Chapter 2

WATER QUALITY

Water Quality in the Ausable Bayfield Maitland Valley
Planning Region,
Including the Nearshore of Lake Huron

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2 Water Quality

Water has many uses in the Ausable Bayfield Maitland Valley Planning Region (refer to WC Map 1-1) and the quality of this water is critical to the local economy. Groundwater is the drinking water source for 100,000 people, more than 837,000 livestock and more than 5,200,000 poultry. Lake Huron provides drinking water to approximately 30,000 people within the area and is exported to about 500,000 others including the City of London. In addition, Lake Huron is the major tourism attraction in the area and is valued for its prime recreational opportunities. Area rivers provide water for irrigation and support an active angling community. While the focus of this chapter is water quality as it pertains to drinking water sources, the impacts and effects on the whole system will be discussed to provide a holistic context.

In order to protect current and future uses of water for drinking water, recreation, agriculture, and the needs of the aquatic ecosystem, water should not contain contaminants which limit its use. Water quality guidelines have been developed for consumption, recreation, and for aquatic protection. Again, to provide a holistic context, where more then one guideline exists based on different uses, the most stringent or lowest value should be used to assess water quality.

The purpose of Chapter 2 is to generally document the quality of water in the Ausable Bayfield Maitland Valley Planning Region. This report can be considered a broad environmental scan of water quality conditions at select sampling sites as opposed to a detailed analysis of all water quality parameters, sources and solutions (Site specific details are provided in Appendix A). Water quality data is summarized in order to outline current water quality conditions and spatial trends. Where data makes it possible, historic trends are documented to be used in predicting future conditions and to assist in identifying potential contaminant sources. This document will be used as a guide for areas of further study and future directions.

Knowledge and data gaps will be documented which are required to better understand water quality and its sources and finally, next steps for filling these gaps will be identified.

Three major water systems will be discussed and include:

- Surface water quality of rivers and streams: Summarized by major basin which will allow the comparison of water quality conditions to the basin characteristics in Chapter 1 in order to begin the process of understanding pathways and relationships to land use and management
- Lake Huron water quality in the nearshore: The two intakes adjacent to the study are compared. As intake protection zones are to be identified in later chapters, the focus will be on water quality results.
- Groundwater quality of the major aquifers: outlined by source aquifer for each municipal system. Again this approach will help focus best management practice efforts

2.0 Background

The purpose of this section is to outline some of the general concepts of landscape scale relationships to water movement and, therefore, its quality. These concepts will be used in discussing the actual water quality results in the document, but is easier to define them here in one place instead of repeating concepts in the discussion. These are general concepts and are not meant to take precedence over the actual water quality discussion.

Water quality issues in rural-agricultural watersheds tend to result from non-point source pollution. The quality of water in these watersheds is a function of the pathway of water through the hydrologic system, the materials it comes in contact with, and the duration between the time when water comes into contact with a contaminant until its chosen use. Generally, the longer the pathway in both real physical terms or in terms of time or duration, the more chance that contaminants can be bound, filtered, diluted, or chemically or biologically stabilized.

Chapter 1 outlined the physical characteristics of the watersheds that define water movement; landform determines hydrologic function.

For water quality and quantity, four main components are used to characterize a basin:

- geology and landform
- land use and land management
- sensitive areas
- drainage modifications

Geology and Landform

The pathway that water follows in a basin is dictated by the permeability of the soil, slope of the land, geology below the soil zone, and elevation differences or varied elevation features. One specific landform in the study area that greatly modifies water movement is hummocky terrain. This landform is defined as depressional areas which have no outlet for surface water. Therefore, water is forced to infiltrate into the groundwater system and/or evaporate.

Basins can be categorized into either surface water or groundwater systems. Surface water systems are those in which the main pathway for water is runoff or overland flow from precipitation to streams and rivers. This is usually due to steep topography, less permeable soils (clay), and less permeable geology (till). In a surface water system, water is generally not infiltrated and as a result, there is a greater likelihood that contaminates will be carried and delivered to streams and rivers resulting in poorer water quality. Water quality problems can be compounded by lack of water quantity, since very little water from precipitation is stored on the landscape or in the ground. Surface water systems have warmer stream temperatures, as there is no opportunity to cool water as it moves through the ground, which further stresses the aquatic environment.

Groundwater systems generally have a pathway of water which includes infiltration into the ground. These types of basins include mostly permeable geology such as sands and gravels and, in this region, are typified by highly variable topography and steep slopes, a result of the glacial provenance of sand and gravel deposits. The high permeability materials allow water to be infiltrated, and the high relief provides a gradient for water to reappear as springs at the ground surface. As a result of this infiltration and storage of water in shallow aquifers, water quality is typically better, flows in streams are more stable, and stream temperatures are cooler in summer and warmer in winter.

Land Use and Land Management

Both water quality and quantity can be further influenced by activities occurring on the land. The major factors are the degree of vegetative cover and the presence of nutrients in the soil. The more exposed the soil, the more likely that sediment and other soil-related contaminants can be carried to streams. As such, a row cropped field is more likely to be significantly eroded by runoff then a grain or hay field. Over time, land management that changes the soil properties (i.e. compaction from farm implements) may cause it to behave more like a surface water system.

The other major factor is the presence of contaminants. The major contaminants in the area are nutrients, specifically nitrogen and phosphorus. The more nutrients that are applied or produced, the greater the likelihood they will be transported to a stream or into the groundwater, and the higher the concentrations of those nutrients will be to the receiving body.

Other major potential contaminants are pathogens from manure, improperly composted manure, and other sources. Livestock and poultry manure may contain a variety of bacteria, viruses and protozoa that are pathogenic to humans including *E. coli*, Salmonella spp., Streptococcus spp., Giardia and Cryptosporidium (Martin 2005). Good agricultural practices reduce the risk of pathogen contamination in water.

Sensitive Areas

For surface water quality, certain landscape features such as highly erodable soil, steep slopes, presence of saturated soil such as springs or high water tables, and riparian areas, are more likely to contribute sediment and nutrients to watercourses. These areas are often marginal for agricultural production and can have a disproportionably high contribution to poor water quality.

Drainage Modifications

A final major factor relates to the distance that precipitation has to travel before reaching a stream, drain, or tile. The shorter the distance, the greater the risk to water quality since there is less of an opportunity for settling or treatment of contaminants (OMAF – BMP Water Quality). Water quantity can be affected as well, as water is removed from the landscape quickly and is less likely to be infiltrated. This can reduce the available water to streams from shallow aquifers during dry periods. The greater the drainage density, the more a basin will exhibit the behaviour of surface water systems. At least seventy-five percent of the agricultural land in the till plain areas of the Ausable Bayfield Maitland Valley Planning Region has been tile drained, greatly modifying the natural drainage network (Dean and Foran 1989). Figure 2-1 is a spring aerial photograph clearly showing the quantity of tiles in agricultural fields.

Figure 2-1: Example of tile drainage density in northern Perth County.

2.0.1 Indicators

Water quality issues can be determined through appropriate indicator selection. Water quality indicators are defined as certain chemicals or organisms that can be used to monitor environmental conditions because they can:

- Represent a contamination source with their presence or lack thereof
- Assist in determining the pathway of water has taken
- Provide information which follows a guideline for determining the impacts on humans or the ecosystem
- May be related to the behaviour of chemicals or pathogens of interest, but they are easier to collect in the field or analyze in the laboratory.

At present the Provincial Water Quality Monitoring Network (PWQMN – see section 2.2.1.1 Data Collection Programs) currently has 44 indicators with the Provincial Groundwater Monitoring Network (PGMN) having between 50 and 100 indicators. For the purposes of this report, it is necessary to select a few key indicators to discuss water quality in order to develop a general understanding of major issues and pathways. The indicators selected are those that have been identified through previous investigations or by Conservation Authority staff as being issues within the partnership area for water resources.

Indicators of nutrient enrichment and erosion are most common for river monitoring in this area, including nitrate, total phosphorus and suspended sediment. Water quality of Lake Huron is a major issue, therefore, the use of fecal coliform (*E.coli*) as an indicators for the presence of harmful bacteria to humans is warranted. Most common issues for groundwater are nitrate, *E.coli* and chloride along with naturally occurring elements such as iron, fluoride, carbonates, and sodium. The new indicator for this area, copper, will be added as a measure of human impacts on water quality.

Six indicators (nitrate, total phosphorous, suspended sediment, chloride, copper, and *E. coli*), were examined in detail for this report. However, a scan of all water quality indicators for rivers that have been sampled and have a standard for comparison will be completed.

Chloride

Chloride is a water soluble and conservative element that is not typically present in natural groundwater or surface water systems in large concentrations. Approximately 0.05% of the lithosphere consists of chloride, with the greatest amount found in oceans. In freshwater systems, concentrations of chloride vary according to climate. Concentrations are typically lower (<10 mg L^{-1}) in humid areas compared to more arid regions (100 mg L^{-1}) (CCME 1999). Therefore, it is a good indicator of the impact from human activities on water quality. The largest single potential source of chloride is from the use of road salt for winter ice control, but is also derived from sewage treatment effluent, septage, animal waste and potassium chloride (potash in fertilizer).

Chloride is not considered a health hazard in the concentrations found in groundwater in Ontario; however, it imparts an undesirable taste above 250 mg L^{-1}, which has been designated as an aesthetic water quality objective for under the Ontario Drinking Water Standard. The benchmark identified in Environment Canada’s Priority Assessment Report, 2001 is 250 mg L^{-1} for aquatic protection. The British Columbia government has developed a standard of 150 mg L^{-1} for the protection of aquatic species.

A potential pathway for chloride in groundwater, particularly in deeper, confined aquifers, is through cross contamination from deeper formational waters via inadequately decommissioned brine wells. Chloride concentrations are useful for determining the source of elevated concentrations, as water contaminated from salt (NaCl) should have elevated and near equal concentrations of both sodium and chloride. Sampling and analysis of chloride should always include an analysis of sodium concentrations, as elevated concentrations of chloride in groundwater, if derived from salt, may indicate coupled elevated concentrations of sodium.

Copper

Copper is a persistent element that is not typically present in natural surface water systems and therefore is a good indicator for heavy metals from human activities. The largest potential source is from sewage treatment effluent. There is an interim PWQO for copper of 1 ug L^{-1} if hardness as $CaCO_3$ is 0-20 mg L^{-1}, or 5ug L^{-1} if hardness as $CaCO_3$ greater then 20 mg L^{-1}. All historic river and stream sampling results in the area have been above 20 mg L^{-1} of $CaCO_3$ and therefore the 5ug L^{-1} guideline applies.

Nitrate

Nitrate is the most common form of nitrogen in the environment in aerobic conditions (i.e. when oxygen is present). Nitrate is the primary source of nitrogen for aquatic plants. All forms of inorganic nitrogen (nitrite and ammonia) have the potential to undergo nitrification to nitrate. In well-oxygenated systems, increasing concentrations of inorganic nitrogen increase the risk of algae blooms and eutrophication. Eutrophication is the process of reduced oxygen levels in an aquatic environment brought about due to excessive plant growth and die-off as a result of elevated nutrients (predominantly phosphorus, but also nitrogen).

There are two water quality guidelines for nitrate, both expressed as mg L^{-1} nitrogen from nitrate. The first guideline is an Ontario Drinking Water Standard (ODWS) and is set at 10 mg L^{-1} of nitrate as N. Above this level, nitrogen can preferentially bind to haemoglobin in the blood of mammals reducing the quantity of oxygen in the blood. Young children are especially susceptible to this condition, but the same effect can occur in young calves as well. The second established by the Canadian Council of Ministers of the Environment (CCME), for the protection of aquatic ecosystems is at 2.93 mg L^{-1} of nitrate as N. Above this level, nitrate can be toxic to fish and amphibian eggs.

In rural areas, potential sources of nitrogen are agricultural and lawn fertilizer, manure, septic systems, sewage treatment effluent and atmospheric deposition. Nitrate is soluble in water and therefore can easily be transported in water in overland runoff or into streams via diverted infiltrating water from tile drainage or aquifers. The fate of nitrogen in natural systems is complex, as it is utilized by all plants and is subject to many biological processes that can bind and transform nitrogen.

Nitrogen sources applied or injected into the shallow aquifers are quickly converted to the relatively inert mineral nitrate form, which is highly soluble in water and extremely persistent in the anaerobic conditions of the saturated groundwater zone. As a result of this, they are considered one of the more conclusive indicators of contamination from surface water in aquifers worldwide.

For the purposes of this study, the presence of any significant concentrations of nitrate in an aquifer can be considered an indicator of a connection with surface water, although the degree of this connection is not necessarily proportional to the concentration of nitrates.

Phosphorus

Phosphorus is often the limiting nutrient in many aquatic ecosystems for primary production (plant growth). Nutrients must be available to plants in certain proportions to be utilized; the nutrient that has the least amount available is considered the limiting nutrient.

For the report, total phosphorus (TP) will be used and includes dissolved phosphorus and forms bound to organic and inorganic material in water. An interim Provincial Water Quality Objective (PWQO) of 0.03 mg L^{-1} of total phosphorus has been established to avoid nuisance algae in streams and rivers. An objective of 0.02 mg L^{-1} is used for lakes during the ice free period to avoid nuisance algae.

The PWQO for phosphorus was not established to delimit toxicity, but rather to identify the indirect impacts of excessive phosphorus on aquatic ecosystems through oxygen imbalances. Since phosphorus is oxygen limiting, any excess in water will result in increased primary production (plants), which is usually algae (Figure 2-2). Like all plants, algae photosynthesize in the daylight which releases oxygen, and respire at night which consumes oxygen. If there is excessive algae, oxygen concentrations in the early morning can approach zero, resulting in fish kills. A second impact may occur when algae decays. Decaying algae is biologically consumed which requires oxygen, once again limiting the oxygen concentration of the water.

Phosphorus ions form ionic bonds with clay through a process called adsorption. Phosphorus therefore often moves attached to soil particles. For this reason, excess phosphorus is very closely associated with rainfall and runoff and is generally found in those areas that have higher clay content soils. Potential sources of phosphorus are from agricultural and lawn fertilizer, manure, septic systems, sewage treatment effluent and milkhouse washwater.

Phosphorus is not considered an important indicator for discussion with respect to groundwater as it typically is adsorbed to soil particles, and does not persist in infiltrating water.

Figure 2-2: Algal bloom due to excess nutrients

Suspended sediment

Suspended sediment is an indicator for the amount of soil erosion that has occurred from runoff, streambank erosion and channel processes. In addition, since some indicators (e.g. phosphorus and aluminium) are bound to soil particles, understanding sediment movement makes it possible to interpret these water quality contaminants. Higher suspended sediment concentrations often result from soils with higher clay or silt contents. Sediment can also directly impact aquatic organisms by removing benthic habitat and fish spawning habitat as interstitial spaces between cobble and gravel substrate are filled. Concentrations of carbon, nitrogen, and phosphorous on the surface or suspended sediments may be 10-100 times more concentrated than on the water column.

In Canada, many agencies recommend that suspended matter should not be added to surface water in concentrations which will change the background level by more than 10 percent. In Ontario, 30 mg L^{-1} is the minimum standard for suspended material permitted in effluent discharged to surface water. The European Inland Fisheries Advisory Committee (EIFAC 1965 In Kerr 1995) reported that there was no evidence that TSS (total suspended sediment) concentrations less than 25 mg L^{-1} have any harmful effects on fisheries. Good fisheries could be maintained in waters that contain TSS at 25 to 80 mg L^{-1}. Waters normally having suspended solids at 80 to 400 mg L^{-1} are considered unlikely to support good fisheries. Only poor fisheries are likely to be found in waters with TSS above 400 mg L^{-1}. For analysis in this report, 25 mg L^{-1} was be used as a standard for aquatic protection based on EIFAC findings.

Microbes

Two indicators for fecal contamination of water include fecal coliform and *Escherichia coli* (*E.coli*). Fecal coliform are a group of bacteria that inhabit the intestines of warm blooded animals and the presence of these bacteria in surface water indicate a potential for harmful bacteria and pathogens to humans. *E.coli* is a member of the fecal coliform group and is the current indicator bacterium.

The applicability of *E.coli* as an indicator bacterium for aquifers is somewhat more tenuous. In the anaerobic conditions of the saturated groundwater zone *E.coli* is not likely to persist for long periods. Enterococci can survive in the absence of oxygen and this bacterium, along with coliphage, are superior indicators of fecal pollution in groundwater because their survival is consistent with both bacterial and viral pathogens. In higher nutrient conditions of surface waters, however, *E.coli* can thrive and it is found in almost all surface water. The presence of *E.coli* in a well would therefore represent a direct connection between an aquifer and a surface water body. What is more likely and more commonly found, is that the presence of E.coli in a given sample is a reflection of the quality of the construction of the well, rather than aquifer conditions.

The Ontario Drinking Water Standard (ODWS) for *E.coli* is set at 0 cfu/100ml and the recreational PWQO is a geometric mean of 100 cfu/100ml of samples taken over a month. As groundwater is primarily a source of drinking water and has no obvious recreational use, the standard for discussion of the results in this report shall be 0 cfu/100ml.

Hardness

Hardness is a naturally occurring characteristic of groundwater and is a calculated quantification of the overall mineral content in water corrected to and expressed as mg L^{-1} $CaCO_3$. Hardness is useful for discussion as it is a relative indicator of the security of an aquifer. Surface water is generally not hard and if an aquifer that is typically hard is displaying a lack of hardness, this may be an indication of interaction with surface water. It should be noted that not all aquifers, as a consequence of differing source material chemistry, produce hard water, such that it is not possible to consider the security of different aquifers based solely on hardness.

Hardness is also considered a nuisance in domestic drinking water, as it leaves a residue on cooking utensils and piping. As such, an ODWS for Hardness of 100 mg L^{-1} has been established as an operational guideline for drinking systems. There is no known health problem associated with hardness.

Fluoride

Fluoride is a common, naturally occurring constituent of groundwater throughout the Ausable Bayfield Maitland Valley Planning Region, most particularly in bedrock aquifers. The level of fluoride in a particular sample is representative of the chemistry of the rocks from which it has been extracted. Fluoride continues to be a concern for a number of municipal drinking water supplies and private well owners.

Fluoride has a health related ODWS of 1.5 mg L^{-1}, but is not considered to be an issue of concern if naturally occurring below 2.5 mg L^{-1}. Fluoride in low concentrations ($\leq$ 1.5 mg L^{-1}) is considered a health benefit, and most municipal water systems fluorinate water for distribution to a concentration of ~1.0 mg L^{-1}.

Iron

Iron occurs both naturally in groundwater and as a result of contamination. Although difficult to separate the sources of iron in groundwater, it is worth considering for the purposes of this report. Caution should be used when interpreting iron analytical data, as discrete samples from one aquifer may have highly variable concentrations. Trends in iron concentrations should only be interpreted with a long record of data from a single, controlled sampling location. Elevated iron in a given sample is often a reflection of the quality of the construction of the well, rather than aquifer conditions

An aesthetic water quality objective has been established for iron at 0.3 mg L^{-1} for Ontario. Above these concentrations, iron is considered a nuisance in domestic drinking water, as it leaves an oxidized residue on household fixtures, cooking utensils, and piping.

Sodium

Sodium occurs both naturally in groundwater as well as a result of contamination from human activities, particularly the application of road salt and via cross contamination from deeper formational waters via inadequately decommissioned brine wells. Determination of the source of sodium can only be accomplished by interpreting the concentration of chloride in a sample. Water contaminated from salt (NaCl) should have elevated concentrations of both sodium and chloride.

Sodium has a health related ODWS of 200 mg L^{-1}, but is considered to be an issue of concern for hypertensive people at concentrations above 20 mg L^{-1}. For the purposes of this study, long-term sodium concentrations are important to monitor the potential impacts of road salt application, particularly in more susceptible aquifers.

2.1 Methodology

2.1.1 Surface Water

Two surface water sources in the Ausable Bayfield Maitland Valley Planning Region are rivers or streams, and Lake Huron. At present, surface drinking water supplies are only drawn from Lake Huron. Despite the fact that there is no drinking water taken from river surface water, it is considered important for the purpose of Source Protection Planning to include riverine water quality in this analysis. The major reason for including surface water is that it can directly impact current groundwater and Lake Huron drinking water sources, for example:

- At least one Lake Huron water intake is within the zone of influence from the mouth of the Maitland River (B.M. Ross and Associates Limited 2002).
- The lower portions of the Maitland River (17 km – Figure 2-3) flow across fractured bedrock where at certain times of the year surface water is entering directly into the bedrock groundwater system.
- Portions of the lower Bayfield River stop flowing in the summer as the water seeps into the river bottom to emerge further downstream, indicating a connection to the groundwater system.
- The presence of sinkholes in the area and the tendency for them to be used as an “adequate outlet” for municipal drains also allows surface water to enter the groundwater system directly.

Figure 2-3: Exposed bedrock in the Maitland River at Falls Reserve Conservation Area

River and stream water quality has been monitored in the area since 1964, both for special projects and as part of structured, long-term monitoring programs. The focus over much of this time has been on nutrients, sediment and bacteria, and more recently biological monitoring. WC Map 2-1 identifies the location of all surface water quality monitoring sites sampling, both short and long-term. In total, water quality data has been collected for varying periods of time at 266 distinct sites in the Ausable Bayfield Maitland Valley Planning Region. For the analysis of surface water quality as part of this report, the data has come from three sampling programs: The Provincial Water Quality Monitoring Network (PWQMN), The Ashfield Colborne Lakeshore Association (ACLA) sampling, and the ABCA enhanced water quality network.

2.1.1.1 Data Collection Programs

Provincial Water Quality Monitoring Network

The majority of the surface water quality data for the area has been collected through the Provincial Water Quality Monitoring Network (PWQMN). This network is a partnership between Conservation Authorities and the Ministry of the Environment (MOE) and has been operating in the area since 1964, with a short hiatus in the late 1990s. Sites are sampled from eight to twelve times a year and consist of single grab samples, typically collected in a stainless steel dipper. The parameters analyzed for this program include nutrients, basic water properties, common metals, bacteria (1970-1994) and heavy metals (since 1998). The MOE lab performs the laboratory analysis. The PWQMN sites in the ABCA watershed are also analyzed at a private lab for *Escherichia coliform* (*E.coli*) and suspended sediment in addition to the network parameters. The PWQMN is a Provincial network aimed at general trends, and as a result not all watercourses are monitored, with sites for the PWQMN are typically located on larger rivers and their main branches.

Ashfield-Colborne Lakefront Association

A second available data source is derived from the sampling of small shoreline watercourses by the Ashfield Colborne Lakefront Association (ACLA) in partnership with the MVCA and is available from 2001 to present. This sampling was initiated in order to fill the gap in water quality information for small lakeshore streams that were not monitored as part of the PWQMN or any other program due to their large number and relatively small catchments. For this program, single grab samples are collected using a stainless steel dipper every other week in the spring/summer/fall period by ACLA volunteers and analyzed for *E.coli*, nitrate and phosphorus at a private lab.

ABCA Enhanced Water Quality Monitoring

A third source of surface water quality data is the enhanced water quality network initiated by the Ausable Bayfield Conservation Authority in 2003. Like the ACLA sampling, the purpose of this sampling is to fill in water quality gaps of the PWQMN, especially for smaller watercourses. The samples are taken monthly in the ice-free period and analyzed for *E.coli*, total phosphorus, dissolved reactive phosphorus, ammonia, nitrate, nitrite, total Kjeldahl nitrogen, and suspended solids.

CURB

A fourth major data source in the area that is not utilized in preparation of this chapter, but that warrants explanation is the CURB (Clean-Up Rural Beaches) Program. The major focus of this program was bacterial contamination, especially of Lake Huron swimming beaches. Sampling occurred from 1986-1989 during development of the CURB Plan and from 1990-1994 during the CURB Plan implementation. Data from this program has not been included in this report due to the short duration of sampling, the age of the data, and the fact that most sites were situated within smaller watercourses.

Drinking Water Surveillance Program

For Lake Huron drinking water sources, indicators of water quality have been collected twice a month year-round at the intake of municipal water treatment plants in the Ontario waters of the Great Lakes since 1976. Trends in total phosphorus (TP) concentrations for 18 municipal water treatment plants have recently been evaluated (Nicholls 2001). This information is not in the perspective of nearshore Lake Huron conditions and other water quality indicators have not been documented. There are two Lake Huron water intake facilities serving the Region, the Town of Goderich intake and the Lake Huron Water Supply at Port Blake. Water samples from both plants were collected prior to any treatment with the analysis of the water samples conducted at the Ministry of the Environment laboratories.

2.1.1.2 Scan of Potential Water Quality Issues

Site Selection – Scan of Potential Water Quality Issues

Four indicators of rural non-point source water quality (nitrate, total phosphorous, suspended sediment and *E. coli*) and two indicators that reflect more common urban water quality issues (chloride and copper) were examined for spatial and temporal trends in the rivers and streams of the study area. In order to assess the presence of other water quality issues, a scan of historic data was completed.

The best source of data for less common water quality contaminants is the PWQMN. Any site that has been sampled under the PWQMN in the 2001 to 2005 time period was scanned. There have been 26 sites sampled; 22 sites are current and 4 are no longer sampled.

Scan of Potential Water Quality Issues – Data Analysis

Using the MS Access water quality database, all samples collected in 2001 to 2005 were compared to all indicators that currently have an objective. The objectives were first based on the

PWQO and the ODWS. If there was no provincial standard, the Canadian Water Quality Guidelines were referenced. Where there were two objectives for the same indicator, the lowest concentration indicator was used for the scan. No reporting was completed for an indicator with no standard.

The number of exceedances for each site for each indicator was totalled and all the exceeded values were averaged in order to develop an appreciation for the magnitude of exceedance over the standard. As a general indicator of sites of highest concern, all exceedances for all indicators were summed.

2.1.1.3 Temporal Changes

Site Selection – Temporal Changes
For temporal change determination to be useful for drinking source water protection, a long term record is needed and current data. For this reason, the CURB data will not be used as well as any other short or project specific sampling. All of the PWQMN sites ever sampled (84) will be summarized for determining trends, and augmented with data from the same site monitored more recently through the ACLA and ABCA Enhanced programs.

For Lake Huron water quality trend analysis, both the Goderich and Lake Huron Water Treatment Plant intake data will be used.

Temporal Change – Data Analysis
All of the PWQMN, ACLA and ABCA enhanced water quality data was imported into an MS Access database created to manage water quality data, graphical trends, statistics and highlighting guideline exceedances. The only filtering of the data was to replace non-detects with the actual value of the method detection limit, and indicate in a 'remarks' field as a non-detect.

Temporal changes were determined for six water quality indicators including chloride, copper, nitrate, total phosphorus, suspended sediment, and bacteria (fecal coliform and *E.coli*) and these indicator data were extracted to MS Excel. All data was attributed with a year grouping in five year blocks, starting with 1961-1965, and going to 2001-2005. All of the data was used without any filtering except for one sample. A nitrate value of 178 mg L^{-1} was removed from the Ausable River data which was measured on December 31, 1986 as the value was outside the plausible expected value for this location.

All of the water quality data was imported into Systat ver.11 (2004) and has been summarized both graphically and statistically. Graphically, a scatterplot of all samples was created with a LOWESS (locally weighted regression) smoothing line with a tension of 0.5 fit to the data. Analysis of water quality is sometimes difficult as this data may not be normally distributed or may have sporadic high and low data values ("outliers"). In the current analysis, data was examined with an exploratory procedure, LOWESS, to detect potential time series trends (SYSTAT version 11, 2004). If a specific geographic site has been sampled through different programs for the same indicator, this data was lumped. This is an exploratory approach and a formal trend analysis will be performed in the future.

The statistical summary for each five year time block included the number of samples, and the minimum, maximum, median, 25th percentile, and 75th percentile values.

2.1.1.4 Temporal Trends

For the purpose of reporting on temporal trends, six sites were selected. These sites were selected due to the length of record (greater then 5 years) and location on major river systems in the watershed. These sites are located in the downstream sections of the watersheds in order to integrate all the potential sources of the indicators for those watersheds. They also represent the six major watersheds in the area, namely: the Ausable, Bayfield, Maitland and Nine Mile Rivers, Parkhill Creek and Blyth Brook. The lakeshore gully system is not monitored and is not included in the analysis. These sites are considered sufficient to provide a general indication of water quality trends for the study area. Details of these six sites can be found in Table 2-1.

- Blyth Brook – PWQMN site from 1964-1994, 1998-2005 (site name Blyth)
- Ausable River – PWQMN site from 1980-1998, 2000-2005 (site name Thedford)
- Bayfield River – PWQMN site from 1975-1995, 2000-2005 (site name Varna)
- Maitland River – PWQMN site from 1964-1994, 1998-2005 (site name Goderich)
- Nine Mile River - PWQMN site from 1964-1994, 1998-2005 (site name Port Albert)
- Parkhill Creek – PWQMN site from 1972-1995, 2003-2005 (site name Downstream Parkhill)

Significant differences between the six sites were determined for each indicator except bacteria. All of the analysis was completed in Systat ver. 11 by first transforming the data, and second performing an ANOVA (analysis of variance). The data was transformed in order to create a more normal distribution.

The data for nitrate, chloride and residue particulate was transformed by taking the square root of the observed value. Total phosphorus and copper observed values were transformed by first multiplying the value by 1000 and taking the square root of this sum.

The ANOVA was performed with the sites as factors, and a Post hoc Tukey test applied. A difference between two sites was considered significant if the pairwise comparison of probabilities had a p-value of less than 0.05 (5% probability that the difference between sites is just a coincidence).

All of the lake intake water quality data was imported into Systat ver.11 and a scatterplot of all samples was created with a LOWESS smoothing line with a tension of 0.5 fit to the data. In the current analysis, data was examined with an exploratory procedure, LOWESS, to detect potential time series trends (SYSTAT version 11, 2004). Difference in mean concentrations for the three variables (TP, nitrate and chloride) between the two locations was determined with non-parametric Mann-Whitney U –Tests (SYSTAT version 11, 2004).

Graphs of the water quality data appear as box and whisker plots. The box length shows the central 50 per cent of the values from the 1st to the 3rd quartile or the 25th percentile to the 75th percentile. The median is indicated as the central line within the box. The whiskers and asterisks denote 1.5 and 3 times, respectively, the absolute values between the 25th percentile and the 75th percentiles. The empty circles are values that are beyond 3 times the absolute values between the 25th percentile and the 75th percentile.

2.1.1.5 Spatial Trends

Site Selection – Spatial Trends

The sites that are presently (2005) sampled and are part of long term structured monitoring program will be used. This is limited to 46 distinct sites in the tributaries draining into the southeast shore of Lake Huron (Table 2-1) from the PWQMN, the ABCA enhanced network and the ACLA sampling. The main rationale for only using these sites as opposed to all 266 sites is that many of the 266 sites are not currently sampled. Data that is 10 years old is not deemed to be beneficial. Historic sites may be useful in the future to add further refinement of issues in a particular watershed. It is important to note some locations are sampled through more than one program and are therefore in the table for each program.

Spatial Trends – Data Analysis

For spatial trends, only three indicators for rural watershed were used: nitrate, total phosphorus and bacteria (*E.coli*).

The data used for determining spatial trends was the same set for the temporal changes, with all the data screened out except for the 2001-2005 time period. This created a larger data set that reflects the water quality issues at each site more accurately. If a specific geographic site has been sampled through different programs for the same indicator, this data was lumped. The data for the 46 sites is presented in two forms: graphically and mapped.

To produce the mapping, the median concentration for nitrate and total phosphorus at each site was calculated using Systat ver.11. The geometric mean for *E. coli* was calculated in MS Excel for each site. The concentration for each site was plotted as a point and colour coded based on a classification scheme. Firstly, breakpoints were created for known guidelines or objectives. Secondly, all data for each indicator at each site was lumped and descriptive statistics calculate median, 25^{th} and 75^{th} percentiles. The values were used as a next level of breakpoint determination. Finally, if still too large a range between categories, the mid-point between breakpoints was used.

The contributing areas to each water quality monitoring site were also shaded based on the classification scheme used for the point data. Where sites were nested, the most upstream site took precedence.

For a more comprehensive comparison of concentrations between sites, statistical graphs were created. The sites were divided into three groupings. This is due in part that the scale of each watercourse, or stream order, greatly impacts water quality conditions (Vannote et al. 1981). To facilitate comparison the sites have been divided into main branch, shoreline, and headwater streams. Shoreline streams were those that empty directly into Lake Huron. Headwater sites were determined generally based on watershed size and the size of the watercourse. Generally, a stream narrower than 2 metres was considered headwater. The main branch category was by default those sites not shoreline or headwater and by far has the most variation. While specific sites are not compared, this level of organization is useful for general water quality discussion, but there was no scientific basis for the headwater and main branch groupings. A statistical comparison will be performed in the future.

The sites placed in each of the three categories are:

- Headwaters: Salem Creek (NMSalem)
  Blyth East (NMBlyth)
  Upper Bayfield (Dublin)
  Upper Bayfield (Silver)
  Steenstra
  Upper Ausable (Staffa)

- Main branches: Lucknow
  Port Albert
  B-Line
  Jamestown
  NEListowel
  Trowbridge
  Wingham-Midd
  Henfryn
  Summerhill
  Blyth
  Zetland
  Benmiller
  Goderich
  Seaforth
  Bannockburn
  Varna
  Upper Parkhill
  Lower Parhill
  Exeter
  Springbank
  Thedford
  Black
  Nairn
  Decker
  Huron Park
  Lucan

- Shoreline: Boyd
  Eighteen Mile
  Kintail
  Kerrys
  Kingsbridge
  Griffins
  Midhuron
  Boundary
  Bogies
  Allans
  Zurich
  Desjardine
  Mud

For each indicator and each of the three groupings, box and whisker plots are displayed and sites are organized from north to south, and, within a watershed, from upstream to downstream. Systat ver.11 was used for the plotting (see Appendix C).

Table 2-1: Water Quality Monitoring Stations in the Ausable Bayfield Maitland Valley Region that were selected for data analysis (2006)

Watershed	Branch	Site Name	MOE ID or local ID	Years	Program	Location
Nine Mile River						
		Lucknow	08007600202	1964-present	PWQMN	Canning St.-Lucknow
		Port Albert	08007600102	1970-present	PWQMN/ACLA Shore	Hwy.21-Port Albert
Maitland River						
	North Maitland					
		B-Line	08005603802	2004-present	PWQMN	B-Line Road, East of Wingham
		NMSalem	08005605002	2005-present	PWQMN (NM)	Salem Road, East of Cty Rd 12
	Little Maitland					
		Jamestown	08005603502	1987-present	PWQMN	Conc. 1/2 Grey
	Middle Maitland					
		NE Listowel	08005604302	2004-present	PWQMN (NM)	Perth Road 157, NE Listowel
		Trowbridge	08005600902	1964-present	PWQMN	Trowbridge
		Wingham	08005603902	2004-present	PWQMN	Clegg Line, 5 km S of Wingham
	Middle Maitland Tributaries					
		Henfryn (Boyle Drain)	08005602002	1972-present	PWQMN	Downstream of Henfryn
		Beauchamp	08005604102	2004-present	PWQMN	St. Michaels Road, E of Cty Rd 12
	South Maitland					
		Summerhill	08005603702	2004-present	PWQMN	Base Line Road, Summerhill
	Lower Maitland					
		Zetland	08005600302	1964-present	PWQMN	Hwy.86-NW Wingham
		Benmiller	08005603602/C3	2003-2005	PWQMN/ACLA Shore	Benmiller Ln, Huron Cnty Rd. 1, Benmiller
		Goderich	08005600102/C3	1964-present	PWQMN/ACLA Shore	Hwy.21-Goderich
	Lower Maitland Tributaries					
		Blyth East (Blyth Brook)	088005604402	2004-present	PWQMN (NM)	Martin Line, East of Blyth
		Blyth (Blyth Brook)	08005600202	1964-present	PWQMN	Currie Line, West of Blyth
Bayfield River						
	Upper Bayfield					
		Dublin (Liffy Ditch)	HBLIF1	2003-present	ABCA Enhanced	Perth Rd 180 (.7 km north of Hwy 8)
		Silver Creek	08004001102	1983-present	PWQMN (NM)	Hwy 8, Seaforth
		Seaforth	08004000202	1964-present	PWQMN	Kippen Road, Egmondville
	Lower Bayfield					
		Bannockburn	MBBAN1	2003-present	ABCA Enhanced	Bannockburn Wildlife Area
		Steenstra	HBSTEEN1	2003-present	ABCA Enhanced	County Rd. 13 East of County Rd 31
		Varna	08004000802	1975-present	PWQMN	Cty Rd 31, N of Varna
Parkhill Creek						
		Upstream Parkhill	MPMCGUF1	2003-present	ABCA Enhanced	McGuffin Hills Drive above Parkhill Resevoir
		Downstream Parkhill	08002201202	1972-present	PWQMN	McInnis Road, West of Parhill
Ausable River						
	Main Branch					
		Staffa	08002200802	1966-1975	PWQMN	Perth Rd 180, Staffa
			HASTAF1	2003-present	ABCA Enhanced	Perth Rd 180, Staffa
		Exeter	08002201602	1975-present	PWQMN	Airport Line, Exeter
		Springbank	08002202002	2003-present	PWQMN	Springbank Dr, N of Springbank
		Thedford	08002100202	1980-present	PWQMN	Bog Line, Lambton Rd 18, NE of Thedford
	Ausable Tributaries					
		Black	08002200702	1966-present	PWQMN	Airport Line, West of Hensall
		Nairn	MANAIRN1	2003-present	ABCA Enhanced	behind Nairn Cemetery downstream of confl with Bear Creek
		Decker	08002201902	2000-present	PWQMN	Gordon Rd, N of Thedford
	Little Ausable					
		Huron Park	08002201402	1974-present	PWQMN (NM)	Park Rd, Usborne Twp, East of Huron Park
		Lucan	08002201002	1969-present	PWQMN	Middlesex Rd 20 (Denfield Road), West of Lucan
Shoreline Watersheds (north to south)						
		Boyd	A1	2001-present	ACLA Shore	Hwy 21 at Boyd Creek
		Eighteen Mile	A2	2001-present	ACLA Shore	Hwy 21 at Eighteen Mile River
		Kintail	A3	2001-present	ACLA Shore	Hwy 21
		Kerrys	A4	2001-present	ACLA Shore	Hwy 21 at Kerrys Creek
			08009000102	2004-present	PWQMN (NM)	Kintail Beach, 200m from Lake Huron
		Kingsbridge	A5	2001-present	ACLA Shore	Hwy 21
		Griffins	A6	2001-present	ACLA Shore	Hwy 21 at Griffins Creek
			08005604902	2005-present	PWQMN (NM)	Birch Beach Road
		Midhuron	A7	2001-present	ACLA Shore	Hwy 21
		Boundary	A9	2001-present	ACLA Shore	Hwy 21 at Boundary Creek
		Bogies	C1	2001-present	ACLA Shore	Bogies Beach Road
		Allans	C2	2001-present	ACLA Shore	Sunset Beach Road
		Zurich (Drain - Pergel Gully	GULZUR8	2003-present	ABCA Enhanced	Hwy 21 just south of Cty Rd 84
		Desjardine	HPDESJ1	2003-present	ABCA Enhanced	Kirkton Rd just off hwy 81 east of Grand Bend
		Port Franks (Mud Creek)	MMOUTER1	2003-present	ABCA Enhanced	Mud Creek crossing on Outer Drive

2.1.2 Groundwater

This section deals explicitly with the water quality of groundwater in the Ausable Bayfield Maitland Valley Source Protection Region. This was undertaken primarily as a result of the high usage of groundwater for municipal water supplies, as well as for private supplies, in the region.

Although many sources of data are available for groundwater in the area, the vast majority of that data is available for only the period after 2001. Given the extended residence times within aquifers in these aquifers (25-500 years), this period of record does not allow for any meaningful analysis of trends in groundwater quality, but rather only provides a characterization of existing conditions.

It is also important, herein, to refer to the many variables that complicate the collection and analysis of groundwater samples. In this report, efforts have been made to characterize the aquifers rather than the water systems themselves. Most sampling completed to date has focused on the end water quality coming form a well. This means that well head safety, casing integrity and plumbing are not considered. As a result, it can be difficult to discern between water quality issues that reflect the natural aquifer conditions, or those that reflect upon the infrastructure used to deliver the water to the end user (Health Canada 2005).

For the purposes of this report, groundwater chemistry analyses were assembled and grouped according to the aquifers from which they were derived and analyzed accordingly. The regionally extensive bedrock aquifers are subdivided to the formation level, as shown in WC Map 1-2. Overburden aquifers were divided based on the physiographic regions of the partnership area, and are shown in Figure 3.10 of the Conceptual Water Budget for the Ausable Bayfield & Maitland Valley region.

Where possible, wells were selected that could be assigned solely to a specific aquifer, and which have water quality considered representative for that aquifer. Within these areas, wells were identified that can be considered exclusively representative of each formation. These wells were selected firstly based on their location. Overburden wells were evaluated by examination of their drilling logs in order to determine if they captured any other aquifer. Bedrock wells were evaluated by comparing the depth they penetrate bedrock to the estimated thickness of the formation in that area in order to determine if they captured any other aquifer

A number of different sources of data were made available for this report. Comprehensive groundwater quality monitoring has been only recently (2003) initiated throughout most of the Ausable Bayfield Maitland Valley PRegion, and the data thus derived is insufficient for long-term, trend analysis. Groundwater quality data from these various sources was assembled for the purpose of providing a preliminary assessment of the issues relating to groundwater quality in the Ausable Bayfield Maitland Valley Source Protection Region.

Groundwater quality has come from three major sampling programs; Provincial Groundwater Monitoring Network, Municipal monitoring, and counties.

2.1.2.1 Provincial Groundwater Monitoring Network

The Provincial Groundwater Monitoring Network (PGMN) was initiated in 2003 by the Maitland Valley and Ausable Bayfield Conservation Authorities, in partnership with the Ontario Ministry of Environment. Areas of interest were selected based on the groundwater issues relevant to the times. Within these areas, where possible, existing wells were evaluated for long term monitoring. Where suitable existing wells were not available, new wells were drilled. These monitoring wells were then equipped with data loggers that record water levels and temperature on an hourly basis.

Sampling of wells for water quality was conducted initially in 2003 and has been performed on an annual basis according to protocols established by the Ministry of Environment. All samples were analyzed at a common, certified laboratory. Subsequent, more frequent samples were taken from wells for which parameters exceeded an Ontario Drinking Water Standard (ODWS).

The PGMN wells are the most reliable source of groundwater water quality data for the Ausable Bayfield Maitland Valley Source Protection Region. These samples were all collected using a standard, rigorous protocol designed to minimize or eliminate any contamination of samples. In addition, the samples from these wells were all analyzed for a comprehensive suite of parameters at a single lab, using standardized analytical methods, which make them ideal for comparing results between wells.

The major limitation of the PGMN data is the length of record for these analyses. The typical length of record for these samples is limited to the two years of the program's existence, and for the majority of these wells only two samples have been taken at the time of writing.

2.1.2.1 Municipal groundwater supplies

Municipal groundwater supplies represent valuable sources of groundwater quality data. Since the establishment of more rigorous sampling requirements in 2001 as part of the Provincial Safe Drinking Water Act (2002), wells servicing municipalities and large communities have been required to take regular samples of raw well water. These analyses are usually limited to those parameters identified in the pertinent regulations and do not typically include as comprehensive a suite of parameters as the PGMN. In addition, municipal data is often presented in summary, qualitative format for parameters that do not exceed drinking water standards, which makes analysis of these data impossible. Efforts are ongoing to locate the original data in order to characterize each municipal well.

Prior to 2001, the availability of data for municipal wells is extremely limited, with most wells only being regularly tested for microbiological parameters and using several different laboratories. In addition, of particular difficulty for performing comprehensive analyses, results are only available in hard copy. The availability of data prior to year 2000 is further hampered by the high turnover of staff as a result of the amalgamation of municipalities in the Ausable Bayfield Maitland Valley Source Protection Region that took place in this time period.

Data collected after 2001 are, by legislation, available to the general public for viewing in the form of reports. However, these reports tend to vary in quality between municipalities and have different reporting formats. In addition to this, samples have been analyzed using different methodologies and laboratories, thereby making comparisons between samples difficult.

Regardless of these limitations, wells which have a good length of records do provide valuable sources of information and can be used to fill holes in the monitoring strategy in the Ausable Bayfield Maitland Valley Source Protection Region. Data records, however, are not yet long enough to analyze trends within the aquifers, and are optimally used to characterize existing groundwater quality conditions.

Several groundwater quality studies have been completed in the Ausable Bayfield Maitland Valley Source Protection Region prior to the initiation of Drinking Water Source Protection efforts. The data collected from these studies is valuable for identifying potential issues in the Ausable Bayfield Maitland Valley Source Protection Region, as well as directing future monitoring efforts.

Huron County undertook a groundwater resource assessment in 1999 that identified and sampled 6 separate clusters of private wells for a comprehensive suite of analytes (Golder and Associates, 2001). Three of these clusters are centered over the regionally significant Lucas aquifer, and one cluster dedicated to the Dundee, Hensall and Seaforth aquifers. Results of this study have been included and are discussed below. As part of this project, a representative well from each cluster was identified for long term monitoring as part of the Huron County Sentinel Well program. Sampling of these wells has continued, in partnership with the Ausable Bayfield and Maitland Valley Conservation Authorities, through 2005.

The former Town of Bosanquet undertook a groundwater quality study within the North Lambton aquifer, located near and around the communities of Grand Bend and Port Franks (BM Ross 2001). The results of this report are not public but were made available for general viewing to the Ausable Bayfield Maitland Valley drinking water source protection staff and technical team. As part of this study, a comprehensive sampling program was undertaken targeting approximately 128 private wells in the area. These wells were sampled for nitrates and microbiology, with a subset of 20 representative wells sampled for a more comprehensive suite of parameters. The details of this study are discussed below.

Additional work completed recently, including the ABCA North Lambton and Sinkhole studies, have incorporated groundwater quality in their investigations. These studies sampled both private and PGMN wells in specific areas. These wells were all sampled using PGMN or equivalent protocols and were analyzed for a comprehensive suite of parameters, similar to that of the PGMN wells.

2.2 Results

2.2.1 River

2.2.1.1 Scan of data – all indicators with standards

The focus for the analysis of surface water quality data has been on past water quality issues and those that are most common in agricultural watersheds. In order to determine if there are any emerging issues, sampling data from the PWQMN for the period from 2001 to 2005 has been compared to the Provincial Water Quality Objectives, or if there are no PWQO, the Canadian Water Quality Guidelines.

There are nineteen metals in the analysis package for the PWQMN. The metals that have never exceeded the PWQO at any sites in the region are listed in Table 2-2. There are some metals in the analysis package for which there is no PWQO or CWQG to be used in determining if the concentrations are an issue. These metals area also listed in Table 2-2.

Table 2-2: Metals in the analysis package for the PWQMN with no exceedances or no guideline

Metals with no Provincial Water Quality Objective Exceedances at any site (2001-2005)	Metals Sampled without a Provincial Water Quality Objective or Canadian Water Quality Guideline
Berylium	Barium
Molybdenum	Magnesium
Nickel	Manganese
Vandium	Potassium
	Sodium
	Strontium
	Titanium

From the water quality data collected at 26 sites in the Ausable Bayfield Maitland Valley Source Protection Region, eight metals have had at least one sample exceed a published guideline in the 2001 to 2005 period. Aluminium, cadmium, chromium, cobalt, copper, iron, lead, and zinc have been found to exceed their respective published guidelines on at least one occasion.

During the process of scanning the data for values exceeding known water quality guidelines, two non-metal parameters that have not been discussed to this point were also discovered, including nitrite and pH. Table 2-3 has a listing of sites and the number of samples exceeding a known water quality guideline.

Table 2-3: Summary of all samples exceeding known PWQO or Canadian Water Quality Guidelines (2001-2005) in the Ausable Bayfield Maitland Valley Source Protection Region

Location	PWQMN ID	Watercourse	Years	Total	Aluminum		Residue Par		Cadmium		Chromium		Cobalt		Copper		Iron		Lead		Nitrite		pH (lab)		pH Field		Zinc	
				Exceedance	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.	Count	Avg.
Gordon Rd, N of Thedford	08002201902	Decker Creek	01-05	81	34	260.2	9	57.2	3	0.659	4	1.11	6	1.29			14	464.57	2	7.14	8	0.09	1	8.58				
Bog Line, Lambton Rd 18, NE of Thedford	08002100202	Ausable River - The Cut	01-05	79	33	305.8	13	70.1	7	0.782	1	1.49	4	1.17			13	559.92	3	7.93	2	0.06	2	8.55	1	8.58		
Hwy.23 - Listowel	08005601302	Middle Maitland River	01-03	70	18	189.8	2	38.8	1	0.604	7	1.19	3	1.13	3	8.63	3	360.33	3	8.29	12	0.23	4	8.71	3	8.82	11	43.33
Trowbridge	08005600902	Middle Maitland River	01-05	68	10	128.9	2	32.1	5	0.870	8	1.62	4	1.11	1	5.12	2	382.00	7	7.32	9	0.10	10	8.59	6	8.78	4	31.98
Cty Rd 31, N of Varna	08004000802	Bayfield River	01-05	66	27	282.9	5	159.4	3	0.793	4	1.46	2	1.11	1	5.15	3	728.00	5	6.36	7	0.08	5	8.54	1	9.18	3	54.13
Springbank Dr, N of Springbank	08002202002	Ausable River	03-05	65	19	339.8	17	50.4	4	0.998	4	1.14	2	1.26			12	422.58	5	8.44			1	8.51	1	8.97		
McInnis Road, West of Parhill	08002201202	Parkhill Creek	03-05	60	20	425.9	12	45.1	1	0.954	3	1.21	1	1.18			9	552.33	6	8.66	7	0.11	1	8.54				
Hwy.21-Port Albert	08007600102	Nine Mile River	01-05	58	26	149.2	4	41.8	3	0.693	6	1.79	6	1.12			1	493.00	4	8.13			6	8.55	2	8.61		
Downst. Henfryn	08005602002	Boyle Drain	01-05	51	21	139.4	1	37.0	2	0.623			8	1.29			2	351.50	3	9.40	8	0.13	4	8.68	2	8.55		
Airport Line, West of Hensall	08002200702	Black Creek	01-05	48	16	135.6	1	38.3	6	0.802	3	1.54	1	1.13					4	7.20	14	0.20	3	8.59				
Cty Rd 5 (Greenway Drive), Tricounty Brid	08002201802	Parkhill Creek	01-02	48	14	279.9	12	38.0			2	1.43	1	1.18			10	435.50			7	0.11	2	8.56				
1stSdRdW.-Blyth	08005600202	Blyth Brook	01-05	44	9	148.4			5	0.914	1	1.03	6	1.22	2	8.01			3	7.75	5	0.09	6	8.58	7	8.63		
Kippen Road, Egmondville	08004000202	Bayfield River	03-05	36	14	155.8	1	39.8	4	0.853	4	1.32	1	1.00					7	11.39	5	0.09						
Middlesex Rd 20 (Denfield Road), West of	08002201002	Little Ausable River	01-05	35	13	208.9	3	72.1	2	1.255	2	1.05	2	1.01			3	328.33	4	9.20	5	0.08	1	8.58				
Hwy.21-Goderich	08005600102	Lower Maitland River	01-05	34	5	102.5	1	25.5	6	1.018	1	1.43	2	1.22					7	8.74			6	8.55	5	8.64	1	21.70
Airport Line, Exeter	08002201602	Ausable River	01-05	33	11	153.8			3	0.957	2	1.08	3	1.22	1	5.55			1	8.10	6	0.09	5	8.73	1	8.89		
Conc.1/2 - Grey	08005603502	Little Maitland River	01-05	28	3	95.6			5	0.878	1	1.31	1	0.96					4	10.37	2	0.10	7	8.57	5	8.56		
E. of Ethel	08005602602	Middle Maitland River	01-03	27	7	120.5	1	44.5	5	0.677			2	1.03			1	352.00	4	6.54	6	0.12	1	8.64				
Canning St.-Lucknow	08007600202	Nine Mile River	01-05	22	6	153.3	1	26.5	5	0.796			2	1.43			1	364.00	3	12.25	1	0.07	3	8.59				
Hwy.86-NW Wingham	08005600302	Lower Maitland River	01-05	14	3	82.7			2	0.637	2	1.80	1	0.95					2	9.29			2	8.58	1	8.54	1	37.50
St. Michaels Road, E of Cty Rd 12	08005604102	Beauchamp Creek	04-05	14	5	138.8			2	0.577	1	1.30					1	313.00	2	11.43	2	0.08	1	8.53				
Base Line Road, Summerhill	08005603702	South Maitland River	04-05	13	6	138.8			1	0.630	1	1.11	1	1.05					1	5.95			2	8.52	1	8.57		
Clegg Line, 5 km S of Wingham	08005603902	Middle Maitland River	04-05	13	2	86.7			2	0.996			3	1.42					2	7.08			3	8.55	1	8.60		
Park Rd, Usborne Twp, East of Huron Par	08002201402	Little Ausable River	04-05	11			4	122.1													6	0.08			1	8.51		
B-Line Road, East of Wingham	08005603802	North Maitland River	04-05	11					1	0.743			3	1.21					1	12.00			5	8.55	1	8.51		
Hannah Line, W of Seaforth	08004000902	Bayfield River	03-05	8	2	134.5							1	1.09							2	0.09	3	8.63				
					IPWQO 75ug/l for pH >6.5 & pH < 9.0 in a clay free sample Refer to residue		General Criteria 25 mg/l		IPWQO 0.5 ug/l for hardness as CaCO3 >100 mg/l		PWQO 1 ug/l for CrVI * results are for total Cr		PWQO 0.9 ug/l		IPWQO 5ug/l for hardness as CaCO3 >20 mg/l		PWQO 300 ug/l		IPWQO 5 ug/l for hardness as CaCO3 >80 mg/l		CWQG 60 ug/l 1987upd. 2002		PWQO 6.5 - 8.5		PWQO 6.5 - 8.5		IPWQO 20 ug/l	

Count is the number of exceedances from 2001-2005 and Avg. is an arithmetic average of only the values exceeding the PWQO. All sites and samples part of the PWQMN.

