64	
Gravel	37302	
Sand	0.063-2	
Silt	<0.063	

Appendix D: Fish species list for the Nairn Creek sub-basin

Appendix D: Fish species collected from 14 sites in the Nairn Creek sub-basin in 1999.

	Nairn Creek			Tributaries			Duncrief Creek				Bear Creek				Site
Fish Species	Site 24	Site 109	Site 114	Site 112	Site 110	Site 118	Site 117	Site 125	Site 135	Site 113	Site 124	Site 122	Site 119	Site 5	Occurrence
Bowfin															
Gizzard Shad															
Pink Salmon															
Coho Salmon															
Chinook Salmon															
Rainbow Trout			X					X	X						3
Brook Trout				X				X	X	X					4
Central Mudminnow		X		X				X	X	X				X	6
Grass Pickerel															
Northern Pike															
Muskellunge															
Central Stone Roller			X											X	2
Northern Redbelly Dace		X			X								X		3
Common Carp											X				1
Brassy Minnow		X					X								2
Hornyhead Chub			X					X							2
River Chub															
Golden Shiner															
Pugnose Shiner*															
Common Shiner			X					X				X	X	X	5
Ghost Shiner															
Striped Shiner														X	1
Blackchin Shiner															
Blacknose Shiner															
Rosyface Shiner			X												1
Spottail Shiner															
Spotfin Shiner															
Sand Shiner															
Redfin Shiner															
Mimic Shiner															
Blacknose Dace	X	X	X	X	X	X	X	X	X	X				X	11
Bluntnose Minnow		X	X			X				X		X	X	X	7
Fathead Minnow	X				X	X	X					X	X		6
Longnose Dace															
Creek Chub	X	X	X		X	X	X	X	X	X	X	X	X	X	13
Quillback															
White Sucker		X	X		X			X	X	X		X	X	X	9
Lake Chubsucker*															
Northern Hog Sucker			X											X	2
River Redhorse*															
Golden Redhorse															
Shorthead Redhorse															
Greater Redhorse															
Black Bullhead										X					1
Brown Bullhead															
Channel Catfish															
Stonecat														X	1
Tadpole Madtom															
Banded Killifish															
Brook Stickleback	X	X	X	X	X	X	X	X		X	X		X		11
Trout-perch															
Rock Bass														X	1
Green Sunfish															
Pumpkinseed														X	1
Bluegill															
Longear Sunfish															
Smallmouth Bass															
Black Crappie															
Yellow Perch															
Pickerel/Walleye															
Greenside Darter*														X	1
Rainbow Darter															
Iowa Darter															
Fantail Darter			X											X	2
Least Darter															
Johnny Darter		X	X						X	X			X	X	6
Logperch															
Blackside Darter													X	X	2
Mottled Sculpin		X						X	X	X					4
Total Species per Site	4	10	13	4	6	5	5	10	8	10	3	5	9	16	

Appendix E: Fish data from the Bowman Farm in Ward (1983) and 2002.

Table E.1: Population estimate of brook trout in Ward (1983) and the current study.

Station	E/N	Year	Catch Totals (per run)	Population Estimate	Estimated Biomass (g)	Standing Crop (kg/h)
M5		1982	6-5-2	17	98.7	5.2
Bowman	463665.89/ 4774194.63	2002	2-1-0-0	3	155.5	5.9

Table E.2: Weight (g) of sampled brook trout in Ward (1983) and the current study.

Station	Year	Number Sampled	Weight (g)
M5	1982	13	3
			3
			4
			5
			5
			5
			6
			6
			6
			7
			8
			8
			9
Bowman	2002	3	74
			47
			32

Appendix F: Notes from the public meeting (August 20, 2002)

Nairn Creek Subwatershed Study
Public Meeting
Ailsa Craig Community Centre
August 20, 2002

Facilitator Tom Prout, asked those attending for comments or questions based on the presentations by Mari Veliz, Biologist and Kate Monk, Stewardship and Conservation Lands Coordinator.

Comments and questions during open discussion:

- key message is that water supports all life
- children should have a right to touch the water in their own backyards and we have lost that privilege
- we should be looking at leaving a legacy that will bring this opportunity back
- will discharge from sewage treatment plants raise the temperature of the water
- more and more communities are going away from lagoons to a tertiary system of continuous discharge which in turn, is providing a substantial amount of flow in the rivers
- what is causing the Ausable River to be green now, as it wasn't in the past
- this is a typical response to being inundated with nutrients, living plant material and sunlight
- shading of the creek will help keep a flow
- frogs and crayfish are available in some spots - what is unique about these spots
- species can be reintroduced if their habitat is maintained
- more diverse substrate
- more stewardship projects with buffer strips, trees, etc.
- water travels through the ground, not just in the watercourse so we need to protect it all
- what is the time frame needed to fix the problems,
- what is contributing to the lack of snow and rain over the last few years
- we can't give up hope - but it is a life style change that is needed and the response is to do best stewardship practices
- we can make a positive impact because the Nairn Creek subwatershed already has good stewards
- ABCA provides resource staff to work with local landowners who want to help themselves

Notes taken by:
Judith Parker
Ausable Bayfield CA
Corporate Services Coordinator