No longer current sampling site

Not all sites were sampled for the entire period. Refer to the years column

Aluminium and chromium need further explanation with respect to both the type of lab analysis and the PWQO in order to interpret the results. The PWQO for aluminium is stipulated for a clay free sample. However, the water samples taken are not filtered before analysis at the Ministry of the Environment lab and, therefore, cannot be considered clay free. The results for residue particulate have been included next to the aluminium column so that if a sample was found to greatly exceed the current PWQO for aluminium and contained high particulate, one can assume that the majority of the aluminium is contained in, or partitioned to, the solids. If, on the other hand, the PWQO was exceeded and the sample was low in suspended sediment, the results are a concern. From Table 2-3, there are instances of high aluminium concentrations without a corresponding high level of sediment at 10 locations.

Chromium is another metal where lab analysis does not conform to the PWQO. The PWQMN results are for total chromium, while the PWQO is 1 ug/l for hexavalent chromium (Cr VI) and 8.9 ug L^{-1} for trivalent chromium (Cr III). Given the fact that Chromium VI is the most toxic form of Chromium, the PWQO (adopted CWQG) for Chromium VI (i.e. 1 ug L^{-1}) will be used for interpreting total chromium results. Chromium toxicity is inversely affected by water hardness, so some leeway is warranted for harder water (>100 mg L^{-1} as $CaCO_3$). Hardness is always above 100 mg L^{-1} as $CaCO_3$ in the watershed region; therefore, this is a data gap as to the bioavailability of chromium in surface water.

Metals have not traditionally been considered an issue in the Ausable Bayfield Maitland Valley Source Protection Region, and this is the first general summary of historic data. Analyses began in 1998 in the MVCA watershed and 2000 in the ABCA watershed, when approximately 14 metals were added to the list of indicators. The distribution of sites exceeding guidelines reflects point sources, likely municipal waste water treatment plant discharge. The sites that most frequently exceeded the guidelines included the Middle Maitland downstream of Listowel, Black Creek and Decker Creek; all small watercourses receiving Wastewater Treatment Plant (WWTP) discharge.

Some water quality indicators that have exceeded their benchmarks require further study. Key metals to be examined further are aluminium, cadmium, cobalt and lead. In addition, of particular concern are the nitrite concentrations at Trowbridge and Black Creek. As well, point sources where high concentrations of iron are identified should be located.

2.2.1.2 Temporal Trends

In order to understand current water quality issues and to assist in determining potential sources of contamination, historic or temporal changes are valuable. Examining trends also allows one to extrapolate into the future to predict impacts on various uses of water.

All PWQMN sites were graphed for each indicator; only the results for the six sites are found in the body of this report and Appendix A has water quality information for all sites.

Chloride

At many stations, the long-term trend for chloride over the length of record has been to undergo a slight increase in concentration as indicated through LOWESS interpretation in Figure 2-4, and chloride concentrations are well below levels of concern. The ODWS and the British Columbia aquatic protection guideline are shown for reference. The Maitland River at Goderich has had the highest concentrations, which peaked in 1989 and since have declined. None of the sites have had any concentrations above the PWQO in the last five years. These results may reflect the more rural nature of the watershed region and the limited use of road salt. The chloride concentrations and changes over time at Goderich are more likely related to salt extraction industry modifications then to road salt. Chloride concentrations have decreased between 1965 and 1970 in Black Creek (Appendix A), which feeds into the Ausable River.

Results of the ANOVA revealed three clusters of sites with significant differences for chloride. Sites within the same cluster have no significant difference. The clusters were, from lowest to highest concentration: 1) Blyth Brook and Nine Mile River; 2) Parkhill Creek, Bayfield River and Ausable River; and 3) the Maitland River.

Other than the Middle Maitland River site at Trowbridge (Appendix A) which has a steeper increase in concentrations with some samples exceeding the British Columbia aquatic protection guideline, the concentrations of chloride are not of concern at this point and monitoring of concentrations would be an appropriate tool to ensure that chloride does not become a drinking water issue.

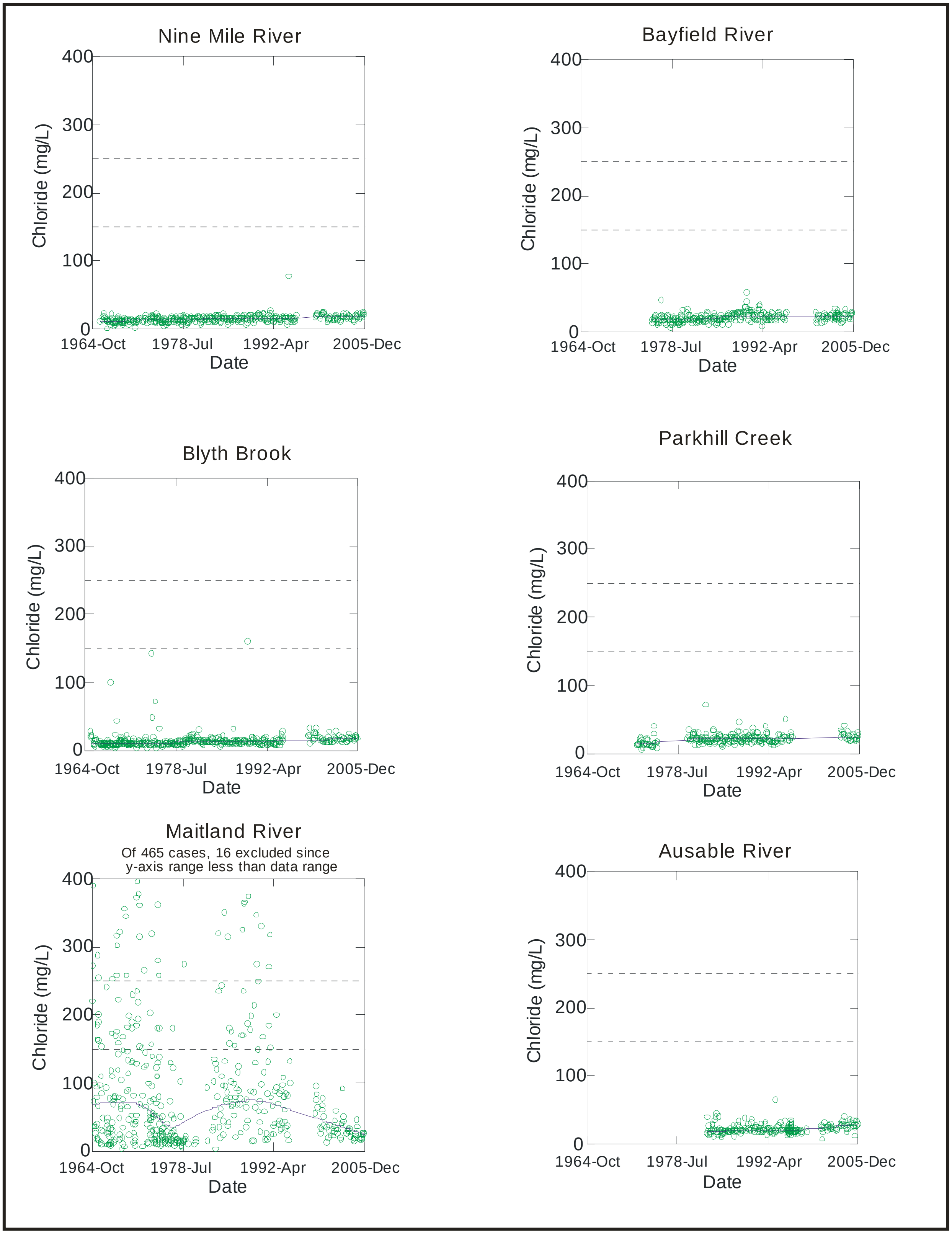

Figure 2-4: Chloride concentrations in major watercourses in the Ausable Bayfield Maitland Valley Source Protection Region, 1964-2005

Copper

Copper concentrations have declined or stayed constant over the period of record and no sites currently have concentrations above the PWQO (shown as dashed line), with significant water quality improvements at Port Albert (Nine Mile River) (Figure 2-5). These results may reflect the more rural nature of the watershed region and lower level of industrialization.

Results of the ANOVA revealed four clusters of sites with significant difference for copper; three of the clusters overlap. Sites within the same cluster have no significant difference. The relationships were, from lowest to highest concentration: **Blyth Brook**, with no significant difference from the Bayfield River; **Bayfield River**, with no significant difference from Blyth Brook or the Nine Mile River; **Nine Mile River**, with no significant difference from Parkhill Creek or the Bayfield and Maitland Rivers; **Maitland River**, with no significant difference from Parkhill Creek or the Nine Mile River; **Parkhill Creek**, with no significant difference from the Maitland and Nine Mile Rivers; and the **Ausable River**, which was significantly different from all sites.

The concentrations of copper at the other monitoring stations are not of concern at this point. Continued monitoring of copper would be an appropriate tool to ensure that copper does not become a drinking water issue.

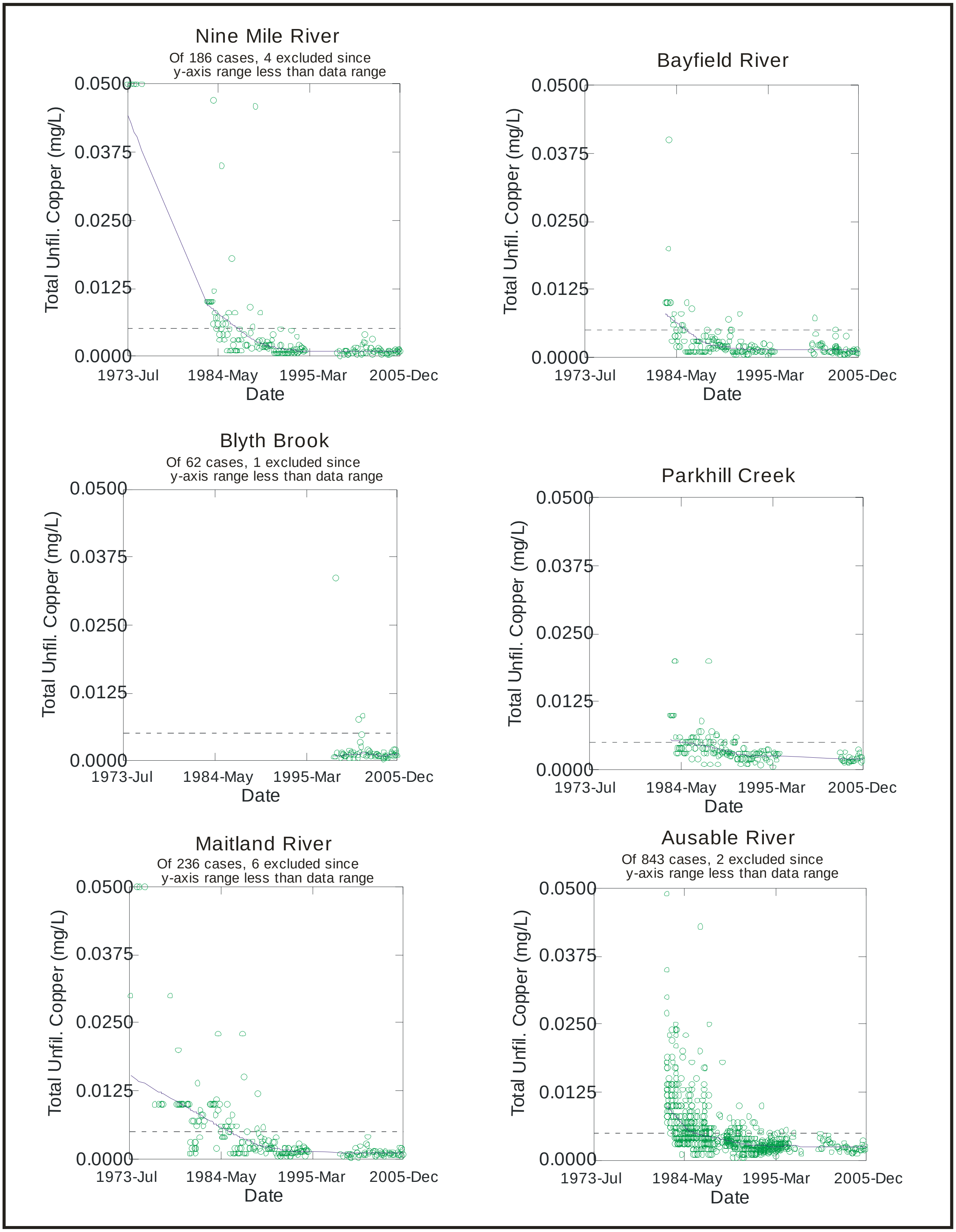

Figure 2-5: Copper concentrations in major watercourses in the Ausable Bayfield Maitland Valley Source Protection Region, 1973-2005

Nitrate

The lab method for determining nitrate concentration in water samples through the PWQMN has changed over the sampling period. The analysis used filtered reactive nitrate until 1984, unfiltered reactive nitrate until 1995, and total nitrates unfiltered reactive to present. A visual scan of the data did not indicate that these method changes influenced the general determination of trends.

Nitrate concentrations have increased at every site over the record, to the point that five of the six sites are above the aquatic protection limit more then 50% of the time (Figure 2-6). The exception is the Nine Mile River which has concentrations below this limit at both Lucknow and Port Albert. However, the Nine Mile River also experienced the increasing nitrate trend. The ODWS and the CCME aquatic protection guideline are shown for reference. The largest increase in concentration occurred between 1970 and 1985.

The increasing nitrate trend ended around 1985 in the Maitland watershed and concentrations have remained steady or even declined. The increasing trend is still occurring in the Bayfield River and Parkhill Creek, and to a lesser degree in the Ausable River.

Since all sites exhibit this trend, it indicates that there may have been a widespread adoption of a land management practice, or practices, which increased the amount of nitrate in watercourses. The nitrate trend has been level or slightly declining since 1985, possibly indicating that this practice or practices are still in use in the Maitland watershed, but not intensifying. In the Bayfield River and Parkhill Creek watersheds, this land management change may still be occurring or intensifying.

The greatest increase during this 1970-1985 time period in terms of nitrate, based on anecdotal evidence, could be related to a possible increase in the use of commercial fertilizers and the replacement of mixed farming with "cash cropping" or specialized systems. The changes that occurred over this time need to be understood in order to better define the sources of the nitrogen and should be considered a data gap.

Results of the ANOVA revealed four distinct clusters of sites with significant differences for nitrate. Sites within the same clusters have no significant difference. The clusters were, from lowest to highest concentration: 1) Maitland and Nine Mile Rivers; 2) Blyth Brook; 3) Parkhill Creek; and 4) the Bayfield and Ausable Rivers.

A considerable number of samples in the Bayfield River were above the ODWS. Even though there are no current surface water uses of the river, the impact of these concentrations on Lake Huron needs to be determined in order to asses drinking water risk for Lake Huron intakes.

One exception in the Maitland watershed is the Little Maitland PWQMN site at Palmerston (Appendix C), which, at the time sampling was discontinued in 1994, nitrate levels were in the 7 to 8 mg L^{-1} range and if the increase stayed constant, would be at the ODWS by early 2000. This site should be monitored again to determine current conditions.

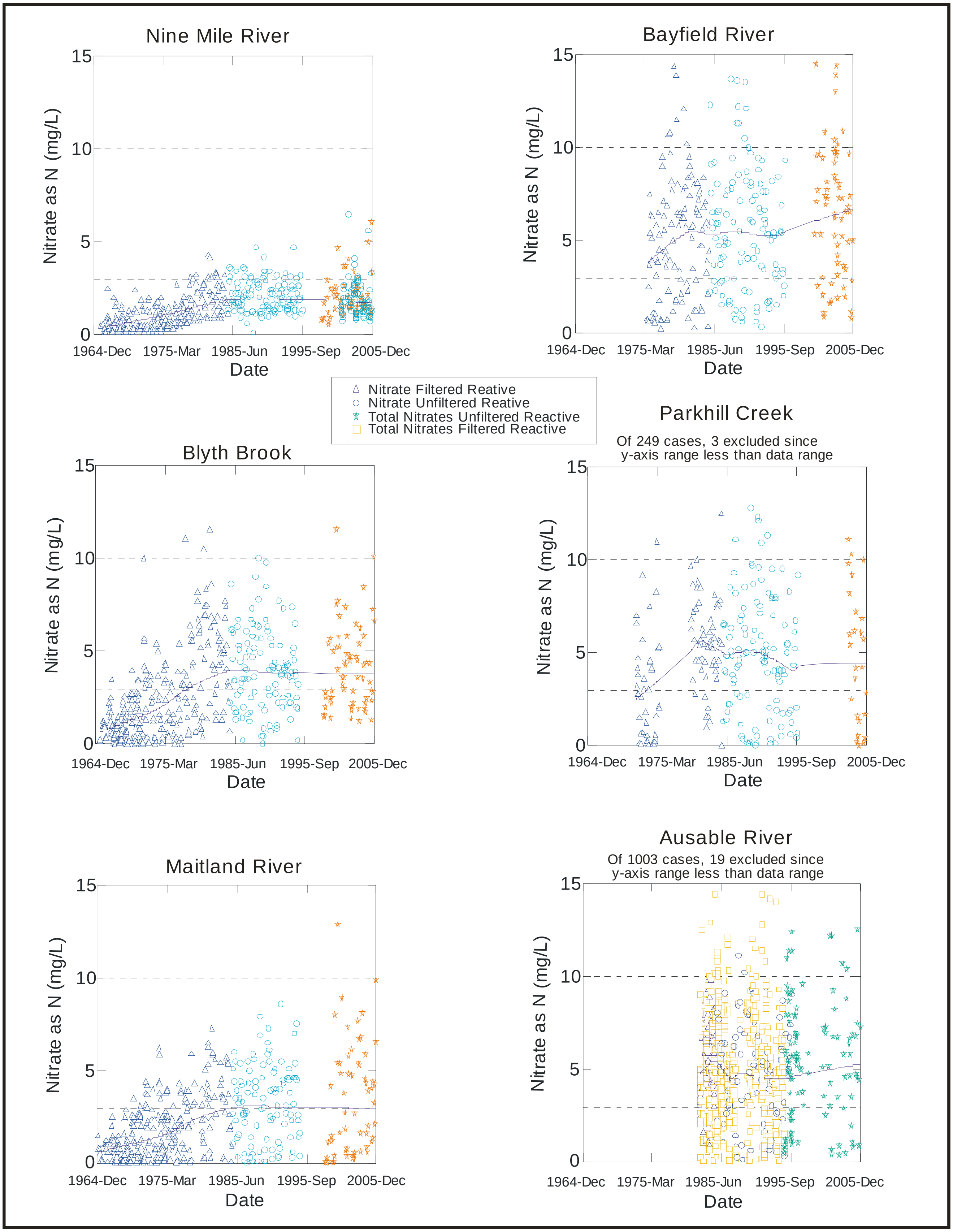

Figure 2-6: Nitrate concentrations in major watercourses in the Ausable Bayfield Maitland Valley Source Protection Region, 1964-2005

Total Phosphorus

Total phosphorus concentrations have slightly declined or remained constant over the record, but median concentrations are at or just above the PWQO (shown as a dashed line) for five of the six sites (Figure 2-7). Parkhill Creek has shown significant declines from 1985, but median concentrations remain five times the PWQO. Phosphorus enrichment is an issue in the entire watershed region.

Results of the ANOVA revealed three distinct clusters of sites with significant differences for total phosphorous. Sites within the same cluster have no significant difference. The clusters were, from lowest to highest concentration: 1) Maitland and Nine Mile Rivers; 2) Blyth Brook and Bayfield River; and 3) Parkhill Creek and Ausable River.

There have been significant improvements in some watersheds, including the Middle Maitland River at Trowbridge and Decker Creek (Appendix A). These large improvements could possibly be attributed to modifications and improvements in effluent quality at the Listowel Wastewater Treatment Plant and demonstrate the impact of an urban area on a watercourse that has lower summer flows.

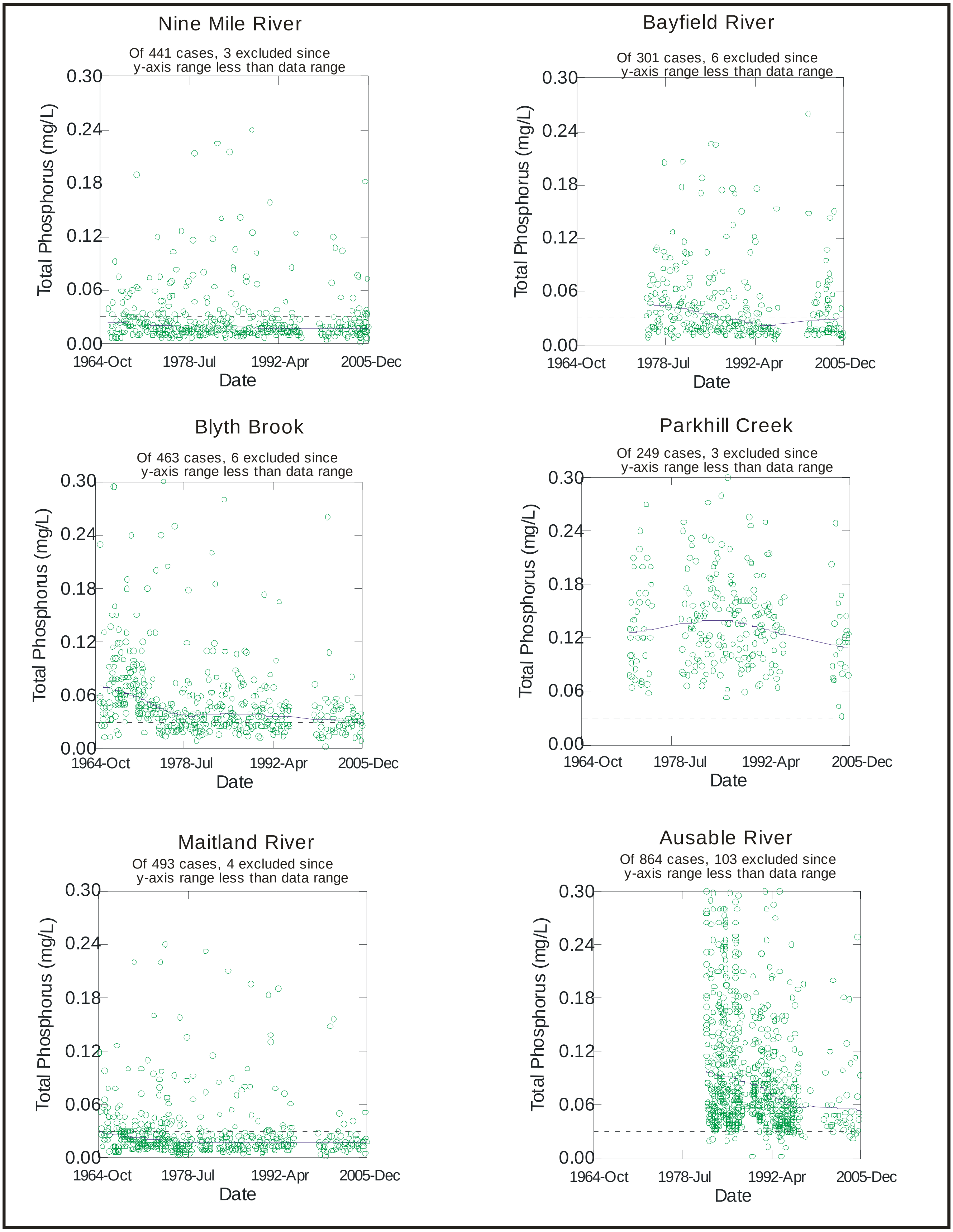

Figure 2-7: Total Phosphorus concentrations in major watercourses in the Ausable Bayfield Maitland Valley Source Protection Region, 1964-2005

Total Suspended Solids

Suspended sediment has declined or remained constant over the record for the Nine Mile River, Maitland River, Bayfield River and Blyth Brook with these sites all below the dashed line representing the aquatic protection general criteria (Figure 2-8). Improvements have occurred in the Ausable River with concentrations at or slightly above this benchmark. Suspended sediment concentrations in Parkhill Creek are above the general criteria for aquatic protection in more than half of the samples, but concentrations have declined since 1985. The shape of the trend line for Parkhill Creek is similar for both total phosphorus and sediment, indicating that they have similar mechanisms and pathways of transport. The declines in sediment loads could be attributed to various agricultural and soil erosion initiatives since the mid 1980s.

Results of the ANOVA revealed five clusters of sites with significant differences for suspended sediment. Three of the clusters overlap. Sites within the same cluster have no significant difference. The relationships were, from lowest to highest concentration: **Blyth Brook**, with no significant difference from the Bayfield and Maitland Rivers; **Maitland River**, with no significant difference from Blyth Brook or the Bayfield River; **Bayfield River**, with no significant difference from Blyth Brook or the Nine Mile and Maitland Rivers; **Nine Mile River**, with no significant difference from the Bayfield River; **Parkhill Creek**, which is significantly different from all sites; and the **Ausable River**, which is also significantly different from all sites.

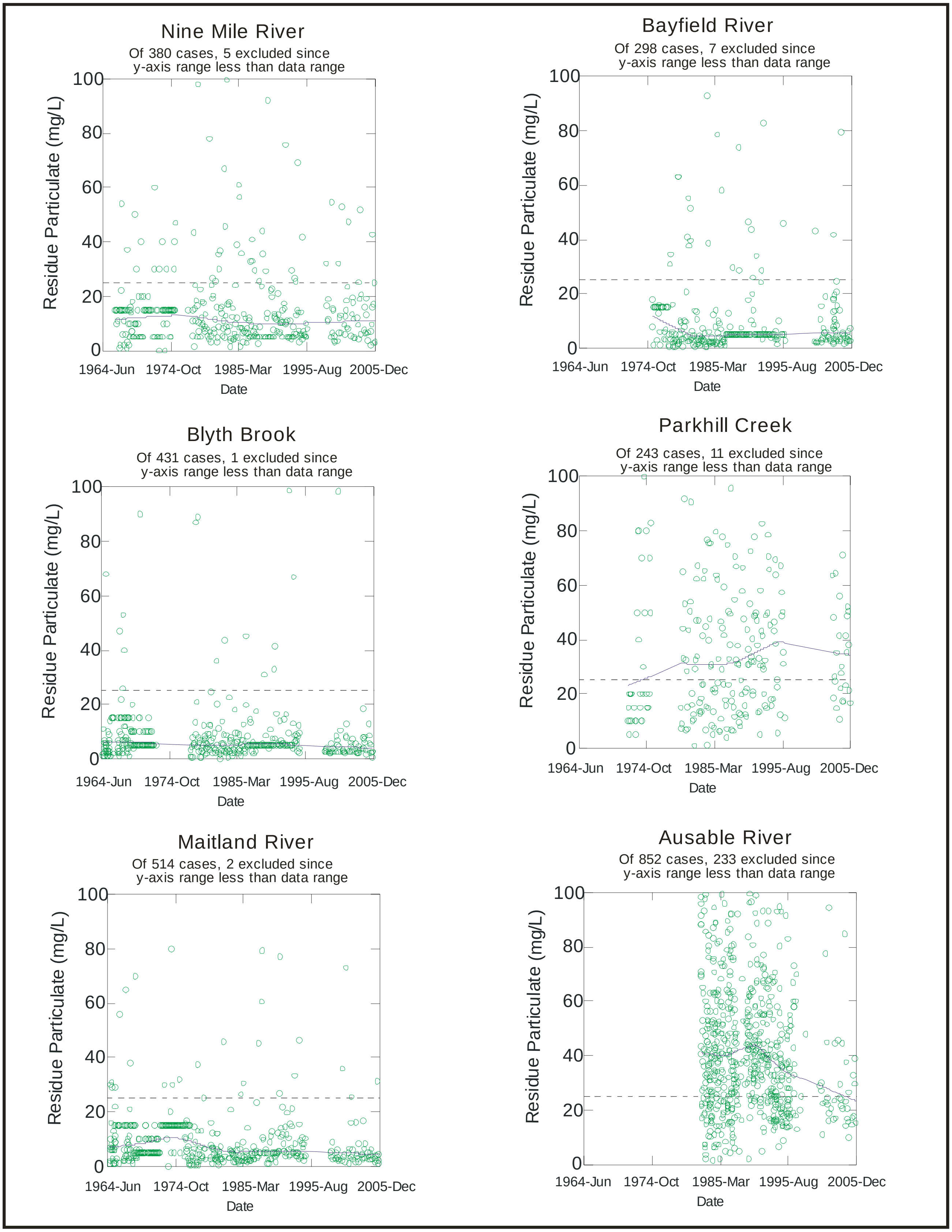

Figure 2-8: Residue Particulate concentrations in major watercourses in the Ausable Bayfield Maitland Valley Source Protection Region, 1964-2005

Bacteria

Fecal coliform were the indicator bacterium until 1995, with *E.coli* being used from 1994 to the present. The two are not directly comparable, but are sufficient to determine general trends for this analysis.

Bacteria concentrations have fluctuated, both within years and between years, but have no evident trends over the period of record for four of the six sites (Figure 2-9). The PWQO recreational guideline is shown for reference.

The Nine Mile River has an increasing trend in *E.coli* concentrations from the fecal coliform levels in the mid-nineties, but this could be due to more samples being collected since 2001 for the ACLA shoreline stream monitoring program. One other site that had a trend from the late seventies to early mid eighties was the Blyth Brook. It has been steady since that time.

Further work is required on the significance and presence of trends using methods appropriate for microbiology.

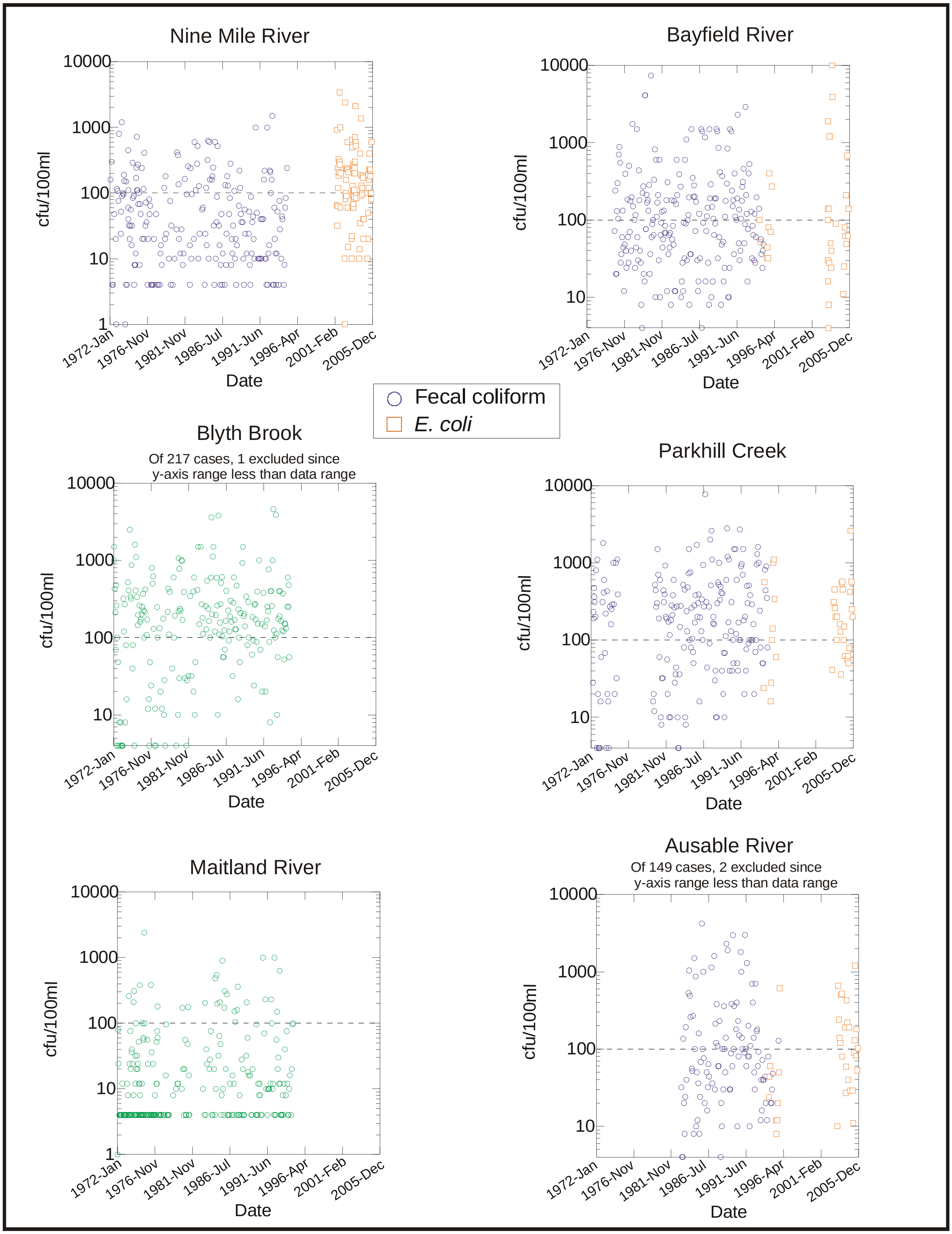

Figure 2-9: Bacteria concentrations in major watercourses in the Ausable Bayfield Maitland Valley Source Protection Region, 1972-2005

Fecal Coliform measured until 1994, *E.coli* from 1995 to present.

2.2.1.3 Spatial Trends

Spatial trends of current water quality are represented in map form and in statistical graph form. Forty-six water quality sites are compared for nitrate, total phosphorus and *E. coli* by grouping all data collected in the years 2001-2005. The details of the water quality data by site can be found in Table 2-4.

The maps have been prepared with the both the site concentration as well a delineating the contributing area to the sites based on the measured water quality data. These maps should be interpreted with caution, because for larger upstream areas there may be tributaries with different concentrations due to geology, point, and non-point source uses. This case is evident for the NMSalem site on the total phosphorus map.

Nitrate

Nitrate results are presented on WC Map 2-2, with the intervals for classifying the sites based on the summary statistics from pooling all the nitrate data. Box and whisker plots in Appendix C illustrate that for main branch watercourses, nitrate concentrations generally increase southward. The results reflect a continuum from more groundwater fed systems to more surface water systems and may also reflect changes in land management. The southern portion of the study area is characterized by:

Less forest cover

- Higher proportion of clay soils
- Increased proportion of agricultural land tile drained
- Increased drainage density
- Higher percentage of row cropping

Nitrate is identified as an issue in the area, with all branches except two having at least one site with a median concentration above the aquatic protection limit. The Nine Mile and Middle Maitland generally fall below the median. As well, the headwaters of the Middle Maitland and the lower branch of the Main Maitland median concentrations are below the aquatic protection limit.

The shoreline streams behave more uniformly since there is not the variation of natural watershed characteristics from north to south. The high concentrations of nitrate in headwater streams (portrayed in pink on WC Map 2-2) demonstrate the possible effects of higher drainage densities and the movement of nitrate. For a given volume of water, there is proportionally more land area in contact with the stream. The Blyth site clearly contrasts the differences between groundwater based streams and surface water streams. Of greatest concern is the Upper Bayfield site where the median is above the drinking water objective.

Total Phosphorus

Total phosphorus results are presented on WC Map 2-3. The maps and Appendix C plots highlight that for the 27 main branch watercourses, concentrations are generally similar and do not reflect an increase to the south as does nitrate concentration. This could be attributed to the dominant pathway of phosphorus being bound to soil particles, specifically clay particles. The sites that have median concentrations above the PWQO (Middle Maitland, Parkhill and Ausable) all have higher proportions of clay soil, and have higher percentages of row cropping, resulting in higher potential for soil erosion.

The 13 shoreline streams also behave more uniformly since the entire shoreline is of similar soil texture properties. The four watercourses that have medians above the PWQO may highlight areas with more severe erosion problems or a point source.

The higher concentrations of total phosphorus in headwater streams compared to main branch stations demonstrate the possible affects of higher drainage densities and the affects of dilution and/or in stream biological processes that cycle phosphorus.

Bacteria (E.coli)

E.coli results are presented on WC Map 2-4 for the sites. For main branch watercourses, concentrations are generally similar, with median concentrations at or slightly above the recreational PWQO. On the graphs in Appendix C, two sites stand out, the upper Middle Maitland River and Black Creek, which indicate the potential for more continual sources of *E.coli*. The similarity between the results highlights that the presence of indicator bacteria is not related to general watershed characteristics and the associated variation in water pathways.

The shoreline streams are generally similar, with median concentrations generally above the recreational PWQO. The watercourses that have higher medians and larger variance also appeared to have higher phosphorus concentrations. Headwater streams have higher concentrations, demonstrating the possible affects of higher drainage densities and the affects of dilution and/or die off of bacteria. Further examination of this relationship is necessary.

Table 2-4: Nitrate, total phosphorus and *E. coli* concentrations at current water quality monitoring sites in the Ausable Bayfield Maitland Valley Source Protection Region

Watershed / Site	Years	Nitrate as N (mg/l) n	median	25th	75th	max	Total Phosphorus (mg/l) n	median	25th	75th	max	*E.Coli* (cfu/100ml) n	median	geomean	25th	75th	max
Nine Mile River																	
Lucknow	01-05	41	1.25	1.06	1.80	6.23	41	0.021	0.018	0.03	0.088						
Port Albert	01-05	134	1.69	1.26	2.40	6.48	75	0.018	0.012	0.025	0.182	93	130	132	67.25	262.5	3400
Maitland River																	
North Maitland																	
Salem	05	14	6.13	5.76	7.97	13.90	14	0.012	0.009	0.02	0.412	13	1000	683	357.5	1900	7000
B-Line	04-05	16	2.95	1.78	4.56	8.61	16	0.013	0.011	0.019	0.033						
Little Maitland																	
Jamestown	01-05	41	4.26	2.19	6.83	9.17	41	0.024	0.02	0.035	0.1						
Middle Maitland																	
NE Listowel	04-05	29	6.16	1.80	7.99	14.00	29	0.071	0.043	0.099	0.294	27	1000	709	190	2200	10000
Trowbridge	01-05	41	2.51	0.55	6.68	10.20	42	0.06	0.035	0.084	0.206						
Wingham	04-05	17	4.67	2.46	7.16	10.70	17	0.025	0.019	0.036	0.137						
Middle Maitland Tributaries																	
Henfryn	01-05	41	6.11	1.20	9.66	14.80	41	0.044	0.027	0.076	0.184						
Beauchamp	04-05	17	4.81	3.71	7.36	9.52	17	0.031	0.021	0.073	0.17						
South Maitland																	
Summerhill	04-05	17	4.31	2.48	6.21	10.60	17	0.02	0.016	0.026	0.076						
Lower Maitland																	
Blyth East	04-05	28	3.22	2.46	3.92	7.17	28	0.037	0.028	0.05	0.343	27	280	261	102.5	890	6300
Blyth	01-05	42	3.64	2.34	4.82	10.10	42	0.032	0.023	0.043	0.081						
Zetland	01-05	41	4.31	1.83	6.26	9.74	41	0.024	0.017	0.033	0.102						
Benmiller	03-05	62	3.88	1.43	5.74	10.50	49	0.019	0.013	0.039	0.315	57	100	91	43.25	210	2400
Goderich	01-05	41	3.79	1.08	5.52	9.89	41	0.016	0.013	0.021	0.051						
Bayfield River																	
Upper Bayfield																	
Dublin	03-05	26	9.91	2.82	11.50	20.30	26	0.056	0.027	0.099	0.978	25	600	441	163	1325	4700
Silver Creek	05	8	3.71	2.80	6.38	9.15	8	0.018	0.014	0.024	0.094	8	157	111	70	255	320
Seaforth	03-05	26	7.01	1.76	9.36	17.60	26	0.026	0.017	0.04	0.144	26	385	323	150	660	2300
Lower Bayfield																	
Bannockburn	03-05	26	5.48	3.10	8.15	13.10	26	0.028	0.017	0.061	0.218	26	211	355	123	1000	50000
Steenstra	03-05	21	10.40	7.81	11.55	14.00	21	0.046	0.024	0.07	1.08	18	260	165	100	820	8200
Varna	01-05	60	6.70	3.28	9.30	14.40	60	0.03	0.016	0.053	0.611	26	71	105	28	210	10000
Parkhill Creek																	
Upstream Parkhill	03-05	26	6.07	2.60	9.50	14.30	26	0.082	0.048	0.113	0.401	26	175	171	80	410	2800
Downstream Parkhill	03-05	26	4.81	1.53	7.22	11.10	26	0.115	0.08	0.136	0.249	25	200	180	74.75	427.5	2600
Ausable River																	
Main Branch																	
Staffa	03-05	26	8.11	6.96	9.12	12.40	26	0.025	0.015	0.034	0.057	26	780	623	250	1600	7300
Exeter	01-05	41	6.73	3.43	9.00	14.30	41	0.101	0.059	0.16	1.17	25	200	120	68	290	720
Springbank	03-05	26	4.96	2.43	8.67	10.70	26	0.068	0.05	0.1	0.277	26	135	138	70	300	1600
Thedford	01-05	40	4.92	2.41	7.37	12.50	40	0.048	0.036	0.096	0.388	26	125	136	53	240	24000
Ausable Tributaries																	
Black	01-05	41	6.55	4.82	8.18	13.50	41	0.046	0.028	0.072	0.23	26	755	933	510	3800	11000
Nairn	03-05	26	4.75	3.86	7.06	11.40	26	0.019	0.011	0.029	0.088	26	185	130	51	380	1100
Decker	01-05	41	5.14	0.23	9.27	17.80	41	0.049	0.033	0.079	0.172	26	170	167	73	490	17000
Little Ausable																	
Huron Park	04-05	29	7.83	2.78	11.13	16.50	29	0.048	0.026	0.07	0.503	27	280	321	105	697.5	67000
Lucan	01-05	41	6.57	0.13	9.63	15.70	41	0.029	0.022	0.05	0.228	26	74.5	77	31	180	1700
Shoreline Watersheds (north to south)																	
Boyd	01-05	51	5.18	0.51	7.55	13.00	21	0.03	0.015	0.039	0.085	51	230	213	70	609	9500
Eighteen Mile	01-05	62	3.72	1.10	5.80	9.79	31	0.028	0.018	0.042	0.143	62	256	226	76	540	7700
Kintail	01-05	63	0.50	0.10	4.27	11.30	33	0.13	0.039	0.221	0.333	63	240	208	62.5	688	17000
Kerrys	01-05	99	3.60	1.67	6.35	13.10	55	0.027	0.018	0.061	0.36	97	280	244	86	712.5	12000
Kingsbridge	01-05	57	5.07	0.20	7.13	13.50	30	0.09	0.034	0.144	0.327	57	480	536	207.5	1550	17000
Griffins	01-05	69	1.60	0.20	6.92	19.40	39	0.106	0.038	0.163	0.501	68	569	544	210	1610	20000
Midhuron	01-05	61	2.10	0.20	6.78	13.90	33	0.067	0.032	0.168	0.721	61	240	269	88.5	835.5	5500
Boundary	01-05	77	2.81	0.54	4.42	13.50	33	0.041	0.028	0.086	0.6	77	360	314	100	857.5	11000
Bogies	01-05	63	2.87	0.34	5.83	11.00	33	0.03	0.019	0.047	0.253	63	105	146	49.25	397.5	42000
Allans	01-05	63	4.30	3.15	5.89	12.10	33	0.027	0.018	0.041	0.708	61	170	213	97.75	472.5	39000
Zurich	03-05	19	5.18	3.35	6.87	13.20	26	0.036	0.025	0.071	0.197	26	274	236	87	610	22000
Desjardine	03-05	25	4.30	0.44	7.85	14.00	25	0.034	0.018	0.044	0.145	25	110	156	45.75	570	25000
Port Franks	03-05	26	5.85	0.20	12.20	21.00	26	0.056	0.039	0.097	0.201	26	110	117	55	220	2000

Some sites have not been sampled for the entire period. Refer to the Years column.
The watersheds have been ordered from north to south, sites within each watershed ordered from upstream to downstream.

(light yellow) result exceeds the CCME Guideline of 2.93 mg/l nitrate as N, or the PWQO of 0.03 mg/l of total phosphorus or 100 cfu/100ml for *E.coli*

(orange) result exceeds the Ontario Drinking Water Standard of 10 mg/l nitrate as N

2.2.1.4 Riverine Water Quality Summary

The surface water quality in the Ausable Bayfield Maitland Valley Source Protection Region reflects traditional rural non-point source issues of nitrogen, phosphorus and bacteria. More urban contaminates such as chloride and copper are not present in concentrations above the PWQO.

Nitrogen, in the form of nitrate, is an issue throughout the area where the majority of water sampling sites outside of the Nine Mile River have at least 50 percent of the samples above the aquatic protection limit. There is a general trend for nitrogen concentrations to increase in watercourses, progressing from north to south, reflecting the shift from more groundwater fed systems to surface water systems. Headwater streams have particularly high concentrations of nitrate indicating that solutions should be aimed at the lower order stream watercourses. A focus for improvements should be applied to the Bayfield River and Parkhill Creek, and to a lesser extent the Ausable River, since the nitrate trend is still increasing. Nitrogen in the form of nitrite, while toxic, is not generally present in surface water and may indicate major degradation. High nitrite concentrations found in Black Creek, Boyle Drain and the Middle Maitland River require further investigation.

Phosphorus concentrations are not high throughout the area, with almost half of the sites having median concentrations below the PWQO. Areas requiring improvement are Parkhill Creek, Middle Maitland River, and to a lesser degree the Bayfield and Ausable Rivers. As well, four shoreline watercourses (Kintail, Kingsbridge, Griffins and at Mid Huron Beach) should also be the focus of improvements.

Bacteria concentrations (*E.coli)* are elevated throughout the area with over 85 percent of the sites having median concentrations above the recreational PWQO. Of particular concern are the upper Middle Maitland River, Black Creek, Kingsbridge and Griffins Creek. At these locations, it would seem as though there is a potential point-source of contamination. There is some indication that the smaller watercourses have higher concentrations, indicating that efforts to improve conditions could be focused at the low order stream watercourses where drainage densities are higher and flows are normally lower.

Heavy metals are elevated to concentrations of concern in some watercourses in the area, and there appears to be a relationship with WWTP discharge locations. Aluminium, cadmium and lead should be explored further for bioavailability. Decker Creek, Black Creek and the Middle Maitland around Trowbridge should be explored further with respect to sources.

2.2.2 Lake Huron

The intent of this section is to summarize trends in the concentrations of total phosphorus (TP), nitrate, chloride, and *E. coli* for two local Lake Huron water intake plants: Goderich and Port Blake (also recognized as the Grand Bend Facility or the Lake Huron Water Supply). Refer to WC Map 2-1 for intake locations.

2.2.2.1 Temporal Trends

Overall, the concentrations of total phosphorus, nitrate, chloride and *E. coli* were greater at the Goderich Water Intake Facility compared to the Port Blake Intake Facility (Table 2-5, and

Figures 2-10 through 2-13). Further, trends in the nutrients (TP and nitrate) over the past 30 years appeared to be similar at the two facilities. Exploratory analyses suggest a decrease in TP concentrations since the 1970s and potentially increasing nitrate concentrations at both locations since 1976. The following discussion focuses on the comparison of TP, nitrate, chloride, and *E. coli* concentrations at the Lake Huron water intake facilities to standards established by the Ontario Ministry of the Environment (Provincial Water Quality Objective – PWQO) and the Canadian Council of Ministers of the Environment (CCME) (Canadian Water Quality Guideline – CWQG).

Table 2-5: Summary of water quality data from the water intake plant in Goderich and Port Blake in Lake Huron (1976 to 2004). (PWQO – Provincial Water Quality Objective and CWQG – Canadian Water Quality Guideline)

Facility	Total Phosphorus (mg L^{-1}) PWQO = 0.02 mg L^{-1}	Nitrate (mg L^{-1}) DRAFT CWQG = 2.93 mg L^{-1}	Chloride (mg L^{-1}) CWQG =250 mg L^{-1}
Goderich			
n	1384	1388	1390
median	0.018	0.58	8.5
range	0.00 – 0.380	0.00 – 6.36	0.00 – 33.50
90th percentile	0.07	1.80	13.70
Port Blake			
n	1104	1105	1107
median	0.012	0.30	6.50
range	0.00 – 0.16	0.00 – 3.70	4.50 -18.50
90th percentile	0.03	0.67	7.50

Phosphorus

The median TP concentration at the Goderich Water Intake Facility (median = 0.018 mg L^{-1} over the past nearly 30 years) is similar to the Interim Provincial Water Quality Objective for TP (IPWQO = 0.02 mg L^{-1} for lakes) (Figure 2-10). The Provincial Objective was established to prevent eutrophication in lentic systems. The median TP concentration at the Port Blake Intake Facility between 1976 and 2004 was significantly lower than at Goderich (median = 0.012 mg L^{-1}; Mann-Whitney U statistic 988358.5; $p < 0.001$). However, the median concentration at the Port Blake Intake Facility is in the range of concentrations that would be considered to contribute to nearshore nutrient enrichment conditions (i.e., the 90th percentile = 0.03 mg L^{-1}).

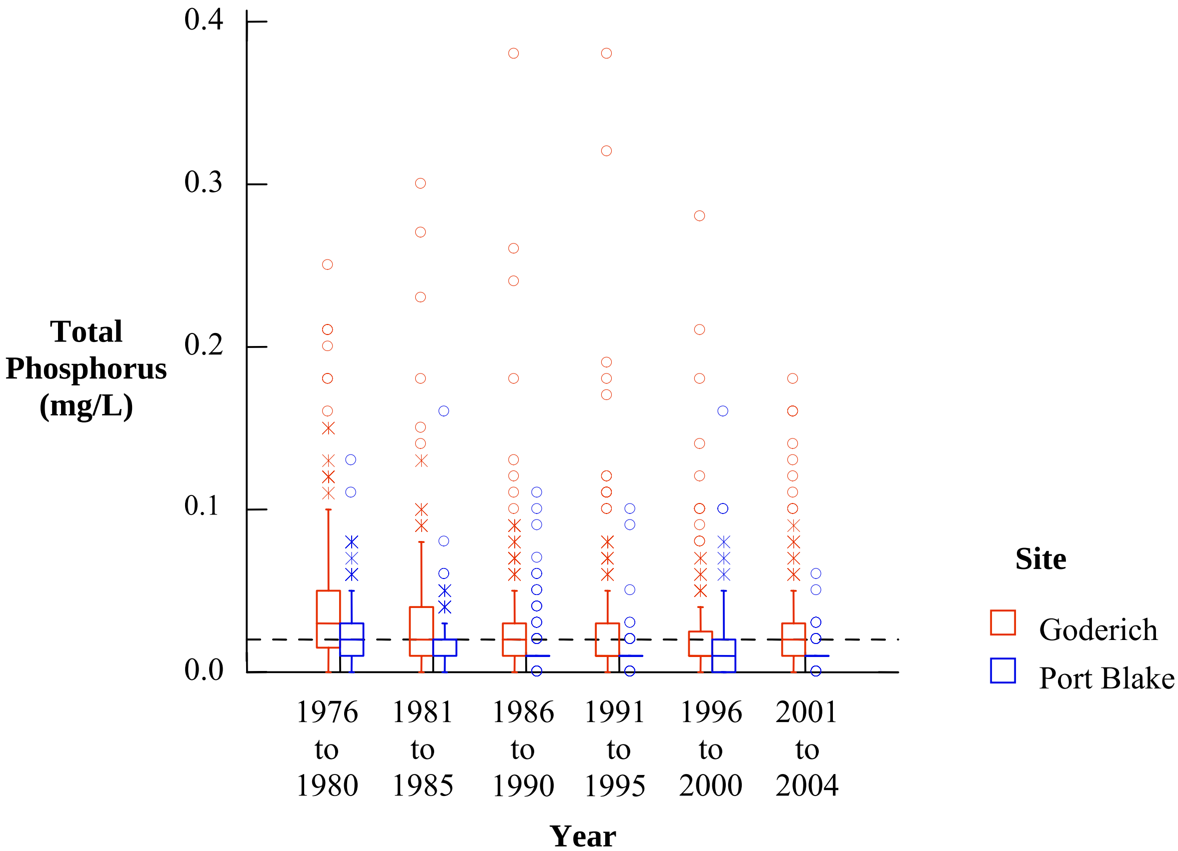

Figure 2-10: Total phosphorus concentrations (mg L^{-1}) at Goderich and Port Blake Water Intake Facilities (1976 to 2004)

The PWQO to prevent eutrophication in lakes (0.02 mg L^{-1}) is indicated with a dashed line.

Nitrate

Between 1976 and 2004, the median nitrate concentration at the Goderich Water Intake Facility was 0.58 mg L^{-1}. Concentrations of nitrate at the Goderich Facility are in the range of concentrations that would be considered to contribute to nearshore nutrient enrichment conditions (i.e., the 90th percentile = 1.80 mg L^{-1}). The Canadian Council of Ministers of the Environment (2002) suggested that nitrate concentrations above 0.9 mg L^{-1} were generally associated with eutrophic conditions (algae and macrophyte blooms, shortened food chains and changes in the aquatic community). Nitrate concentrations at the Goderich station rarely exceeded a water quality objective of 2.93 mg L^{-1} (Figure 2-11 the draft Canadian Water Quality Guideline for the protection of aquatic life from direct toxic effects; CCME 2002) and never exceeded the drinking water guideline of 10 mg L^{-1} (CCME 1978). Nitrate concentrations at the Port Blake Facility (median = 0.34) were significantly lower than at the Goderich Facility (Mann-Whitney U Test Statistic 11933230; p <0.001), between 1976 and 2004.

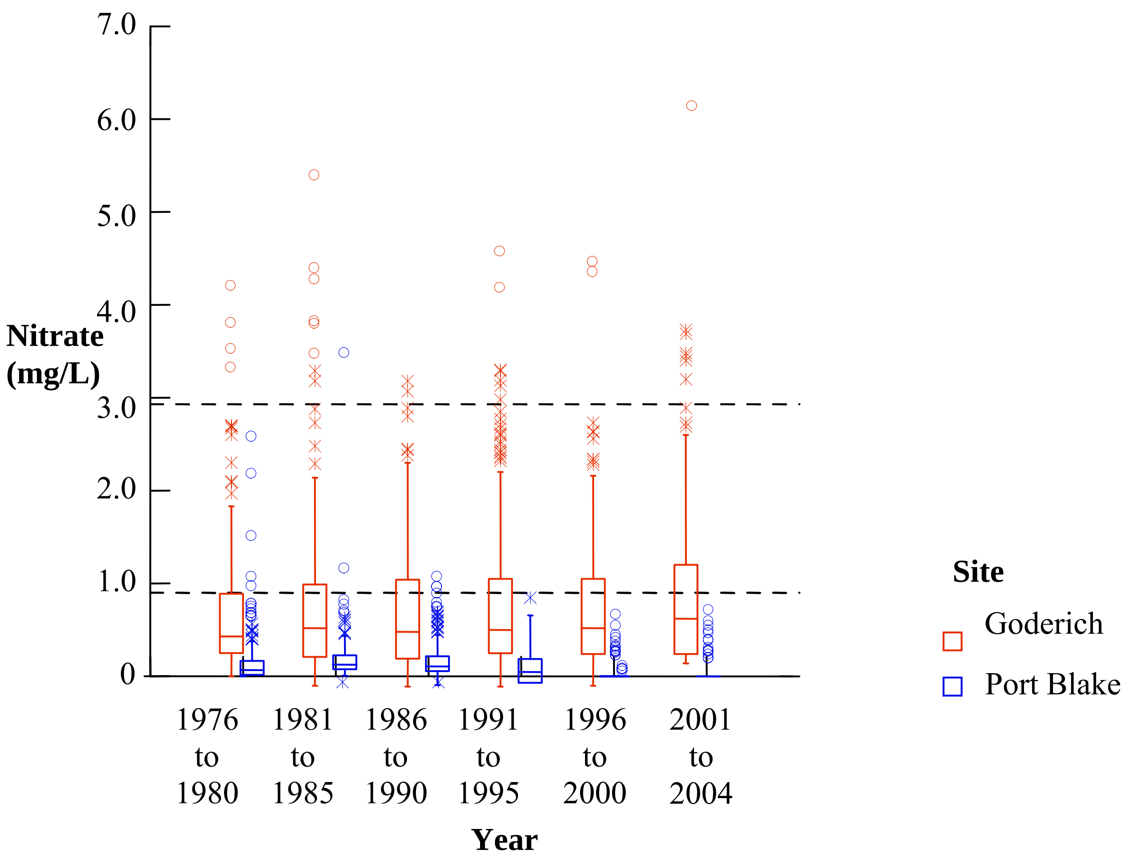

Figure 2-11: Nitrate concentrations (mg L^{-1}) at Goderich and Port Blake Water Intake Facilities (1976 to 2004)

The Canadian Council for Ministers of the Environment (CCME) standard to prevent eutrophication (0.9 mg L^{-1}) and the CCME draft guideline for the protection of aquatic life (2.93 mg L^{-1}) are indicated with dashed lines.

Chloride

The median chloride concentrations at both the Goderich and Port Blake Facilities were substantially below the Canadian guideline (Figure 2-12). Between 1976 and 2004, the median concentration at the Goderich Facility (8.5 mg L^{-1}) was higher than the median concentration at the Port Blake Facility (median = 6.5 mg L^{-1}; Mann-Whitney U Statistic 12999734.5; $p < 0.001$).

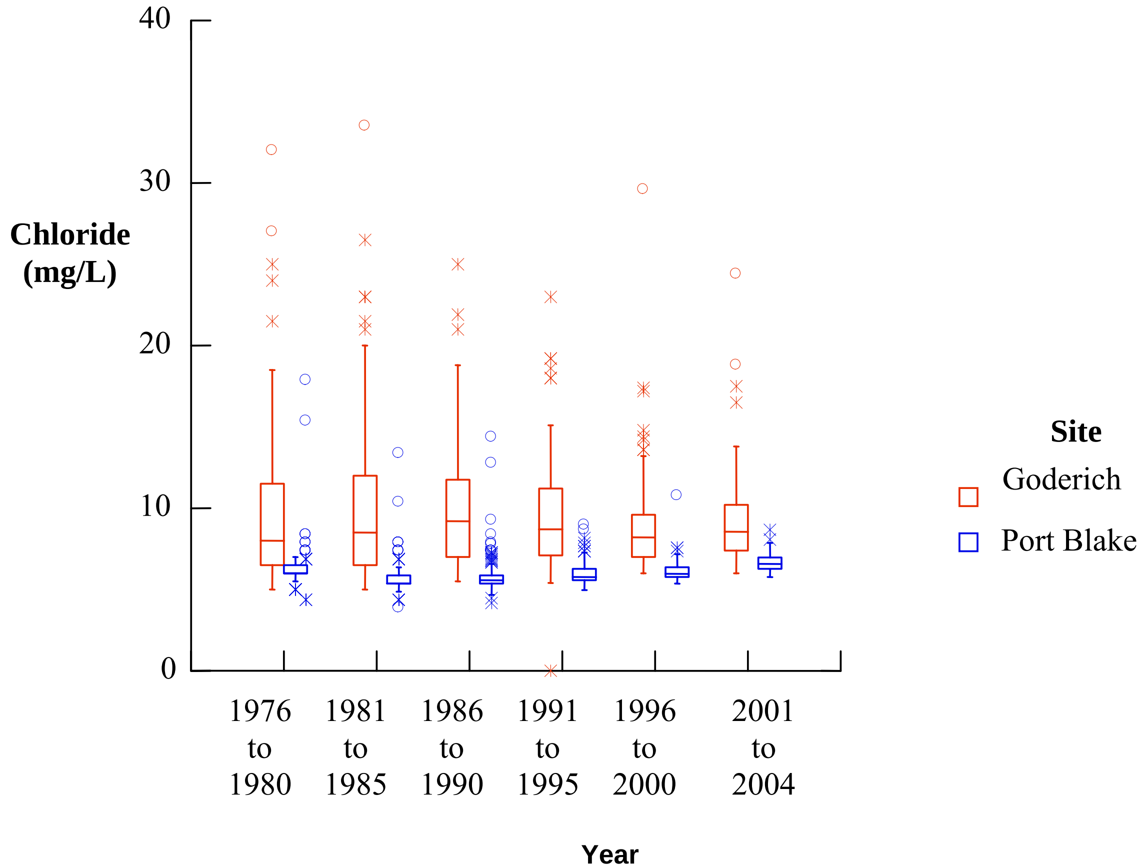

Figure 2-12: Chloride concentrations (mg L^{-1}) at Goderich and Port Blake Water Intake Facilities (1976 to 2004)

The Canadian drinking water guideline is 250 mg L^{-1} (Canadian Council for Ministers of the Environment 1999).

Bacteria

Bacterial contamination most likely poses a greater risk to water intakes in Lake Huron compared to nutrient and sediment concentrations, as discussed above. A recent report prepared by the Ministry of Environment (Howell et al. 2005) analyzed the Huron County Health Unit beach water data collected between 1993 and 2003. Over this period, the median *Escherichia coli* (*E.coli*) concentration at the beaches sampled was between 50 and 100 cfu/100 mL. The recreational water quality guideline of 100 cfu/100 mL was exceeded approximately 25 per cent of the sampling opportunity. The analysis of the Huron County Health Unit data highlighted the current understanding of bacteria in the nearshore of Lake Huron, however, it did not provide drinking water related information. The determination of *E.coli* concentrations from the raw water at the Lake Huron water intake plants is a recent undertaking and the analysis that follows is also preliminary.

Table 2-6: Summary statistics of *Escherichia coli* (*E. coli*) concentrations in raw water samples collected for the water intake plants in Goderich and Port Blake in Lake Huron (2005 to September 2006)

Facility	*n*	median	Count if >"0"	Count if = "0"	Range	90^{th} percentile
Goderich	92	4	73 (79%)	19 (21%)	0-700	42
Port Blake	349	0	14 (4%)	335 (96%)	0-100	0

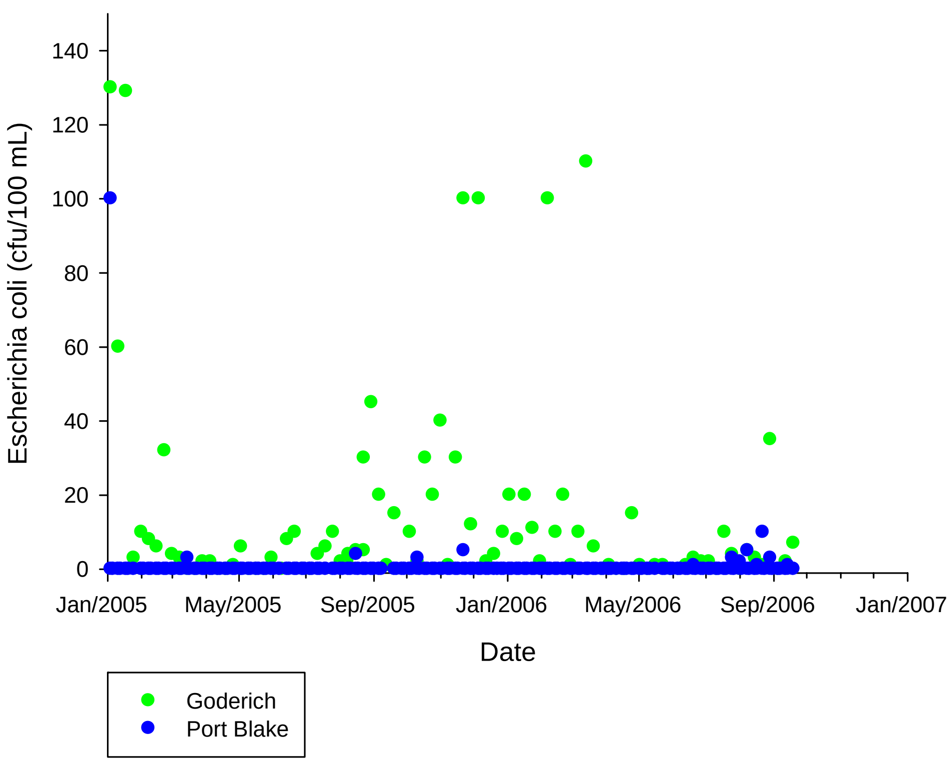

Figure 2-13*: Escherichia coli* concentrations in raw water samples collected for the Lake Huron intakes at the Goderich and Port Blake Water Treatment Facilities (2005 to 2006)
One value (y=700) missing from the Goderich Facility data (September 27, 2005)

Raw water concentrations of the fecal waste indicator organism, *E. coli*, were typically low at both water intake facilities. Concentrations of *E. coli* in the raw water samples did however, exceed the Ontario Drinking Water Standard (ODWS = 0 *E. coli* cfu/100 mL) at both locations on more than one occasion. The frequency with which the ODWS was exceeded was greater at the Goderich Facility compared to that number for the Port Blake Facility (Table 2-6 and Figure 2-13). Further, the raw water concentration of *E. coli* was greater at the Goderich Facility (median *E.coli* concentration = 4 cfu/100mL) compared to the raw water concentration of *E. coli* at the Port Blake Facility (median *E. coli* concentration = 0 cfu/100mL; Mann-Whitney U statistic 28331.5; $p < 0.001$). Although, the raw water is treated within both treatment facilities the raw water at the Goderich Facility had higher concentrations of *E.coli* more frequently than did the Port Blake Facility.

2.2.2.2 Lake Huron Intake Summary

The median concentrations of the nutrients examined in this section (TP and nitrate) at the Goderich Facility are in the range of contributing to eutrophic conditions in the nearshore of Lake Huron and were nearly twice the median concentrations at the Port Blake Facility. The median concentration of chloride and the concentration of *E. coli* are also higher at the Goderich Facility compared to the Port Blake Facility. Although both intakes are located in the nearshore environment of Lake Huron, the Goderich Facility is directly within the zone of influence of a tertiary tributary, the Maitland River. More work is needed to understand the plume, of this river and its effects on nearshore nutrient and bacteria enrichment.

2.2.3 Groundwater

This section is intended to discuss the ambient water quality of aquifers throughout the Ausable Bayfield Maitland Valley Source Protection Region. The baseline groundwater quality for these aquifers was defined in order to provide a basis for developing sound Source Protection activities. This section is preliminary in nature, and reflects the best available data at the time of writing.

It is important to note that these analyses were not tested statistically. Due to the small number of data points, these results should not be used to characterize the entire aquifer, as there can be marked differences between wells within like aquifers with respect to groundwater quality. Furthermore, the data is not of sufficient length to evaluate trends in aquifer water quality. Aquifer complexes are displayed on CWB Map 12 associated with the Conceptual Water Budget.

2.2.3.1 Overburden Aquifers

Howick

The Howick Aquifer complex is located within a large area glacial outwash and kame moraine in and around the Township of Howick. Within this area, numerous overburden wells are exploiting this shallow groundwater resource. Two wells were selected for analysis from the Howick Aquifer and are listed in Table 2-7.

Table 2-7: Representative samples for the Howick Aquifer complex

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Lakelet A* n=1	0	233	0.44	3.2	1	1.78	0
Lakelet B* n=1	0.23	275	0.1	3.0	5	0.23	0

* PGMN Well – 2004 Sampling

Analysis of these results indicates that groundwater quality in the Howick Aquifer is of excellent quality, with no exceedances for any health related indicators and only two exceedances of aesthetic objectives for iron. Furthermore, the groundwater quality analyses in the Howick Aquifer indicate high quality with respect to other aquifers in the Ausable Bayfield Maitland Valley Source Protection Region, with acceptable concentrations of hardness, fluoride, chloride, and sodium, and lack of any *E.coli* results. Nitrates reported in Lakelet B may be the consequence of influence from surface water, but are at very low concentrations and are not considered a significant issue at this time.

Wyoming

The Wyoming Aquifer complex is associated with the large Wyoming moraine which runs in a north south orientation, and crosses the entire study area just east of the present day Lake Huron shoreline. Within this area, numerous overburden wells are exploiting several distinct shallow groundwater resources. Wells have been identified which can be considered representative of the Wyoming Aquifer exclusively, however, caution should be used when interpreting this data as these wells are spread widely apart and are not likely hydraulically connected. Three wells were selected for analysis from the Wyoming Aquifer and are listed in Table 2-8.

Table 2-8: Representative samples for the Wyoming aquifer complex

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Kinloss* n=1	0.17	373	0.44	1.5	3	0	0
Parkhill* n=1	0	97	1.59	47.9	3	0.36	0
Rock Glen* n=1	0	422	0.63	17.8	67	0.23	0

* PGMN Well – 2004 Sampling

Analysis of these results indicates that groundwater quality in the Wyoming Aquifer is of good quality, with exceedances for the lower, health-related ODWS for sodium and for fluoride. There are also exceedances of aesthetic objectives for iron and hardness. Elevated sodium and chloride values in the Rock Glen well may be indicative of some contamination via road salt in this area. Nitrates reported in the Kinloss well may be the consequence of influence from surface water, but are at very low concentrations and are not considered a significant issue at this time.

Hensall

The Hensall Aquifer complex is an intermediate overburden aquifer located directly below and in the vicinity of the community of Hensall. Within this area, numerous overburden wells are exploiting the intermediate groundwater resource. Two wells were selected for analysis from the Hensall Aquifer but the data for these wells was not released by January 2007 for the production of this report.

The Hensall Aquifer was studied in some detail within the Groundwater Quality Assessment completed on 2001 for Huron County (Golder Associates 2001). This report identified six clusters of private domestic wells which were sampled for a comprehensive suite of indicators and one of the clusters focussed on the Hensall Aquifer.

Within this cluster (labelled M6 in the report) groundwater quality was found to be moderate. Of the 30 wells which were sampled in the cluster, 13 exceeded the ODWS for total coliform and three for *E.coli*, which may reflect the more typical and less secure practice of using bored wells for shallow aquifers rather than the quality of the aquifer itself. One sample exceeded the ODWS for nitrates, with several showing elevated concentrations in the aquifer. Iron continues to be a problem with 18 of 30 wells testing above the aesthetic drinking water objective, but all within the plausible range of naturally occurring groundwater. There were no exceedances detected for sodium. The samples were also analyzed for a more comprehensive suite, including hydrocarbons, volatile organics and pesticides, of which no significant amounts were detected.

Locating and identifying monitoring sites and historical data for the Hensall Aquifer should be a priority for future reporting and monitoring.

Holmesville

The Holmesville Aquifer complex is associated with the large glacial outwash deposit that sits between the Wyoming and Wawanosh moraines. This deposit runs the length of the Ausable Bayfield Maitland Source Protection Region in a north south orientation. Within this area, numerous overburden wells are exploiting shallow groundwater resources and springs. Wells have been identified which can be considered representative of the Holmesville Aquifer exclusively, however, caution should be used when interpreting this data as these wells are spread widely apart and may not be hydraulically connected. Four wells were selected for analysis from the Holmesville Aquifer and are listed in Table 2-9.

Table 2-9: Representative samples for the Holmesville aquifer

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Hay #1* n=1	0	235	0.73	1.4	2	0.87	0
Hay #2* n=1	0	266	0.25	1.4	4	0.28	4
Hay #3* n=1	0	590	0.37	1.9	3	3.80	0
Tricks TR9* n=1	0.9	322	0	4.6	15	0	0

* PGMN Well – 2004 Sampling

Analysis of these results indicates that groundwater quality in the Holmesville Aquifer is of good quality, with exceedances of aesthetic objectives for iron and hardness. *E.coli* was also found in one of the wells in very low numbers and should be confirmed. Nitrates reported in the Tricks (TR9) well may be the consequence of influence from surface water, but are at very low concentrations and are not considered a significant issue at his time. This well also displays unusually high hardness and iron values. The hardness values are within a plausible range for naturally occurring groundwater, but are well above expected concentrations for an overburden aquifer. The unusually high iron values are likely attributed to some form of contamination, although at this time the source of that contamination cannot be determined.

North Lambton

The North Lambton Aquifer complex is a shallow overburden aquifer located in northern part of Lambton County adjacent to Lake Huron. Within this area, numerous overburden wells are exploiting the shallow groundwater resource. Three wells were selected for analysis from the North Lambton Aquifer and are listed in Table 2-10.

Table 2-10: Representative samples for the North Lambton Aquifer

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Museum* n=1	0	234	0.15	3.2	10	0.84	0
PP10**	0.21	195	0.14	13.4	12	0.06	n/s
PP19**	0.14	205	0	0.8	2	0	n/s

* PGMN Well – 2004 Sampling, **ABCA North Lambton Study - 2004

Wells PP10 and PP19 were initially analyzed in 1999 and 2001 as part of Master's Thesis completed at the University of Western Ontario, and were subsequently sampled in 2001 for the Town of Bosanquet Study of Rural Water Quality in which they were sampled for microbiology and nitrates. They were again analyzed in 2004 as part of the ABCA North Lambton Aquifer characterization project for a more comprehensive suite of parameters using the PGMN protocols for sampling and analysis.

The Town of Bosanquet Study of Rural Water Quality, completed in 2001, found that 12 of 128 dug wells into the overburden aquifer had adverse bacteria results, which more likely reflects wellhead practice than actually aquifer quality. In addition, 46 of 128 wells had elevated nitrate concentrations, with 5 over the ODWS for nitrates.

Analysis of the results shown in Table 2-17 support results of the Town of Bosanquet Study that groundwater quality in the North Lambton aquifer is of moderate quality, with nitrates reported in two wells, and elevated concentrations of sodium and chloride which may indicate influence from surface water. These indicators are at low concentrations and are not considered a significant issue at this time. This well also displays unusually high hardness and iron values. The typically high iron values are likely naturally occurring.

Seaforth

The Seaforth Aquifer complex is an overburden aquifer located within the Seaforth moraine and a small glacial outwash plain located on its western flank. Within this area, numerous overburden wells are exploiting the shallow groundwater resource through dug wells. No wells could be found for analysis within the Seaforth Aquifer.

The Seaforth Aquifer was studied in some detail within the Groundwater Quality Assessment completed on 2001 for Huron County (Golder Associates 2001). This report identified six clusters of private domestic wells which were sampled for a comprehensive suite of indicators and one of the clusters focussed on the Seaforth Aquifer.

Within this cluster (labelled P1 in the report) groundwater quality was found to be poor. Of the 29 wells which were sampled in the clusters, 23 exceeded the ODWS for total coliform or *E.coli*, which may reflect the more typical and less secure practice of using bored wells for shallow aquifers rather than the quality of the aquifer itself. One sample exceeded the ODWS for nitrates, with several showing elevated concentrations in the aquifer. Iron is also a problem with 4 of 29 wells testing above the aesthetic drinking water objective, but all within the plausible range of naturally occurring groundwater. There were no exceedances detected for sodium. The samples were also analyzed for a more comprehensive suite, including hydrocarbons, volatile organics and pesticides, of which no significant concentrations were detected. Two samples had detectable amounts of hydrocarbons, eight with detectable (but very low) concentrations of trihalomethanes (THM) and three with detectable (but also very low) concentrations of perchloroethylene (PCE). Three samples also detected trace amounts of some organochlorine pesticides.

2.2.3.2 Bedrock Aquifers

Salina

The Salina formation subcrops as a narrow strip on the eastern fringe of the Ausable Bayfield Maitland Valley Source Protection Region. Three wells were selected for analysis from the Salina formation and are listed in Table 2-11.

Table 2-11: Representative samples for the Salina Aquifer

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Harriston-2*	0	n/s	1.1	7.56	n/s	n/s	0
Harriston-3*	0	n/s	0.73	11.8	n/s	n/s	0
Harriston** n=1	0.54	325	0.1	3.2	4	0.67	0

* Municipal Well Data – 2004, ** PGMN Well – 2004 Sampling

Analysis of these results indicates that groundwater quality in the Salina is of good quality, with no exceedances for any health related indicators and only two exceedances of aesthetic objectives for hardness and iron. The other analyses demonstrate that the aquifer is not under the influence of surface water as indicated by the general lack or low concentrations of nitrates and the high iron and hardness values. Furthermore, the groundwater quality analyses in the Salina are of high quality with respect to other bedrock aquifers in the Ausable Bayfield Maitland Valley Source Protection Region, with acceptable concentrations of fluoride, chloride, and sodium and a lack of any *E.coli* results.

Bass Islands

The Bass Islands formation subcrops as a narrow strip on the eastern fringe of the Ausable Bayfield Maitland Valley Source Protection Region immediately west of the underlying Salina

Formation. Three wells were selected for analysis from the Bass Islands formation and are listed in Table 2-12.

Table 2-12: Representative samples for the Bass Islands aquifer

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Palmerston #1*	0.3	n/s	0.27	16.9	n/s	n/s	0
Palmerston #2*	0.3	n/s	0.31	13.3	n/s	n/s	0
Palmerston #3*	0.3	n/s	0.23	8.6	n/s	n/s	0

* Municipal Well Data - 2004

Based on the available data, analysis of these results indicates that groundwater quality in the Bass Islands is of good quality with no exceedances in any indicators. The presence of low concentrations of nitrates is not considered to be a concern at present, but warrants attention for any long term sampling programs to ensure that concentrations are not increasing over time. Sodium concentrations are within the accepted naturally occurring level for bedrock aquifers in the Ausable Bayfield Maitland Valley Source Protection Region, but are approaching the lower ODWS for persons with hypertension (20 mg L^{-1}) and should be monitored carefully. The relatively low concentrations of fluoride can be considered a characteristic quality for the Bass Islands Aquifer.

Bois Blanc

The Bois Blanc formation subcrops as a narrow strip on the eastern fringe of the Ausable Bayfield Maitland Valley Source Protection Region immediately west of the underlying Bass Islands Formation. Three wells were selected for analysis from the Bois Blanc formation and are listed in Table 2-13.

Table 2-13: Representative samples for the Bois Blanc Aquifer

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Gowanstown*	0	n/s	0.6	11.1	n/s	n/s	0
Gowanstown Mun. Office*	0	n/s	0.4	9.7	n/s	n/s	0
Milverton*	0	n/s	0.56	8.9	n/s	n/s	0

* Municipal Well Data - 2004

Based on the available data, analysis of these results indicates that groundwater quality in the Bois Blanc is of good quality with no exceedances in any indicators. Nitrate, fluoride and sodium concentrations are within the accepted naturally occurring level for bedrock aquifers in the Ausable Bayfield Maitland Valley Source Protection Region. The relatively low concentrations of fluoride, nitrates and sodium can be considered characteristic for the Bois Blanc Aquifer.

Lucas

The Lucas formation, of the Detroit River Group, subcrops throughout a large portion of the Ausable Bayfield Maitland Valley Source Protection Region and is the most commonly exploited aquifer in the area. The Lucas formation overlies the Bois Blanc Formation throughout and has been the subject of numerous recent investigations into karst development in the study area. Many wells which are drilled into the overlying Dundee formation extend into the Lucas Formation due to the high yields and generally high quality of the Lucas formation.

For this report, wells have been identified which can be considered representative of the Lucas exclusively, and therefore do not extend through the overlying Dundee Formation or into the underlying Bois Blanc Formation. Wells in karst areas thought to be directly connected to surface water were also excluded and will be discussed in a future section dealing with vulnerable areas. Five wells were selected for analysis from the Lucas Formation and are listed in Table 2-14.

Table 2-14: Representative samples for the Lucas Aquifer

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Atwood* n=1	2.24	302	0.48	9.8	11.0	0.58	0
Amberley* n=1	0	300	2.32	13.0	5.0	0.254	n/s
Grey Twp* n=1	0.3	242	1.72	12.3	4.0	0.29	0
Pollard* n=1	0	n/s	1.58	n/s	0.4	0.671	n/s
Seaforth* n=1	0.1	403	1.47	169.0	361.0	0.1	0

* PGMN Wells – 2004 Sampling

The Lucas Formation was studied in some detail within the Groundwater Quality Assessment completed on 2001 for Huron County (Golder Associates 2001). This report identified six clusters of private domestic wells which were sampled for a comprehensive suite of indicators and three of these clusters focused on the Lucas formation.

Within these three clusters (labelled M3, M4 and M5 in the report) groundwater quality was generally found to be good. Of the 88 wells which were sampled in the three clusters, only two exceeded ODWS for nitrate and *E.coli*, none exceeded the ODWS for sodium. The samples were also analyzed for a more comprehensive suite, including hydrocarbons, volatile organics and pesticides, of which none were detected. The key groundwater quality issue identified in this report was iron, with 48 of 88 wells testing above the aesthetic drinking water objective.

Based on the data in Table 2-14, analysis of these results supports the findings of the Huron County Groundwater Quality Assessment (2001) that groundwater quality in the Lucas aquifer is of good quality with exceedances reported only in the naturally occurring indicators of hardness, fluoride and iron. Nitrates, reported in the Atwood PGMN well located in an area of thin overburden, may be indicative of influence from surface water. Sodium concentrations through the whole of the aquifer appear to be within expected ranges for natural groundwater, with the exception of the Seaforth PGMN well. This well is also elevated in chloride indicating contamination from salt as a likely source of elevated sodium concentrations, and is located in an area of historic brine well operation and may be associated with cross contamination via improperly decommissioned brine wells.

High concentrations of fluoride are a distinctive feature of groundwater from the Lucas Formation. Water quality analyses from the Lucas Formation are consistently above ODWS. In fact, the discovery of the ability of fluoride enriched water to reduce tooth decay was made in Ripley, Ontario, just north of the Ausable Bayfield Maitland Valley Source Protection Region, in wells that are exploiting the Lucas Formation for drinking water.

Another locally significant and unusual feature of groundwater quality in the Lucas formation is the presence of radiogenic isotopes. Unusually high concentrations of uranium and radium as well as dissolved radium gas have been identified in wells in the Seaforth area which exploit the Lucas Formation for drinking water. These isotopes are naturally derived and are not considered a long term health threat.

Dundee

The Dundee formation subcrops throughout the southwestern portion of the Ausable Bayfield Maitland Valley Source Protection Region and is the second most commonly exploited aquifer in the area. The Dundee formation overlies the high yielding Lucas Formation and as a consequence, many wells which are drilled into the Dundee formation extend into the Lucas Formation. The Dundee Formation, nevertheless, is a large scale aquifer of importance for the region. Four wells were selected for analysis from the Dundee formation and are listed in Table 2-15. Well, NL-2 was drilled as part of the ABCA North Lambton Aquifer characterization study and was sampled as part of that program according to the protocols established in the PGMN.

Table 2-15: Representative samples for the Dundee Aquifer

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Shipka* n=1	0	77.3	1.75	76.4	4	0.1	0
Tricks* n=1	0	101	1.7	21.9	1	0.6	0
Godboldt* n=1	0	227	1.64	7.3	3	0.1	0
NL2**	0	261	1.43	291	343	0.35	0

* PGMN Wells – 2004 Sampling, **ABCA North Lambton Study - 2004

The Dundee Formation was studied in some detail within the Groundwater Quality Assessment completed on 2001 for Huron County (Golder Associates 2001). Of the six clusters, one is focused primarily on the Dundee formation. Within this cluster (labelled P2 in the report) groundwater quality was generally found to be good. Of the 30 wells which were sampled in the three clusters, only 7 exceeded ODWS for total coliform or *E.coli*, and none exceeded the ODWS for sodium or nitrates. The samples were also analyzed for a more comprehensive suite, including hydrocarbons, volatile organics and pesticides, of which none were detected. The key groundwater quality issue identified in this report was Iron, with 18 of 30 wells testing above the aesthetic drinking water objective.

Based on this data, analysis of these results supports the findings of the Huron County Groundwater Quality Assessment (2001) that groundwater quality in the Dundee formation is of good quality with the exceedances reported only in the naturally occurring indicators of hardness, fluoride and iron. High concentrations of fluoride are a distinctive feature of groundwater from the Dundee Formation. Water quality analyses from the Dundee Formation are consistently near or above the ODWS of 1.5 mg L^{-1}.

Sodium concentrations are within the accepted naturally occurring level for bedrock aquifers in the Ausable Bayfield Maitland Valley Source Protection Region, but are approaching or exceeding the lower ODWS for persons with hypertension (20 mg L^{-1}) and should be monitored carefully. Sodium concentrations within NL-2 are elevated, and coupled with the elevated concentrations of chloride in the aquifer, are indicative of some form of contamination via salt. The ABCA North Lambton Aquifer characterization study noted the possible presence of improperly decommissioned brine wells in the area which may be a source of cross contamination for the Dundee Aquifer.

Another characteristic of Dundee-derived groundwater are high concentrations of sulphates, which lead to corrosion of wells and fixtures and a distasteful odour.

Hamilton

The Hamilton formation subcrops only in a very small area on the farthest southern and western limit of the Ausable Bayfield Maitland Valley Source Protection Region overlying the Dundee Formation. Three wells were selected for analysis from the Hamilton formation and are listed in Table 2-16.

Table 2-16: Representative samples for the Hamilton Aquifer

Well Name	Nitrates (mg L^{-1})	Hardness (Calculated as mg L^{-1} $CaCO_3$)	Fluoride (mg L^{-1})	Sodium (mg L^{-1})	Chloride (mg L^{-1})	Iron (mg L^{-1})	*E.coli* (cfu/100ml)
Hamilton 1	0	481	0.37	22.1	39	6.73	0
Hamilton 2	0	222	0.5	236	273	0.17	1
Hamilton 3	0	190	2.7	216	300	0	0

All Data from ABCA North Lambton Study – 2004

The Hamilton 1, 2 and 3 wells are domestic wells that serve private residences within the community of Port Franks. These wells were initially analyzed in 2001 as part of the Town of Bosanquet Study of Rural Water Quality in which they were sampled for microbiology and nitrates and were subsequently analyzed as part of the ABCA North Lambton Aquifer characterization project for a more comprehensive suite of parameters using the PGMN protocols for sampling and analysis.

Based on the available data, analysis of these results indicates that groundwater quality in the Hamilton is highly variable and of poor quality, with at least one exceedance in all indicators, with the exception of nitrates. The highly variable concentrations of iron, sodium and chloride are indicative of some form of localized contamination. The high concentrations of fluoride in the Hamilton -3 well may be the result of analytical error or influence from the overlying Dundee formation. Fluoride and hardness concentrations are within the accepted naturally occurring level for bedrock aquifers in the Ausable Bayfield Maitland Valley Source Protection Region area. Sodium concentrations are elevated, and coupled with the elevated concentrations of chloride in the aquifer, are indicative of some form of contamination via salt. The ABCA North Lambton aquifer characterization study noted the presence of improperly decommissioned brine wells in the area which may have cross contaminated the Hamilton Aquifer. It is herein recommended that these wells be identified, located and decommissioned as soon as possible. The extremely high concentrations of iron in at least one sample, and confirmed in another sample warrant further investigation. In addition to the parameters discussed in this report, it is well known in the community by drillers and landowners that the groundwater in this aquifer is high in sulphates. The generally poor quality of water in this aquifer and the overlying North Lambton overburden aquifer (see discussion below) has led to the utilization of Lake Huron based drinking water supplies in the area.

2.2.3.3 Groundwater Quality Summary

In general the groundwater quality within the Ausable Bayfield Maitland Valley Source Protection Region is of good quality, with only minor problems identified in the production of this report. Some of the major issues identified herein include:

- Salt contamination of aquifers in areas of historic brine well operations
- Contamination of shallow overburden aquifers via surface water, in particular determining if the contamination is a reflection of overall aquifer quality, or that of wellhead practice
- Elevated concentrations of naturally occurring parameters, such as fluoride, sodium, iron, sulphate and hardness in bedrock aquifers

A summary of overall water quality for the important overburden and bedrock aquifers in the Ausable Bayfield Maitland Valley Source Protection Region is included below in tables 2-17 and 2-18, respectively.

Table 2-17: Summary of water quality for overburden aquifers in the Ausable Bayfield Maitland Valley Partnership area

Aquifer	Water Quality	Key Issues
Howick	Excellent	Iron Trace presence of nitrates
Wyoming	Good	Fluoride Iron Sodium Trace presence of nitrates
Hensall	Moderate	Bacteria Nitrates Iron
Holmesville	Good	Hardness Iron contamination Trace presence of nitrates
North Lambton	Moderate	Iron Hardness Widespread presence of nitrates Evidence of significant salt contamination
Seaforth	Poor Evidence of high susceptibility to contamination via surface water	Bacteria Hardness Iron Widespread presence of nitrates Trace presence of hydrocarbons and pesticides

Table 2-18: Summary of water quality for bedrock aquifers in the Ausable Bayfield Maitland Valley Partnership area

Aquifer	Water Quality	Key Issues
Salina	Good	Hardness Iron
Bass Islands	Good	Sodium Presence of nitrates
Bois Blanc	Excellent	None Identified
Lucas	Moderate to Good	Fluoride Iron Hardness Localized evidence of salt contamination Radionuclides
Dundee	Good	Fluoride Iron Hardness Sodium Localized evidence of salt contamination
Hamilton	Poor Highly variable	Fluoride Hardness Iron contamination Evidence of significant salt contamination

Bedrock aquifers have good water quality; however, are plagued by naturally occurring water quality problems such as fluoride, iron and sodium. Overburden aquifers tend to have excellent natural water quality; however, are more susceptible to contamination, and as a result have significant problems for highly mobile parameters such as road salt, iron and nitrates. Overburden aquifers are also more susceptible as a result of the wellhead practices that are commonly used to exploit these shallow resources. Bored and dug wells with unsealed caps are more common, and as a result can act as conduits for surface water to enter the well and lead to higher concentrations of certain parameters that do not reflect the overall quality of individual aquifers.

The results of this report should guide development of an enhanced monitoring strategy for the Ausable Bayfield Maitland Valley Source Protection Region. However, it is important to reiterate that these analyses are not statistically significant and should not be used to characterize entire aquifers, as there can be marked differences in groundwater quality between wells within an aquifer. Furthermore, as has been stated above, the data is not of sufficient length to evaluate water quality trends in these aquifers.

2.3 Microbial Source and Raw Water Characterization

A comprehensive examination of all municipal water intake quality has not been undertaken at this point in the report. There are currently two surface water intakes from Lake Huron and approximately 32 groundwater intakes: WC Map 2-5 identifies these locations.

For drinking water intakes, there are three main data sources that can be used to characterize the raw water quality and potential microbial contamination for surface water and groundwater.

These include the Drinking Water Surveillance Program (DWSP), the Drinking Water Information System and from the municipality directly or from the water system operator.

The DWSP is a voluntary program that currently monitors the raw water quality of 175 Municipal drinking water treatment plants. There are 3 treatment plants in the Ausable Bayfield Maitland Valley Source Protection Region participating in the DWSP (Exeter, Goderich, and the Lake Huron system at Port Blake).

DWIS has data from all Municipal water treatment plants which must sample raw water quality for microbial indicators under the Safe Drinking Water Act (2002). This data has not been provided to undertake a characterization.

Data has been obtained from municipalities in the Ausable Bayfield Maitland Valley Source Protection Region for water quality, but it is summary in nature and not suitable for detailed analysis.

A microbial source and raw water characterization will not be conducted at this point on the basis that DWIS data will be used in the future. The raw water quality characterization for a limited number of indicators has been prepared in the Lake Huron Intake section of this report.

A less suitable approach to characterize Municipal raw groundwater quality is through aquifer sampling for programs such as the PGMN. The major aquifers have been characterized in the groundwater section of this report, using data from municipal wells in some cases.

2.4 Discussion

Nutrient enrichment appears to be the greatest water quality impairment in the Ausable Bayfield Maitland Valley Source Protection Region. Nutrient enrichment is evident in rivers, the nearshore of Lake Huron and vulnerable overburden aquifers. This enrichment reflects the rural agricultural nature of the study areas. Indicators typical of urban water quality issues (chloride and copper) have low concentrations. Typical rural sources of nutrients include agricultural land use and urban or private waste water treatment plants. A large potential source of nutrients is from agricultural uses with some streams enriched by waste water treatment plants, especially in low flow periods.

This preliminary analysis identified two important trends. Primarily, riverine surface water concentrations for nitrate and phosphorus increase from north to south. This trend possibly reflects landscape level relationships between land use, land management, forest cover and geology. These factors require further analysis it identify the key pathway differences. Secondly, headwater streams tend to have higher concentrations of nutrients compared to main channels. Therefore, to address nutrient issues in the area, improvements may be best directed to headwater stream areas.

Results suggest that bacteria do not behave like chemical contaminants. Bacterial sampling appears to provide more site specific information. To understand the movement and sources of bacteria, more information is needed on the transport and persistence of microbial indicators.

Groundwater quality in vulnerable aquifers is being influenced by surface activities based on the concentrations of salt and nitrate. Overburden aquifer sources are most likely road salt, with some deep bedrock wells having elevated salt concentrations due to cross contamination from non-decommissioned brine wells, as seen in Goderich.

The most common groundwater quality issues in the Ausable Bayfield Maitland Valley Source Protection Region are naturally occurring elements such as iron, hardness, fluoride, and sulphate in bedrock aquifers. From a drinking water perspective, only fluoride and sulphate have health related objectives.

2.5 Implications for Source Water Protection – Municipal

Generally, drinking water source protection activities for water quality in the Ausable Bayfield Maitland Valley Source Protection Region should focus on protection of the resource, as opposed to restoration. While water is of good quality in both Lake Huron and most aquifers, rivers and streams have unacceptable concentrations of nutrients and bacteria which require restoration efforts.

Source water protection activities for water quality should also include increasing the understanding of knowledge gaps outlined in the report, and repeated in Appendix A: Data and Knowledge Gaps of Chapter 5: Summary. A further activity involves the development and operation of a monitoring system that will allow water quality conditions to be tracked to ensure concentrations are not increasing and to evaluate the effectiveness of protection efforts.

Lake Huron provides drinking water to the largest number of people of the three water systems (lake, river, or groundwater). It also provides the majority of bathing recreation in the area and is a major attraction for tourism. The quality of the drinking water at the two water intakes indicate that it is of good water quality, and if the trends outlined stay constant, it would take more then twenty years for nitrate levels to approach the aquatic protection limit. However, it is clear that these intakes, especially Goderich, are under the influence of river contamination. A better understanding of the plume dynamics and other nearshore factors are necessary to determine the magnitude of pulses of contaminants that could reach the intakes.

It is clear that nearshore water quality in the vicinity of the intakes is being enriched by river water. It is not clear how bacteria are behaving in the nearshore; bacteria are subject to a number of additional processes that nitrate and phosphorus are not. Bacteria may be deposited by itself, and may be able to lumping that would affect water at the intake. It is currently understood that bacteria are able to survive and reproduce outside of a warm blooded animal. The presence of pathogens in the area is unknown, and should be considered a data gap.

Groundwater is the next largest source of drinking water in the area. Protection of existing water quality should be the focus. Naturally occurring elements are the greatest exceedance of ODWS and a better understanding of their distribution is necessary. Further work needs to be completed to understand the extent of karst conditions in the area and the impact on water quality. Also, the impact of river contaminants to bedrock water quality in those areas that have exposed bedrock should be quantified.

Local issues have occurred including contamination of some municipal groundwater supplies with nutrients as well as salt that do need to be addressed at a local scale. The analysis of the DWIS data will assist in determining those supplies with issues and the scope of the contaminants.

Consideration needs to be given to the potential time lag for surface water pathways to groundwater, especially bedrock aquifers. The water quality conditions discussed may not represent the impacts of current practices on groundwater quality and therefore provide a false sense of security. Monitoring networks need to be developed that attempt to intercept groundwater recharge that reflects the impact of current practices on groundwater quality.

Good surface water is required for the protection of aquatic ecosystems and is important to Lake and groundwater quality protection since it is the major pathway of contaminants to Lake Huron and may be a pathway to bedrock groundwater contamination. For nutrients and bacteria, surface water in most of the area is above guidelines and restoration work is required.

A better understanding is required around sources of nitrate by examining historic changes during the large nitrate increase, as well as quantifying atmospheric deposition. The presence of pathogens in surface water is unknown, and in order to determine the impact to drinking water supplies of Lake Huron intakes, this information is required. Sources and the cycling of heavy metals need to be investigated further, but at this point they are of a greater risk to the aquatic protection then to drinking water contamination.

2.6 Water Quantity

Water quantiy is not discussed in this document; it is dicussed further in the Conceptual Water Budget and the Tier 1 Water Budget. However, WC Map 2-6 and WC Map 2-7 show the permit-to-take-water (PTTW) by point location and the water use in the region, respectively. From these water budgets, it is determined that, overall, the Ausable Bayfield Maitland Valley Source Protection Region does not have water quantity stress. There may be local issues for private well owners if the water is located in a shallow aquifer, but no issues were identified for municipal drinking water sources. The exception occurs when a large business is established in the region, like the Greenfield Ethanol facility in Hensall. The total capacity of the Hensall drinking water system is 3231 m^3/day while projected maximum demands including the facility are 3600 m^3/day increasing to 4040 m^3/day by 2027 (B.M. Ross 2006). A new water line is being built between Hensall and Exeter to extend the water from the Lake Huron Primary Water System pipeline.

2.7 Knowledge and Data Gaps

The understanding of water quality in the Ausable Bayfield Maitland Valley Source Protection Region has been supported by comprehensive monitoring networks, both long term such as the PWQMN (Provincial Water Quality Monitoring Network), and newer such as the PGMN (Provincial Groundwater Monitoring Network). However, to better understand water quality issues to support drinking water source protection planning, there are gaps in data (spatially and in some indicators) as well as knowledge (information that helps determine relationships and make decisions). The following are key items of information that would assist in developing a local source protection plan:

Data

- *E.coli* concentrations in the MVCA watershed – lack of regular sampling locations for indicator bacteria.

- Use of Enterococci and coliphage as indicators for fecal pollution; their survival is consistent with both bacterial and viral pathogens, and it has been identified that *E. coli* dies off too rapidly.
- Site-specific sampling to determine the current state of water quality at historic locations identified in the report (e.g. Palmerston)
- Waste Water Treatment Plant discharge data and dates of plant modifications (in order to relate water quality conditions with potential sources, concentrations and volumes of discharge will be collected from municipalities). Information has been collected by the municipalities but has not been summarized.
- Types and concentrations of pathogens in the area
- No groundwater quality from certain aquifers (mostly overburden and out of Huron County)
- Raw water characterization of municipal drinking water supplies (data exists)
- New water quality sampling sites on headwater streams to further understand nutrient pathways
- No data on presence of or concentrations of pesticides and pesticide breakdown products
- Identification and remediation of brine wells associated with cross contamination of groundwater aquifers.
- Seasonal trends were not considered in the analysis; do not necessarily possess water discharge data for Varna, Parkhill, etc.

Knowledge

- Determine reasons for the increase in nitrate concentration generally seen throughout the 1970s. Determine reasons for currently increasing nitrate concentrations in the Bayfield River and Parkhill Creek.
- Determine reasons for the peak in chloride concentrations in the Maitland River at Goderich and Black Creek during the mid 1980s. Investigate if brine plant operation produces correlation.
- Research the changes in agricultural practices especially related to commercial fertilizers and the replacement of mixed farming with ‘cash cropping.’
- Further analysis to relate microbial data to nutrient concentrations.
- Research the dominant pathways for nutrients should be undertaken at a sub-basin scale to determine the best method for modifying or lengthening the time of travel in that area. Determine those agricultural practices that are most effective in reducing nutrient delivery to watercourses.
- Further analysis of heavy metal data to determine bioavailability and human or aquatic concerns.
- Fate and persistence of bacteria in riverine, groundwater and large lake systems.
- Dynamics of the outlet plume of the Maitland River in Lake Huron and its relationship to the Goderich water. Potential methods include the use of conductivity to define river plume under various environmental conditions.
- Areas of karst development and the effect of this feature on groundwater quality.

In summary, the water quality data and knowledge gaps that have a higher priority include: determining the reasons behind the increase of nitrates in the 1970s; determining the reasons behind the increase in nitrates in the Bayfield River; determining the relationship between nitrate and total phosphorous with respect to forest cover, row cropping, tile drainage density, commercial fertilizer use and *E. coli* concentration, and; determining the concentrations of nutrients, *E coli* and other contaminants in headwater systems compared to main channels using a more rigorous approach.

Planned Work

In this calendar year, a number of planned undertakings will assist in the understanding of water quality in the Ausable Bayfield Maitland Valley Source Protection Region. These include:

- Raw water characterization of municipal water intakes
- Waste Water Treatment Plant discharge data and dates of plant modifications
- Statistical analysis of riverine trends and comparison of sites
- Small tributary contribution of nutrients and bacteria through a shoreline hydrology project
- Continued monitoring of groundwater and riverine water quality
- Analysis of current monitoring network and monitoring recommendations
- Studies are currently underway in Goderich and Port Blake and include coastal geomorphology and nearshore bathymetry
- Fate and persistence of bacteria in riverine, groundwater and large lake systems through the Southeast Shore Working Group.

Monitoring Recommendations

In order to develop, implement and measure progress for drinking water source protection, good water quality data is necessary. Good data depends on proper site selection, collection methods and indicator choices.

Bacterial contamination is the biggest drinking water issue as some can be the cause of waterborne illnesses. There is a need to start testing for E. coli within the Maitland Valley Region, and to measure other pathogenic indicators within the entire Source Water Protection Planning Region. Understanding loading of small gully streams in the area around Port Blake is also a high priority.

The current monitoring system for riverine, groundwater, and Lake Huron will be evaluated and recommendation will be made on sites, sampling protocol and indicators. This will be completed once the raw water characterization and Intake Protection Zones in Lake Huron are developed. At that point, all the known water quality impairments will be identified.

Initial recommendations based on riverine water quality data are more monitoring of headwater sites, especially in the Maitland watershed due to the connection to the Goderich water intake. Shallow overburden aquifer information is also limited.

Table 2-19: Data Gap Reporting for the Water Quality Chapter of the Ausable Bayfield Maitland Valley Watershed Characterization

WC Deliverable	Data Set Name	Data Gap Problem	Comment
		None	

2.8 References

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Appendix A: Historic PWQMN summary data and graphs for chloride, copper, nitrate, total phosphorus, residue particulate, fecal coliform and *E. coli*

All riverine water quality stations in the Ausable Bayfield Maitland Valley Source Protection Region were examined using the methodology for temporal trends outlined in the report for the six chosen indicators (chloride, copper, nitrate, total phosphorus and bacteria). After the analysis, six sites were chosen to illustrate trends in the region and are in the body of the report. As well, notable exceptions of the trends were discussed and are presented again in Appendix B.

This appendix contains the exploratory graphs and summary statistics for the other sites. The data has been grouped into five year sections.

Sites with more than four years of data are summarized in the tables. Sites with more then ten years of data, with the range of years later then the seventies, are also summarized in graph form. Sites not meeting these criteria are not reported in this appendix.

Chloride - North, Little, South and Lower Maitland River and Nine Mile River

	Major Basin	Nine Mile		North Maitland						Little Maitland			South Maitland		Lower Maitland						
	Tributary			Upper				Salem Creek	Lower						Belgrave Creek	Blyth Brook		Sharpes Creek		Main Branch	
	MOE or local ID	08007600202	08007600102	08005600802	08005600702	08005602502	08005600402	08005605002	08005603802	08005600602	08005602202	08005603502	08005601502	08005603702	08005603002	08005604402	08005600202	08005602702	08005602802	08005600302	08005600102
	Site Name	Lucknow	Port Albert	Palmer_N	Harristn	Fordwich	Wroxeter	NMSalem	B-Line	Palmer	Palme_23	Jamestown	Londesbo	Summerhill	WNC_Belg	Blyth East	Blyth	Sharpes	SharpBen	Zetland	Goderich
1964-1965	n	1	1	6	2		1			1							5			22	27
	min	14.00	12.00	16.00	10.00		13.00			25.00							11.00			9.00	16.00
	max	14.00	12.00	30.00	14.00		13.00			25.00							28.00			540.00	696.00
	median	14.00	12.00	18.50	12.00		13.00			25.00							22.00			15.00	97.00
	25th			18.00	10.00												17.75			14.00	36.50
	75th			24.00	14.00												23.50			18.00	198.25
1966-1970	n	62	64	62	100		101			100							101			99	95
	min	1.00	1.00	6.00	2.00		1.00			5.00							3.00			7.00	3.00
	max	52.00	24.00	78.00	290.00		73.00			146.00							100.00			22.00	634.00
	median	15.00	13.00	16.00	12.00		11.00			40.00							9.00			11.00	79.00
	25th	11.00	10.00	14.00	10.00		9.00			31.50							8.00			10.00	27.50
	75th	18.00	14.00	19.00	15.50		13.00			52.00							12.25			15.00	174.50
1971-1975	n	59	64	51	66		66			29	32		51				69	7	7	67	102
	min	4.00	3.00	6.00	4.00		3.00			25.00	5.00		5.00				4.00	3.00	4.50	6.00	7.00
	max	38.00	22.00	42.00	116.00		20.00			120.00	24.00		72.00				142.00	14.00	14.00	29.00	511.00
	median	18.00	13.00	18.00	16.00		13.00			55.00	12.00		13.00				10.00	4.00	6.00	15.00	50.00
	25th	14.00	10.50	17.00	13.00		11.00			47.00	9.50		10.00				8.88	3.00	5.25	12.00	21.00
	75th	24.75	16.00	21.75	20.00		15.00			70.00	14.00		16.00				13.00	4.75	6.00	19.00	130.00
1976-1980	n	55	55		58		59			48	32		58		23		61	30	45	58	50
	min	8.00	7.00		8.00		8.00			9.50	7.50		6.50		7.50		6.00	2.50	4.50	3.50	6.00
	max	39.50	20.00		70.00		215.00			140.00	19.00		23.00		17.00		23.00	6.00	12.00	130.00	275.00
	median	20.00	14.00		14.50		14.50			42.00	10.00		13.25		11.00		11.50	3.50	7.00	14.75	16.50
	25th	14.25	11.63		11.50		11.63			32.50	9.50		10.50		9.13		9.00	3.00	6.00	12.00	13.00
	75th	22.88	16.88		17.00		16.50			54.75	11.75		15.50		13.13		14.00	4.00	7.50	17.50	28.50
1981-1985	n	58	56		59		59			58			58		35		58			56	38
	min	7.50	7.00		5.00		9.00			15.00			7.00		8.00		6.00			5.70	2.70
	max	35.50	22.00		110.00		710.00			112.00			33.00		37.50		31.00			395.00	475.00
	median	21.25	15.75		14.50		14.50			45.50			14.50		12.00		13.50			16.00	90.25
	25th	16.50	12.25		12.00		12.63			33.00			12.50		10.63		12.00			14.00	43.50
	75th	24.50	17.75		18.00		16.00			64.00			17.50		13.75		16.00			18.00	135.00
1986-1990	n	56	55		55		55			54		38	56				57			53	53
	min	6.99	7.27		0.14		8.78			18.50		10.27	11.00				9.00			5.20	14.46
	max	32.90	23.50		53.00		29.40			222.00		29.37	31.80				160.00			208.00	613.00
	median	21.65	15.50		16.50		17.20			52.75		17.90	16.45				12.90			18.00	99.00
	25th	18.00	14.38		14.23		14.93			40.33		15.50	14.40				11.00			16.23	63.96
	75th	27.55	19.38		23.21		18.45			75.00		20.40	19.00				14.63			21.00	219.25
1991-1995	n	52	50		43		42			43		38	42				41			42	40
	min	7.60	6.00		10.60		10.00			16.80		9.60	7.10				6.70			9.70	15.80
	max	55.50	77.80		44.60		179.00			137.00		29.30	35.50				28.30			83.60	318.00
	median	19.70	15.35		16.10		15.60			57.10		16.10	15.45				11.60			16.80	74.10
	25th	15.60	12.70		14.75		13.80			38.45		14.40	12.90				9.70			15.00	35.30
	75th	23.95	17.50		20.40		17.10			91.33		18.90	17.00				15.10			19.70	95.20
1996-2000	n	20	21									20					20			20	19
	min	9.80	10.00									18.00					10.40			14.80	13.00
	max	37.60	24.80									36.80					33.00			36.80	95.00
	median	25.60	19.20									26.70					18.60			23.90	38.00
	25th	22.90	15.75									23.00					15.00			23.00	31.10
	75th	30.90	22.20									33.70					23.90			30.20	66.65
2001-2005	n	41	41						16			41		17		14	42			41	41
	min	11.00	11.80						14.80			17.20		11.80		3.50	11.20			16.40	15.30
	max	31.10	24.60						54.90			30.60		21.90		9.90	28.50			34.50	91.70
	median	22.20	17.60						19.80			24.40		17.10		6.20	16.20			23.00	26.50
	25th	17.78	15.68						16.95			21.10		15.30		4.90	14.00			20.28	19.05
	75th	24.80	21.03						21.55			27.25		20.48		6.60	19.40			27.48	34.00

Chloride - Middle Maitland River

	Major Basin	Middle Maitland River																
	Tributary	Above Listowel		Chapman	Below Listowel				Boyle Drain		Beachamp	Lower Middle Maitland						
	MOE or local ID	08005601402	08005604302	08005602102	08005601302	08005600902	08005601902	08005602602	08005601002	08005602002	08005604102	08005601802	08005601102	08005600502	08005601602	08005603102	08005601702	08005603902
	Site Name	Listw_NE	NE Listowel	Chapman	Listowel	Trowbridge	Grey_Elm	Ethel	Milvertn	Henfryn	Beauchamp	Grey	Brusl_12	Brus_DSc	Brussl_D	Bruss_16	Morris	Wingham
1964-1965	n					2			5					1				
	min					11.00			13.00					12.00				
	max					24.00			306.00					12.00				
	median					17.50			94.00					12.00				
	25th					11.00			57.25									
	75th					24.00			178.50									
1966-1970	n					100			67				60	100				
	min					4.00			7.00				3.00	2.00				
	max					400.00			203.00				340.00	129.00				
	median					37.50			38.00				10.00	16.00				
	25th					18.00			22.25				8.00	10.50				
	75th					97.50			79.50				12.00	26.00				
1971-1975	n	52		33	52	67	35	7	53	33		33	21	60	45		33	
	min	5.00		12.00	4.00	5.00	4.00	7.50	8.00	4.00		5.00	5.00	6.00	7.00		5.00	
	max	160.00		140.00	510.00	367.00	149.00	43.00	370.00	54.00		169.00	243.00	105.00	128.00		79.00	
	median	26.50		84.00	59.50	63.00	25.00	17.00	54.00	14.00		17.00	15.00	33.00	19.00		16.00	
	25th	16.00		45.25	27.00	29.25	20.25	16.25	34.50	11.75		12.75	7.75	23.50	14.00		12.00	
	75th	50.50		109.00	198.50	155.00	57.50	33.25	99.75	17.25		30.00	31.00	49.50	32.00		21.25	
1976-1980	n	59			59	60			12					10	45	12		
	min	9.00			3.50	5.00			31.00					17.50	8.00	12.50		
	max	95.00			105.00	200.00			300.00					63.00	47.50	36.50		
	median	20.50			24.50	36.25			110.25					40.00	17.50	19.50		
	25th	16.63			19.13	24.00			64.25					28.00	15.00	13.75		
	75th	31.38			36.88	62.75			195.00					58.00	24.50	30.25		
1981-1985	n	36			60	59			59							58		
	min	12.00			9.50	13.00			12.50							9.00		
	max	275.00			58.50	260.00			250.00							37.00		
	median	20.50			24.00	32.00			68.50							17.75		
	25th	16.00			20.75	24.13			45.00							15.00		
	75th	28.75			31.00	46.75			109.50							21.00		
1986-1990	n				54	54			56	39						56		
	min				2.53	2.85			14.50	10.00						10.10		
	max				360.00	124.00			948.00	116.00						47.00		
	median				27.31	38.75			124.00	23.80						19.12		
	25th				20.50	26.00			79.86	21.05						16.60		
	75th				34.00	77.30			187.50	37.26						25.29		
1991-1995	n			1	42	43			42	39						42		
	min			24.90	10.50	10.20			12.70	9.10						9.20		
	max			24.90	160.00	142.00			444.00	39.00						58.60		
	median			24.90	27.05	37.40			102.00	19.00						18.75		
	25th				19.70	20.48			72.90	17.20						16.40		
	75th				47.00	57.58			159.00	23.08						22.20		
1996-2000	n				19	20		21		21								
	min				31.40	25.80		17.20		16.20								
	max				172.00	173.00		122.00		166.00								
	median				68.40	88.30		44.00		27.60								
	25th				43.05	55.30		31.70		25.25								
	75th				121.60	156.50		85.85		37.90								
2001-2005	n		14		24	42		24		41	17							17
	min		14.50		31.20	17.20		21.20		13.60	11.80							16.40
	max		33.60		195.00	189.00		118.00		68.80	21.20							58.60
	median		19.90		94.30	82.10		43.00		29.60	16.20							24.20
	25th		18.20		62.10	53.60		38.10		25.45	15.00							20.70
	75th		22.40		176.00	133.00		73.55		34.65	17.38							35.93

Chloride - Bayfield River and Parkhill Creek

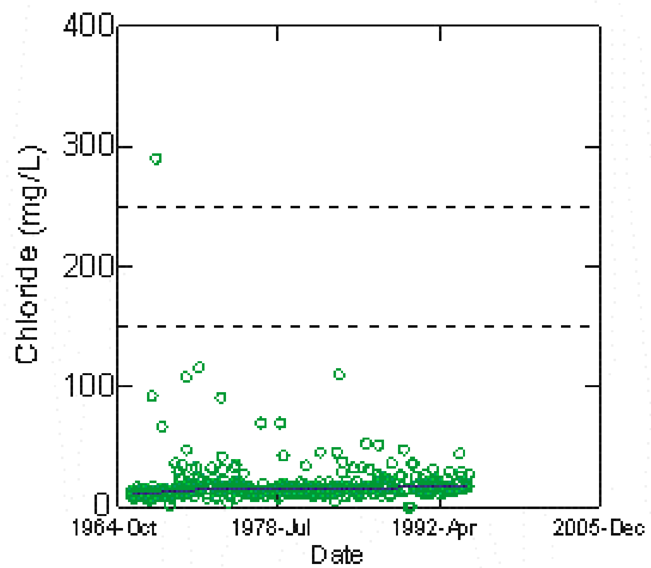
	Major Basin	Bayfield River														Parkhill Creek							
	Tributary	Bannockburn	Liffy Ditch			Silver Creek		Upper Bayfield			Steenstra	Lower Bayfield				Upper Parkhill					Tributary	Lower Parkhill	
	MOE or local ID	MBBAN1	HBLIF1	08004000402	08004000502	08004001102	08004000302	08004000202	08004000902	08004000602	HBSTEEN1	08004001002	08004000802	08004000102	08004000783	08002200302	MPMCGUF1	08002200402	08002200902	08002201202	08002201802	08002201302	08002200102
	Site Name	Bannockburn	Dublin	HBLIF2	HBLIF3	Silver	MBSILV1	Seaforth	MBHAN1	MBCLIN2	Steenstra	MBGRANT	Varna	MBBAY1	MBBAY2	HPCAM	Upstream Parkhill	MPDAM	MPHARM	Downstream Parkhill	MPTRI1	MPGBEND2	MPGBEND1
1964-1965	n			5	5		5	5						5		5		5					5
	min			10.00	11.00		21.00	13.00						11.00		53.00		12.00					6.00
	max			170.00	179.00		59.00	55.00						19.00		270.00		70.00					21.00
	median			42.00	53.00		50.00	43.00						15.00		217.00		24.00					11.00
	25th			22.00	25.25		42.00	23.50						12.50		175.25		15.00					9.00
	75th			147.50	89.75		56.75	46.75						16.00		237.00		49.00					19.50
1966-1970	n			63	65		65	65						64		73		13	56				70
	min			1.00	5.00		2.00	2.00						2.00		13.00		3.00	5.00				5.00
	max			115.00	98.00		236.00	87.00						40.00		233.00		177.00	80.00				77.00
	median			11.00	13.00		31.00	16.00						13.50		49.00		10.00	14.00				10.00
	25th			9.00	9.00		22.00	13.00						11.00		38.00		7.75	10.00				8.00
	75th			20.25	23.00		46.50	28.25						17.00		90.00		18.75	22.00				15.00
1971-1975	n			9	45		48	46	6	35			6	57	23	52			15	36		29	63
	min			6.00	7.00		17.00	9.00	22.00	12.00			13.00	7.00	9.00	12.00			8.00	6.00		8.00	5.00
	max			72.00	86.00		88.00	92.00	30.00	56.00			23.00	26.00	34.00	86.00			38.00	40.00		27.00	36.00
	median			15.00	23.00		41.00	26.50	24.50	25.00			19.00	14.00	13.00	44.50			15.00	14.00		13.00	12.00
	25th			11.75	15.75		28.00	20.00	23.00	19.25			17.00	11.00	11.00	32.50			9.50	12.00		11.00	9.00
	75th			47.00	37.00		65.50	56.00	27.00	34.75			21.00	16.00	14.75	64.00			16.75	17.50		15.25	15.00
1976-1980	n								59	59		32	62							11		60	
	min								7.00	6.50		7.00	7.00							18.50		8.50	
	max								80.00	63.50		29.00	47.00							35.00		80.00	
	median								25.00	27.50		18.50	18.00							21.50		21.00	
	25th								20.25	21.50		14.50	14.00							20.13		16.75	
	75th								36.25	34.88		21.00	22.00							27.88		25.50	
1981-1985	n					34			59	58			59							60		58	
	min					11.00			9.50	10.00			10.50							10.50		11.50	
	max					63.00			65.00	43.00			30.50							71.50		75.50	
	median					27.25			24.00	24.25			19.00							20.00		21.75	
	25th					22.00			20.63	22.00			17.13							17.25		17.50	
	75th					32.50			28.88	31.00			21.38							23.00		25.50	
1986-1990	n					56			55	56			57							58		55	
	min					10.00			12.00	12.00			11.00							11.50		8.57	
	max					67.80			98.30	112.00			58.20							46.35		43.40	
	median					29.25			27.78	31.00			25.00							22.30		22.60	
	25th					25.37			21.50	23.89			21.88							18.90		19.93	
	75th					38.85			36.48	36.05			28.86							25.10		25.75	
1991-1995	n					48			44	47			49							51		45	
	min					10.40			10.30	10.60			9.90							11.20		13.90	
	max					62.30			162.00	79.50			41.00							50.20		43.80	
	median					28.15			27.40	27.70			23.10							20.10		24.00	
	25th					23.80			21.20	21.35			19.35							17.53		20.48	
	75th					42.55			36.05	38.43			27.18							24.88		26.48	
1996-2000	n								7				7							26	7		
	min								19.40				13.20							18.70	13.60		
	max								46.40				29.80							40.90	30.60		
	median								23.00				21.40							24.15	19.40		
	25th								21.85				18.95							20.10	17.30		
	75th								38.05				25.80							28.00	25.45		
2001-2005	n							26	15				60								15		
	min							14.70	18.40				13.40								21.50		
	max							76.90	188.00				35.40								34.80		
	median							25.65	36.00				23.50								23.80		
	25th							22.30	29.50				20.55								22.45		
	75th							35.40	92.43				26.30								28.35		

Chloride - Ausable River

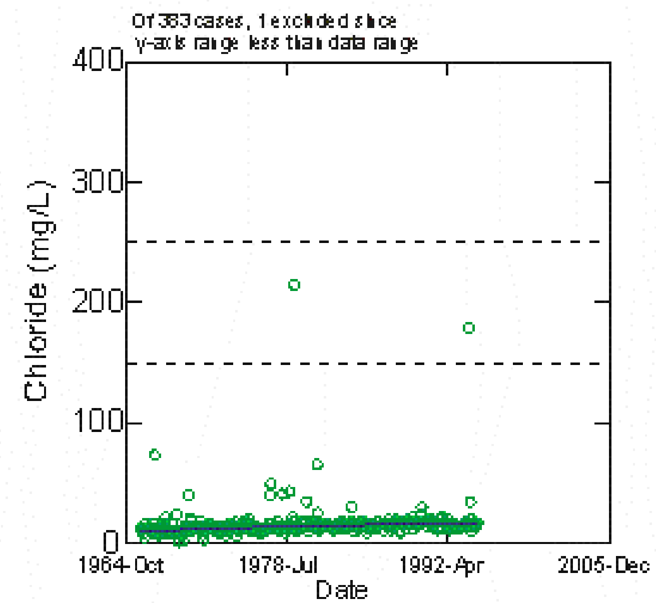
	Major Basin	Ausable															
	Tributary	Black Creek	Little Ausable River		Nairn Creek	Ausable River								Decker Creek		The Cut	
	MOE or local ID	08002200702	08002201402	08002201002	MANAIRN1	08002200802	08002201702	08002200602	08002201602	08002200502	08002201102	08002202002	08002201502	08002201902	08002200202	08002100202	08002100102
	Site Name	Black	Huron Park	Lucan	Nairn	Staffa	MAMOR2	MATHAMES	Exeter	HATRIB	MAMTCARM	Springbank	MAGLAS1	Decker	MADECK3	Thedford	MAWAL
1964-1965	n																
	min																
	max																
	median																
	25th																
	75th																
1966-1970	n	69		23		68		71		69					70		
	min	15.00		8.00		5.00		4.00		2.00					10.00		
	max	236.00		33.00		62.00		910.00		35.00					100.00		
	median	67.00		14.00		10.50		21.00		7.00					30.00		
	25th	47.25		11.00		8.50		13.25		6.00					21.00		
	75th	93.50		19.75		13.00		68.50		9.25					57.00		
1971-1975	n	58	103	57		52	21	52	6	17	42		1		58		39
	min	8.00	6.90	5.00		7.00	8.00	8.00	9.00	2.00	9.00		20.00		11.00		9.00
	max	117.00	196.00	42.00		28.00	18.00	862.00	175.00	9.00	240.00		20.00		83.00		46.00
	median	15.00	16.00	13.00		13.00	11.00	29.50	37.00	7.00	25.00		20.00		41.50		15.00
	25th	12.00	13.50	10.00		11.50	10.00	17.00	21.00	6.00	17.00				26.00		13.00
	75th	46.00	19.50	19.00		15.00	13.25	153.50	65.00	8.00	34.00				59.00		18.00
1976-1980	n	59	324	57			61		60		58				59		42
	min	7.00	5.00	6.00			0.18		6.50		7.00				17.00		9.00
	max	35.00	39.00	50.50			22.50		230.00		38.50				130.00		30.50
	median	15.50	14.00	17.00			13.00		21.50		19.00				43.50		15.50
	25th	13.00	11.00	14.75			11.50		17.00		16.00				36.13		13.50
	75th	19.75	15.75	20.13			15.50		32.00		22.50				65.00		20.00
1981-1985	n	60		57			60	1	58		59				57	36	
	min	10.50		12.00			9.00	20.50	9.50		10.00				9.50	10.00	
	max	39.50		37.50			93.00	20.50	108.00		48.50				84.50	45.00	
	median	18.25		20.00			16.00	20.50	20.75		19.50				37.00	19.25	
	25th	16.00		16.88			14.50		18.00		18.00				26.25	16.25	
	75th	21.00		23.13			17.75		27.00		22.50				50.63	22.75	
1986-1990	n	56		55			56		57		53				56	49	
	min	8.50		8.50			3.00		12.00		10.00				20.00	10.50	
	max	60.40		67.50			30.91		111.00		40.45				133.00	38.66	
	median	22.62		23.00			16.87		27.00		23.50				69.25	20.49	
	25th	18.33		20.28			14.75		20.86		19.95				54.95	19.50	
	75th	29.00		27.17			20.20		36.05		28.25				83.85	24.09	
1991-1995	n	48		47			49		44		45				49	80	
	min	11.00		13.20			9.10		10.20		9.70				43.70	13.60	
	max	66.00		50.80			24.80		148.00		61.00				618.00	64.70	
	median	20.20		22.50			16.50		22.45		20.10				93.90	21.05	
	25th	17.10		18.50			15.08		19.40		17.95				68.45	19.15	
	75th	27.05		27.70			17.93		39.10		22.18				150.25	24.15	
1996-2000	n	7		7					7					7		31	
	min	12.60		12.80					13.80					28.80		7.80	
	max	80.40		31.00					48.00					48.60		31.20	
	median	22.00		25.40					25.60					39.60		19.00	
	25th	17.95		16.95					18.80					33.20		18.05	
	75th	32.25		26.15					43.15					41.05		21.75	
2001-2005	n	41	17	41					41			26		41		40	
	min	14.60	17.60	17.00					18.80			14.10		30.20		12.40	
	max	182.00	47.80	50.40					192.00			41.20		77.80		40.30	
	median	21.30	27.00	28.40					39.30			29.20		49.80		27.00	
	25th	18.88	23.50	23.88					27.43			25.60		41.58		23.75	
	75th	27.80	30.98	33.30					53.93			31.80		57.25		29.70	

North Maitland

Harriston
08005600702

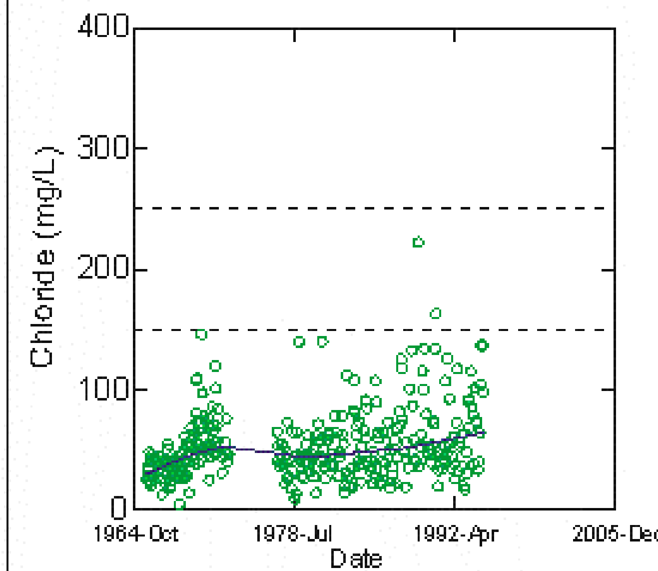


Wroxeter
08005600402

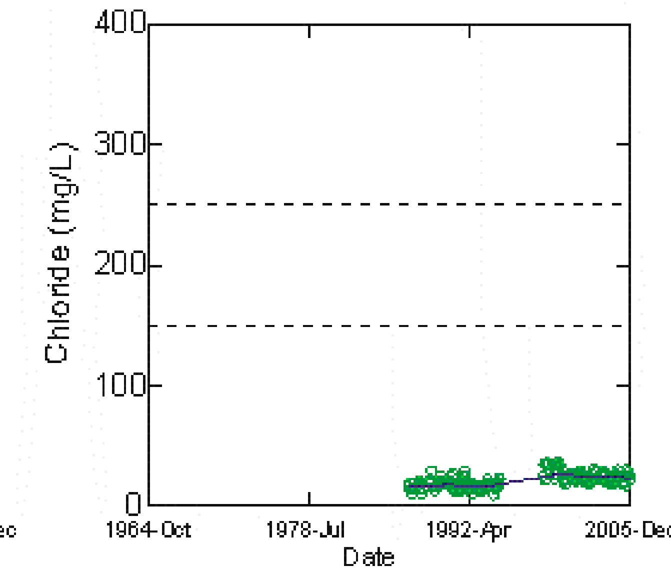


Little Maitland

Palmer
08005600602

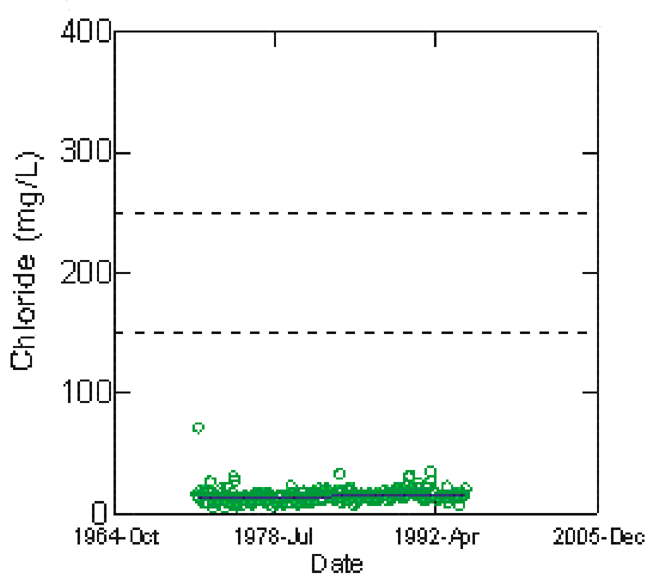


Jamestown
08005603502



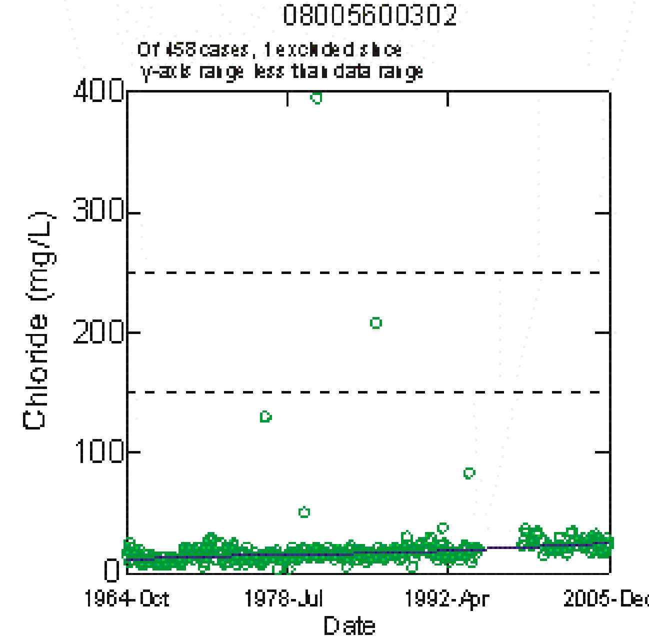
South Maitland

Londesborough
08005601502



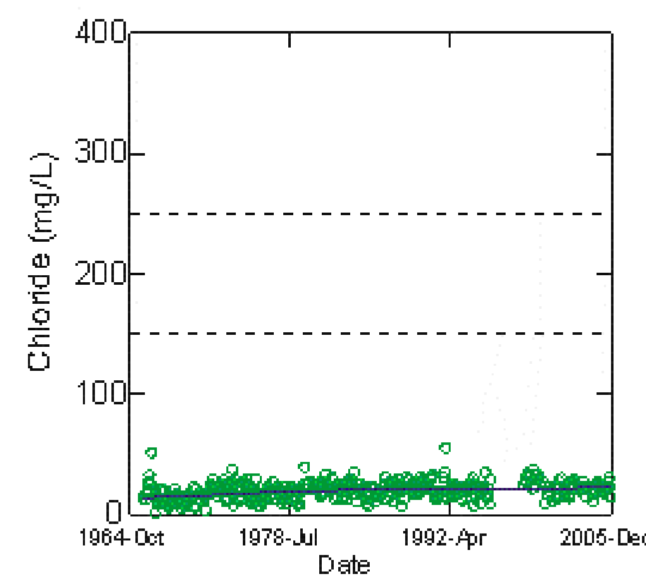
Lower Maitland

Zetland
08005600302



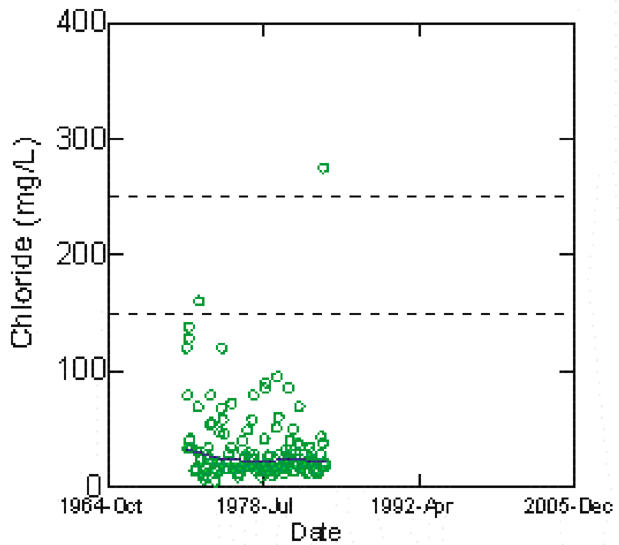
Nine Mile

Lucknow
08007600202

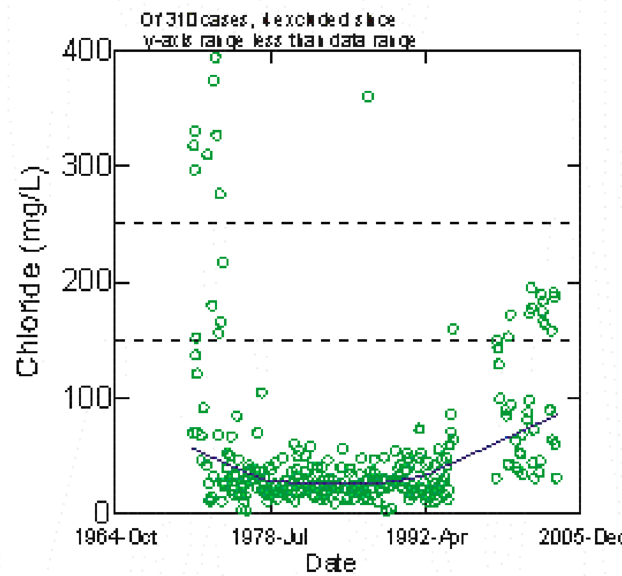


Middle Maitland

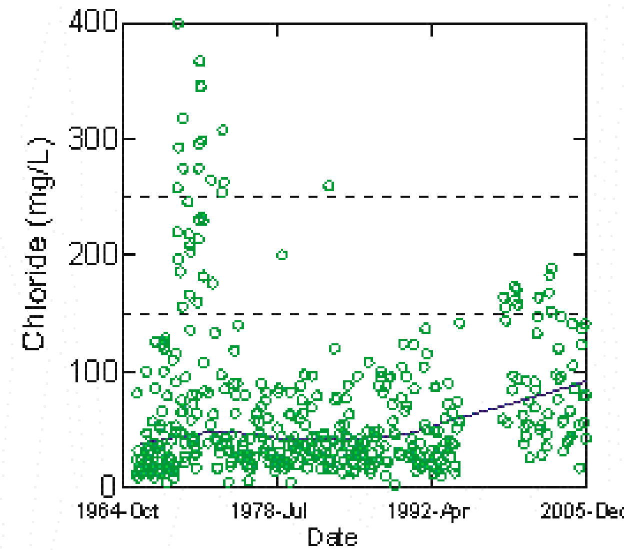
Listowel_NE
08005601402



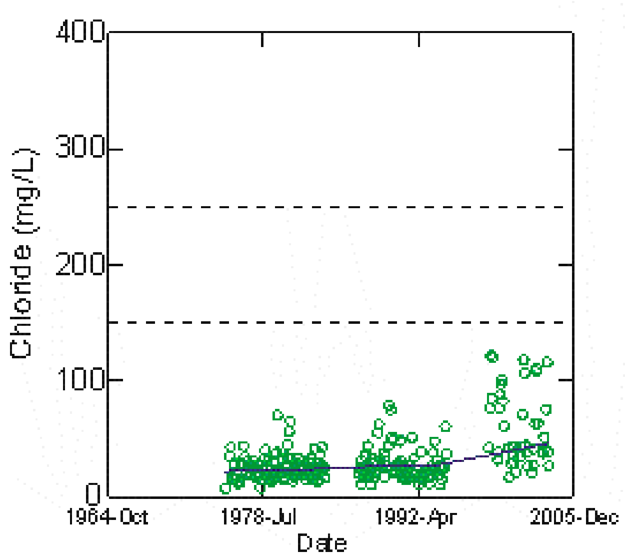
Listowel
08005601302



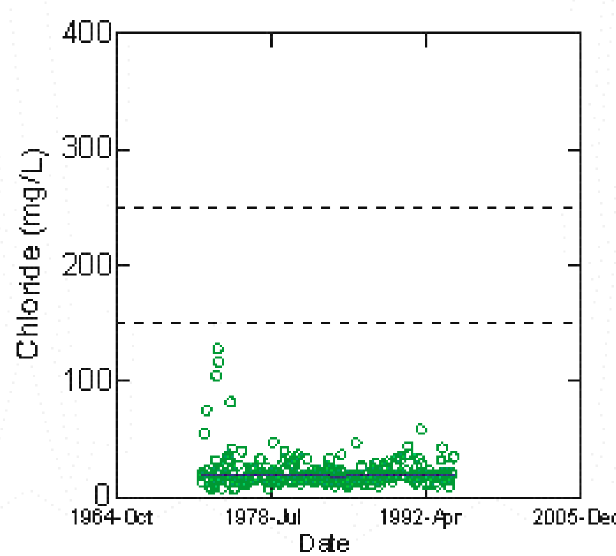
Trowbridge
08005600902



Ethel
08005602602

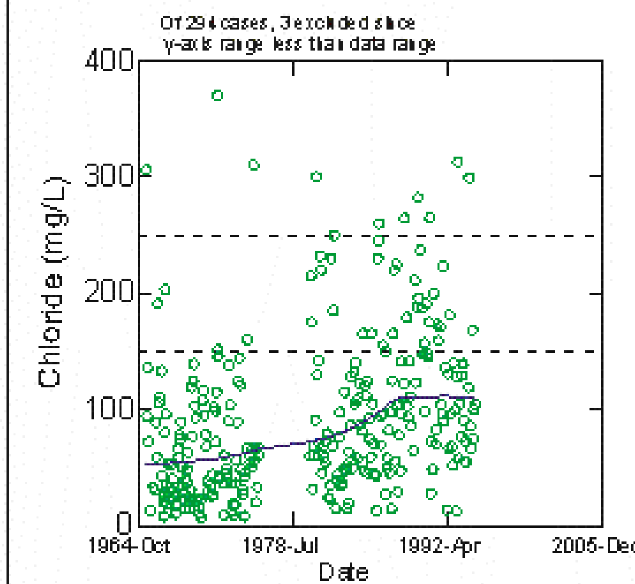


Bruss16D
08005601602 (1972-1979)
08005603102 (1980-1994)

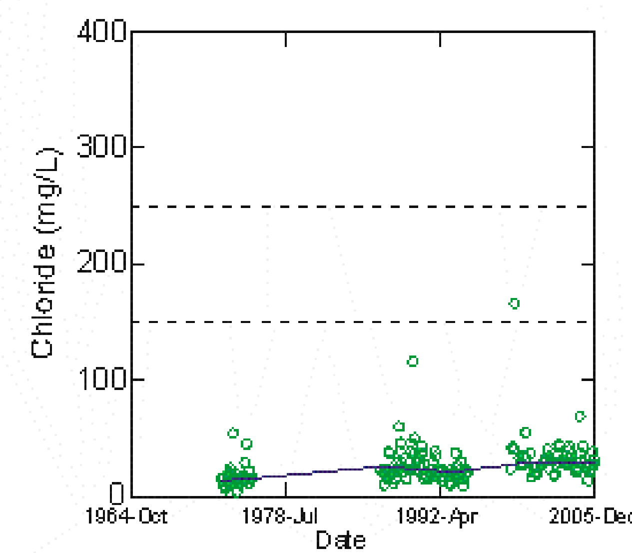


Boyle Drain

Milverton
08005601002

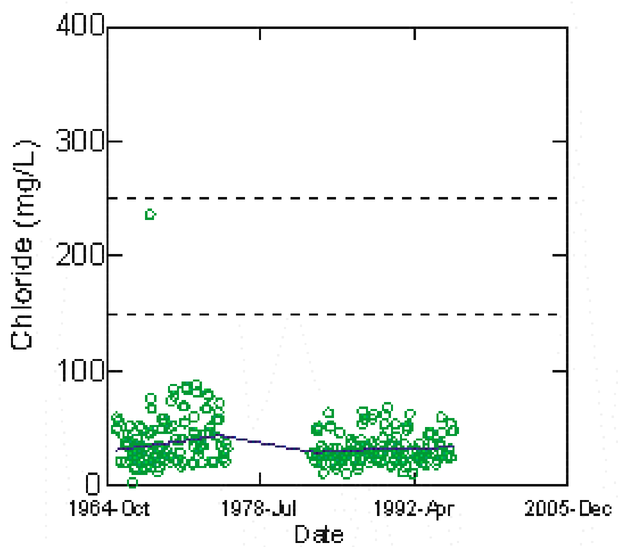


Henfryn
08005602002



Bayfield River

MBSILV1&2 (Silver Creek)
08004000302 (1965-1975)
08004001102 (1983-2005)



MBSEA1
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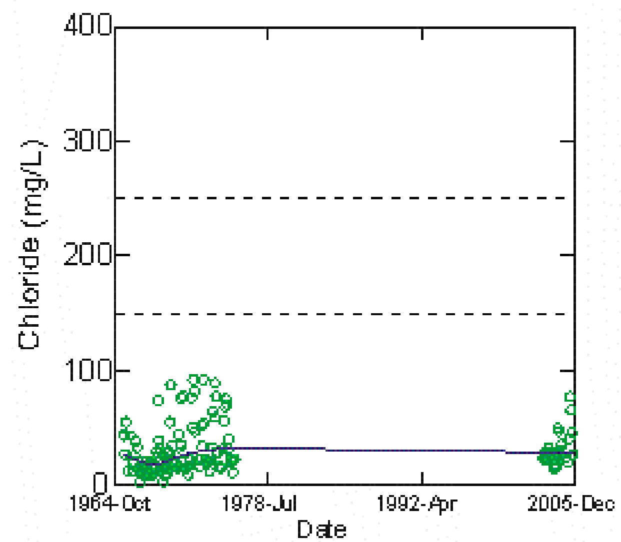
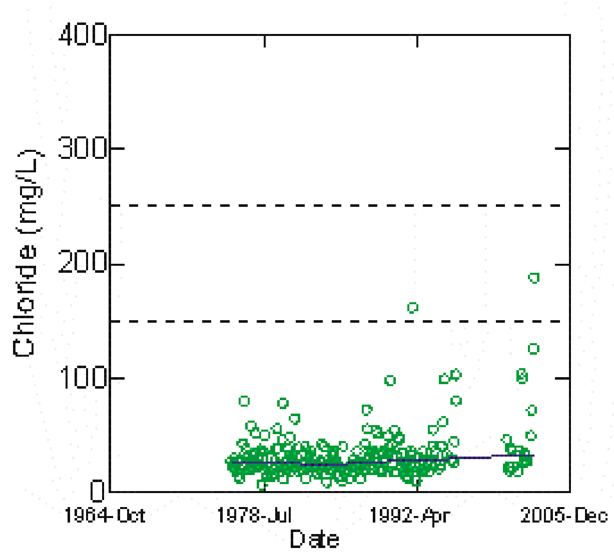


MBHAN1
08004000902



MBCLIN2
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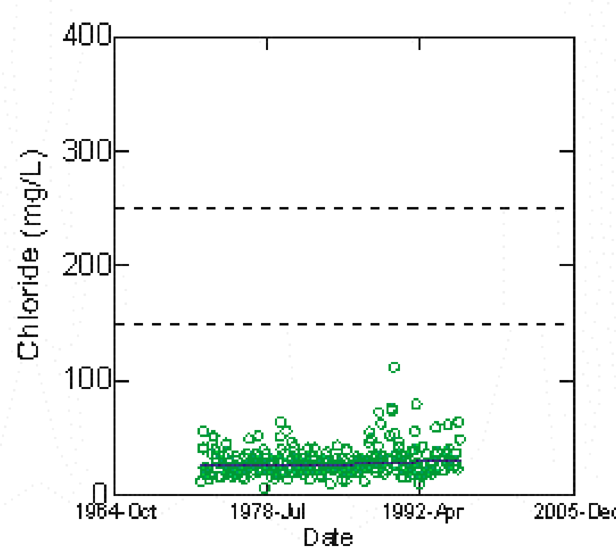
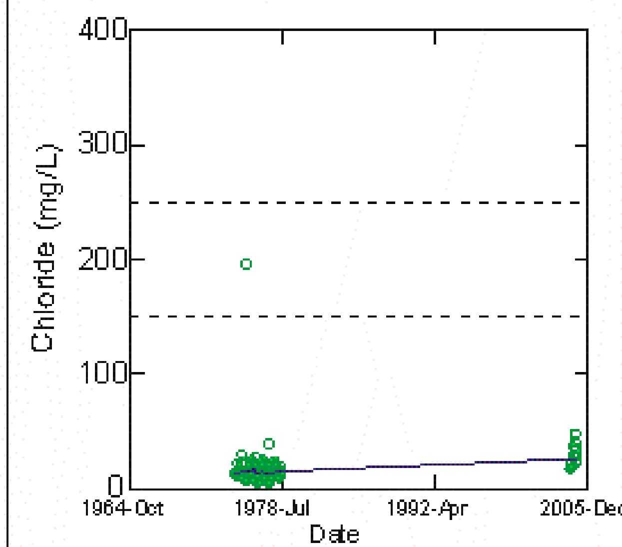
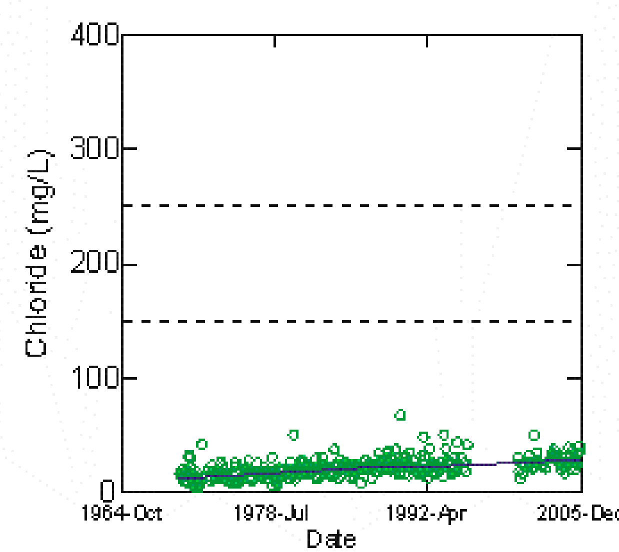


Little Ausable

ABCA14
08002201402

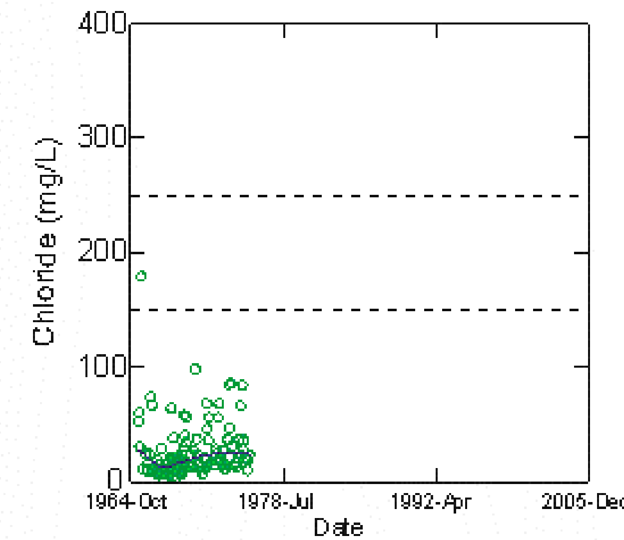


MALIT2
08002201002

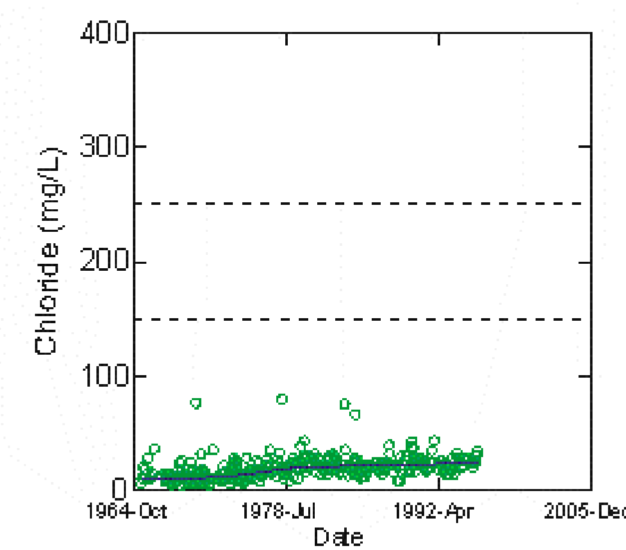


Parkhill Creek

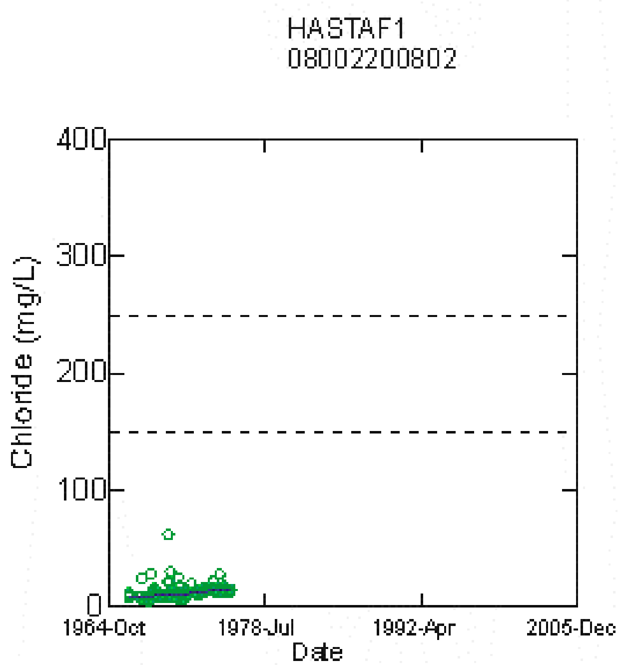
HBLIF3
08004000502

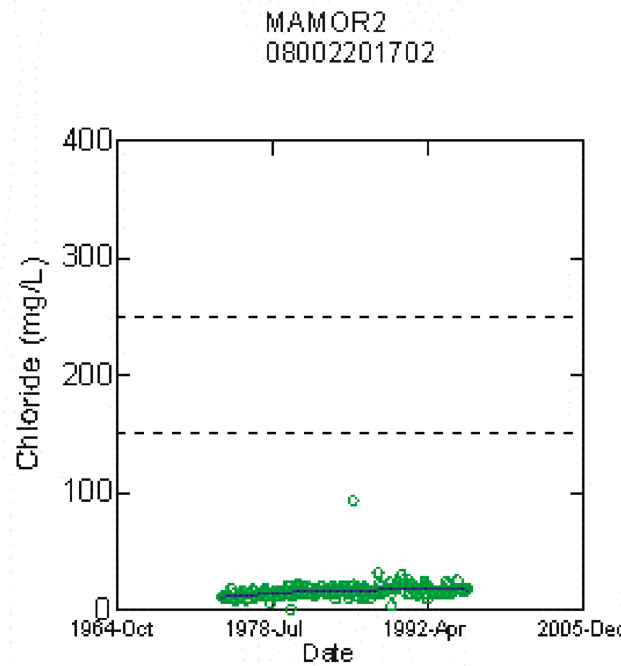


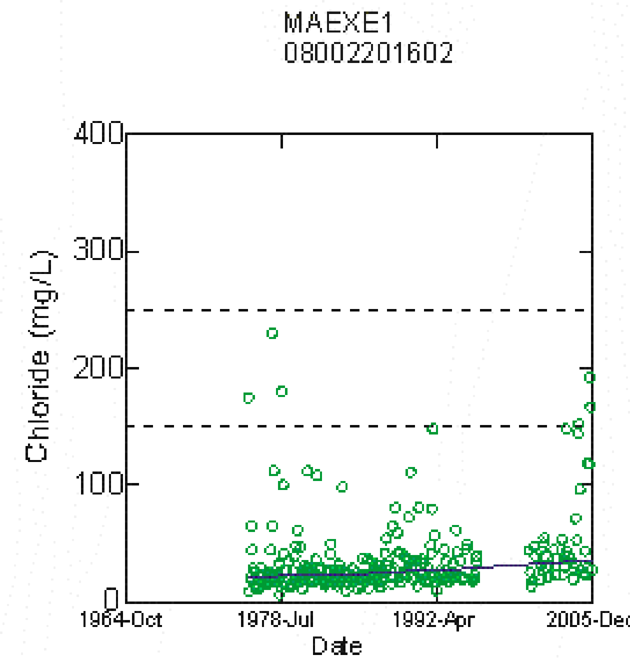
MPGBEND1&2
08002200102 (1965-1975)
08002201302 (1974-1995)

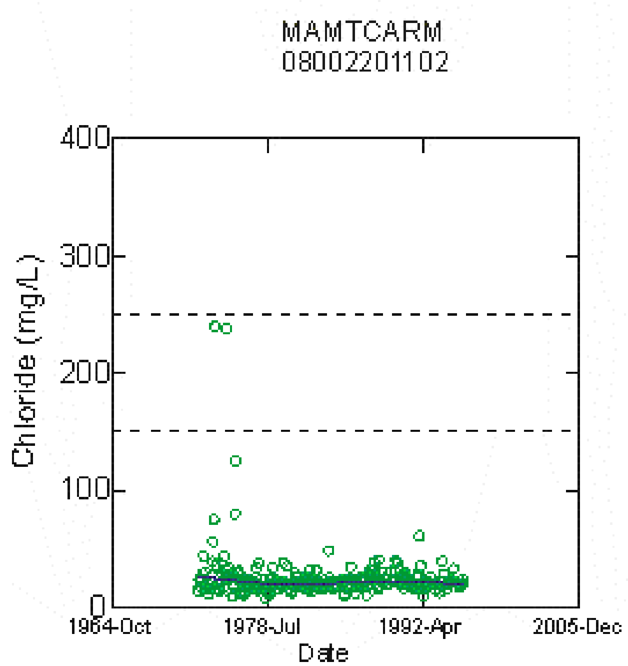


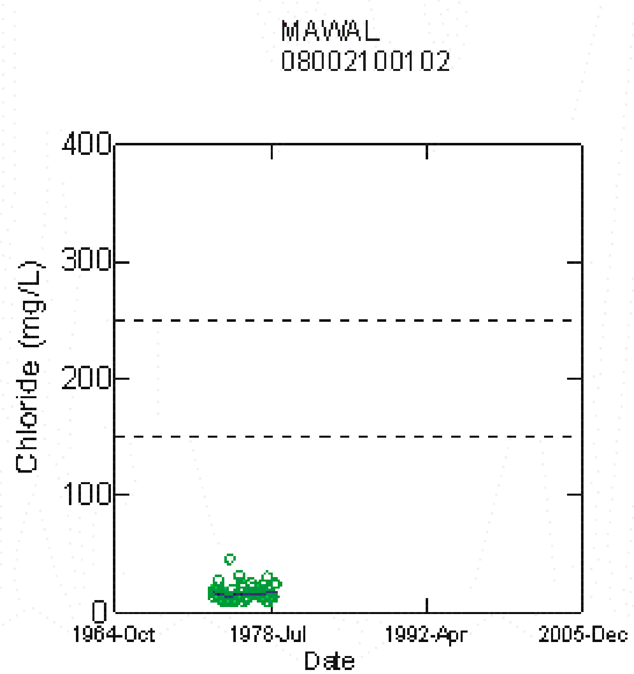
Ausable River



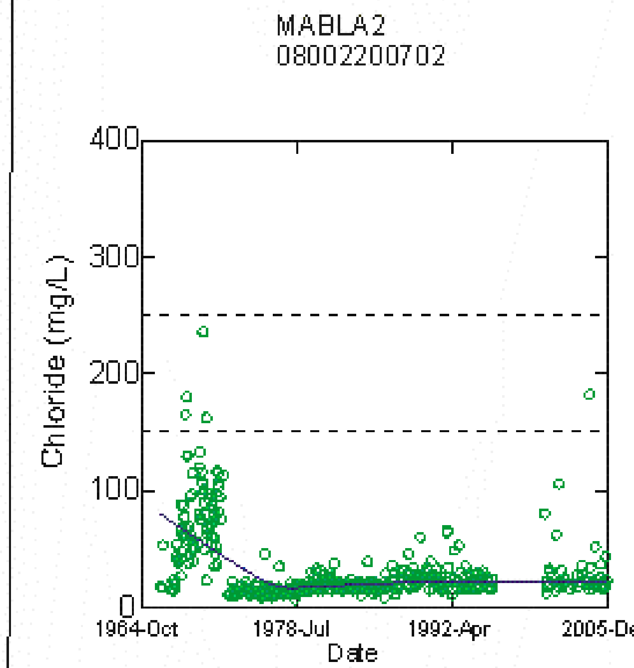




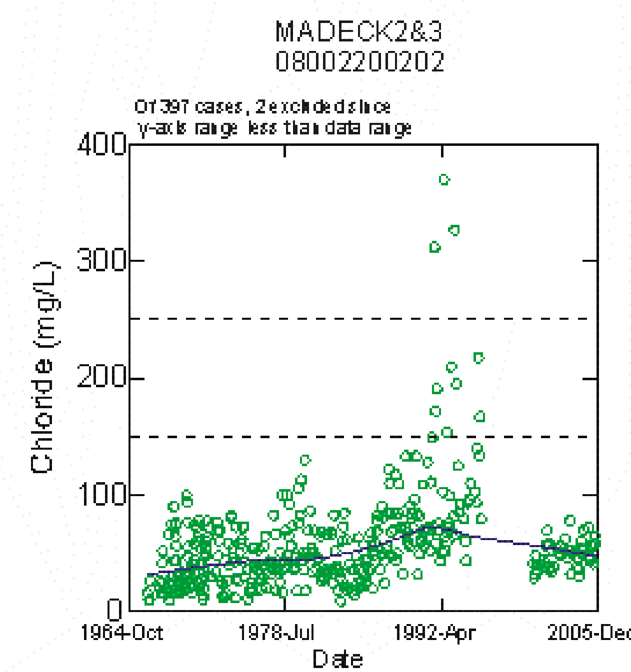




Black Creek



Decker Creek



Copper - North, Little, South and Lower Maitland River and Nine Mile River

	Major Basin	Nine Mile		North Maitland						Little Maitland			South Maitland		Lower Maitland						
	Tributary			Upper				Salem Creek	Lower						Belgrave Creek	Blyth Brook		Sharpes Creek		Main Branch	
	MOE or local ID	08007600202	08007600102	08005600802	08005600702	08005602502	08005600402	08005605002	08005603802	08005600602	08005602202	08005603502	08005601502	08005603702	08005603002	08005604402	08005600202	08005602702	08005602802	08005600302	08005600102
	Site Name	Lucknow	Port Albert	Palmer_N	Harristn	Fordwich	Wroxeter	NMSalem	B-Line	Palmer	Palme_23	Jamestown	Londesbo	Summerhill	WNC_Belg	Blyth East	Blyth	Sharpes	SharpBen	Zetland	Goderich
1964-1965	n																				
	min																				
	max																				
	median																				
	25th																				
	75th																				
1966-1970	n																				
	min																				
	max																				
	median																				
	25th																				
	75th																				
1971-1975	n		5																		4
	min		0.050																		0.030
	max		0.050																		0.050
	median		0.050																		0.050
	25th		0.050																		0.040
	75th		0.050																		0.050
1976-1980	n																				26
	min																				0.001
	max																				0.070
	median																				0.010
	25th																				0.010
	75th																				0.010
1981-1985	n		32		34					33			33							30	50
	min		0.001		0.002					0.003			0.001							0.001	0.001
	max		0.047		0.062					0.022			0.240							0.012	0.023
	median		0.007		0.004					0.006			0.007							0.003	0.006
	25th		0.005		0.003					0.004			0.003							0.002	0.004
	75th		0.010		0.010					0.010			0.010							0.009	0.009
1986-1990	n		44		48					49			49							47	49
	min		0.001		0.001					0.001			0.001							0.001	0.001
	max		0.088		0.011					0.027			0.450							0.007	0.023
	median		0.002		0.002					0.004			0.002							0.002	0.002
	25th		0.002		0.002					0.003			0.002							0.002	0.002
	75th		0.004		0.003					0.005			0.004							0.003	0.003
1991-1995	n		44		43					44			44							43	45
	min		0.001		0.001					0.001			0.001							0.001	0.001
	max		0.005		0.003					0.080			0.004							0.003	0.003
	median		0.001		0.001					0.002			0.001							0.001	0.001
	25th		0.001		0.001					0.002			0.001							0.001	0.001
	75th		0.001		0.001					0.003			0.001							0.002	0.002
1996-2000	n	21	20									19					20			19	21
	min	-0.003	-0.002									-0.002					0.000			-0.002	-0.002
	max	0.007	0.002									0.002					0.034			0.006	0.002
	median	0.001	0.001									0.001					0.001			0.001	0.001
	25th	0.000	0.000									0.000					0.001			0.000	0.000
	75th	0.001	0.001									0.001					0.001			0.001	0.001
2001-2005	n	41	41						16			41		17			42			41	41
	min	0.000	0.000						0.000			0.000		0.000			0.000			0.000	0.000
	max	0.004	0.004						0.002			0.004		0.002			0.008			0.005	0.004
	median	0.001	0.001						0.001			0.001		0.001			0.001			0.001	0.001
	25th	0.001	0.001						0.001			0.001		0.001			0.001			0.001	0.001
	75th	0.001	0.001						0.001			0.002		0.001			0.002			0.002	0.001

Copper - Middle Maitland River

		Listw_NE	NE Listowel	Chapman	Listowel	Trowbridge	Grey_Elm	Ethel	Milvertn	Henfryn	Beauchamp	Grey	Brusl_12	Brus_DSc	Brussl_D	Bruss_16	Morris	Wingham
	Major Basin	Middle Maitland River																
	Tributary	Above Listowel		Chapman	Below Listowel				Boyle Drain		Beachamp	Lower Middle Maitland						
	MOE or local ID	08005601402	08005604302	08005602102	08005601302	08005600902	08005601902	08005602602	08005601002	08005602002	08005604102	08005601802	08005601102	08005600502	08005601602	08005603102	08005601702	08005603902
	Site Name	Listw_NE	NE Listowel	Chapman	Listowel	Trowbridge	Grey_Elm	Ethel	Milvertn	Henfryn	Beauchamp	Grey	Brusl_12	Brus_DSc	Brussl_D	Bruss_16	Morris	Wingham
1964-1965	n																	
	min																	
	max																	
	median																	
	25th																	
	75th																	
1966-1970	n																	
	min																	
	max																	
	median																	
	25th																	
	75th																	
1971-1975	n																	
	min																	
	max																	
	median																	
	25th																	
	75th																	
1976-1980	n																	
	min																	
	max																	
	median																	
	25th																	
	75th																	
1981-1985	n					34			34					1		34		
	min					0.001			0.002					0.012		0.001		
	max					0.017			0.020					0.012		0.020		
	median					0.004			0.005					0.012		0.004		
	25th					0.003			0.003							0.003		
	75th					0.010			0.010							0.009		
1986-1990	n					49			51							49		
	min					0.001			0.001							0.001		
	max					0.016			0.014							0.027		
	median					0.003			0.004							0.003		
	25th					0.002			0.003							0.002		
	75th					0.003			0.005							0.003		
1991-1995	n					43			42							44		
	min					0.001			0.001							0.001		
	max					0.004			0.012							0.003		
	median					0.001			0.001							0.001		
	25th					0.001			0.001							0.001		
	75th					0.002			0.002							0.002		
1996-2000	n				20	19		21		21								
	min				0.000	0.000		-0.002		-0.001								
	max				0.007	0.012		0.004		0.004								
	median				0.001	0.001		0.001		0.002								
	25th				0.001	0.001		0.001		0.001								
	75th				0.002	0.002		0.002		0.002								
2001-2005	n				24	41		24		41	17							17
	min				0.001	0.001		0.001		0.001	0.000							0.001
	max				0.014	0.005		0.004		0.005	0.004							0.003
	median				0.002	0.001		0.002		0.002	0.001							0.001
	25th				0.001	0.001		0.001		0.001	0.001							0.001
	75th				0.003	0.002		0.002		0.002	0.002							0.002

Copper - Bayfield River and Parkhill Creek

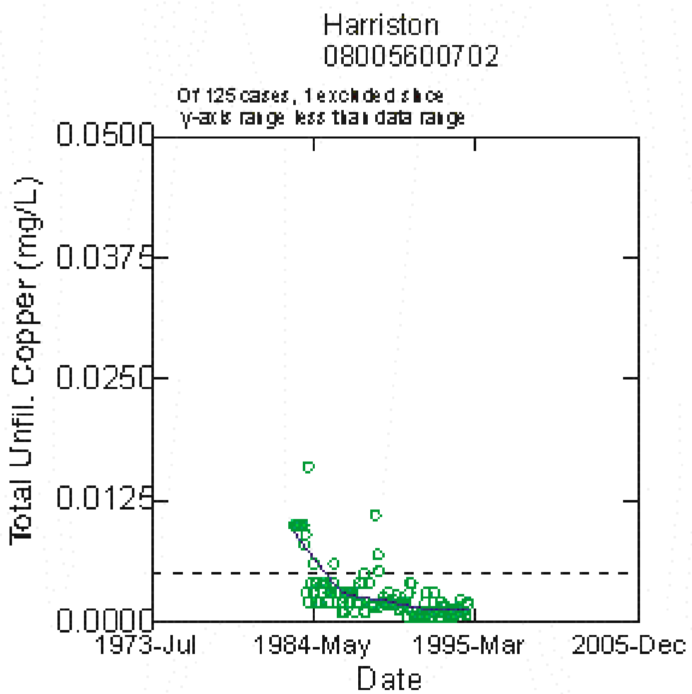
	Major Basin	Bayfield River														Parkhill Creek							
	Tributary	Bannockburn	Liffy Ditch			Silver Creek		Upper Bayfield			Steenstra	Lower Bayfield				Upper Parkhill					Tributary	Lower Parkhill	
	MOE or local ID	MBBAN1	HBLIF1	08004000402	08004000502	08004001102	08004000302	08004000202	08004000902	08004000602	HBSTEEN1	08004001002	08004000802	08004000102	08004000783	08002200302	MPMCGUF1	08002200402	08002200902	08002201202	08002201802	08002201302	08002200102
	Site Name	Bannockburn	Dublin	HBLIF2	HBLIF3	Silver	MBSILV1	Seaforth	MBHAN1	MBCLIN2	Steenstra	MBGRANT	Varna	MBBAY1	MBBAY2	HPCAM	Upstream Parkhill	MPDAM	MPHARM	Downstream Parkhill	MPTRI1	MPGBEND2	MPGBEND1
1964-1965	n																						
	min																						
	max																						
	median																						
	25th																						
	75th																						
1966-1970	n																						
	min																						
	max																						
	median																						
	25th																						
	75th																						
1971-1975	n													1	3							2	1
	min													0.030	0.050							0.050	0.050
	max													0.030	0.070							0.050	0.050
	median													0.030	0.050							0.050	0.050
	25th														0.050							0.050	
	75th														0.065							0.050	
1976-1980	n																					5	
	min																					0.010	
	max																					0.040	
	median																					0.010	
	25th																					0.010	
	75th																					0.025	
1981-1985	n								34	34			34							32		34	
	min								0.001	0.001			0.001							0.002		0.001	
	max								0.050	0.031			0.040							0.020		0.020	
	median								0.003	0.004			0.005							0.005		0.007	
	25th								0.003	0.003			0.002							0.004		0.005	
	75th								0.010	0.010			0.010							0.006		0.010	
1986-1990	n								57	56			58							59		56	
	min								0.001	0.001			0.001							0.001		0.001	
	max								0.011	0.020			0.009							0.020		0.018	
	median								0.003	0.003			0.002							0.004		0.004	
	25th								0.002	0.002			0.002							0.003		0.003	
	75th								0.004	0.004			0.003							0.005		0.006	
1991-1995	n								44	46			49							50		44	
	min								0.001	0.001			0.000							0.001		0.000	
	max								0.006	0.009			0.008							0.004		0.006	
	median								0.001	0.001			0.001							0.002		0.003	
	25th								0.001	0.001			0.001							0.002		0.003	
	75th								0.002	0.002			0.002							0.003		0.004	
1996-2000	n								7				7								7		
	min								0.001				0.000								0.003		
	max								0.003				0.007								0.004		
	median								0.002				0.002								0.003		
	25th								0.002				0.001								0.003		
	75th								0.003				0.004								0.004		
2001-2005	n							26	14				50							26	14		
	min							0.000	0.000				0.000							0.001	0.002		
	max							0.002	0.003				0.005							0.004	0.004		
	median							0.001	0.002				0.001							0.002	0.003		
	25th							0.001	0.001				0.001							0.002	0.002		
	75th							0.001	0.002				0.002							0.002	0.004		

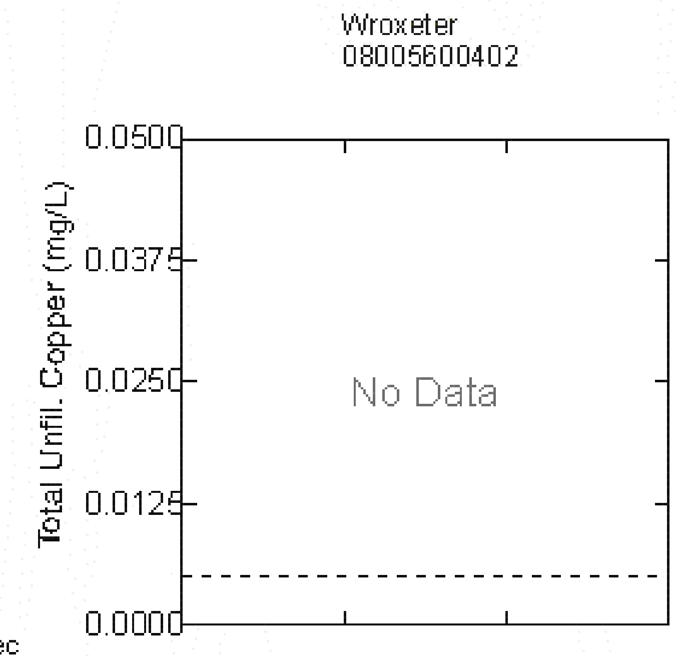
Copper - Ausable River

Period	Major Basin	Ausable							
	Tributary	Black Creek	Little Ausable River		Nairn Creek	Ausable River			
	MOE or local ID	08002200702	08002201402	08002201002	MANAIRN1	08002200802	08002201702	08002200602	08002201602
	Site Name	Black	Huron Park	Lucan	Nairn	Staffa	MAMOR2	MATHAMES	Exeter
1964-1965	n								
	min								
	max								
	median								
	25th								
	75th								
1966-1970	n								
	min								
	max								
	median								
	25th								
	75th								
1971-1975	n		102						
	min		0.001						
	max		0.130						
	median		0.009						
	25th		0.004						
	75th		0.021						
1976-1980	n		81						
	min		0.001						
	max		0.038						
	median		0.003						
	25th		0.002						
	75th		0.004						
1981-1985	n	36		31				1	33
	min	0.001		0.001				0.003	0.002
	max	0.021		0.034				0.003	0.029
	median	0.003		0.005				0.003	0.003
	25th	0.002		0.004					0.002
	75th	0.007		0.010					0.010
1986-1990	n	58		56					58
	min	0.001		0.001					0.001
	max	0.007		0.025					0.006
	median	0.003		0.003					0.003
	25th	0.002		0.002					0.002
	75th	0.004		0.003					0.003
1991-1995	n	48		47				1	43
	min	0.000		0.000				0.001	0.001
	max	0.005		0.005				0.001	0.003
	median	0.001		0.001				0.001	0.001
	25th	0.001		0.001					0.001
	75th	0.002		0.002					0.002
1996-2000	n	7		7					7
	min	0.001		0.001					0.001
	max	0.007		0.004					0.003
	median	0.002		0.002					0.002
	25th	0.002		0.002					0.002
	75th	0.003		0.003					0.003
2001-2005	n	40		40					40
	min	-0.001		0.000					0.000
	max	0.003		0.003					0.006
	median	0.001		0.001					0.001
	25th	0.001		0.001					0.001
	75th	0.001		0.002					0.002

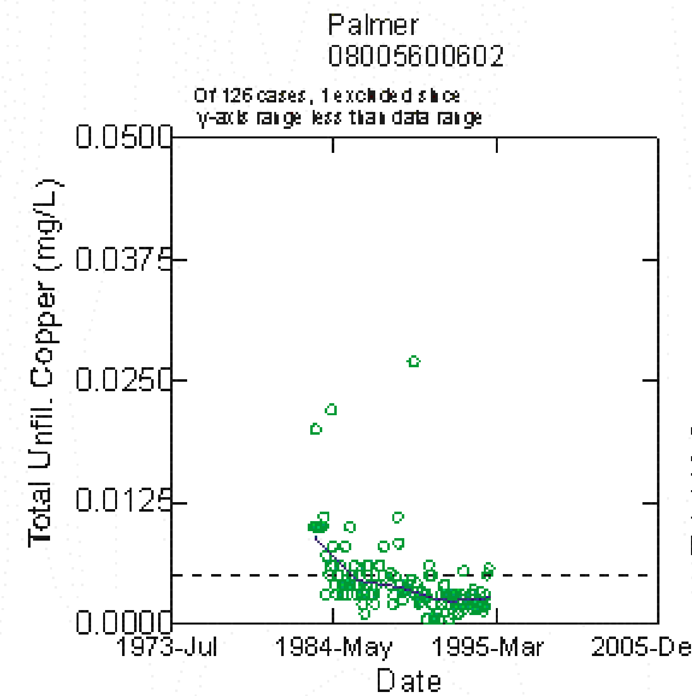
Period	Major Basin	Ausable							
	Tributary	Ausable River				Decker Creek		The Cut	
	MOE or local ID	08002200502	08002201102	08002202002	08002201502	08002201902	08002200202	08002100202	08002100102
	Site Name	HATRIB	MAMTCARM	Springbank	MAGLAS1	Decker	MADECK3	Thedford	MAWAL
1964-1965	n								
	min								
	max								
	median								
	25th								
	75th								
1966-1970	n								
	min								
	max								
	median								
	25th								
	75th								
1971-1975	n				1				4
	min				0.006				0.050
	max				0.006				0.110
	median				0.006				0.050
	25th								0.050
	75th								0.080
1976-1980	n								31
	min								0.001
	max								0.120
	median								0.010
	25th								0.010
	75th								0.010
1981-1985	n		34				33	295	26
	min		0.003				0.001	0.001	0.003
	max		0.030				0.020	0.120	0.074
	median		0.004				0.006	0.006	0.009
	25th		0.003				0.004	0.004	0.006
	75th		0.006				0.010	0.010	0.012
1986-1990	n		54				56	243	
	min		0.001				0.001	0.001	
	max		0.050				0.032	0.043	
	median		0.004				0.005	0.004	
	25th		0.003				0.003	0.003	
	75th		0.005				0.006	0.005	
1991-1995	n		43				47	235	
	min		0.001				0.001	0.001	
	max		0.004				0.014	0.010	
	median		0.002				0.002	0.002	
	25th		0.001				0.002	0.002	
	75th		0.002				0.003	0.003	
1996-2000	n					7		31	
	min					0.002		0.001	
	max					0.006		0.006	
	median					0.003		0.003	
	25th					0.003		0.002	
	75th					0.004		0.004	
2001-2005	n			26		40		39	
	min			0.001		0.001		0.001	
	max			0.004		0.005		0.005	
	median			0.002		0.002		0.002	
	25th			0.002		0.002		0.002	
	75th			0.002		0.002		0.003	

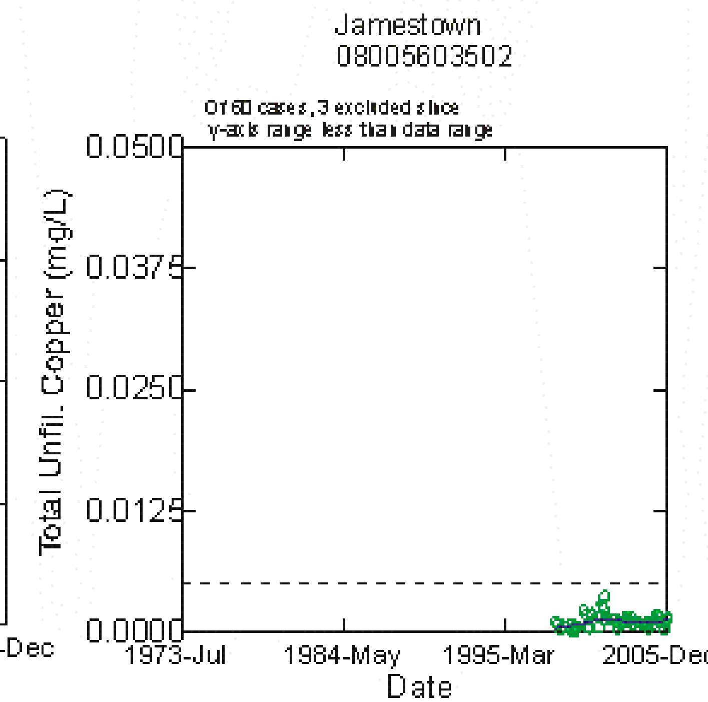
North Maitland



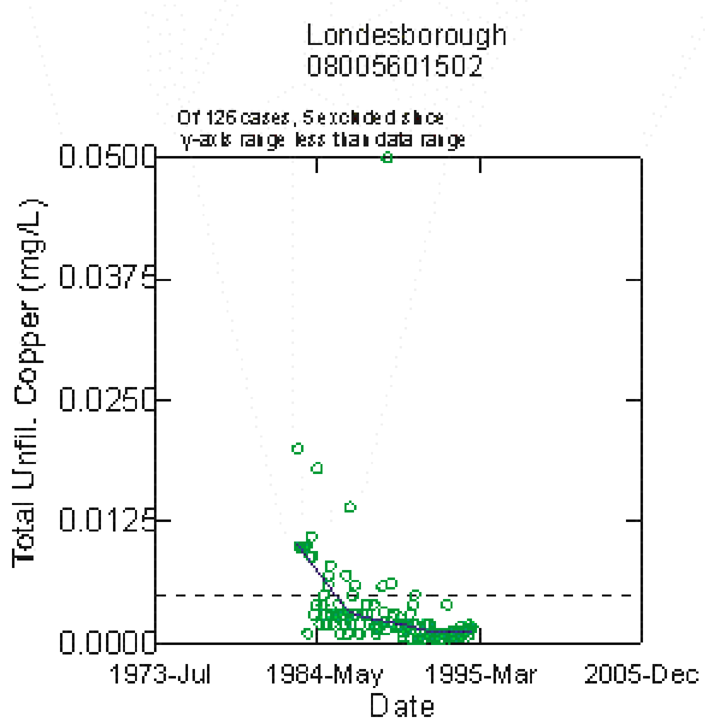


Little Maitland

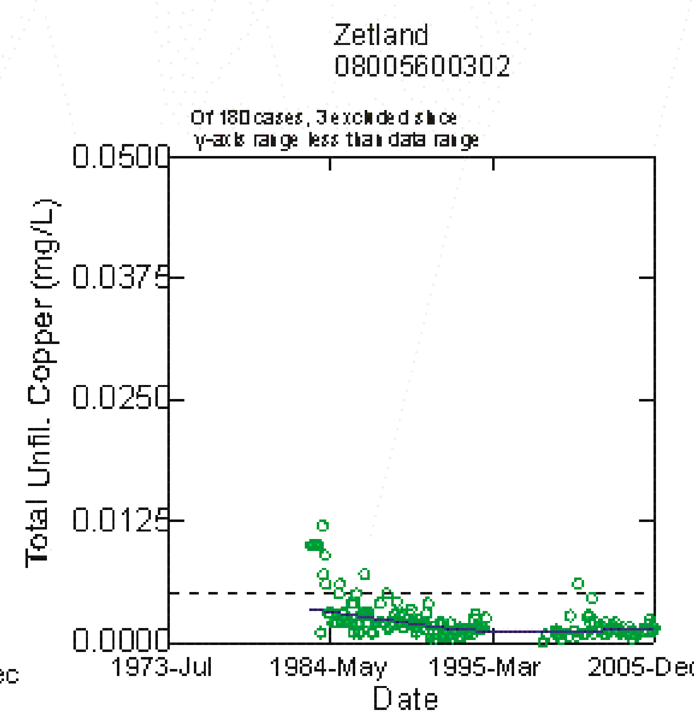




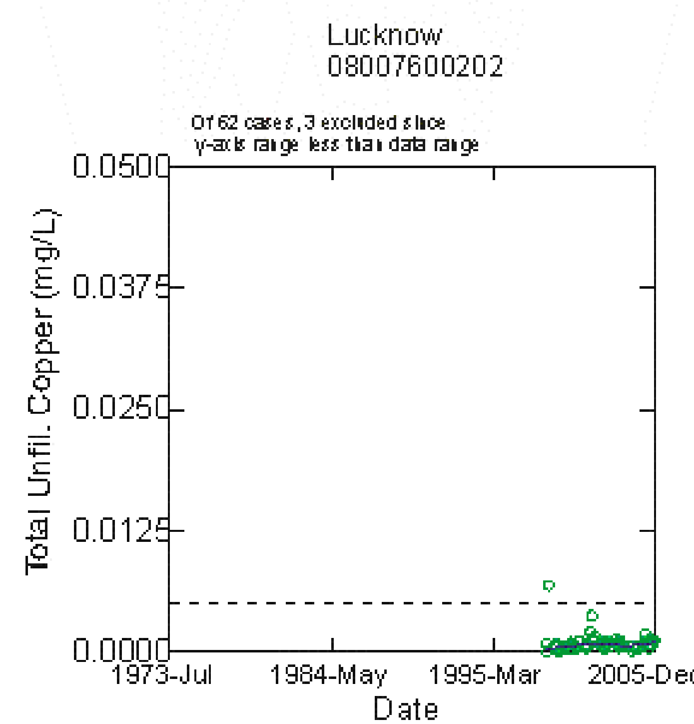
South Maitland



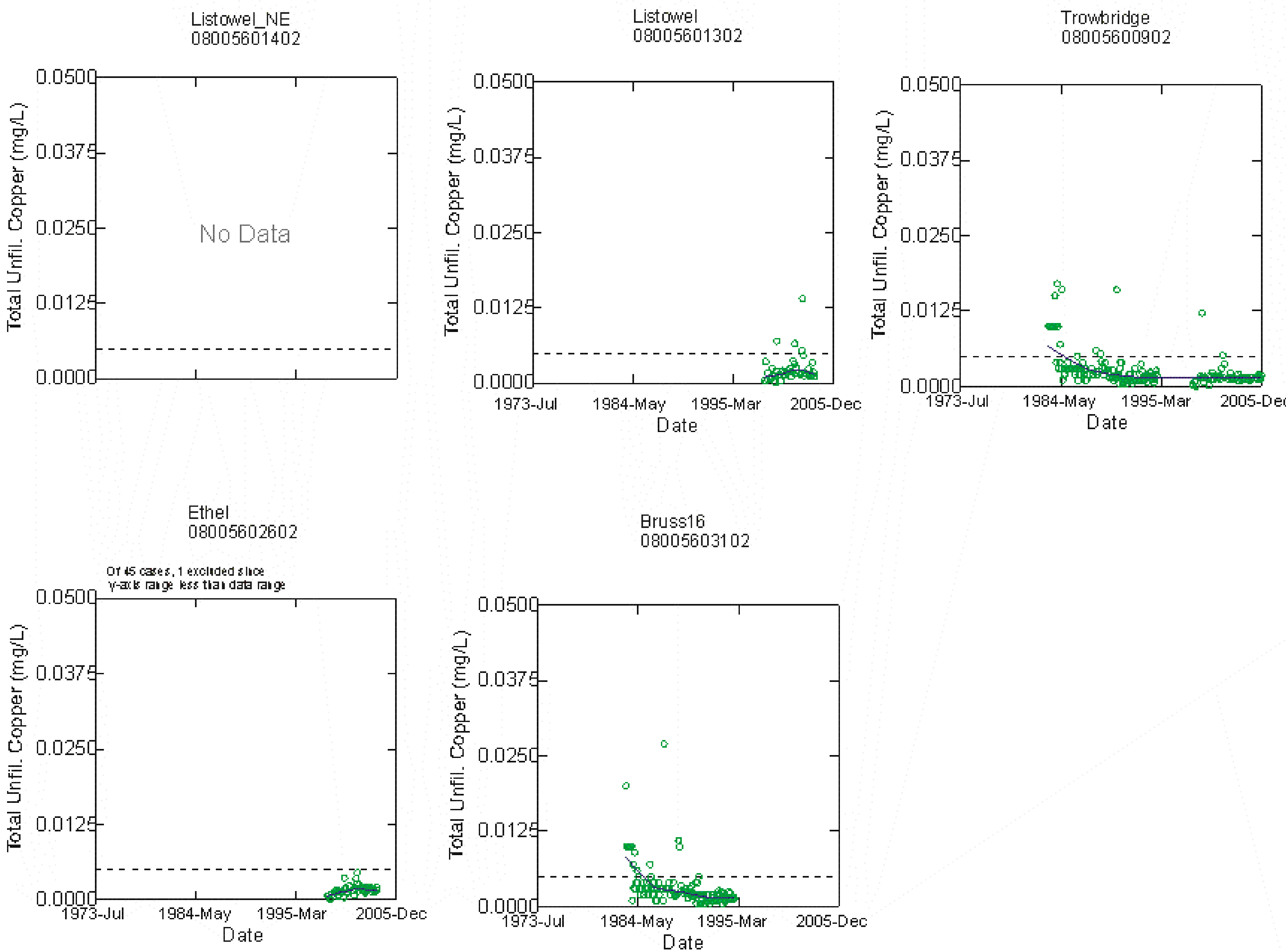
Lower Maitland



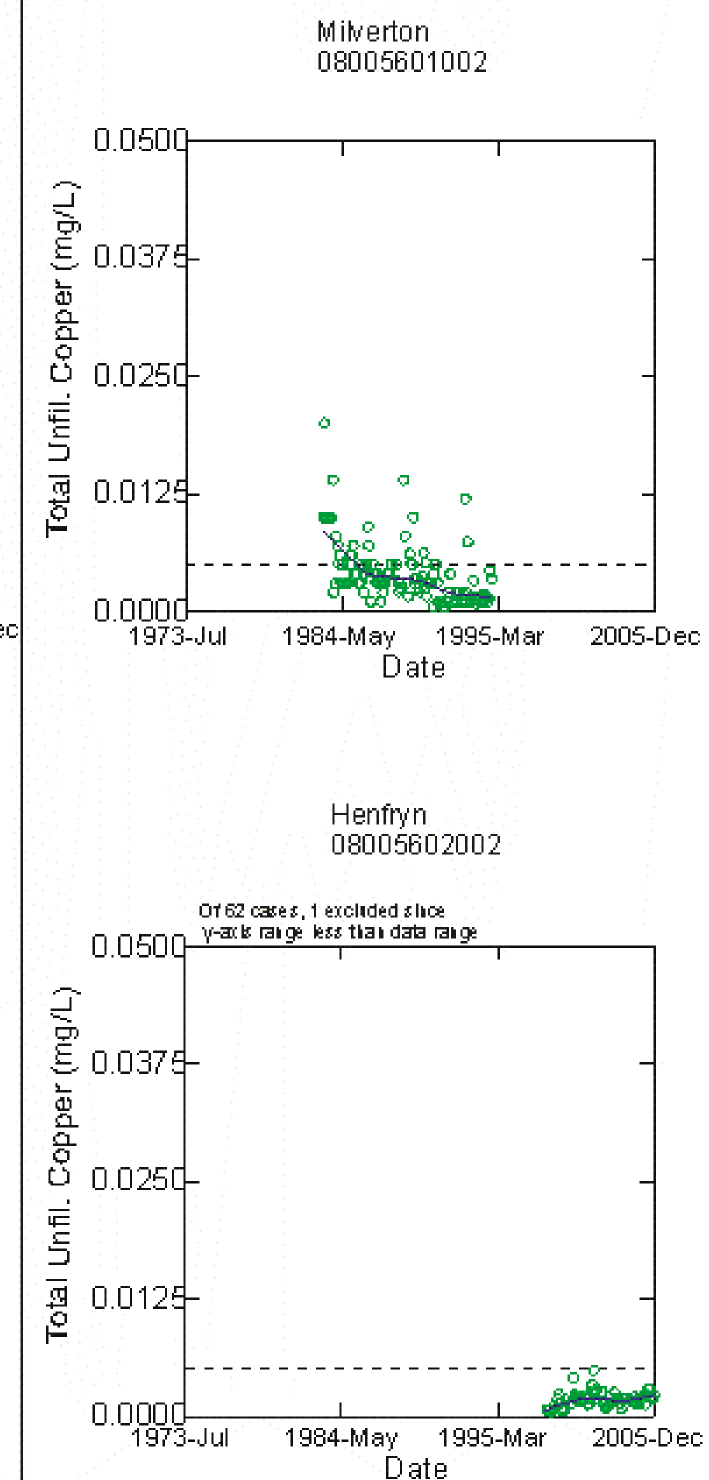
Nine Mile



Middle Maitland

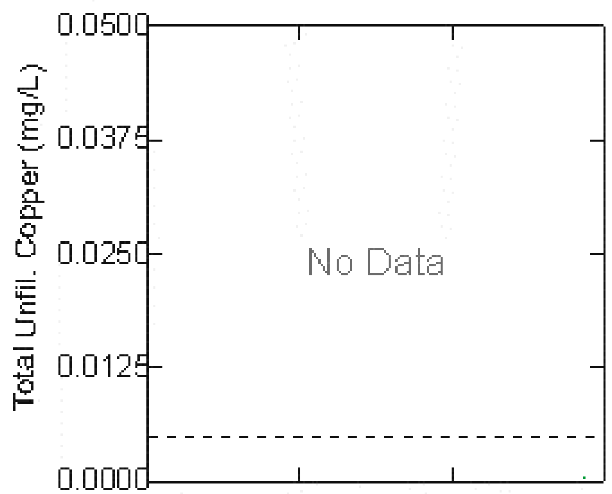


Boyle Drain



Bayfield River

MBSILV1&2 (Silver Creek)
08004000302 (1965-1975)
08004001102 (1983-2005)



MBSEA1
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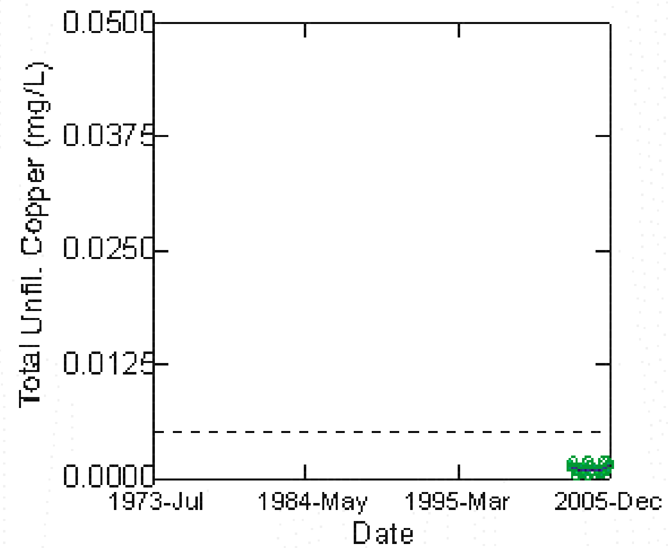

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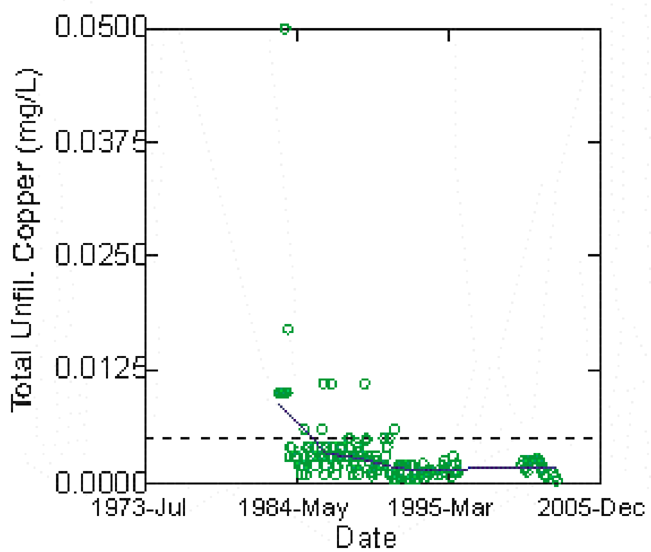

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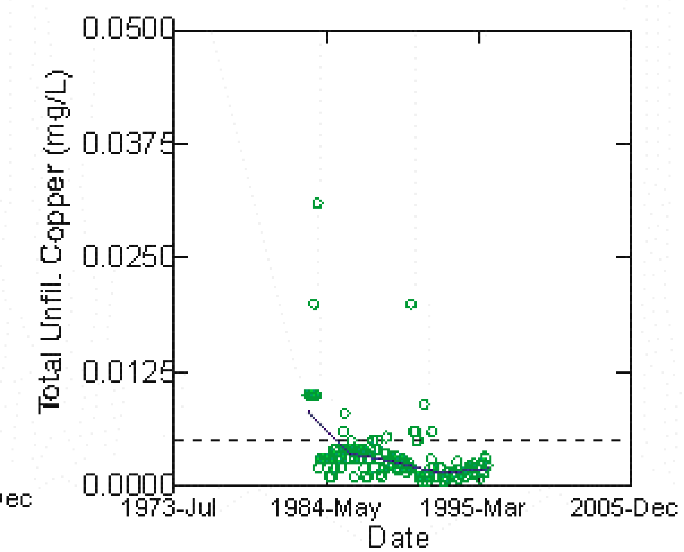
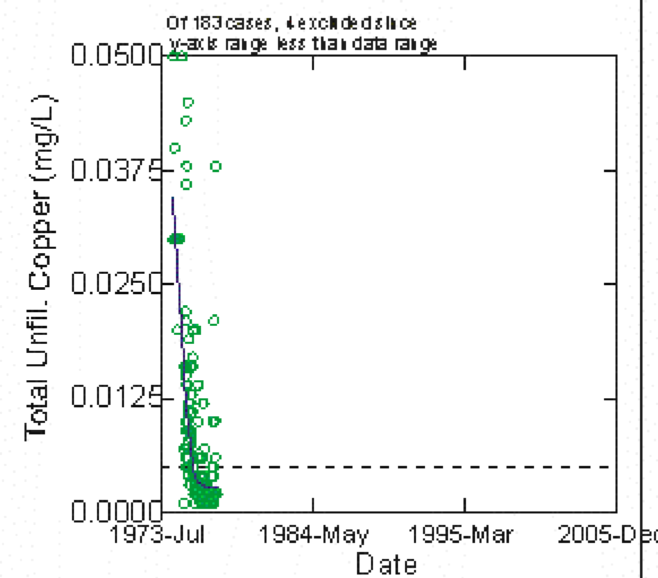
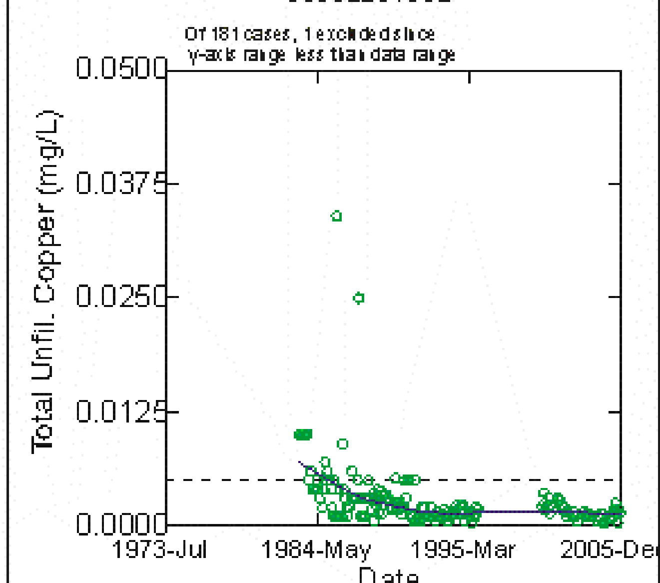


Little Ausable

ABCA14
08002201402

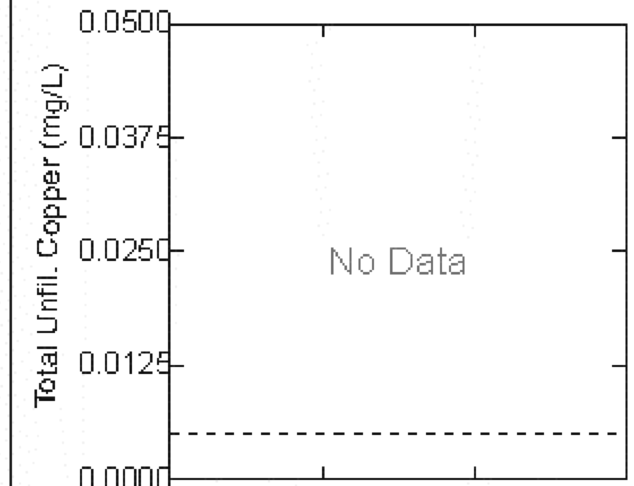


MALIT2
08002201002



Parkhill Creek

HBLIF3
08004000502



MPGBEND1&2
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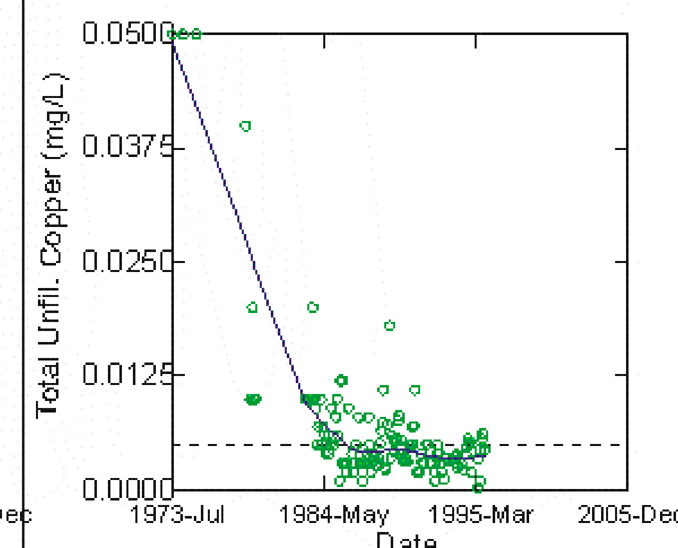
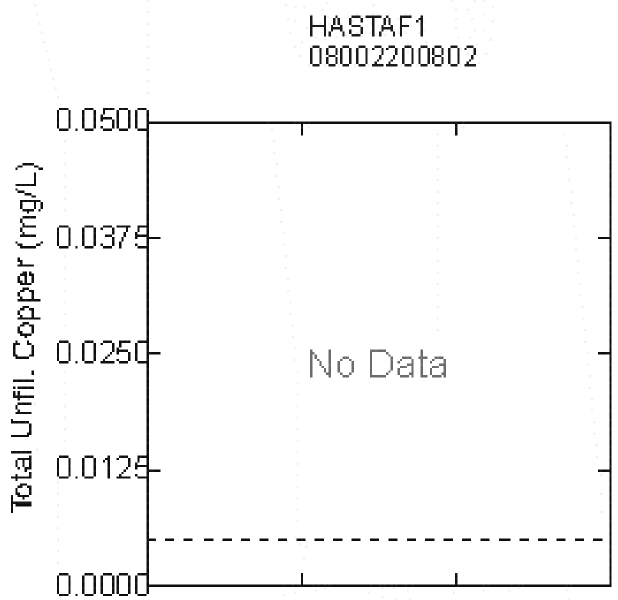
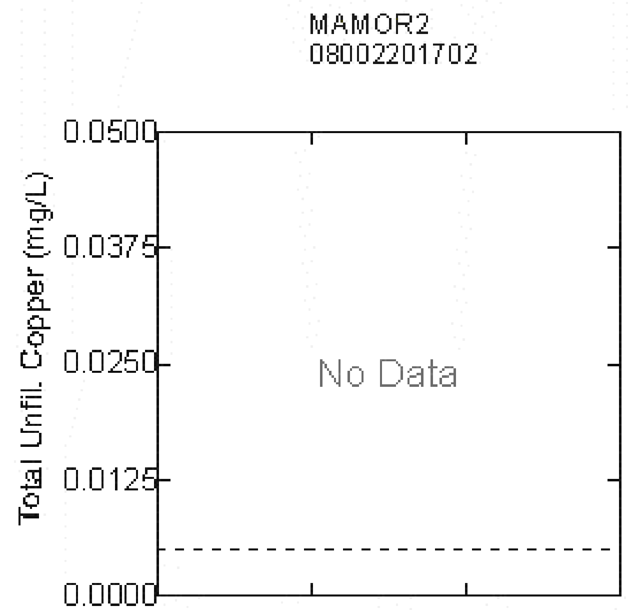
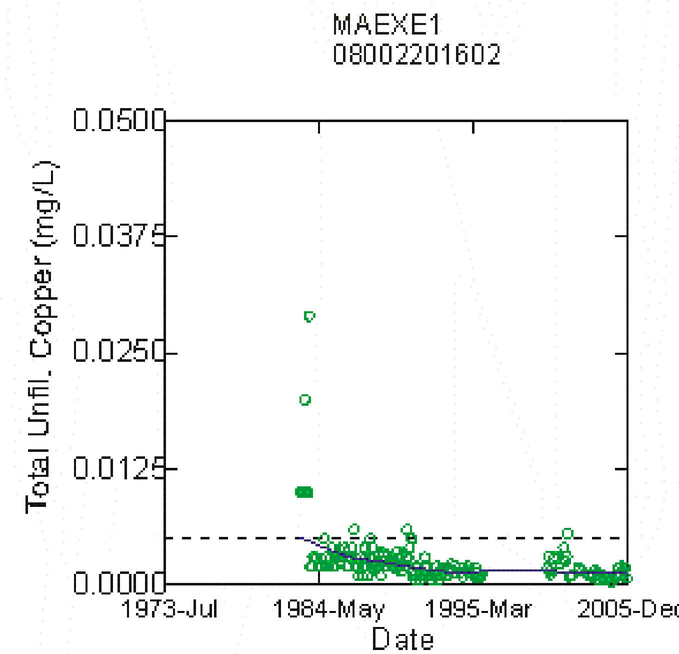
08002201302 (1974-1995)

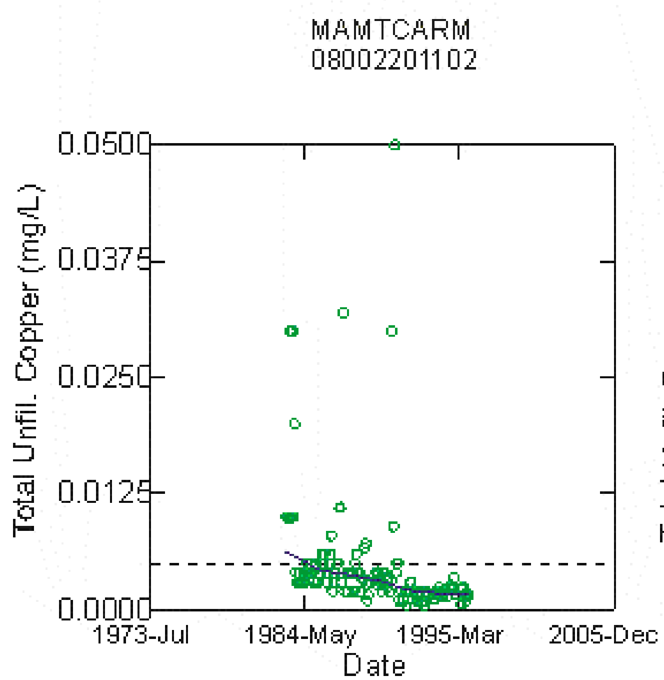


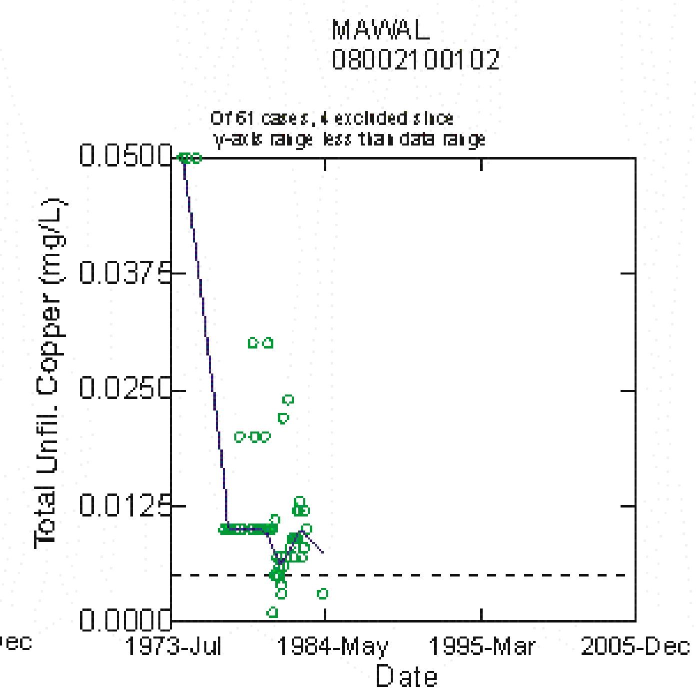
Ausable River



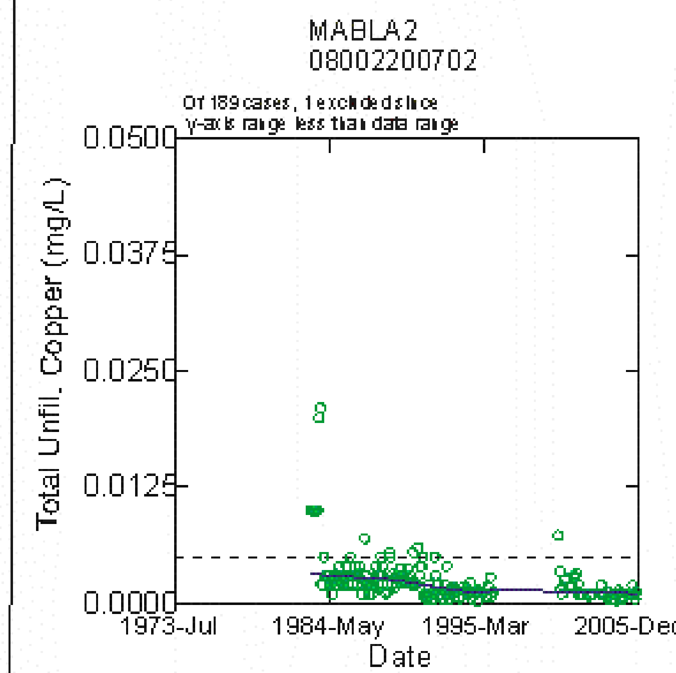




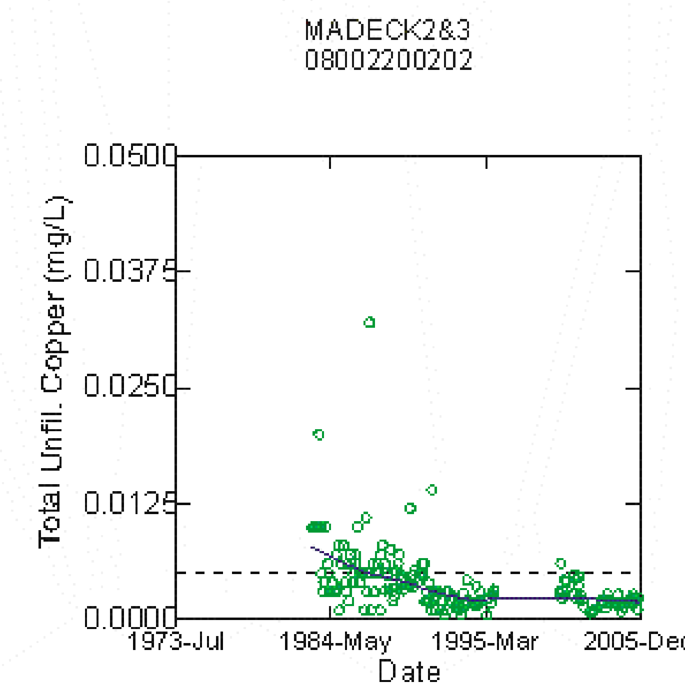




Black Creek



Decker Creek



Nitrate - North, Little, South and Lower Maitland River and Nine Mile River

Major Basin		Nine Mile		North Maitland						Little Maitland			South Maitland		Lower Maitland						
Tributary				Upper				Salem Creek	Lower						Belgrave Creek	Blyth Brook		Sharpes Creek		Main Branch	
MOE or local ID		08007600202	08007600102	08005600802	08005600702	08005602502	08005600402	08005605002	08005603802	08005600602	08005602202	08005603502	08005601502	08005603702	08005603002	08005604402	08005600202	08005602702	08005602802	08005600302	08005600102
Site Name		Lucknow	Port Albert	Palmer_N	Harristn	Fordwich	Wroxeter	NMSalem	B-Line	Palmer	Palme_23	Jamestown	Londesbo	Summerhill	WNC_Belg	Blyth East	Blyth	Sharpes	SharpBen	Zetland	Goderich
1964-1965	n	1	1	2	2		1			1							4			1	8
	min	0.80	0.50	1.00	0.90		1.10			2.20							0.15			1.00	0.15
	max	0.80	0.50	1.50	1.00		1.10			2.20							1.00			1.00	1.50
	median	0.80	0.50	1.25	0.95		1.10			2.20							0.20			1.00	0.68
	25th			1.00	0.90												0.15				0.20
	75th			1.50	1.00												0.63				0.90
1966-1970	n	61	63	59	100		102			102							100			100	96
	min	0.04	0.10	0.01	0.01		0.03			0.01							0.01			0.01	0.01
	max	4.70	2.50	2.00	2.60		2.00			3.00							4.00			2.60	3.50
	median	0.48	0.48	0.92	0.50		0.80			0.80							1.00			0.95	0.79
	25th	0.27	0.25	0.39	0.18		0.39			0.20							0.34			0.26	0.14
	75th	0.77	0.96	1.45	0.93		1.25			1.20							1.50			1.45	1.25
1971-1975	n	62	67	56	72		72			35	32		58				76	7	7	73	108
	min	0.04	0.14	0.01	0.01		0.07			0.01	0.04		0.01				0.01	0.01	1.07	0.01	0.01
	max	8.72	2.40	8.00	3.90		5.20			4.40	27.00		11.00				10.00	6.30	2.34	6.50	6.20
	median	0.44	0.56	1.05	0.72		1.27			1.00	1.50		3.41				1.55	0.47	1.78	1.34	1.05
	25th	0.33	0.33	0.30	0.14		0.55			0.21	0.18		1.58				0.38	0.11	1.38	0.21	0.20
	75th	1.10	1.28	2.00	1.50		2.00			2.35	2.75		5.80				3.25	1.09	2.24	2.33	2.50
1976-1980	n	55	55		58		59			48	32		57		23		61	30	45	58	62
	min	0.29	0.28		0.04		0.20			0.37	0.07		0.10		1.41		0.01	0.08	0.54	0.04	0.00
	max	2.70	3.24		4.93		5.75			8.40	4.06		12.10		6.49		11.10	1.97	4.30	6.03	5.93
	median	0.82	1.16		1.38		2.00			1.69	1.88		4.20		3.40		2.60	0.37	2.50	2.12	1.93
	25th	0.57	0.67		0.45		0.85			1.29	0.72		1.42		1.86		1.04	0.25	1.87	0.60	0.54
	75th	1.40	1.95		2.28		2.80			2.49	2.30		6.72		4.43		4.74	0.56	3.10	3.10	3.20
1981-1985	n	58	56		59		59			58			58		35		58			57	54
	min	0.60	0.84		0.00		0.46			0.30			0.19		1.51		0.71			0.03	0.10
	max	5.40	4.30		4.70		8.62			5.70			9.70		6.53		11.60			6.00	7.30
	median	1.53	1.99		2.59		3.15			3.12			5.53		4.14		4.70			3.50	3.52
	25th	0.96	1.47		0.70		1.64			1.50			3.90		2.42		2.62			1.67	2.03
	75th	2.19	2.82		3.28		3.88			4.30			7.20		5.04		6.30			4.81	5.37
1986-1990	n	56	54		55		54			55		38	54				57			49	52
	min	0.10	0.10		0.00		0.00			0.10		0.10	0.10				0.02			0.10	0.01
	max	2.90	4.70		5.80		13.60			13.20		8.10	15.30				10.00			7.80	7.90
	median	1.35	2.00		2.40		3.30			5.50		4.05	5.35				4.20			3.40	2.95
	25th	0.80	1.30		0.23		0.80			2.65		1.10	3.20				2.40			1.40	0.80
	75th	1.90	2.80		3.80		4.60			7.88		5.80	7.20				5.88			4.53	4.75
1991-1995	n	51	50		42		41			41		37	41				41			40	40
	min	0.02	1.00		0.10		0.70			3.40		0.20	0.50				0.20			0.20	0.30
	max	4.60	4.70		7.90		7.00			13.90		8.60	12.20				7.70			9.30	8.60
	median	1.30	1.90		3.10		3.30			6.40		3.30	5.10				3.70			3.95	3.50
	25th	0.90	1.40		1.60		2.38			5.60		2.10	3.35				2.43			2.40	1.85
	75th	1.80	2.50		3.80		4.33			7.80		4.93	6.23				4.33			4.85	4.60
1996-2000	n	21	21									20					21			20	19
	min	0.39	0.53									0.01					1.42			0.04	0.02
	max	2.89	4.68									11.20					11.60			10.50	12.90
	median	9.35	1.71									0.99					4.05			1.49	1.18
	25th	0.56	0.86									0.57					2.34			0.21	0.09
	75th	1.62	2.34									6.15					5.72			5.93	5.25
2001-2005	n	41	134					14	16			41		17		28	42			41	41
	min	0.70	0.69					5.54	1.32			0.75		1.54		0.03	1.22			0.32	0.20
	max	6.23	6.48					13.90	8.61			9.17		10.60		7.17	10.10			9.74	9.89
	median	1.25	1.69					6.13	2.95			4.26		4.31		3.22	3.64			4.31	3.79
	25th	1.06	1.26					5.76	1.78			2.19		2.48		2.46	2.34			1.83	1.08
	75th	1.80	2.40					7.97	4.56			6.83		6.21		3.92	4.82			6.26	5.52

Nitrate - Middle Maitland River

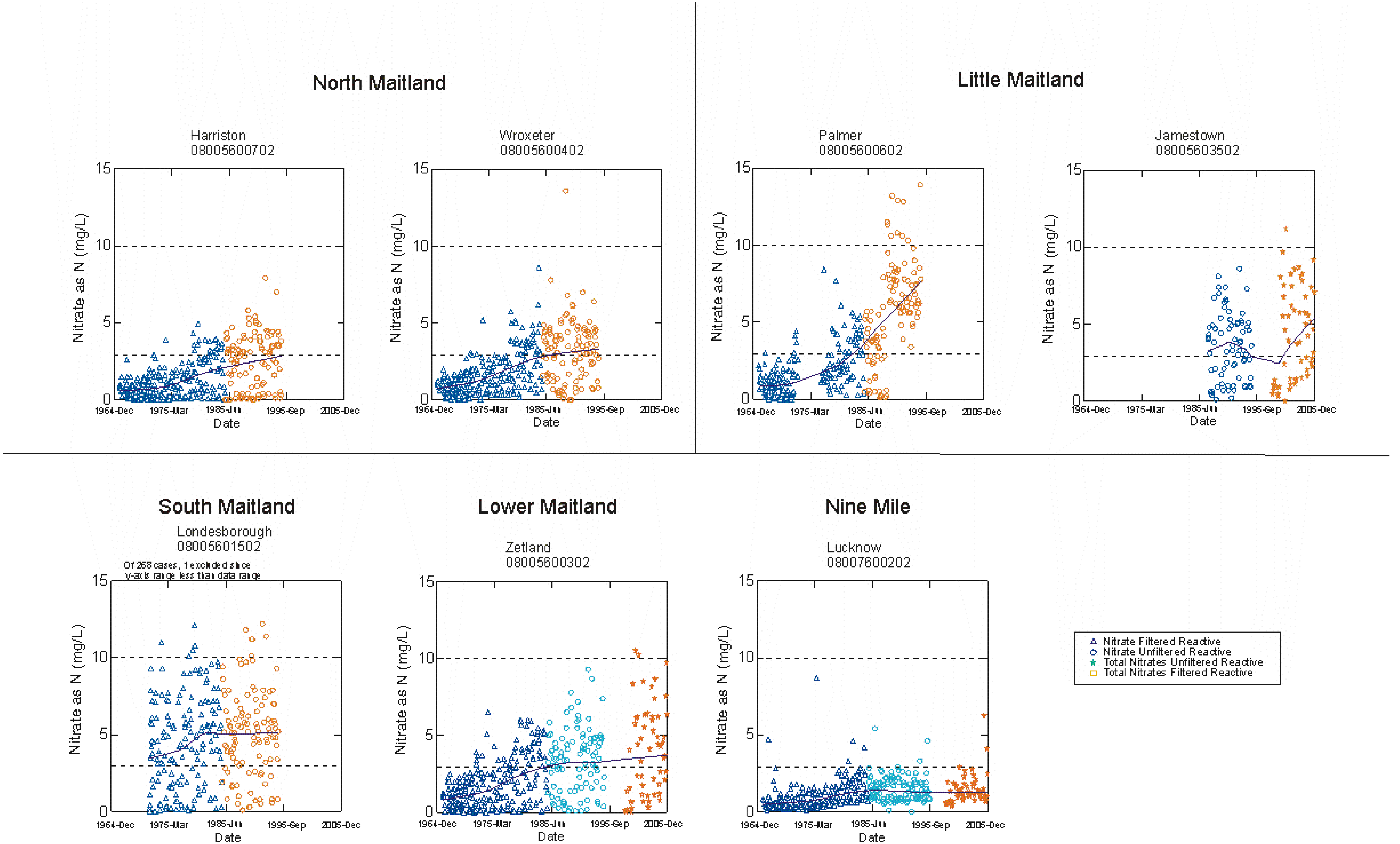
	Major Basin	Middle Maitland River																
	Tributary	Above Listowel		Chapman	Below Listowel				Boyle Drain		Beachamp	Lower Middle Maitland						
	MOE or local ID	08005601402	08005604302	08005602102	08005601302	08005600902	08005601902	08005602602	08005601002	08005602002	08005604102	08005601802	08005601102	08005600502	08005601602	08005603102	08005601702	08005603902
	Site Name	Listw_NE	NE Listowel	Chapman	Listowel	Trowbridge	Grey_Elm	Ethel	Milvertn	Henfryn	Beauchamp	Grey	Brusl_12	Brus_DSc	Brussl_D	Bruss_16	Morris	Wingham
1964-1965	n					2		1						1.25				
	min					1.10		3.00						1.25				
	max					1.25		3.00						1.25				
	median					1.18		3.00										
	25th					1.10												
	75th					1.25												
1966-1970	n					101		63					61	102				
	min					0.01		0.01					0.01	0.01				
	max					5.00		8.00					5.50	4.50				
	median					0.80		1.60					1.50	1.23				
	25th					0.39		0.56					0.11	0.20				
	75th					1.20		2.88					2.90	1.80				
1971-1975	n	58		33	58	74	35	60	33	7		33	22	60	52		33	
	min	0.01		0.06	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01	0.01	0.01		0.03	
	max	26.00		5.90	23.00	26.00	7.00	9.70	8.60	2.05		8.90	5.40	8.40	8.20		7.60	
	median	1.15		1.40	0.78	0.99	1.20	2.75	1.30	1.19		1.70	0.53	1.75	1.94		1.80	
	25th	0.01		0.42	0.11	0.01	0.40	0.90	0.28	0.29		0.53	0.01	1.04	0.49		3.55	
	75th	3.00		1.90	2.80	2.40	3.43	5.50	3.78	1.83		3.60	4.10	3.15	4.00		3.60	
1976-1980	n	59			58	60		12		57				10	45	12		
	min	0.01			0.01	0.01		0.01		0.01				0.50	0.02	0.46		
	max	7.50			6.03	5.92		9.13		9.90				6.30	9.80	6.53		
	median	1.75			1.40	1.57		3.30		1.86				1.79	2.33	3.74		
	25th	0.22			0.36	0.05		0.30		0.39				1.32	0.19	1.39		
	75th	2.70			2.30	2.57		5.55		3.70				4.40	4.30	4.82		
1981-1985	n	36			60	59		59		35						58		
	min	0.01			0.01	0.01		0.01		0.10						0.17		
	max	7.14			6.29	6.30		12.30		9.00						8.70		
	median	3.07			2.29	2.79		4.80		4.30						4.37		
	25th	1.05			0.77	0.10		2.53		2.20						2.47		
	75th	4.45			3.80	4.08		7.54		5.95						5.60		
1986-1990	n				52	54		56	38	45						56		
	min				0.10	0.10		0.10	0.10	0.10						0.30		
	max				11.60	9.70		16.80	16.20	14.50						10.80		
	median				2.75	2.95		5.20	5.00	4.50						4.10		
	25th				0.85	0.50		2.80	0.60	1.58						3.00		
	75th				4.55	4.50		8.00	8.30	7.28						5.85		
1991-1995	n			1	41	42		42	39	39						41		
	min			3.40	0.10	0.10		0.10	0.10	0.50						0.20		
	max			3.40	10.50	9.80		13.30	12.90	11.10						12.90		
	median				3.90	3.15		4.45	4.20	4.50						4.40		
	25th				2.13	1.00		2.70	2.38	2.70						2.78		
	75th				5.08	4.40		6.30	5.83	5.75						5.35		
1996-2000	n				19	20			21	21								
	min				0.07	0.01			0.01	0.01								
	max				12.00	11.90			14.70	13.90								
	median				1.13	0.54			0.80	0.76								
	25th				0.75	0.02			0.02	0.03								
	75th				6.03	6.04			9.72	8.11								
2001-2005	n		29		24	41			41	24	17							17
	min		0.02		0.51	0.01			0.01	0.05	0.74							0.18
	max		14.00		9.81	10.20			14.80	12.10	9.52							10.70
	median		6.16		2.70	2.51			6.11	4.56	4.81							4.67
	25th		1.80		1.38	0.55			1.20	0.70	3.71							2.46
	75th		7.99		6.56	6.68			9.66	8.54	7.36							7.16

Nitrate - Bayfield River and Parkhill Creek

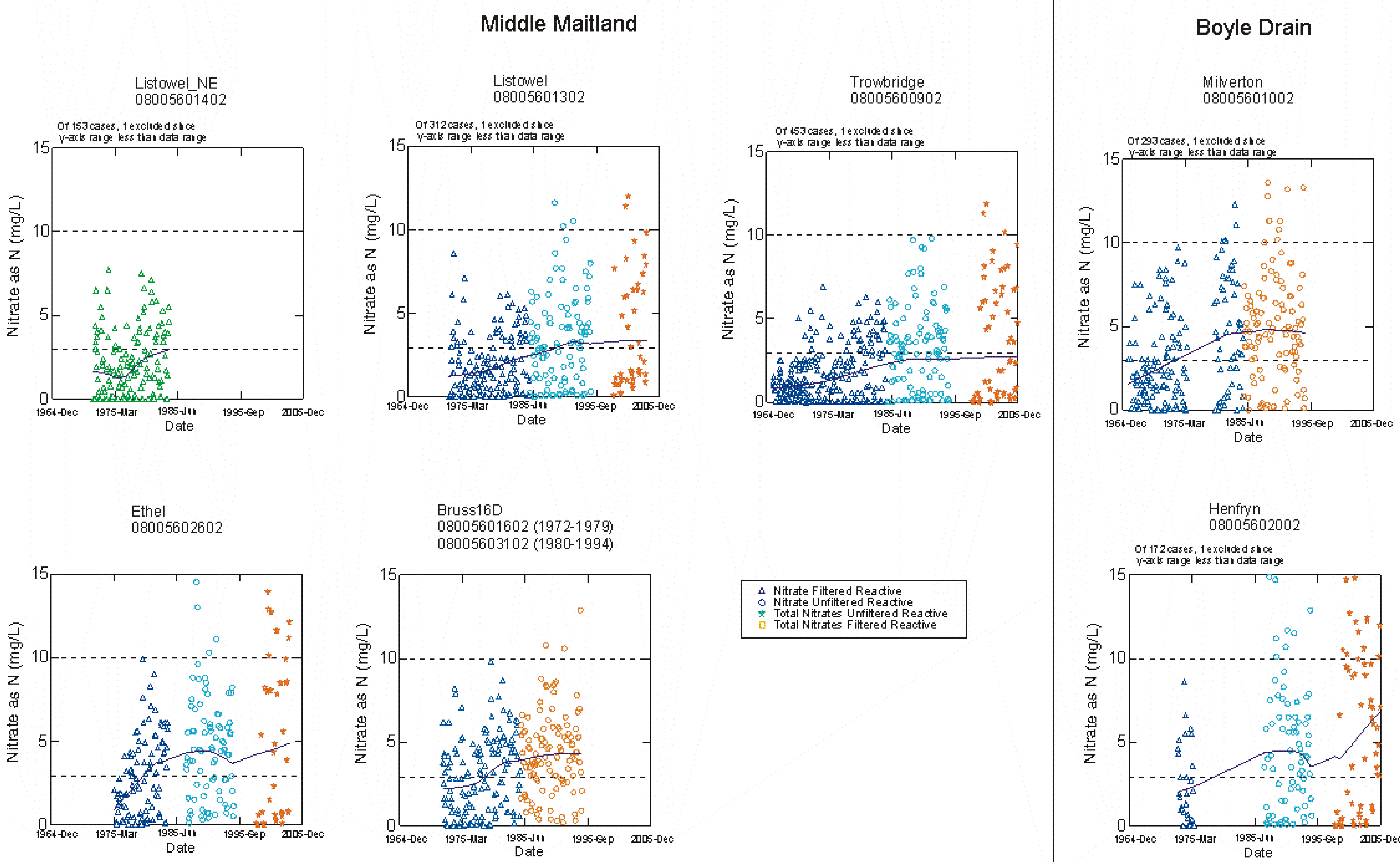
	Major Basin	Bayfield River														Parkhill Creek							
	Tributary	Bannockburn	Liffy Ditch			Silver Creek		Upper Bayfield			Steenstra	Lower Bayfield				Upper Parkhill					Tributary	Lower Parkhill	
	MOE or local ID	MBBAN1	HBLIF1	08004000402	08004000502	08004001102	08004000302	08004000202	08004000902	08004000602	HBSTEEN1	08004001002	08004000802	08004000102	08004000783	08002200302	MPMCGUF1	08002200402	08002200902	08002201202	08002201802	08002201302	08002200102
	Site Name	Bannockburn	Dublin	HBLIF2	HBLIF3	Silver	MBSILV1	Seaforth	MBHAN1	MBCLIN2	Steenstra	MBGRANT	Varna	MBBAY1	MBBAY2	HPCAM	Upstream Parkhill	MPDAM	MPHARM	Downstream Parkhill	MPTRI1	MPGBEND2	MPGBEND1
1964-1965	n			1	2		4	5						4		2		1					5
	min			2.00	0.15		0.20	0.20						1.50		2.80		4.00					0.25
	max			2.00	3.00		2.50	3.00						3.00		5.00		4.00					8.50
	median			2.00	1.58		0.65	0.40						2.50		3.90		4.00					3.10
	25th				0.15		0.35	0.28						2.00		2.80							2.16
	75th				3.00		1.65	1.41						2.75		5.00							5.88
1966-1970	n			62	64		65	63						61		75		14	55				74
	min			0.02	0.01		0.01	0.05						0.02		0.01		0.02	0.01				0.02
	max			7.30	7.60		17.00	7.20						6.90		25.00		44.00	6.30				13.00
	median			1.50	1.50		2.00	1.50						1.60		1.40		0.60	1.30				1.28
	25th			0.20	0.31		0.74	0.63						0.13		0.33		0.15	0.26				0.34
	75th			2.50	3.00		3.20	3.00						2.90		3.15		2.50	3.18				3.40
1971-1975	n			9	46		52	49	6	36			6	60	23	59			15	43		29	71
	min			0.17	0.01		0.01	0.06	0.14	0.09			0.60	0.01	0.01	0.01			0.03	0.02		0.17	0.09
	max			7.10	21.00		12.00	14.00	7.10	13.00			7.50	11.00	9.10	14.00			6.70	11.00		14.00	13.00
	median			3.20	3.20		3.55	3.00	2.12	4.30			1.63	1.65	1.50	3.10			2.20	2.80		3.35	2.40
	25th			0.80	0.74		0.95	0.86	0.46	0.82			0.70	0.13	0.38	0.39			0.52	0.52		0.46	0.30
	75th			5.53	7.20		6.75	7.23	4.30	6.50			3.70	6.10	5.30	4.88			4.20	4.58		7.08	5.20
1976-1980	n								59	59		32	62							11		60	
	min								0.03	0.01		0.77	0.24							2.76		0.14	
	max								15.10	14.00		9.80	14.40							10.00		27.00	
	median								5.20	4.75		4.05	5.05							6.80		5.20	
	25th								1.29	1.33		2.00	2.10							4.88		1.80	
	75th								7.18	6.68		6.30	6.90							8.38		7.70	
1981-1985	n					34			60	58			59							60		58	
	min					1.59			0.01	0.05			0.28							0.01		0.43	
	max					16.10			13.30	13.10			12.30							12.50		15.80	
	median					7.70			5.99	6.05			5.90							5.40		6.10	
	25th					5.77			2.85	3.26			3.32							3.95		4.00	
	75th					8.61			7.90	7.70			7.52							6.45		6.80	
1986-1990	n					56			55	56			56							58		54	
	min					1.00			0.10	0.10			0.60							0.00		0.10	
	max					24.40			16.20	14.40			13.70							16.20		15.10	
	median					6.30			5.20	5.35			5.00							5.05		5.70	
	25th					3.10			1.83	2.35			2.75							3.30		3.00	
	75th					10.50			9.10	8.60			8.15							8.20		8.50	
1991-1995	n					48			45	47			49							51		45	
	min					1.10			0.10	0.10			0.30							0.10		0.10	
	max					15.30			12.00	9.70			9.40							15.80		13.80	
	median					6.60			5.40	5.20			5.30							4.10		4.80	
	25th					3.69			1.15	2.60			3.13							1.90		2.33	
	75th					8.55			7.00	7.08			6.75							6.65		6.40	
1996-2000	n								7				7								7		
	min								1.46				2.52								1.18		
	max								18.80				14.50								20.60		
	median								9.64				7.72								8.70		
	25th								6.91				5.77								5.87		
	75th								12.65				9.63								11.31		
2001-2005	n	26	26			8		26	15		21		60				26			26	15		
	min	0.50	0.01			2.64		0.01	5.19		6.02		0.79				0.01			0.01	0.17		
	max	13.10	20.30			9.15		17.60	14.00		14.00		14.40				14.30			11.10	14.70		
	median	5.48	9.91			3.71		7.01	2.13		10.40		6.70				6.07			4.81	5.23		
	25th	3.10	2.82			2.80		1.76	0.91		7.81		3.28				2.60			1.53	0.95		
	75th	8.15	11.50			6.38		9.36	9.38		11.55		9.30				9.50			7.22	9.51		

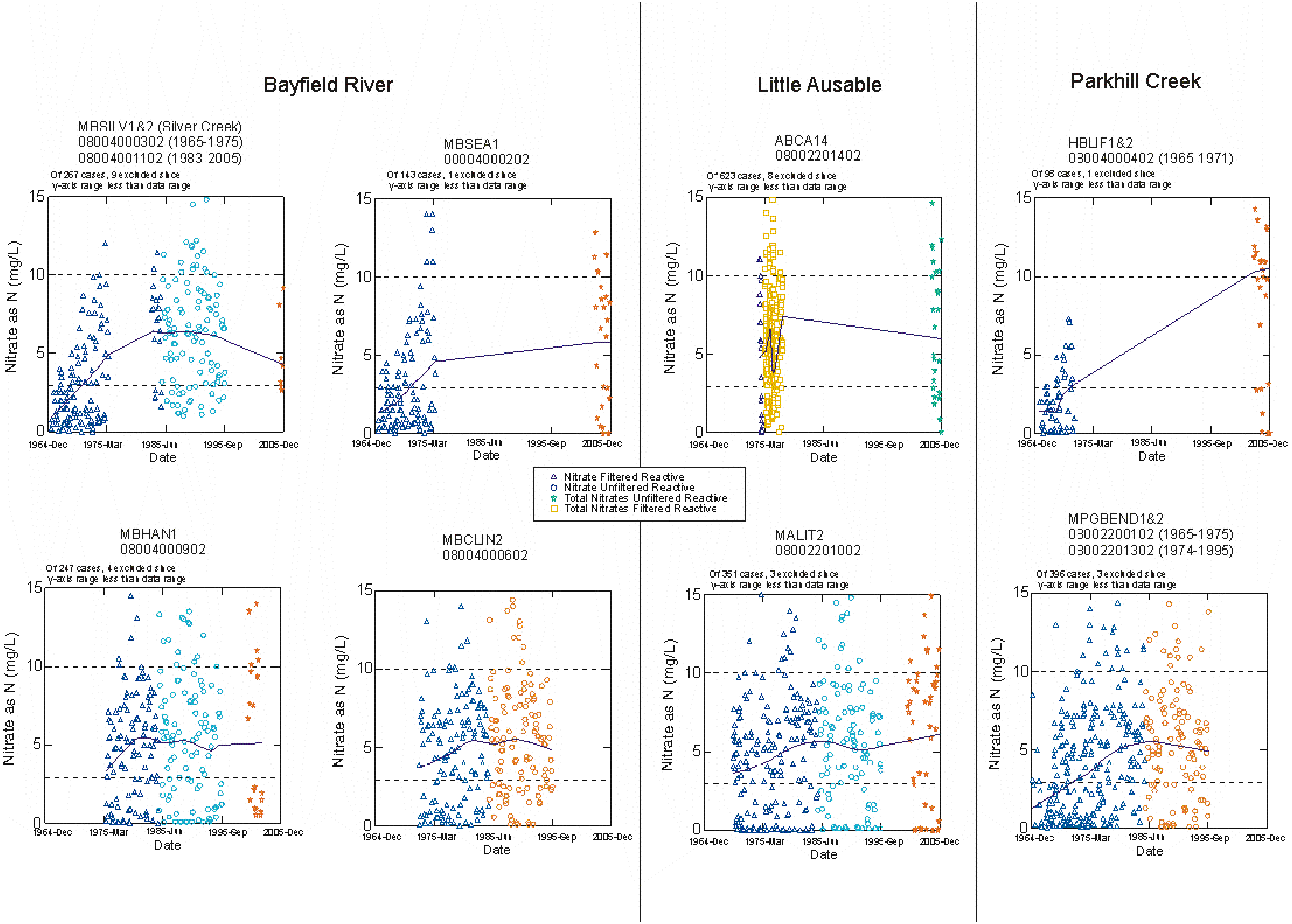
Nitrate - Ausable River

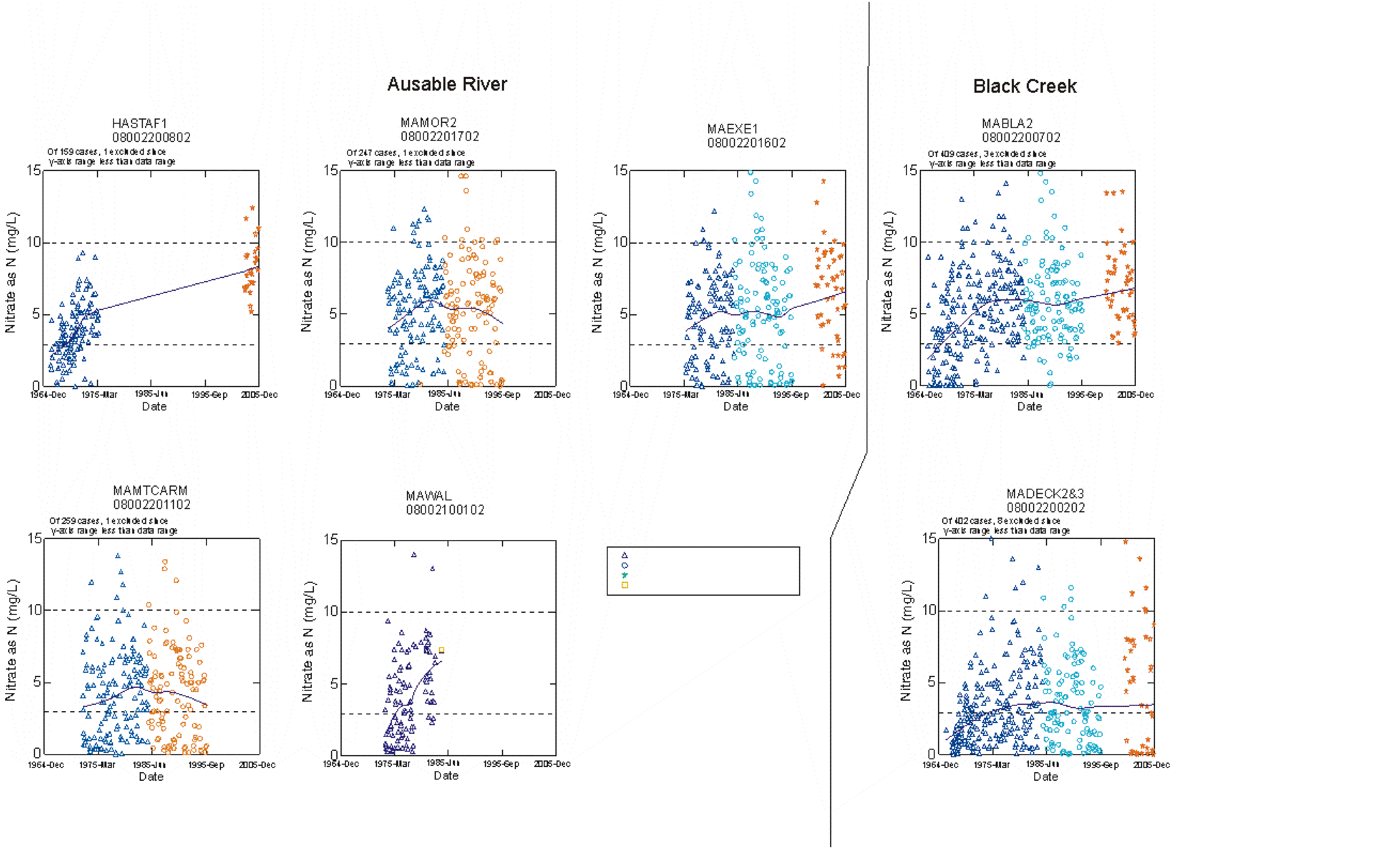
	Major Basin	Ausable															
	Tributary	Black Creek	Little Ausable River		Nairn Creek	Ausable River								Decker Creek		The Cut	
	MOE or local ID	08002200702	08002201402	08002201002	MANAIRN1	08002200802	08002201702	08002200602	08002201602	08002200502	08002201102	08002202002	08002201502	08002201902	08002200202	08002100202	08002100102
	Site Name	Black	Huron Park	Lucan	Nairn	Staffa	MAMOR2	MATHAMES	Exeter	HATRIB	MAMTCARM	Springbank	MAGLAS1	Decker	MADECK3	Thedford	MAWAL
1964-1965	n																
	min																
	max																
	median																
	25th																
	75th																
1966-1970	n	72		23		73		74		73					69		
	min	0.01		0.03		0.01		0.02		0.17					0.01		
	max	9.00		9.70		32.00		8.00		8.50					6.40		
	median	2.80		4.60		3.00		2.50		2.60					1.30		
	25th	0.33		1.41		1.90		0.92		1.58					0.75		
	75th	4.25		6.15		3.60		3.80		3.43					2.55		
1971-1975	n	66	103	64		60	22	60	6	17	44		1		66		39
	min	0.01	0.01	0.01		0.19	0.19	0.02	1.00	1.30	0.23		6.50		0.09		0.29
	max	16.00	22.00	15.00		9.30	11.00	9.90	7.20	6.00	12.00		6.50		15.00		9.40
	median	5.15	5.40	3.90		4.95	5.04	4.30	2.47	3.50	3.35		6.50		2.80		1.68
	25th	2.20	3.03	0.13		3.76	1.49	0.83	1.28	2.40	0.68				1.40		0.54
	75th	7.70	9.28	5.90		6.00	6.60	6.55	4.90	3.93	6.05				4.60		4.28
1976-1980	n	59	491	57			61		60		58				58		44
	min	1.04	0.01	0.01			0.01		0.01		0.01				0.04		0.32
	max	30.10	20.40	14.00			12.30		12.20		13.80				13.60		14.00
	median	6.00	5.30	5.30			5.22		5.00		3.85				3.08		3.21
	25th	4.11	3.40	1.63			2.62		2.07		1.43				1.50		1.82
	75th	7.80	7.10	7.65			7.13		6.69		6.40				5.30		6.10
1981-1985	n	60		57			60	1	58		59				57	453	29
	min	1.99		0.01			0.86	8.50	0.26		0.44				0.18	0.03	2.34
	max	14.10		12.10			11.70	8.50	10.20		10.40				16.00	27.80	13.00
	median	6.52		6.40			6.31	8.50	5.79		5.08				4.40	5.25	6.50
	25th	4.44		2.73			4.10		3.27		2.96				1.88	3.94	4.25
	75th	7.39		7.69			7.82		7.20		6.45				6.41	6.99	7.66
1986-1990	n	56		55			54		56		53				56	244	
	min	0.02		0.10			0.04		0.10		0.10				0.00	0.04	
	max	14.80		15.80			15.70		14.90		16.10				15.70	30.20	
	median	5.50		6.20			5.45		5.35		4.40				2.90	4.62	
	25th	3.65		3.10			3.20		2.40		1.68				1.70	3.60	
	75th	8.05		9.18			8.80		8.50		7.30				5.60	6.44	
1991-1995	n	48		47			50		45		45				48	235	
	min	1.90		0.10			0.00		0.10		0.10				0.10	0.01	
	max	11.00		10.80			10.20		9.00		9.30				7.30	22.60	
	median	5.35		4.60			5.80		4.90		4.50				2.60	4.51	
	25th	3.90		1.33			1.30		0.88		0.90				0.65	1.85	
	75th	6.40		6.80			7.00		6.30		5.43				4.86	6.06	
1996-2000	n	7		7					7					7		31	
	min	6.06		5.74					4.87					1.00		1.06	
	max	13.40		17.00					12.80					16.80		19.50	
	median	7.90		8.18					8.31					6.73		5.80	
	25th	6.77		7.60					7.02					4.76		5.00	
	75th	9.66		10.48					9.38					13.11		7.15	
2001-2005	n	41	29	41	26	26			41			26		41		40	
	min	2.98	0.01	0.01	0.01	5.18			0.06			0.33		0.01		0.36	
	max	13.50	16.50	15.70	11.40	12.40			14.30			10.70		17.80		12.50	
	median	6.55	7.83	6.57	4.75	8.11			6.73			4.96		5.14		4.92	
	25th	4.82	2.78	0.13	3.86	6.96			3.43			2.43		0.23		2.41	
	75th	8.18	11.13	9.63	7.06	9.12			9.00			8.67		9.27		7.37	



North Maitland
Harriston
08005600702
Wroxeter
08005600402
Little Maitland
Palmer
08005600602
Jamestown
08005603502
South Maitland
Londesborough
08005601502
Of 268 cases, 1 excluded since
y-axis range less than data range
Lower Maitland
Zetland
08005600302
Nine Mile
Lucknow
08007600202
Nitrate as N (mg/L)
Date
1964-Dec
1975-Mar
1985-Jun
1995-Sep
2005-Dec
Nitrate Filtered Reactive
Nitrate Unfiltered Reactive
Total Nitrates Unfiltered Reactive
Total Nitrates Filtered Reactive


Middle Maitland
Boyle Drain
Listowel_NE
08005601402
Of 153 cases, 1 excluded sl ce
y-axis ra ge less tha data ra ge
Listowel
08005601302
Of 312 cases, 1 excluded sl ce
y-axis ra ge less tha data ra ge
Trowbridge
08005600902
Of 453 cases, 1 excluded sl ce
y-axis ra ge less tha data ra ge
Milverton
08005601002
Of 293 cases, 1 excluded sl ce
y-axis ra ge less tha data ra ge
Ethel
08005602602
Bruss16D
08005601602 (1972-1979)
08005603102 (1980-1994)
Henfryn
08005602002
Of 172 cases, 1 excluded sl ce
y-axis ra ge less tha data ra ge
Nitrate as N (mg/L)
Date
1964-Dec
1975-Mar
1985-Jun
1995-Sep
2005-Dec
Nitrate Filtered Reactive
Nitrate Unfiltered Reactive
Total Nitrates Unfiltered Reactive
Total Nitrates Filtered Reactive


Bayfield River
Little Ausable
Parkhill Creek
MBSILV1&2 (Silver Creek)
08004000302 (1965-1975)
08004001102 (1983-2005)
Of 257 cases, 9 excluded since
y-axis range less than data range
MBSEA1
08004000202
Of 143 cases, 1 excluded since
y-axis range less than data range
ABCA14
08002201402
Of 623 cases, 8 excluded since
y-axis range less than data range
HBLIF1&2
08004000402 (1965-1971)
Of 98 cases, 1 excluded since
y-axis range less than data range
MBHAN1
08004000902
Of 247 cases, 4 excluded since
y-axis range less than data range
MBCLIN2
08004000602
MALIT2
08002201002
Of 351 cases, 3 excluded since
y-axis range less than data range
MPGBEND1&2
08002200102 (1965-1975)
08002201302 (1974-1995)
Of 396 cases, 3 excluded since
y-axis range less than data range
Nitrate as N (mg/L)
Date
1964-Dec
1975-Mar
1985-Jun
1995-Sep
2005-Dec
Nitrate Filtered Reactive
Nitrate Unfiltered Reactive
Total Nitrates Unfiltered Reactive
Total Nitrates Filtered Reactive


Ausable River
Black Creek
HASTAF1
08002200802
Of 159 cases, 1 excluded since y-axis range less than data range
MAMOR2
08002201702
Of 247 cases, 1 excluded since y-axis range less than data range
MAEXE1
08002201602
MABLA2
08002200702
Of 409 cases, 3 excluded since y-axis range less than data range
MAMTCARM
08002201102
Of 259 cases, 1 excluded since y-axis range less than data range
MAWAL
08002100102
MADECK2&3
08002200202
Of 402 cases, 8 excluded since y-axis range less than data range
Nitrate as N (mg/L)
Date
1964-Dec
1975-Mar
1985-Jun
1995-Sep
2005-Dec

Total Phosphorus - North, Little, South and Lower Maitland River and Nine Mile River

	Major Basin	Nine Mile		North Maitland						Little Maitland			South Maitland		Lower Maitland						
	Tributary			Upper				Salem Creek	Lower						Belgrave Creek	Blyth Brook		Sharpes Creek		Main Branch	
	MOE or local ID	08007600202	08007600102	08005600802	08005600702	08005602502	08005600402	08005605002	08005603802	08005600602	08005602202	08005603502	08005601502	08005603702	08005603002	08005604402	08005600202	08005602702	08005602802	08005600302	08005600102
	Site Name	Lucknow	Port Albert	Palmer_N	Harristn	Fordwich	Wroxeter	NMSalem	B-Line	Palmer	Palme_23	Jamestown	Londesbo	Summerhill	WNC_Belg	Blyth East	Blyth	Sharpes	SharpBen	Zetland	Goderich
1964-1965	n	1	1	8	2		1			1							5			1	15
	min	0.039	0.039	212.000	0.039		0.026			0.078							0.026			0.065	0.013
	max	0.039	0.039	474.000	0.052		0.026			0.078							0.229			0.065	0.118
	median	0.039	0.039	409.000	0.045		0.026			0.078							0.052			0.065	0.052
	25th			378.000	0.039												0.041				0.026
	75th			445.000	0.052												0.102				0.064
1966-1970	n	60	61	62	100		99			99							101			100	95
	min	0.007	0.007	1.000	0.020		0.007			0.040							0.013			0.007	0.007
	max	1.830	0.190	860.000	1.300		0.373			11.275							1.200			0.575	0.220
	median	0.029	0.023	395.000	0.100		0.033			0.621							0.072			0.040	0.020
	25th	0.020	0.013	360.000	0.078		0.020			0.354							0.050			0.029	0.013
	75th	0.046	0.033	450.000	0.191		0.048			1.758							0.101			0.059	0.030
1971-1975	n	61	67	20	72		72			35	32		58				76	7	7	73	109
	min	0.014	0.006	310.000	0.029		0.006			0.100	0.016		0.007				0.014	0.008	0.004	0.016	0.008
	max	0.200	0.360	610.000	1.900		0.300			4.700	1.000		0.250				0.300	0.030	0.036	0.250	0.460
	median	0.031	0.020	430.000	0.160		0.028			1.800	0.040		0.031				0.047	0.015	0.008	0.040	0.022
	25th	0.024	0.014	390.000	0.088		0.021			0.702	0.029		0.022				0.039	0.011	0.006	0.030	0.015
	75th	0.040	0.034	460.000	0.370		0.043			2.975	0.053		0.056				0.072	0.023	0.028	0.060	0.038
1976-1980	n	55	55		57		59			48	32		58		23		61	30	44	57	65
	min	0.011	0.006		0.014		0.009			0.015	0.018		0.010		0.007		0.009	0.003	0.002	0.008	0.003
	max	0.134	0.214		1.020		2.100			2.750	2.300		0.740		0.118		0.250	0.078	0.048	1.210	0.590
	median	0.023	0.016		0.090		0.023			0.755	0.037		0.024		0.015		0.030	0.018	0.009	0.032	0.015
	25th	0.018	0.012		0.058		0.016			0.387	0.028		0.018		0.012		0.023	0.009	0.006	0.022	0.010
	75th	0.036	0.025		0.175		0.036			1.275	0.054		0.036		0.023		0.043	0.023	0.012	0.044	0.025
1981-1985	n	56	56		59		59			56			58		35		58			57	54
	min	0.010	0.006		0.024		0.008			0.089			0.010		0.007		0.016			0.012	0.006
	max	0.295	0.380		0.560		0.375			3.680			0.530		0.270		0.280			0.280	0.400
	median	0.025	0.022		0.091		0.028			0.653			0.033		0.021		0.041			0.038	0.018
	25th	0.019	0.015		0.048		0.020			0.320			0.022		0.012		0.029			0.025	0.011
	75th	0.036	0.041		0.145		0.044			1.240			0.060		0.027		0.063			0.053	0.028
1986-1990	n	56	54		54		55			54		39	56				57			53	52
	min	0.012	0.007		0.018		0.009			0.042		0.016	0.008				0.012			0.016	0.005
	max	0.148	0.240		1.950		0.255			10.800		0.204	0.300				0.173			1.130	0.195
	median	0.020	0.017		0.086		0.022			0.258		0.030	0.025				0.036			0.035	0.015
	25th	0.017	0.012		0.035		0.017			0.100		0.021	0.019				0.026			0.024	0.011
	75th	0.024	0.028		0.135		0.031			0.840		0.049	0.042				0.059			0.055	0.024
1991-1995	n	52	51		43		42			43		38	42				42			43	43
	min	0.010	0.007		0.013		0.010			0.026		0.013	0.012				0.014			0.010	0.008
	max	0.160	0.124		0.188		0.440			0.565		0.148	0.087				0.335			0.240	0.190
	median	0.020	0.015		0.040		0.021			0.070		0.025	0.023				0.032			0.028	0.020
	25th	0.016	0.014		0.023		0.018			0.049		0.019	0.018				0.025			0.023	0.014
	75th	0.025	0.021		0.056		0.031			0.109		0.032	0.035				0.047			0.043	0.030
1996-2000	n	21	21									20					21			19	19
	min	0.004	0.004									0.004					0.002			0.008	0.002
	max	0.056	0.120									0.140					0.260			0.140	0.156
	median	0.020	0.016									0.018					0.032			0.020	0.012
	25th	0.012	0.010									0.011					0.016			0.016	0.008
	75th	0.029	0.020									0.024					0.049			0.034	0.023
2001-2005	n	41	75					14	16			41		17		28	42			41	41
	min	0.012	0.002					0.003	0.006			0.009		0.007		0.011	0.009			0.002	0.005
	max	0.088	0.182					0.412	0.033			0.100		0.076		0.343	0.081			0.102	0.051
	median	0.021	0.018					0.012	0.013			0.024		0.020		0.037	0.032			0.024	0.016
	25th	0.018	0.012					0.009	0.011			0.020		0.016		0.028	0.023			0.017	0.013
	75th	0.030	0.025					0.020	0.019			0.035		0.026		0.050	0.043			0.033	0.021

Total Phosphorus - Middle Maitland River

	Major Basin	Middle Maitland River																
	Tributary	Above Listowel		Chapman	Below Listowel				Boyle Drain		Beachamp	Lower Middle Maitland						
	MOE or local ID	08005601402	08005604302	08005602102	08005601302	08005600902	08005601902	08005602602	08005601002	08005602002	08005604102	08005601802	08005601102	08005600502	08005601602	08005603102	08005601702	08005603902
	Site Name	Listw_NE	NE Listowel	Chapman	Listowel	Trowbridge	Grey_Elm	Ethel	Milvertn	Henfryn	Beauchamp	Grey	Brusl_12	Brus_DSc	Brussl_D	Bruss_16	Morris	Wingham
1964-1965	n					2			5					1				
	min					0.157			0.196					0.118				
	max					0.699			21.961					0.118				
	median					0.428			20.327					0.118				
	25th					0.157			1.079									
	75th					0.699			21.225									
1966-1970	n					100			66				59	100				
	min					0.011			0.021				0.020	0.020				
	max					3.500			180.000				9.500	1.100				
	median					0.421			0.450				0.095	0.140				
	25th					0.237			0.261				0.600	0.091				
	75th					1.030			0.780				0.237	0.229				
1971-1975	n	58		33	58	74	35	7	59	33		33	22	60	52		33	
	min	0.023		0.051	0.007	0.005	0.024	0.040	0.050	0.012		0.026	0.012	0.100	0.025		0.017	
	max	0.620		2.800	2.700	2.000	0.750	0.108	5.500	0.360		0.500	7.000	3.400	0.930		0.320	
	median	0.081		0.710	0.155	0.345	0.130	0.061	0.680	0.076		0.075	0.180	0.230	0.099		0.040	
	25th	0.038		0.148	0.100	0.200	0.072	0.052	0.260	0.043		0.040	0.100	0.150	0.070		0.028	
	75th	0.110		1.725	0.220	0.550	0.220	0.084	1.875	0.113		0.110	2.100	0.835	0.150		0.083	
1976-1980	n	59			59	60		57	12					10	45	12		
	min	0.013			0.021	0.025		0.032	0.161					0.210	0.026	0.014		
	max	0.450			1.920	1.350		0.295	2.600					3.000	0.670	0.072		
	median	0.047			0.092	0.138		0.087	0.795					0.745	0.056	0.029		
	25th	0.036			0.064	0.076		0.070	0.338					0.510	0.042	0.019		
	75th	0.082			0.141	0.203		0.136	0.325					2.400	0.800	0.050		
1981-1985	n	36			59	59		35	59							58		
	min	0.020			0.036	0.024		0.029	0.045							0.011		
	max	0.900			6.150	0.540		0.255	7.400							0.167		
	median	0.058			0.088	0.113		0.080	0.620							0.042		
	25th	0.038			0.065	0.061		0.052	0.236							0.024		
	75th	0.098			0.139	0.168		0.132	0.928							0.068		
1986-1990	n				52	54		45	56	39						55		
	min				0.028	0.026		0.036	0.003	0.018						0.010		
	max				0.370	0.710		0.400	6.700	0.570						0.270		
	median				0.083	0.097		0.076	0.478	0.060						0.039		
	25th				0.054	0.051		0.055	0.328	0.041						0.024		
	75th				0.111	0.166		0.120	1.235	0.117						0.067		
1991-1995	n			1	41	43		40	41	39						42		
	min			0.031	0.018	0.019		0.032	0.075	0.021						0.013		
	max			0.031	0.286	0.850		0.184	4.850	1.290						1.690		
	median			0.031	0.060	0.091		0.065	0.315	0.058						0.041		
	25th				0.042	0.046		0.047	0.188	0.043						0.023		
	75th				0.085	0.141		0.095	0.495	0.106						0.068		
1996-2000	n				19	20		21		21								
	min				0.038	0.022		0.016		0.012								
	max				0.284	0.210		0.520		0.152								
	median				0.132	0.051		0.060		0.054								
	25th				0.066	0.041		0.034		0.036								
	75th				0.180	0.101		0.092		0.071								
2001-2005	n		29		24	42		24		41	17							17
	min		0.011		0.028	0.015		0.019		0.015	0.011							0.008
	max		0.294		0.556	0.206		0.184		0.184	0.170							0.137
	median		0.071		0.131	0.060		0.062		0.044	0.031							0.025
	25th		0.043		0.065	0.035		0.035		0.027	0.021							0.019
	75th		0.099		0.204	0.084		0.096		0.076	0.073							0.036

Total Phosphorus - Bayfield River and Parkhill Creek

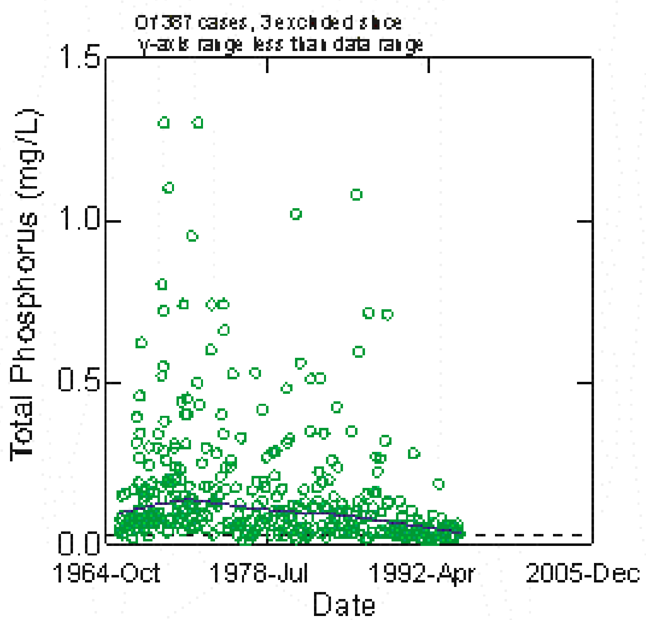
	Major Basin	Bayfield River														Parkhill Creek							
	Tributary	Bannockburn	Liffy Ditch			Silver Creek		Upper Bayfield			Steenstra	Lower Bayfield				Upper Parkhill					Tributary	Lower Parkhill	
	MOE or local ID	MBBAN1	HBLIF1	08004000402	08004000502	08004001102	08004000302	08004000202	08004000902	08004000602	HBSTEEN1	08004001002	08004000802	08004000102	08004000783	08002200302	MPMCGUF1	08002200402	08002200902	08002201202	08002201802	08002201302	08002200102
	Site Name	Bannockburn	Dublin	HBLIF2	HBLIF3	Silver	MBSILV1	Seaforth	MBHAN1	MBCLIN2	Steenstra	MBGRANT	Varna	MBBAY1	MBBAY2	HPCAM	Upstream Parkhill	MPDAM	MPHARM	Downstream Parkhill	MPTRI1	MPGBEND2	MPGBEND1
1964-1965	n			5	5		4	5						8		6		5					8
	min			0.118	0.092		0.392	0.157						0.033		0.105		0.039					0.033
	max			1.961	10.327		1.242	1.830						0.137		21.961		0.137					0.131
	median			0.471	0.294		0.771	0.438						0.049		2.092		0.065					0.075
	25th			0.167	0.170		0.477	0.255						0.039		0.261		0.049					0.055
	75th			1.324	4.592		1.111	0.948						0.088		2.941		0.093					0.098
1966-1970	n			63	63		64	64						63		76		13	56				75
	min			0.007	0.003		0.010	0.003						0.007		0.150		0.023	0.036				0.012
	max			1.600	10.980		10.000	5.200						0.130		11.797		0.810	0.392				0.627
	median			0.060	0.092		0.310	0.110						0.050		0.620		0.092	0.110				0.070
	25th			0.036	0.050		0.181	0.062						0.033		0.320		0.083	0.067				0.052
	75th			0.117	0.289		0.790	0.338						0.072		1.400		0.112	0.159				0.101
1971-1975	n			9	46		52	49	6	35			6	60	23	59			15	43		29	71
	min			0.054	0.039		0.037	0.030	0.029	0.045			0.008	0.015	0.020	0.120			0.054	0.058		0.034	0.030
	max			0.910	2.200		3.200	2.500	0.094	1.400			0.053	2.200	0.150	8.200			0.300	0.270		0.280	0.350
	median			0.100	0.185		0.255	0.220	0.054	0.140			0.025	0.056	0.041	0.440			0.110	0.130		0.110	0.072
	25th			0.077	0.088		0.130	0.097	0.041	0.087			0.012	0.034	0.029	0.242			0.094	0.087		0.071	0.056
	75th			0.450	0.720		0.495	0.377	0.065	0.210			0.036	0.090	0.054	1.675			0.128	0.168		0.155	0.100
1976-1980	n								59	59		32	62							11		60	
	min								0.020	0.028		0.015	0.008							0.066		0.033	
	max								0.650	0.770		0.180	0.520							0.250		0.385	
	median								0.080	0.108		0.049	0.046							0.141		0.093	
	25th								0.053	0.076		0.025	0.027							0.087		0.071	
	75th								0.120	0.189		0.079	0.074							0.193		58.000	
1981-1985	n					34			59	58			59							60		0.054	
	min					0.010			0.013	0.019			0.011							0.066		0.600	
	max					0.540			0.400	0.270			0.226							0.325		0.110	
	median					0.033			0.050	0.052			0.033							0.143		0.085	
	25th					0.023			0.032	0.040			0.020							0.107		0.156	
	75th					0.051			0.102	0.093			0.067							0.181		55.000	
1986-1990	n					56			54	56			57							58		0.036	
	min					0.007			0.010	0.012			0.010							0.053		1.060	
	max					0.200			0.280	0.346			3.560							0.405		0.106	
	median					0.032			0.049	0.045			0.026							0.137		0.082	
	25th					0.018			0.035	0.033			0.019							0.100		0.145	
	75th					0.055			0.100	0.071			0.055							0.164		45.000	
1991-1995	n					48			45	47			50							51		0.042	
	min					0.001			0.008	0.007			0.007							0.064		0.315	
	max					0.790			1.010	1.750			1.750							0.440		0.100	
	median					0.025			0.040	0.028			0.020							0.130		0.078	
	25th					0.017			0.026	0.020			0.015							0.103		0.126	
	75th					0.045			0.065	0.045			0.035							0.156			
1996-2000	n					8			7				7								7		
	min					0.008			0.014				0.012								0.048		
	max					0.094			0.342				0.260								0.200		
	median					0.018			0.064				0.018								0.146		
	25th					0.014			0.021				0.016								0.116		
	75th					0.024			0.083				0.117								0.193		
2001-2005	n	26	26					26	15		21		60				26			26	15		
	min	0.004	0.007					0.009	0.016		0.009		0.008				0.033			0.032	0.075		
	max	0.218	0.978					0.144	0.131		1.080		0.611				0.401			0.249	0.172		
	median	0.028	0.056					0.026	0.043		0.046		0.030				0.082			0.115	0.092		
	25th	0.017	0.027					0.017	0.036		0.024		0.016				0.048			0.080	0.078		
	75th	0.061	0.099					0.040	0.052		0.070		0.053				0.113			0.136	0.123		

Total Phosphorus - Ausable River

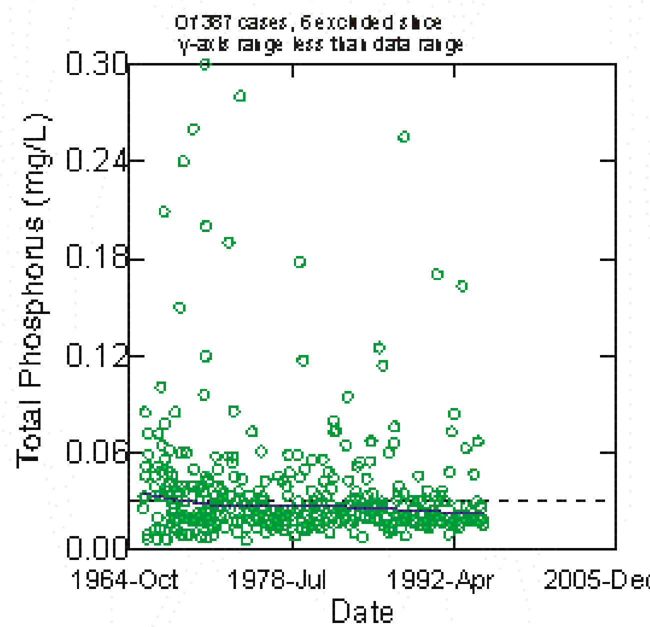
	Major Basin	Ausable															
	Tributary	Black Creek	Little Ausable River		Nairn Creek	Ausable River								Decker Creek		The Cut	
	MOE or local ID	08002200702	08002201402	08002201002	MANAIRN1	08002200802	08002201702	08002200602	08002201602	08002200502	08002201102	08002202002	08002201502	08002201902	08002200202	08002100202	08002100102
	Site Name	Black	Huron Park	Lucan	Nairn	Staffa	MAMOR2	MATHAMES	Exeter	HATRIB	MAMTCARM	Springbank	MAGLAS1	Decker	MADECK3	Thedford	MAWAL
1964-1965	n																
	min																
	max																
	median																
	25th																
	75th																
1966-1970	n	72		23		72		73		72					70		
	min	0.007		0.018		0.013		0.020		0.007					0.052		
	max	32.614		0.420		18.000		3.300		2.940					5.300		
	median	0.980		0.055		0.360		0.275		0.021					0.329		
	25th	0.490		0.041		0.118		0.091		0.013					0.170		
	75th	2.494		0.070		0.846		0.780		0.039					0.752		
1971-1975	n	66	185	64		60	22	59	6	17	44		2		66		39
	min	0.012	0.009	0.010		0.010	0.007	0.056	0.034	0.006	0.052		0.030		0.084		0.023
	max	7.600	8.083	0.310		0.500	0.140	3.400	0.700	0.130	0.440		0.045		2.800		0.590
	median	0.139	0.059	0.061		0.040	0.037	0.200	0.177	0.022	0.150		0.037		0.340		0.061
	25th	0.051	0.034	0.039		0.023	0.028	1.220	0.111	0.014	0.102		0.030		0.170		0.040
	75th	0.720	0.102	0.090		0.086	0.064	0.668	0.320	0.035	0.185		0.045		0.800		0.115
1976-1980	n	59	985	57			61	1	60		58				57		65
	min	0.015	0.000	0.020			0.010	0.048	0.013		0.023				0.030		0.024
	max	1.430	0.920	0.780			0.540	0.048	0.910		0.420				1.700		1.020
	median	0.050	0.058	0.062			0.029	0.048	0.057		0.099				0.200		0.054
	25th	0.034	0.033	0.038			0.022		0.041		0.070				0.115		0.038
	75th	0.105	0.114	0.118			0.039		0.134		0.155				0.592		0.084
1981-1985	n	60	29	57			60		58		59				57	312	28
	min	0.012	0.011	0.015			0.014		0.016		0.300				0.035	0.020	0.036
	max	0.395	0.503	1.100			0.540		1.070		0.245				0.780	2.720	0.250
	median	0.040	0.048	0.051			0.031		0.055		0.102				0.099	0.116	0.072
	25th	0.029	0.026	0.028			0.026		0.033		0.057				0.055	0.058	0.054
	75th	0.070	0.070	0.099			0.050		0.108		0.147				2.140	0.245	0.098
1986-1990	n	56		55			55		57		53				55	245	
	min	0.016		0.020			0.016		0.021		0.043				0.028	0.002	
	max	0.705		0.445			0.338		3.100		0.500				2.580	1.250	
	median	0.045		0.062			0.038		0.059		0.101				0.200	0.080	
	25th	0.030		0.040			0.026		0.041		0.063				0.106	0.056	
	75th	0.076		0.092			0.072		0.155		0.159				0.390	0.159	
1991-1995	n	48		47			50		45		45					236	
	min	0.010		0.006			0.014		0.010		0.034					0.002	
	max	0.535		0.795			0.275		0.230		0.340					2.630	
	median	0.039		0.038			0.036		0.039		0.083					0.062	
	25th	0.024		0.029			0.027		0.025		0.051					0.040	
	75th	0.080		0.054			0.055		0.070		0.111					0.096	
1996-2000	n	7		7					7					7		31	
	min	0.024		0.016					0.036					0.016		0.024	
	max	0.524		0.442					0.272					0.940		0.864	
	median	0.164		0.036					0.060					0.052		0.076	
	25th	0.062		0.026					0.046					0.032		0.046	
	75th	0.288		0.177					0.213					0.141		0.195	
2001-2005	n	41		41	26	26			41			26		41		40	
	min	0.012		0.012	0.002	0.009			0.014			0.033		0.015		0.022	
	max	0.230		0.228	0.088	0.057			1.170			0.277		0.172		0.388	
	median	0.046		0.029	0.019	0.025			0.101			0.068		0.049		0.048	
	25th	0.028		0.022	0.011	0.015			0.059			0.050		0.033		0.036	
	75th	0.072		0.050	0.029	0.034			0.160			0.100		0.079		0.096	

North Maitland

*Harriston
08005600702

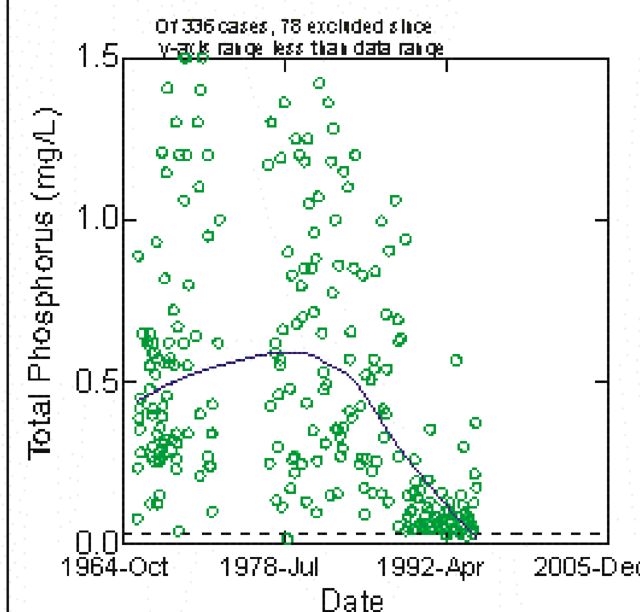


Wroxeter
08005600402

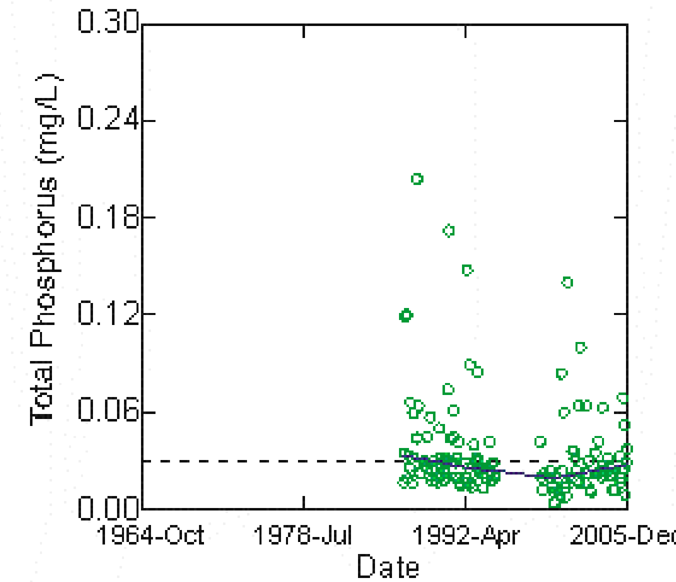


Little Maitland

*Palmer
08005600602

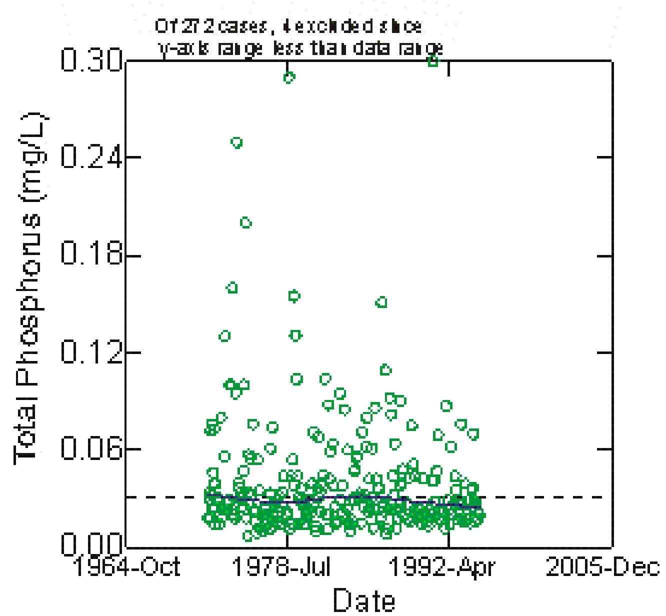


Jamestown
08005603502



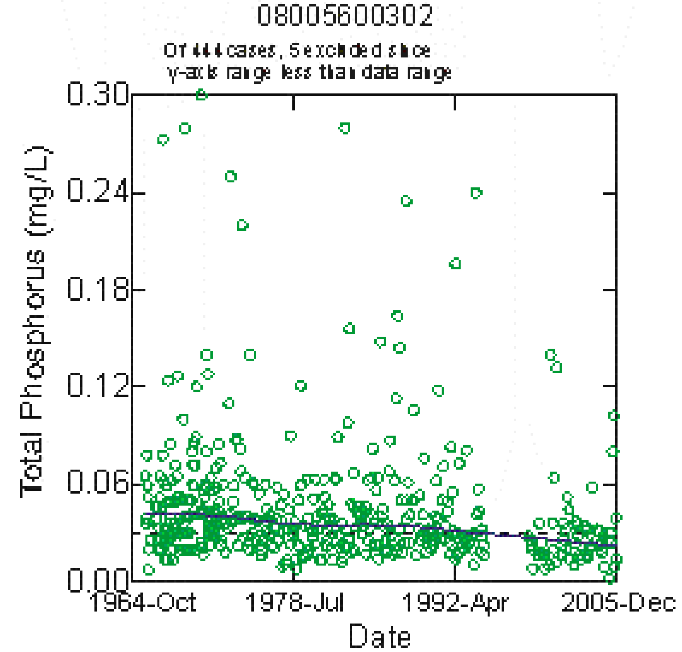
South Maitland

Londesborough
08005601502



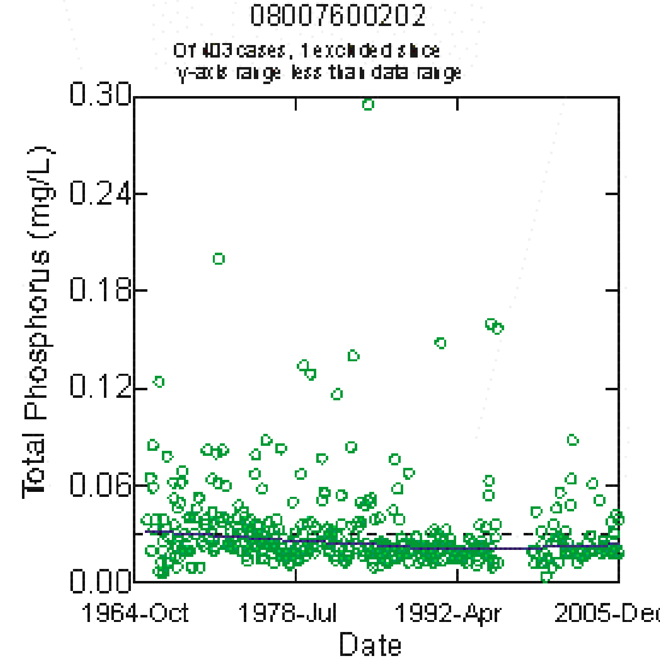
Lower Maitland

Zetland
08005600302



Nine Mile

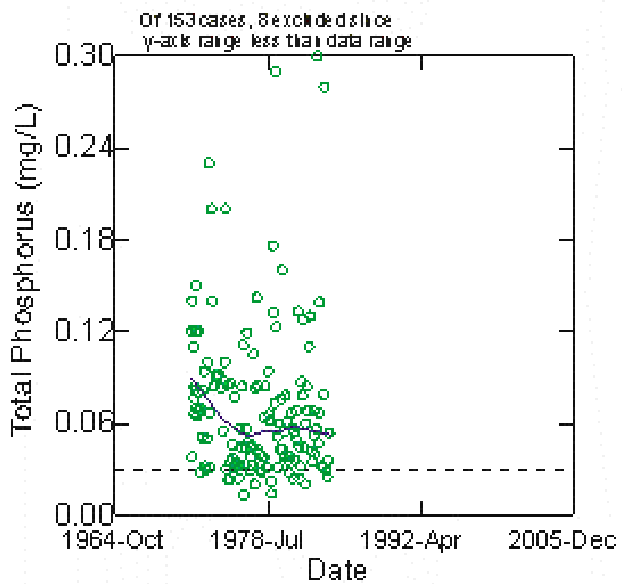
Lucknow
08007600202



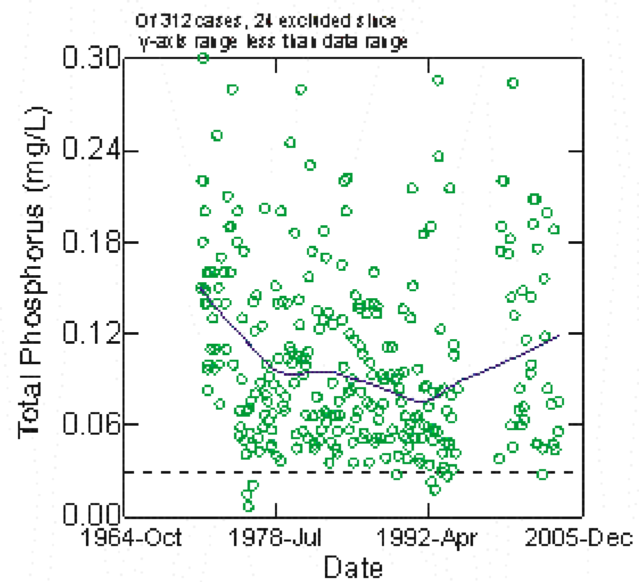
* Note: y-axis range extended to fit data

Middle Maitland

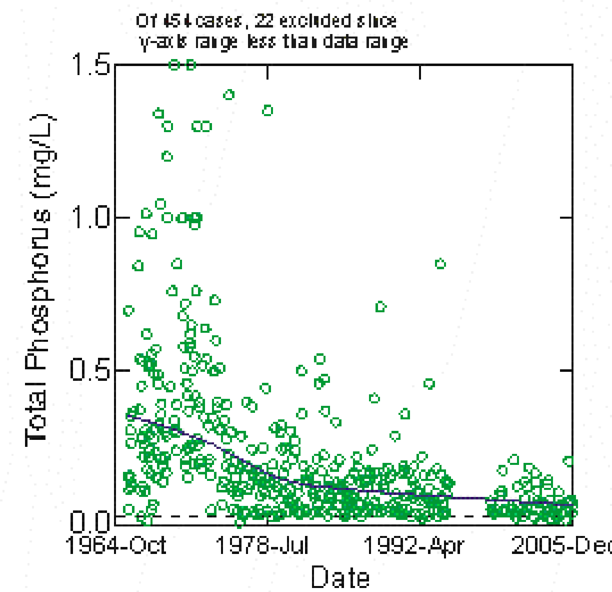
Listowel_NE
08005601402



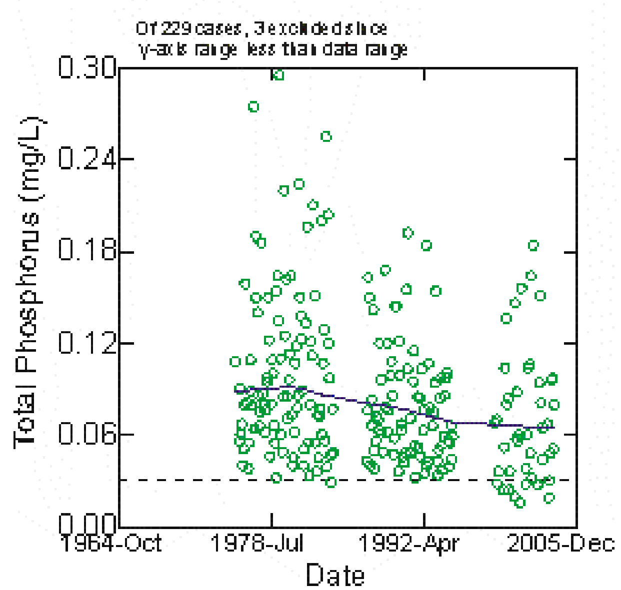
Listowel
08005601302



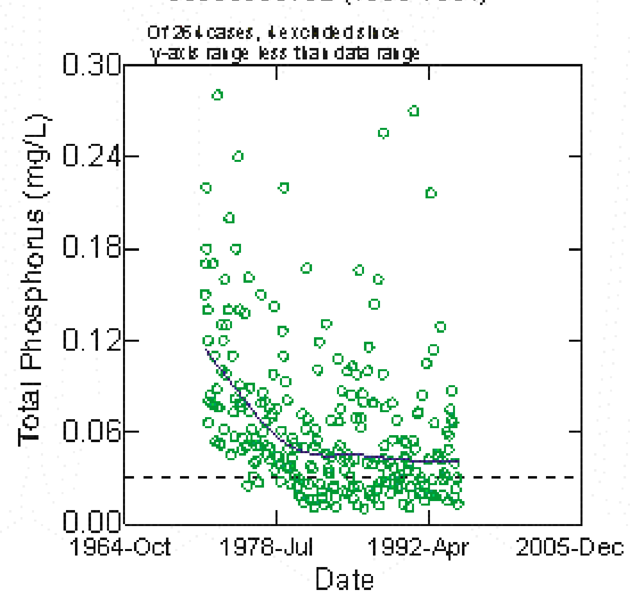
*Trowbridge
08005600902



Ethel
08005602602



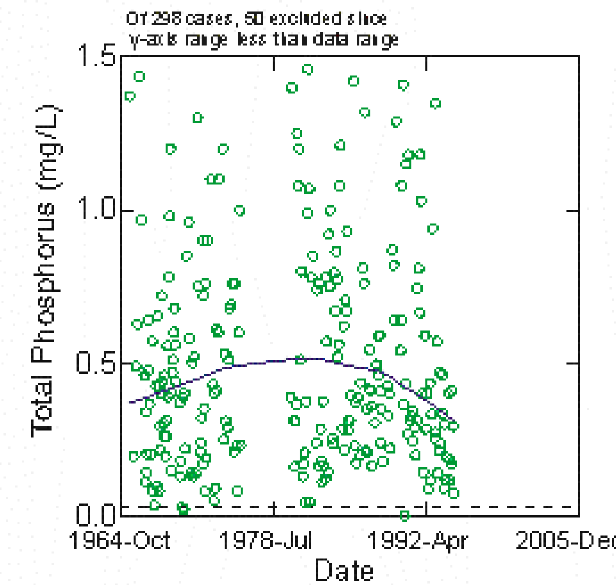
Bruss16D
08005601602 (1972-1979)
08005603102 (1980-1994)



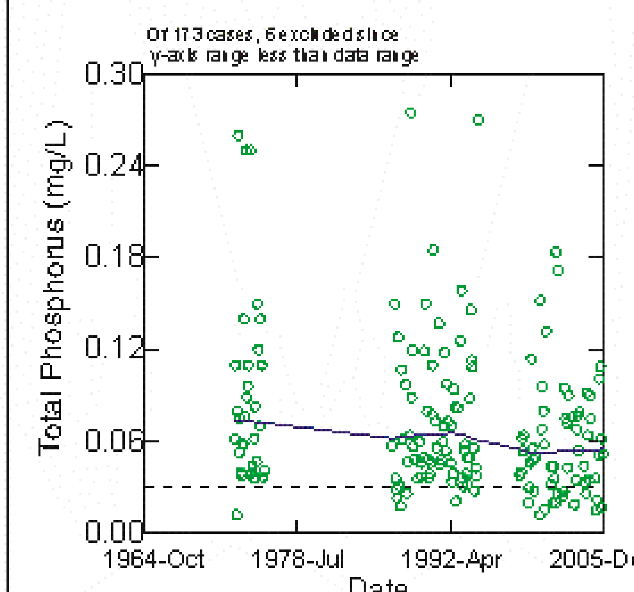
* Note: y-axis range extended to fit data

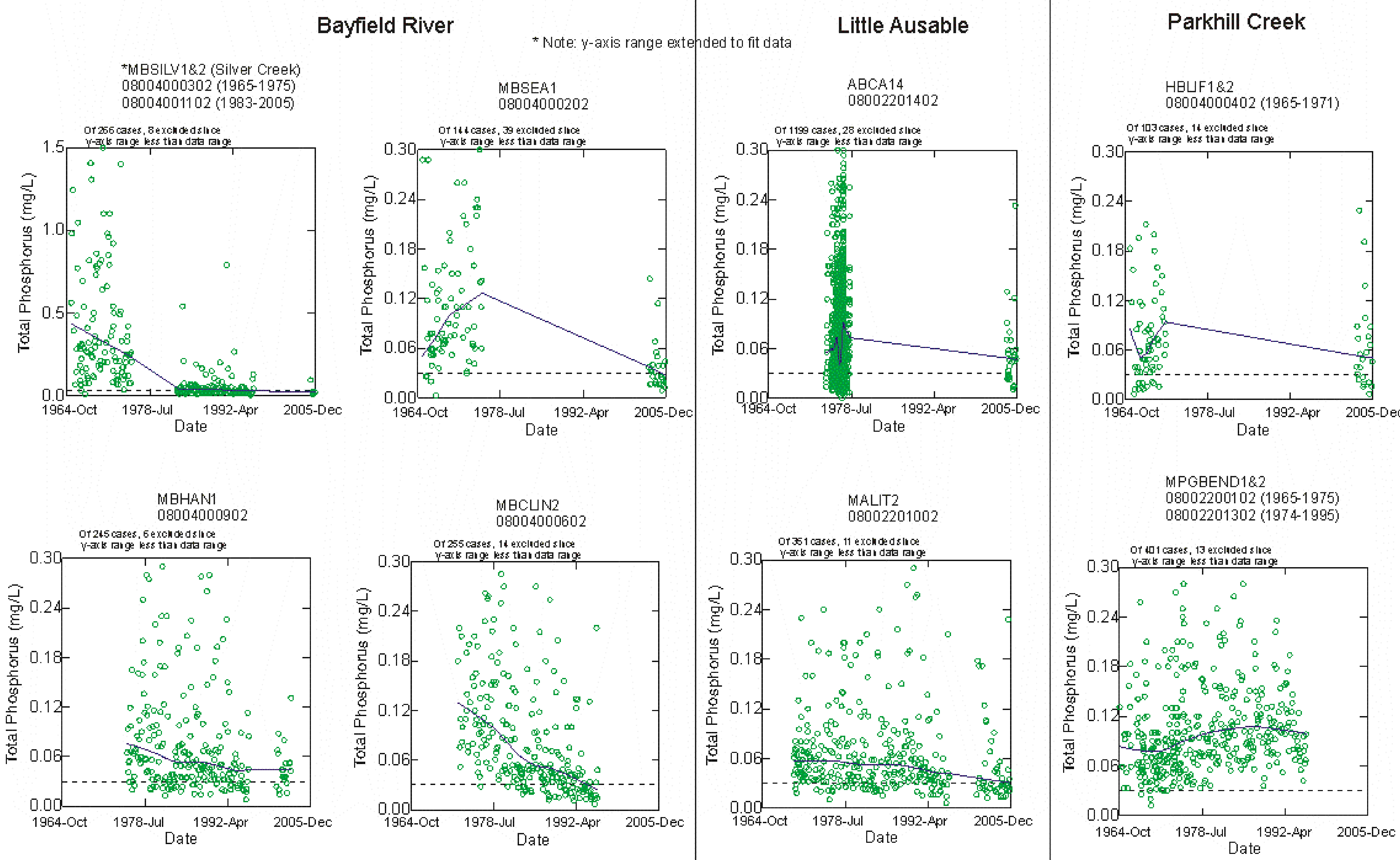
Boyle Drain

*Milverton
08005601002

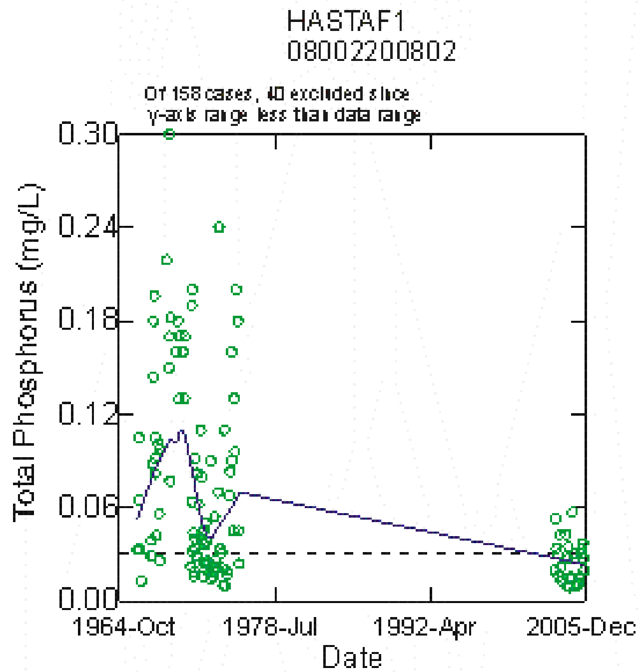


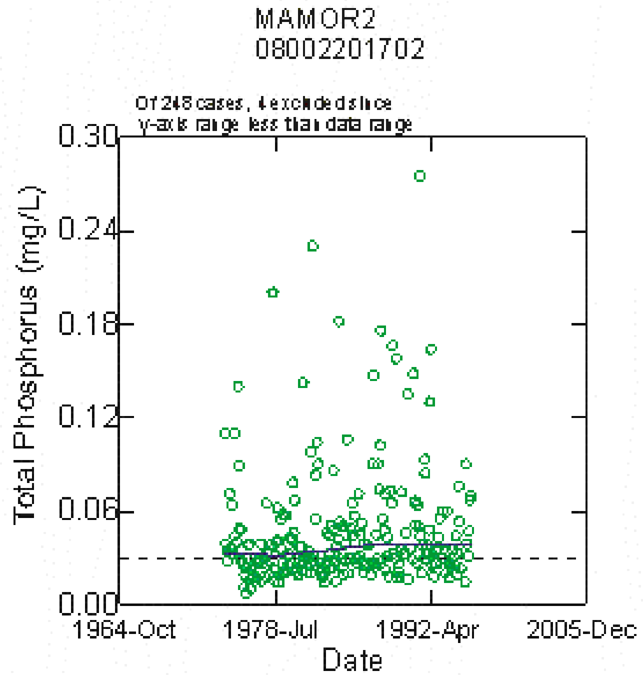
Henfryn
08005602002

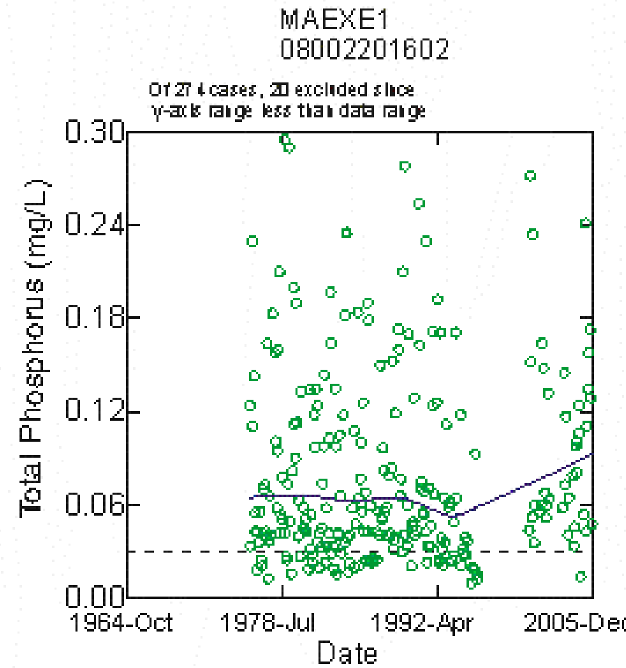


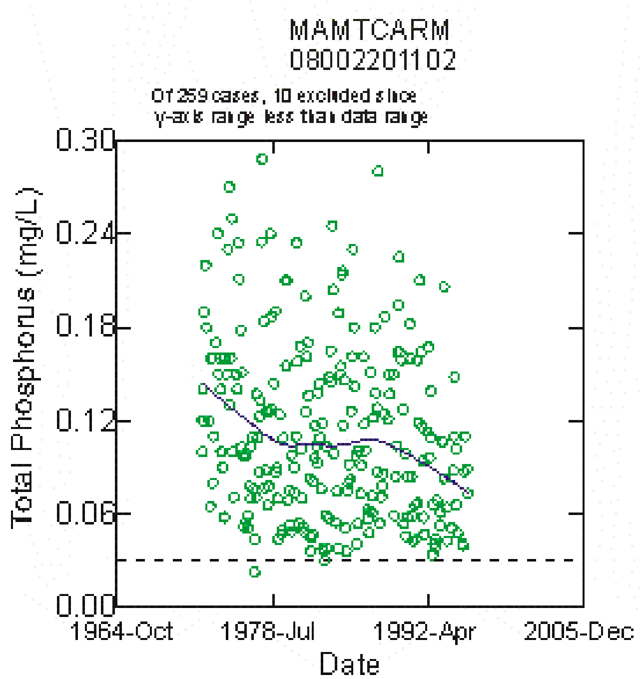

Bayfield River
* Note: y-axis range extended to fit data
Little Ausable
Parkhill Creek
*MBSILV1&2 (Silver Creek)
08004000302 (1965-1975)
08004001102 (1983-2005)
Of 256 cases, 8 excluded since y-axis range less than data range
MBSEA1
08004000202
Of 144 cases, 39 excluded since y-axis range less than data range
ABCA14
08002201402
Of 1199 cases, 28 excluded since y-axis range less than data range
HBLIF1&2
08004000402 (1965-1971)
Of 103 cases, 14 excluded since y-axis range less than data range
MBHAN1
08004000902
Of 245 cases, 6 excluded since y-axis range less than data range
MBCLIN2
08004000602
Of 255 cases, 14 excluded since y-axis range less than data range
MALIT2
08002201002
Of 351 cases, 11 excluded since y-axis range less than data range
MPGBEND1&2
08002200102 (1965-1975)
08002201302 (1974-1995)
Of 401 cases, 13 excluded since y-axis range less than data range
Total Phosphorus (mg/L)
Date
1964-Oct
1978-Jul
1992-Apr
2005-Dec

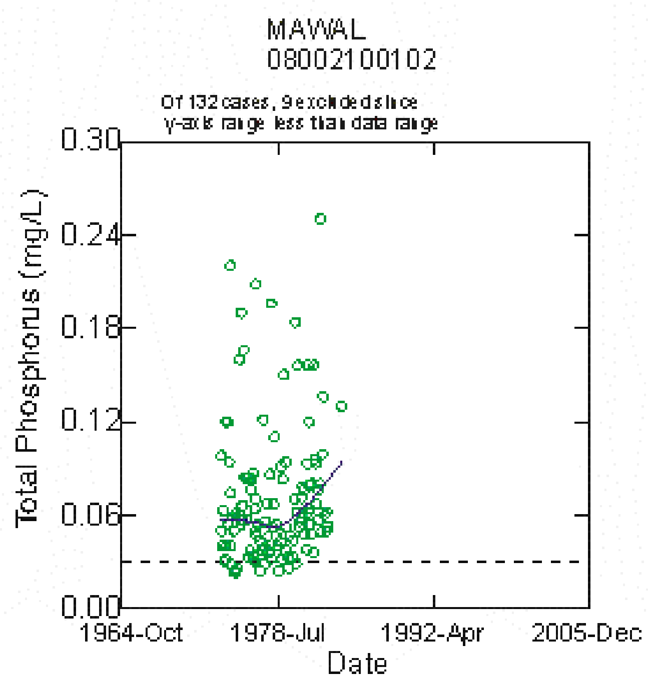
Ausable River



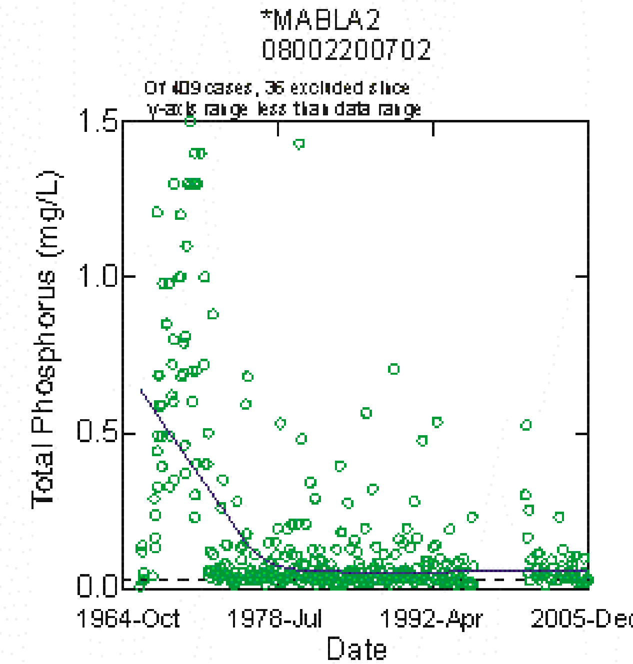




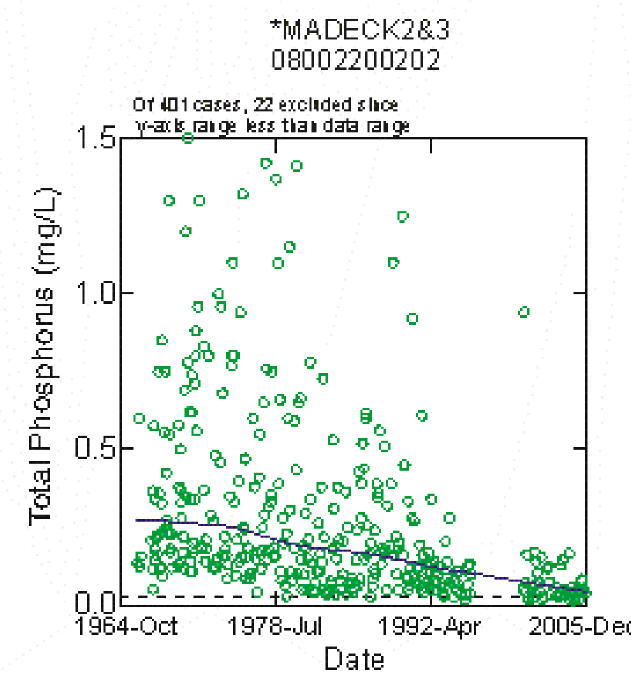




Black Creek



Decker Creek



* Note: y-axis range extended to fit data

Residue Particulate - North, Little, South and Lower Maitland River and Nine Mile River

	Major Basin	Nine Mile		North Maitland						Little Maitland			South Maitland		Lower Maitland						
	Tributary			Upper				Salem Creek	Lower						Belgrave Creek	Blyth Brook		Sharpes Creek		Main Branch	
	MOE or local ID	08007600202	08007600102	08005600802	08005600702	08005602502	08005600402	08005605002	08005603802	08005600602	08005602202	08005603502	08005601502	08005603702	08005603002	08005604402	08005600202	08005602702	08005602802	08005600302	08005600102
	Site Name	Lucknow	Port Albert	Palmer_N	Harristn	Fordwich	Wroxeter	NMSalem	B-Line	Palmer	Palme_23	Jamestown	Londesbo	Summerhill	WNC_Belg	Blyth East	Blyth	Sharpes	SharpBen	Zetland	Goderich
1964-1965	n				31					29							36			28	35
	min				1.00					1.00							1.00			1.00	1.00
	max				46.00					169.00							68.00			76.00	31.00
	median				6.00					8.00							3.00			4.50	7.00
	25th				4.00					4.00							2.00			2.00	3.00
	75th				12.75					15.00							6.00			7.00	12.50
1966-1970	n	64	66		101		101			102							101			101	96
	min	1.00	1.00		1.00		1.00			3.00							1.00			1.00	1.00
	max	35.00	54.00		110.00		90.00			2000.00							170.00			63.00	70.00
	median	10.00	15.00		10.00		5.00			15.00							7.00			5.00	5.00
	25th	5.00	5.00		5.00		4.00			10.00							5.00			5.00	5.00
	75th	15.00	15.00		15.00		15.00			24.00							15.00			15.00	15.00
1971-1975	n	20	57		35		31			30			17				35	6	6	36	107
	min	5.00	0.00		5.00		5.00			5.00			5.00				5.00	1.00	3.00	5.00	0.00
	max	15.00	60.00		70.00		60.00			90.00			15.00				15.00	15.00	15.00	60.00	80.00
	median	15.00	15.00		5.00		5.00			10.00			5.00				5.00	15.00	15.00	5.00	15.00
	25th	12.50	15.00		5.00		5.00			5.00			5.00				5.00	15.00	15.00	5.00	5.00
	75th	15.00	15.00		10.00		10.00			10.00			5.00				5.00	15.00	15.00	10.00	15.00
1976-1980	n	33	34		58		36			36	9		36		23		39	29	44	58	66
	min	1.00	1.50		1.00		0.50			2.00	0.50		0.50		0.50		0.50	1.00	0.50	0.50	0.50
	max	55.00	135.00		38.00		50.00			39.00	15.00		20.00		39.00		89.00	52.00	19.00	40.00	505.00
	median	6.00	10.75		7.00		4.25			7.50	5.50		5.00		4.00		5.00	15.00	6.75	8.50	6.50
	25th	4.00	6.80		3.80		2.80			6.00	2.38		2.55		1.78		3.10	4.00	2.00	4.00	3.00
	75th	8.70	17.50		15.00		7.50			14.75	8.50		6.75		6.63		8.00	15.00	15.00	15.00	14.50
1981-1985	n	58	56		59		59			58			58		35		58			57	54
	min	0.70	1.50		0.10		0.30			0.90			0.40		0.10		0.10			1.00	0.40
	max	39.40	99.60		36.50		25.90			26.40			26.40		74.70		43.80			64.90	45.80
	median	4.40	11.75		5.50		3.90			5.00			5.05		2.90		5.10			5.30	3.80
	25th	3.10	6.40		2.55		2.18			3.10			3.10		2.00		2.80			3.10	2.30
	75th	8.10	22.20		10.33		7.08			7.40			8.70		6.35		8.90			9.33	6.00
1986-1990	n	54	54		53		54			52		38	55				57			48	53
	min	0.60	2.60		0.50		0.20			0.30		1.00	1.20				1.90			0.60	1.10
	max	43.70	156.20		48.80		75.00			36.50		41.50	66.80				45.10			57.40	79.50
	median	5.00	8.55		5.00		5.00			5.00		5.00	5.00				5.00			5.00	5.00
	25th	4.70	5.00		4.58		3.40			5.00		5.00	5.00				5.00			4.90	3.10
	75th	5.00	22.80		8.78		5.60			8.95		6.00	7.70				6.55			9.60	7.63
1991-1995	n	50	51		43		42			42		36	42				42			41	43
	min	2.00	3.10		2.90		2.40			2.60		2.30	1.50				2.30			2.10	2.30
	max	125.00	75.60		42.50		221.00			107.00		27.80	41.80				98.70			174.00	46.30
	median	5.00	8.00		5.40		5.00			5.10		5.15	5.05				5.65			6.20	6.90
	25th	5.00	5.15		5.00		5.00			5.00		5.00	5.00				5.00			5.00	4.33
	75th	8.60	13.85		8.53		7.10			10.10		8.30	8.20				9.00			10.03	11.68
1996-2000	n	21	21									20					21			20	19
	min	1.50	3.00									1.50					2.00			1.50	1.50
	max	13.50	121.00									16.00					98.50			24.50	73.00
	median	3.50	12.00									3.25					3.00			6.00	3.50
	25th	3.00	6.25									2.00					2.50			4.00	2.50
	75th	9.13	22.25									5.00					5.13			7.75	5.38
2001-2005	n	41	41					14	16			41		17		28	42			41	41
	min	2.70	2.00					0.70	1.00			0.60		1.00		2.80	0.60			1.20	1.00
	max	26.50	51.90					63.20	5.40			15.50		16.70		520.00	18.40			12.00	31.40
	median	4.80	11.80					1.50	2.35			4.00		4.50		7.35	3.40			5.00	4.00
	25th	3.98	6.15					1.10	1.60			2.50		3.18		4.75	2.50			3.08	2.65
	75th	7.43	18.63					2.00	3.25			6.23		7.10		19.60	6.00			7.55	6.10

Residue Particulate - Middle Maitland River

	Major Basin	Middle Maitland River																
	Tributary	Above Listowel		Chapman	Below Listowel				Boyle Drain		Beachamp	Lower Middle Maitland						
	MOE or local ID	08005601402	08005604302	08005602102	08005601302	08005600902	08005601902	08005602602	08005601002	08005602002	08005604102	08005601802	08005601102	08005600502	08005601602	08005603102	08005601702	08005603902
	Site Name	Listw_NE	NE Listowel	Chapman	Listowel	Trowbridge	Grey_Elm	Ethel	Milvertn	Henfryn	Beauchamp	Grey	Brusl_12	Brus_DSc	Brussl_D	Bruss_16	Morris	Wingham
1964-1965	n					25			10				9	17				
	min					3.00			3.00				2.00	1.00				
	max					77.00			98.00				29.00	18.00				
	median					13.00			22.00				5.00	4.00				
	25th					7.00			15.00				4.50	2.00				
	75th					17.50			58.00				11.75	8.25				
1966-1970	n					102			67				61	101				
	min					2.00			5.00				1.00	1.00				
	max					508.00			492.00				180.00	458.00				
	median					15.00			26.00				10.00	10.00				
	25th					10.00			15.00				5.00	5.00				
	75th					20.00			66.00				15.00	15.00				
1971-1975	n	17		31	17	33	33	6	25	31		32	22	24	24		32	
	min	5.00		5.00	5.00	5.00	4.00	4.00	5.00	3.00		8.00	5.00	5.00	5.00		4.00	
	max	10.00		80.00	40.00	130.00	80.00	15.00	240.00	55.00		180.00	140.00	30.00	50.00		50.00	
	median	5.00		15.00	5.00	10.00	15.00	15.00	10.00	15.00		15.00	12.50	5.00	15.00		15.00	
	25th	5.00		15.00	5.00	5.00	15.00	15.00	5.00	11.25		15.00	5.00	5.00	5.00		15.00	
	75th	5.00		15.00	6.25	21.25	15.00	15.00	25.00	15.00		15.00	50.00	10.00	15.00		15.00	
1976-1980	n	36			36	37		57	12						45	12		
	min	1.00			0.50	0.10		0.50	2.50						0.50	0.50		
	max	48.00			57.00	49.00		25.00	108.00						54.00	12.50		
	median	6.00			5.55	5.10		7.00	15.50						14.00	3.00		
	25th	3.75			3.50	2.58		3.38	7.10						5.75	1.75		
	75th	8.50			8.75	11.50		15.00	66.65						15.00	6.00		
1981-1985	n	36			60	59		35	59							58		
	min	0.60			0.40	0.10		0.90	0.30							0.10		
	max	110.60			87.40	26.60		94.00	341.80							50.80		
	median	4.85			4.40	3.70		5.80	12.90							3.20		
	25th	2.90			2.80	1.90		4.50	5.98							1.60		
	75th	8.25			6.55	5.70		11.23	35.83							6.30		
1986-1990	n				46	51		45	53	38						55		
	min				2.00	0.90		2.30	1.50	1.10						1.20		
	max				82.80	101.10		87.00	231.90	118.00						46.10		
	median				5.00	5.00		8.00	12.70	6.65						5.00		
	25th				4.00	4.78		5.00	6.60	5.00						5.00		
	75th				5.10	7.03		5.00	25.53	15.00						5.23		
1991-1995	n			1	41	43		5.825	43	39						42		
	min			5.00	2.70	0.90		40.00	4.70	2.90						2.00		
	max			5.00	108.00	129.00		2.20	1395.00	938.00						99.00		
	median			5.00	6.10	8.60		47.20	14.60	12.20						5.00		
	25th				5.00	5.00		7.20	7.03	7.95						5.00		
	75th				11.10	17.43		5.00	27.40	20.03						12.40		
1996-2000	n					20		14.5		21								
	min					1.00		1.00		1.50								
	max					37.50		21.00		36.00								
	median					2.50		3.00		8.00								
	25th					2.00		2.00		3.88								
	75th					3.50		9.13		13.38								
2001-2005	n		29		24	42		24		41	17							17
	min		1.10		0.80	0.00		0.80		1.80	0.70							0.90
	max		43.60		48.00	38.50		44.50		37.00	17.70							10.60
	median		4.30		3.95	4.50		3.00		6.00	3.60							2.90
	25th		2.68		2.70	2.70		1.90		3.25	2.90							1.60
	75th		9.33		5.90	7.80		4.35		8.83	7.18							5.25

Residue Particulate - Bayfield River and Parkhill Creek

	Major Basin	Bayfield River														Parkhill Creek							
	Tributary	Bannockburn	Liffy Ditch			Silver Creek		Upper Bayfield			Steenstra	Lower Bayfield				Upper Parkhill					Tributary	Lower Parkhill	
	MOE or local ID	MBBAN1	HBLIF1	08004000402	08004000502	08004001102	08004000302	08004000202	08004000902	08004000602	HBSTEEN1	08004001002	08004000802	08004000102	08004000783	08002200302	MPMCGUF1	08002200402	08002200902	08002201202	08002201802	08002201302	08002200102
	Site Name	Bannockburn	Dublin	HBLIF2	HBLIF3	Silver	MBSILV1	Seaforth	MBHAN1	MBCLIN2	Steenstra	MBGRANT	Varna	MBBAY1	MBBAY2	HPCAM	Upstream Parkhill	MPDAM	MPHARM	Downstream Parkhill	MPTRI1	MPGBEND2	MPGBEND1
1964-1965	n			5	5		6	9						7		9		9					6
	min			2.00	15.00		6.00	1.00						1.00		7.00		8.00					14.00
	max			45.00	40.00		132.00	15.00						29.00		352.00		39.00					56.00
	median			15.00	31.00		11.00	6.00						10.00		31.00		20.00					19.00
	25th			11.00	15.00		7.00	1.75						8.25		9.00		10.00					15.00
	75th			24.00	37.00		15.00	8.00						17.00		48.75		22.50					55.00
1966-1970	n			64	64		66	65						64		76		15	56				72
	min			2.00	1.00		4.00	2.00						4.00		6.00		15.00	15.00				12.00
	max			158.00	450.00		185.00	60.00						298.00		806.00		930.00	213.00				784.00
	median			13.50	13.00		15.00	12.00						15.00		15.00		51.00	26.00				30.00
	25th			5.00	5.00		12.00	5.75						9.00		15.00		32.25	15.00				15.50
	75th			17.50	17.00		23.00	15.00						18.50		26.50		78.25	54.00				54.00
1971-1975	n			8	39		45	42	6	31			6	60	23	54			15	38		29	71
	min			15.00	5.00		5.00	5.00	2.00	2.00			1.00	0.00	5.00	5.00			15.00	5.00		9.00	0.00
	max			130.00	75.00		90.00	70.00	20.00	90.00			18.00	300.00	100.00	470.00			95.00	190.00		111.00	290.00
	median			30.00	15.00		15.00	15.00	15.00	15.00			15.00	15.00	15.00	15.00			25.00	20.00		30.00	20.00
	25th			20.00	15.00		15.00	15.00	15.00	15.00			8.00	41.82	15.00	15.00			15.00	15.00		23.75	15.00
	75th			55.00	25.00		15.00	15.00	15.00	15.00			15.00	15.00	18.75	20.00			38.75	50.00		60.00	30.00
1976-1980	n								59	59		32	62	30							11	60	
	min								0.50	0.20		0.50	0.50								6.90	1.00	
	max								170.00	276.00		22.50	179.00								91.70	214.00	
	median								9.00	5.50		5.00	6.75								32.40	25.25	
	25th								4.08	2.58		2.25	3.00								10.50	14.75	
	75th								15.00	15.00		14.25	15.00								50.83	49.00	
1981-1985	n					34			59	58			59							59		58	
	min					0.10			0.10	0.10			0.50							1.00		3.90	
	max					403.30			201.00	81.70			92.90							202.40		274.20	
	median					2.95			5.80	2.85			3.40							30.00		34.90	
	25th					1.40			3.23	1.50			2.03							14.00		15.60	
	75th					5.40			11.75	5.80			7.80							62.38		56.00	
1986-1990	n					54			54	56			56							58		55	
	min					1.50			0.40	1.30			0.90							4.00		4.70	
	max					73.30			108.00	104.00			136.00							272.00		237.00	
	median					5.00			5.00	5.00			5.00							30.90		30.70	
	25th					5.00			5.00	5.00			5.00							15.70		16.98	
	75th					7.30			10.40	7.10			7.25							49.50		53.38	
1991-1995	n					47			44	45			48							51		45	
	min					2.60			2.40	2.40			1.40							5.00		8.90	
	max					328.00			461.00	923.00			844.00							110.00		178.00	
	median					5.00			6.80	5.00			5.00							38.40		35.30	
	25th					5.00			5.00	5.00			5.00							20.25		23.38	
	75th					9.95			20.15	15.35			5.00							50.10		54.85	
1996-2000	n								7				7								7		
	min								2.50				2.00								8.00		
	max								167.00				164.00								84.00		
	median								11.50				2.50								69.50		
	25th								4.00				2.00								31.75		
	75th								73.25				32.88								82.88		
2001-2005	n	18	18			8		26	15		21		60				18			26	15		
	min	1.00	1.00			0.60		1.60	1.50		1.00		1.60				1.00			10.70	14.00		
	max	153.00	150.00			15.70		39.80	13.50		883.00		319.00				98.00			71.10	56.50		
	median	5.00	5.50			3.25		4.50	4.00		8.00		5.50				21.50			32.60	30.20		
	25th	2.00	2.00			1.15		2.70	3.13		2.75		3.30				8.00			21.40	25.63		
	75th	10.00	9.00			7.65		11.60	5.85		16.00		13.65				44.00			48.80	40.93		

Indicator is Total Suspended Sediment

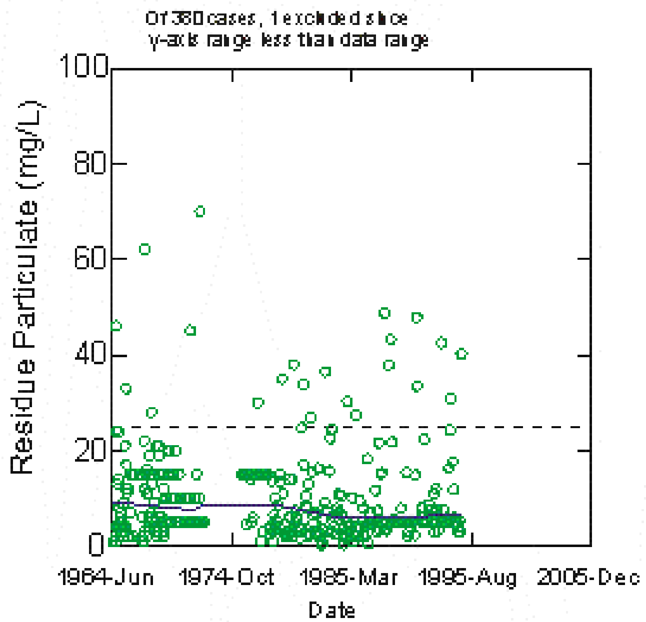
Residue Particulate - Ausable River

	Major Basin	Ausable															
	Tributary	Black Creek	Little Ausable River		Nairn Creek	Ausable River								Decker Creek		The Cut	
	MOE or local ID	08002200702	08002201402	08002201002	MANAIRN1	08002200802	08002201702	08002200602	08002201602	08002200502	08002201102	08002202002	08002201502	08002201902	08002200202	08002100202	08002100102
	Site Name	Black	Huron Park	Lucan	Nairn	Staffa	MAMOR2	MATHAMES	Exeter	HATRIB	MAMTCARM	Springbank	MAGLAS1	Decker	MADECK3	Thedford	MAWAL
1964-1965	n																
	min																
	max																
	median																
	25th																
	75th																
1966-1970	n	71		22		72		75		75					74		
	min	1.00		15.00		7.00		2.00		1.00					12.00		
	max	709.00		21.00		840.00		178.00		296.00					396.00		
	median	15.00		15.00		19.50		15.00		15.00					38.00		
	25th	15.00		15.00		15.00		15.00		15.00					20.00		
	75th	37.75		15.00		49.50		15.00		15.00					69.00		
1971-1975	n	61	88	60		55	22	55	6	16	39				61		39
	min	1.00	2.00	3.00		5.00	5.00	5.00	1.00	15.00	5.00				4.00		0.00
	max	190.00	240.00	75.00		110.00	45.00	55.00	60.00	20.00	90.00				950.00		350.00
	median	15.00	15.00	15.00		15.00	15.00	15.00	15.00	15.00	20.00				30.00		20.00
	25th	15.00	13.75	15.00		15.00	15.00	10.00	15.00	15.00	15.00				15.00		15.00
	75th	15.00	25.00	15.00		20.00	15.00	15.00	42.00	15.00	30.00				61.25		31.50
1976-1980	n	59	496	57			61		60		58				59		65
	min	0.50	0.50	0.50			0.50		0.50		0.50				0.50		0.50
	max	63.00	426.00	93.00			131.00		128.00		227.00				748.00		838.00
	median	7.00	12.75	11.00			9.00		10.25		15.00				18.00		23.00
	25th	3.25	7.00	4.00			4.63		5.00		9.00				13.75		11.38
	75th	15.00	23.00	15.00			15.00		15.00		36.00				34.50		39.25
1981-1985	n	60		56			60	1	58		59				57	314	28
	min	0.10		0.90			0.10	2.90	0.10		0.10				1.50	1.60	4.90
	max	207.80		504.60			28.90	2.90	111.50		47.70				261.40	2434.00	91.10
	median	3.55		5.45			3.45	2.90	4.20		12.60				21.50	63.26	32.45
	25th	2.05		3.00			2.05		2.90		4.58				12.68	34.04	18.10
	75th	6.70		9.70			6.00		8.90		27.08				37.33	164.20	42.10
1986-1990	n	55		55			55		56		53				56	245	
	min	0.80		1.50			0.90		1.30		2.40				5.00	2.20	
	max	180.00		93.30			74.90		81.20		180.00				217.00	1270.00	
	median	5.00		6.60			5.00		5.00		16.80				23.50	50.40	
	25th	5.00		5.00			5.00		5.00		6.78				13.95	32.23	
	75th	8.70		13.80			12.93		12.20		25.18				36.60	92.28	
1991-1995	n	47		48			50		43		45				49	222	
	min	1.80		3.20			1.70		1.70		5.00				3.90	4.80	
	max	272.00		396.00			94.20		70.00		63.80				147.00	771.00	
	median	5.00		6.55			5.00		5.00		11.10				24.60	39.15	
	25th	5.00		5.00			5.00		5.00		6.08				15.78	24.00	
	75th	15.10		21.55			10.10		8.50		28.90				44.35	66.80	
1996-2000	n	7		7					7					7		31	
	min	4.00		4.00					3.00					3.00		11.00	
	max	136.00		223.00					120.00					843.00		447.00	
	median	9.50		14.00					7.50					19.00		58.00	
	25th	5.88		6.75					5.25					13.00		26.25	
	75th	34.75		40.50					30.25					69.25		130.00	
2001-2005	n	41	29	41	18	18			41					41		40	
	min	0.70	2.70	0.50	1.00	1.00			1.20					3.10		9.90	
	max	38.30	289.00	86.30	28.00	23.00			13.30					120.00		151.00	
	median	4.10	10.80	4.70	8.50	5.50			3.60					15.00		23.70	
	25th	2.90	7.73	2.50	5.00	5.00			2.30					10.40		17.40	
	75th	7.80	19.53	7.18	16.00	8.00			6.50					26.20		44.55	

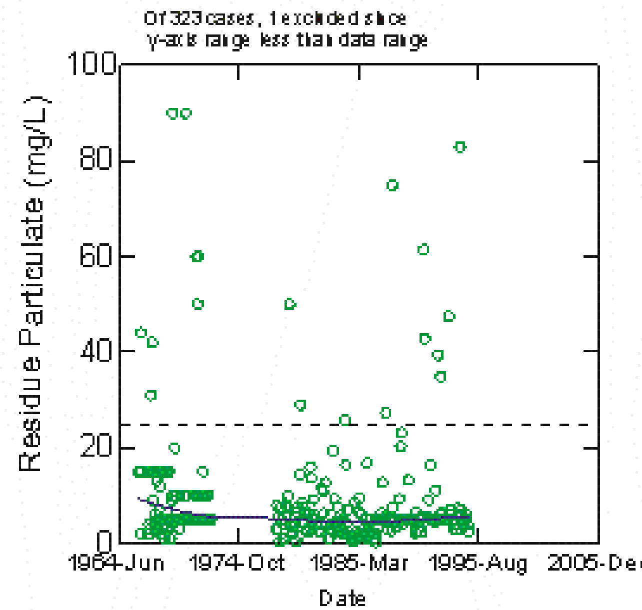
Indicator is Total Suspended Sediment

North Maitland

Harriston
08005600702

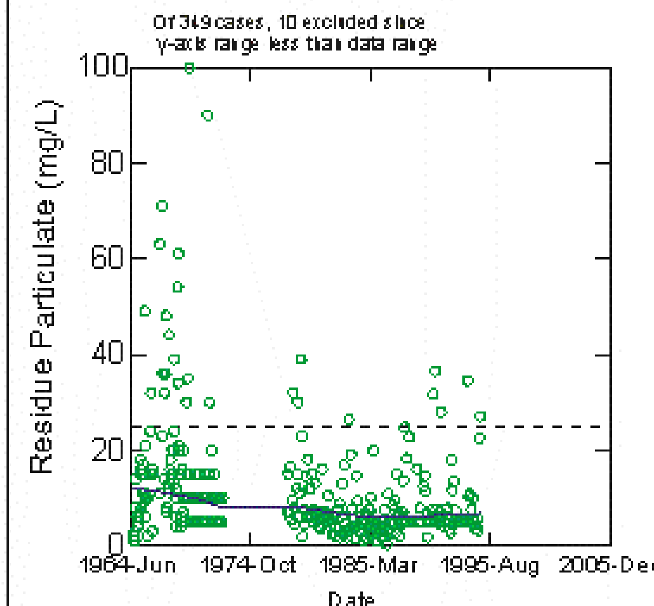


Wroxeter
08005600402

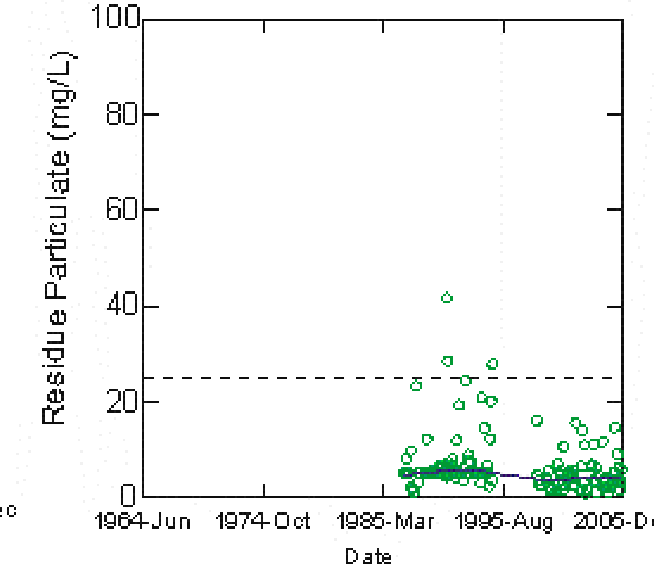


Little Maitland

Palmer
08005600602

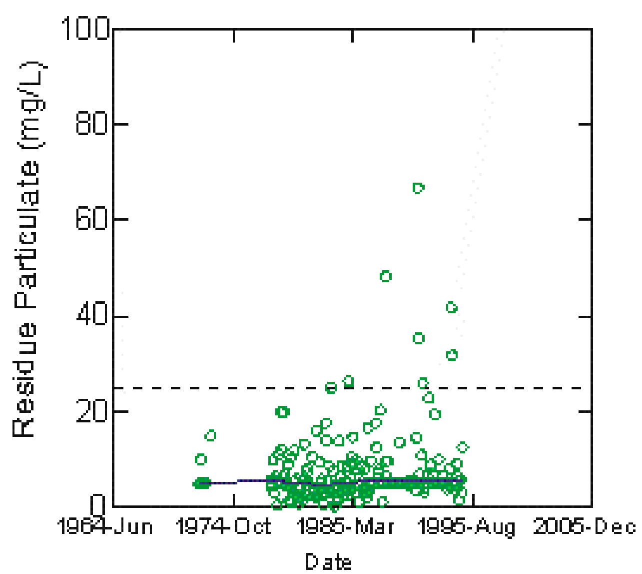


Jamestown
08005603502



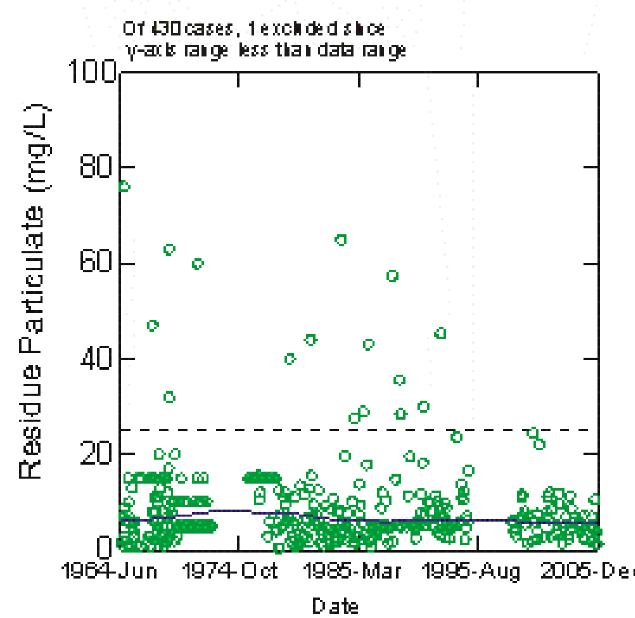
South Maitland

Londesborough
08005601502



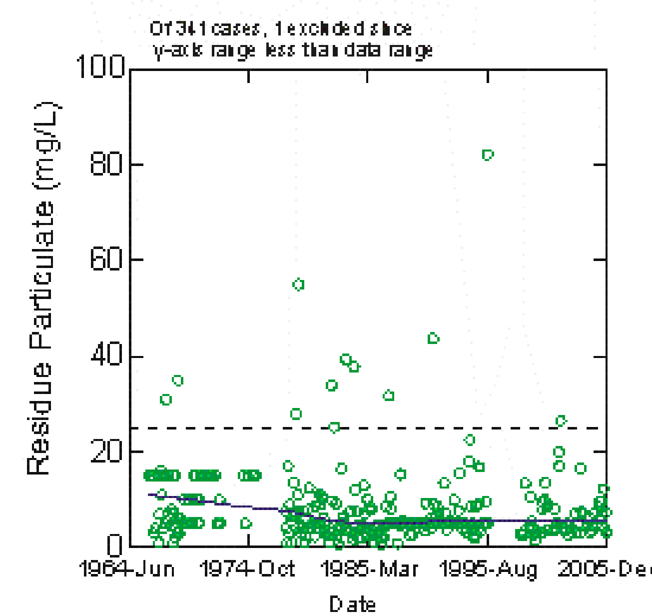
Lower Maitland

Zetland
08005600302



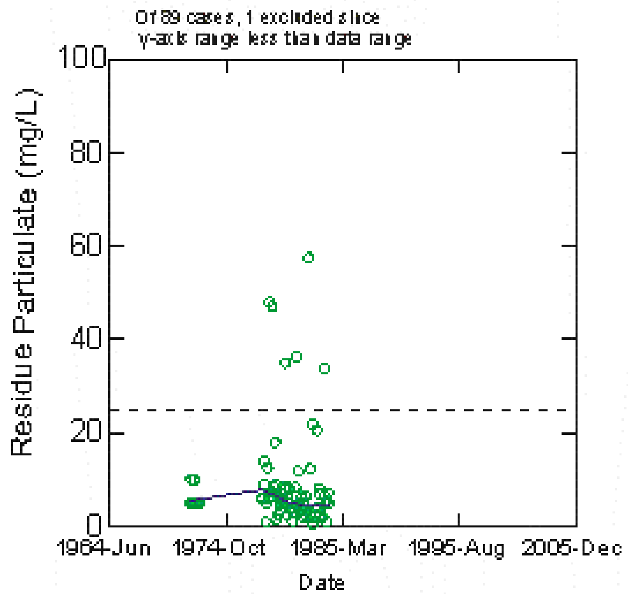
Nine Mile

Lucknow
08007600202

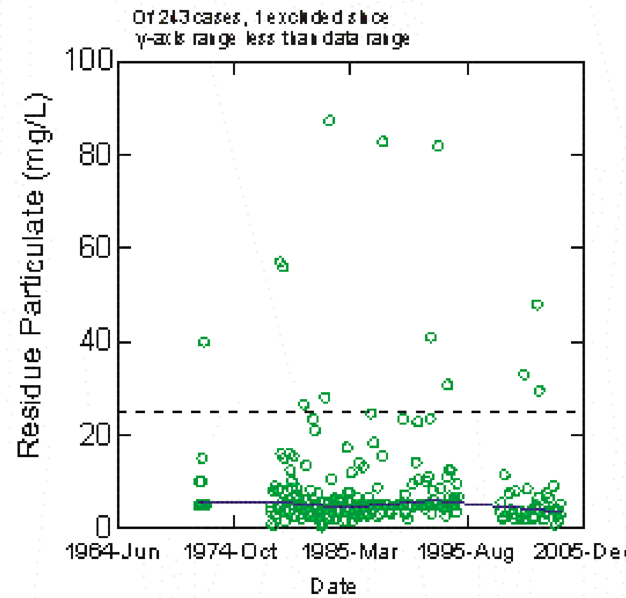


Middle Maitland

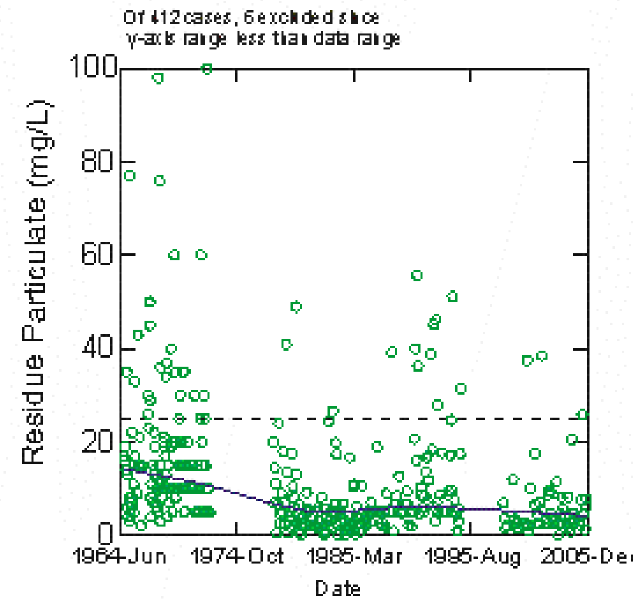
Listowel_NE
08005601402



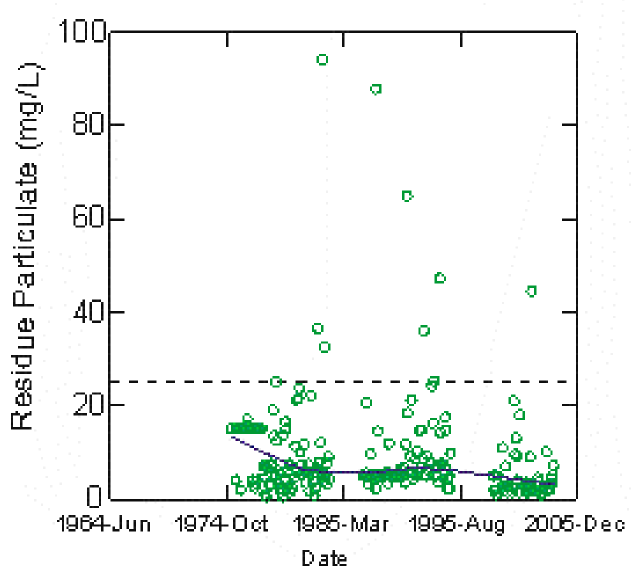
Listowel
08005601302



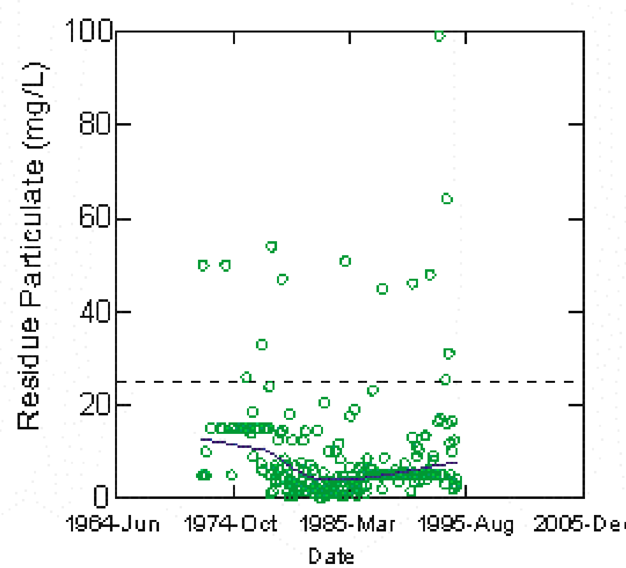
Trowbridge
08005600902



Ethel
08005602602

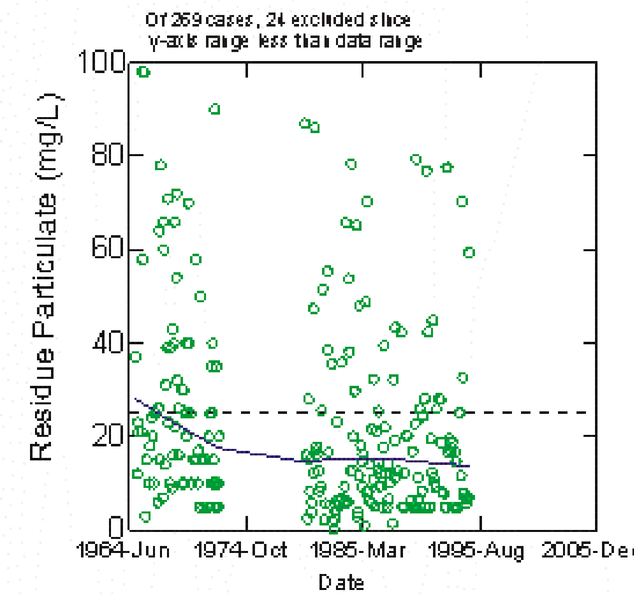


Bruss16D
08005601602 (1972-1979)
08005603102 (1980-1994)

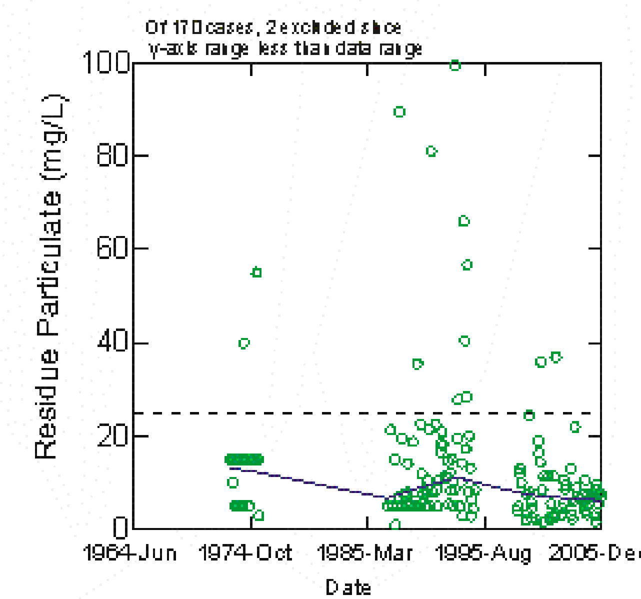


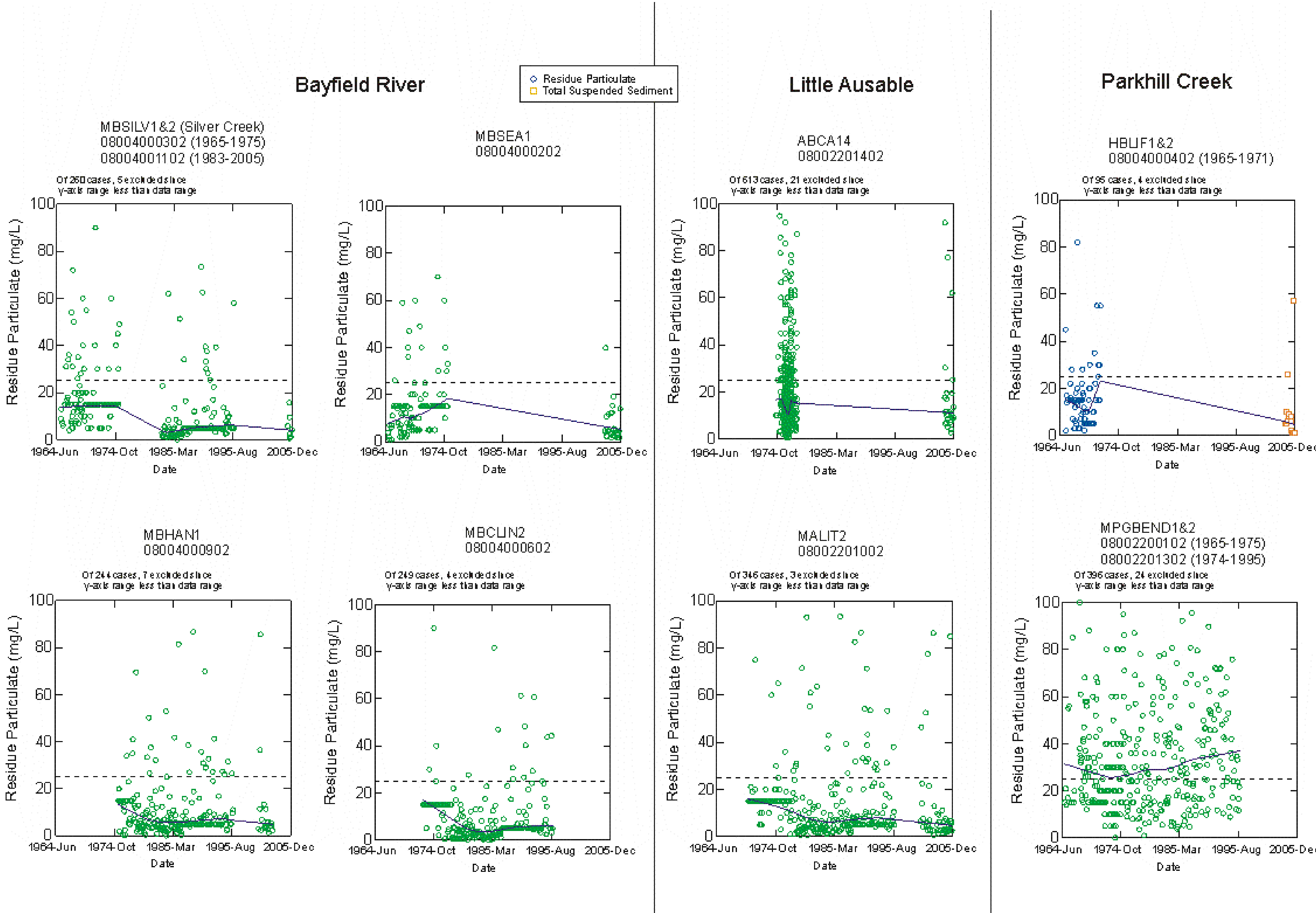
Boyle Drain

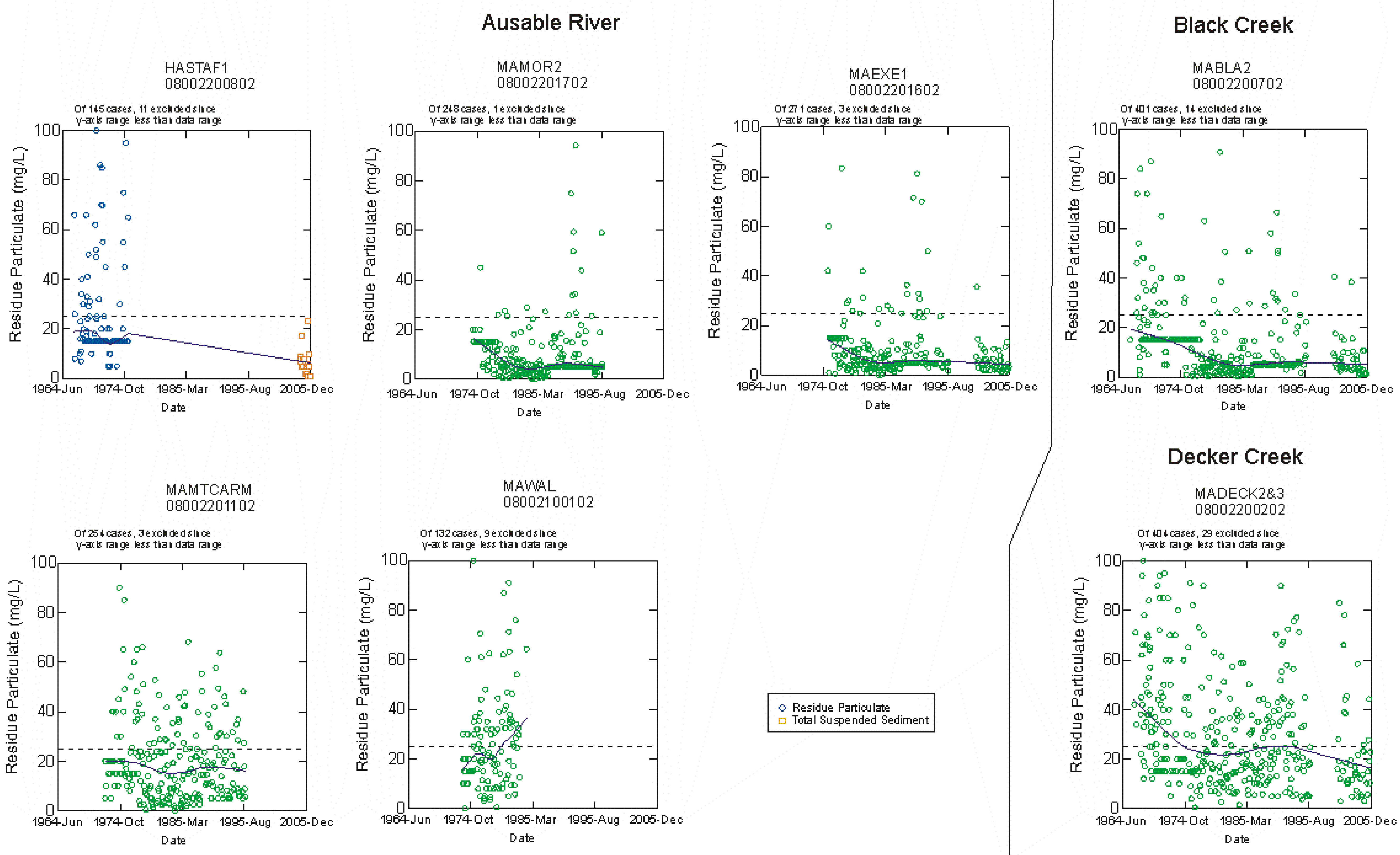
Milverton
08005601002



Henfryn
08005602002




Bayfield River
Little Ausable
Parkhill Creek
Residue Particulate
Total Suspended Sediment
MBSILV1&2 (Silver Creek)
08004000302 (1965-1975)
08004001102 (1983-2005)
MBSEA1
08004000202
ABCA14
08002201402
HBLIF1&2
08004000402 (1965-1971)
MBHAN1
08004000902
MBCLIN2
08004000602
MALIT2
08002201002
MPGBEND1&2
08002200102 (1965-1975)
08002201302 (1974-1995)
Residue Particulate (mg/L)
Date
1964-Jun
1974-Oct
1985-Mar
1995-Aug
2005-Dec


Ausable River
HASTAF1
08002200802
MAMOR2
08002201702
MAEXE1
08002201602
MAMTCARM
08002201102
MAWAL
08002100102
Black Creek
MABLA2
08002200702
Decker Creek
MADECK2&3
08002200202
Residue Particulate (mg/L)
Date
1964-Jun
1974-Oct
1985-Mar
1995-Aug
2005-Dec
Residue Particulate
Total Suspended Sediment

Bacteria - North, Little, South and Lower Maitland River and Nine Mile River

		Major Basin	Nine Mile		North Maitland						Little Maitland			South Maitland		Lower Maitland						
		Tributary			Upper				Salem Creek	Lower						Belgrave Creek	Blyth Brook		Sharpes Creek		Main Branch	
		MOE or local ID	08007600202	08007600102	08005600802	08005600702	08005602502	08005600402	08005605002	08005603802	08005600602	08005602202	08005603502	08005601502	08005603702	08005603002	08005604402	08005600202	08005602702	08005602802	08005600302	08005600102
		Site Name	Lucknow	Port Albert	Palmer_N	Harristn	Fordwich	Wroxeter	NMSalem	B-Line	Palmer	Palme_23	Jamestown	Londesbo	Summerhill	WNC_Belg	Blyth East	Blyth	Sharpes	SharpBen	Zetland	Goderich
Fecal Coliform	1964-1965	n																				
		min																				
		max																				
		median																				
		25th																				
		75th																				
	1966-1970	n																				
		min																				
		max																				
		median																				
		25th																				
		75th																				
	1971-1975	n		52	40	45		45			14							46			45	76
		min		1	4	4		4			4							4			4	1
		max		1200	14000	70000		1110			4800							2500			1200	2400
		median		68	110	204		16			430							198			40	4
		25th		18	36	77		8			180							40			12	4
		75th		133	297	503		60			1000							370			131.5	24
	1976-1980	n		40		41		39			29							44			41	49
		min		4		4		4			190							4			4	4
		max		420		3800		430			47900							1070			920	384
		median		20		220		30			1220							131			50	4
		25th		6		48		10.5			436							18			16	4
		75th		74		540		92			2100							319			117	17
	1981-1985	n		41		41		44			42							40			41	33
		min		4		10		4			100							4			4	4
		max		630		41000		1000			69000							3800			1140	900
		median		88		600		80			2550							218			92	24
		25th		15		242.5		33			1100							105			40	4
		75th		241		1500		142			8500							527			258	173
	1986-1990	n		47		45		47			45							46			48	44
		min		4		4		4			16							16			4	4
		max		1000		2400000		1000			240000							1500			1500	1000
		median		24		430		32			710							167			68	10
		25th		10		126		16			405							92			20	4
		75th		55		710		88			4450							284			294	24
	1991-1995	n		41		40		38			40							41			40	42
		min		4		4		4			24							8			4	4
		max		1500		2300		1200			5700							8			1500	1000
		median		28		148		42			208							17200			53	12
		25th		10		66		20			108							168			20	4
		75th		78		365		124			495							109			186	56
E. coli	1996-2000	n																400				
		min																				
		max																				
		median																				
		25th																				
		75th																				
	2001-2005	n							13								27					
		min							28								12					
		max							7000								6300					
		median							1000								280					
		25th							357.5								102.5					
		75th							1900								890					

Bacteria - Middle Maitland River

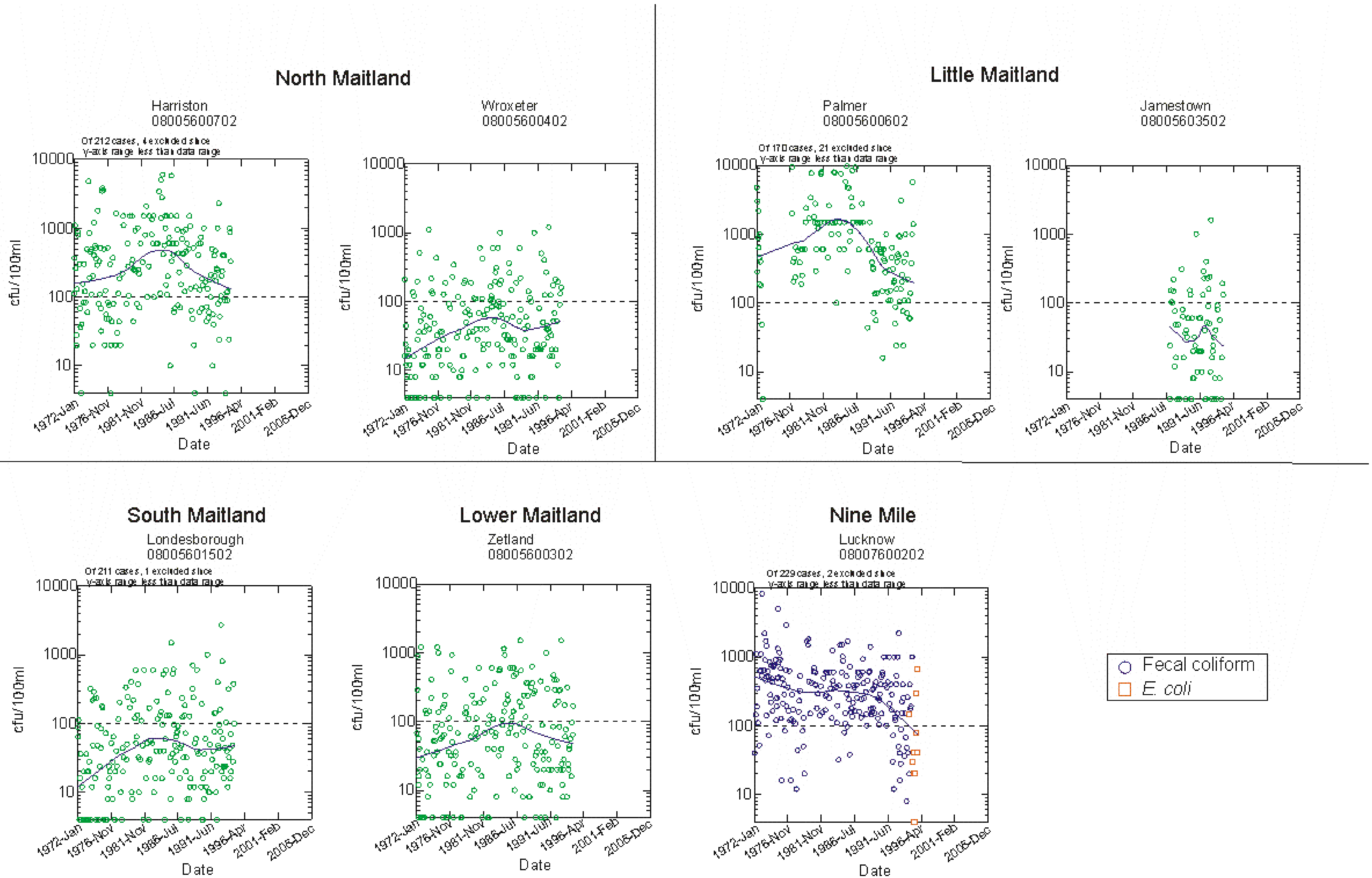
		Major Basin	Middle Maitland River																
		Tributary	Above Listowel		Chapman	Below Listowel				Boyle Drain		Beachamp	Lower Middle Maitland						
		MOE or local ID	08005601402	08005604302	08005602102	08005601302	08005600902	08005601902	08005602602	08005601002	08005602002	08005604102	08005601802	08005601102	08005600502	08005601602	08005603102	08005601702	08005603902
		Site Name	Listw_NE	NE Listowel	Chapman	Listowel	Trowbridge	Grey_Elm	Ethel	Milvertn	Henfryn	Beauchamp	Grey	Brusl_12	Brus_DSc	Brussl_D	Bruss_16	Morris	Wingham
Fecal Coliform	1964-1965	n																	
		min																	
		max																	
		median																	
		25th																	
		75th																	
	1966-1970	n																	
		min																	
		max																	
		median																	
		25th																	
		75th																	
	1971-1975	n					43			40	29				30	45			
		min					4			4	4				4	4			
		max					16700			1100000	5400				37000	26000			
		median					104			543	40				910	210			
		25th					43			64	7				320	51			
		75th					313			1800	137				5200	882.5			
	1976-1980	n					42			8					10	30	9		
		min					4			20					280	12	10		
		max					600			150000					300000	3800	260		
		median					74			1050					1500	232	60		
		25th					36			435					440	140	19		
		75th					150			17250					13400	480	149		
	1981-1985	n					43										43		
		min					8										4		
		max					1500										77000		
		median					190										70		
		25th					65										28		
		75th					440										230		
	1986-1990	n					46				31						45		
		min					4				4						4		
		max					1600				6000						1000		
		median					88				170						32		
		25th					36				38						11		
		75th					448				508						68		
	1991-1995	n					39				37						41		
		min					10				10						4		
		max					1100				4300						2200		
		median					160				160						32		
		25th					50.5				78						16		
		75th					246.5				299						111		
E. coli	1996-2000	n																	
		min																	
		max																	
		median																	
		25th																	
		75th																	
	2001-2005	n		27															
		min		20															
		max		10000															
		median		1000															
		25th		190															
		75th		2200															

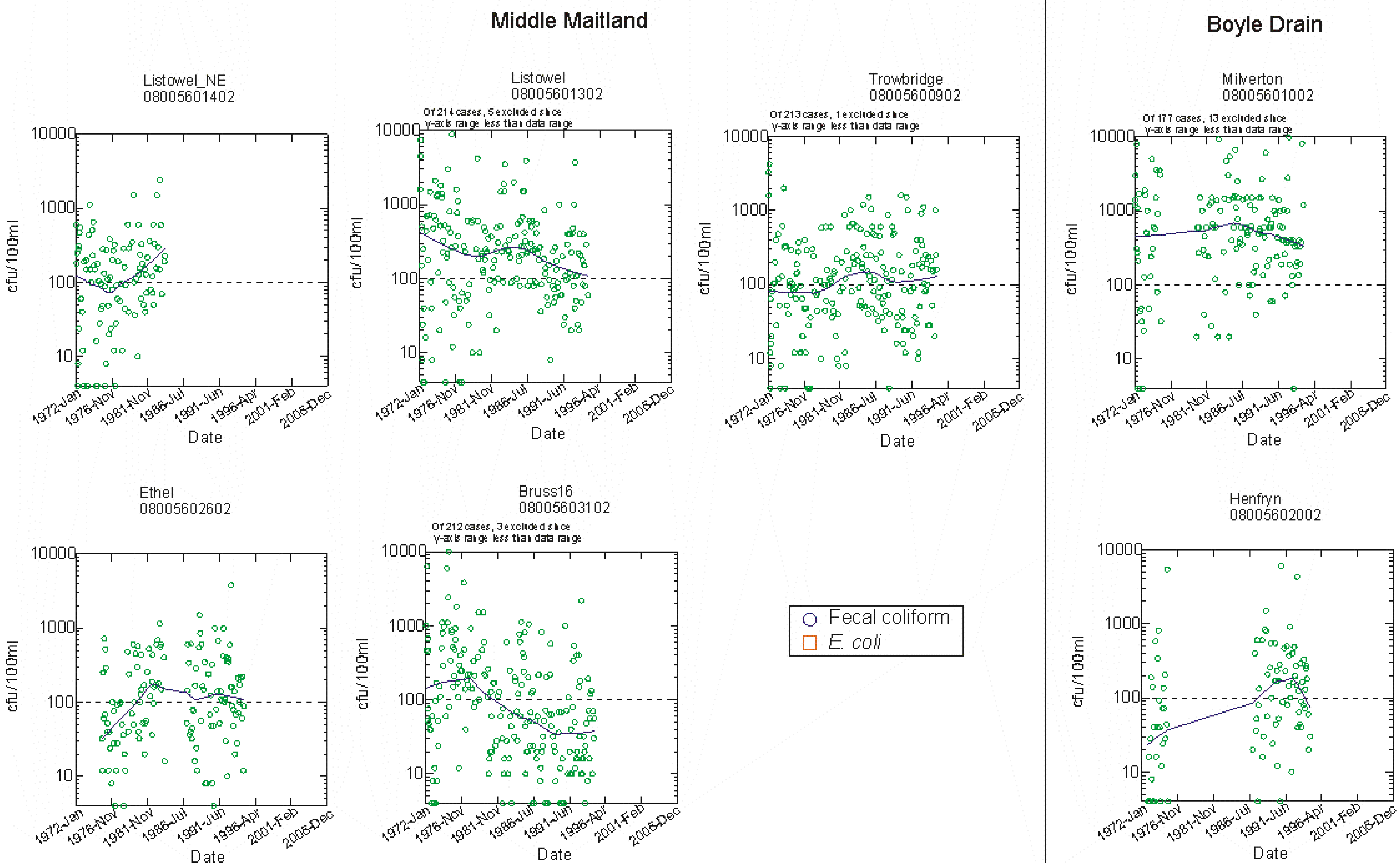
Bacteria - Bayfield River and Parkhill Creek

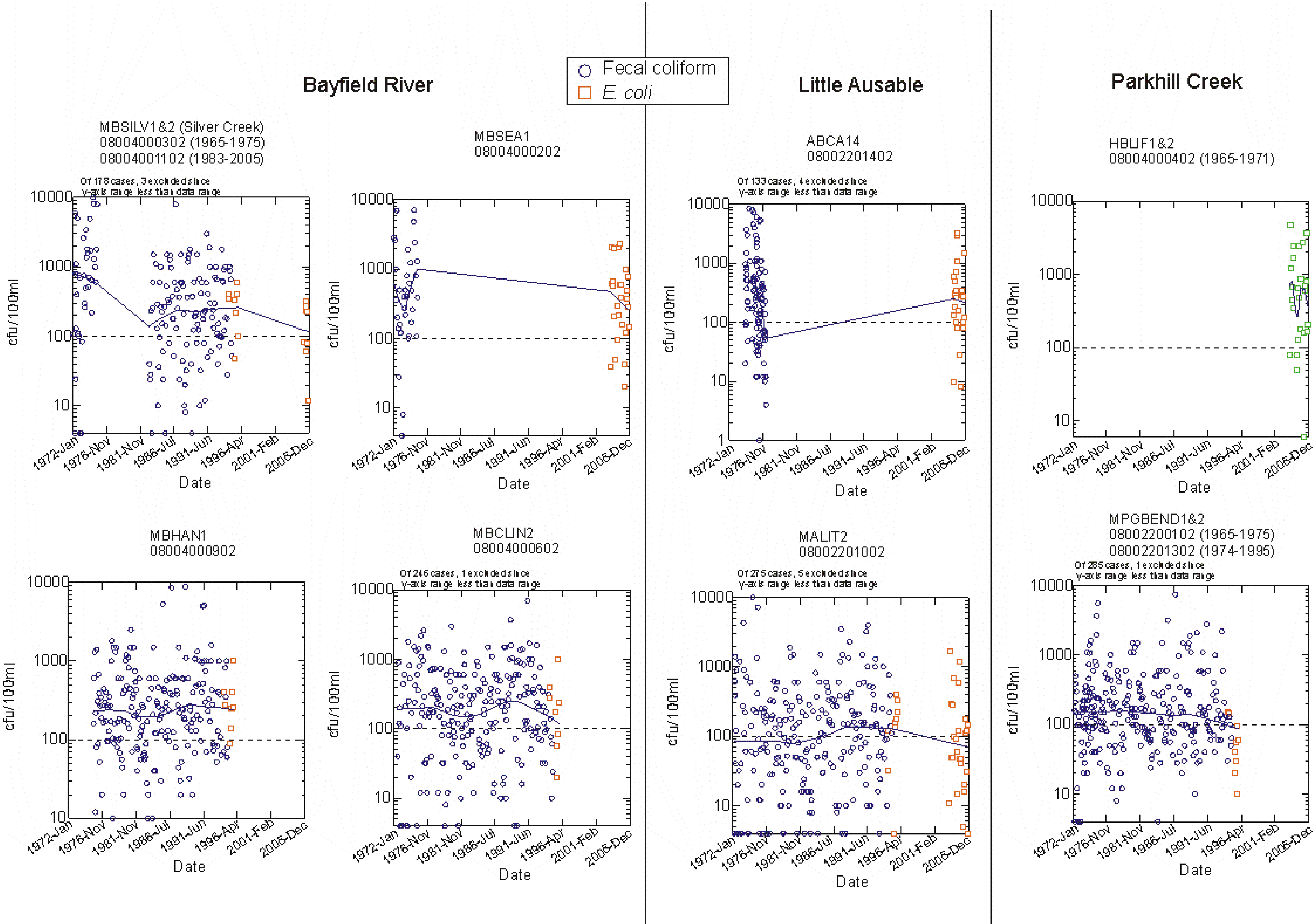
		Major Basin	Bayfield River														Parkhill Creek							
		Tributary	Bannockburn	Liffy Ditch			Silver Creek		Upper Bayfield			Steenstra	Lower Bayfield				Upper Parkhill					Tributary	Lower Parkhill	
		MOE or local ID	MBBAN1	HBLIF1	08004000402	08004000502	08004001102	08004000302	08004000202	08004000902	08004000602	HBSTEEN1	08004001002	08004000802	08004000102	08004000783	08002200302	MPMCGUF1	08002200402	08002200902	08002201202	08002201802	08002201302	08002200102
		Site Name	Bannockburn	Dublin	HBLIF2	HBLIF3	Silver	MBSILV1	Seaforth	MBHAN1	MBCLIN2	Steenstra	MBGRANT	Varna	MBBAY1	MBBAY2	HPCAM	Upstream Parkhill	MPDAM	MPHARM	Downstream Parkhill	MPTRI1	MPGBEND2	MPGBEND1
Fecal Coliform	1964-1965	n																						
		min																						
		max																						
		median																						
		25th																						
		75th																						
	1966-1970	n																						
		min																						
		max																						
		median																						
		25th																						
		75th																						
	1971-1975	n				35		40	37	6	35			6	47	20								
		min				4		4	4	12	4			20	0	4								
		max				53000		11000	7100	1300	27000			300	1360	550								
		median				910		730	400	190	240			101	90	62								
		25th				88		175	135	80	25			20	21	20								
		75th				1875		1800	1057.5	610	807.5			240	272.5	196								
	1976-1980	n								59	58		31	61									59	
		min								10	4		4	4									8	
		max								2500	3000		10600	7400									15000	
		median								270	187		150	100									168	
		25th								104	76		76	39									81	
		75th								570	480		294	275									397.5	
	1981-1985	n					30			55	54			56									55	
		min					4			10	4			8									4	
		max					1500			5300	1500			1500									3200	
		median					228			200	154			87									130	
		25th					40			71.5	56			36									72	
		75th					528			370	350			198									297.5	
	1986-1990	n					52			51	52			53									50	
		min					4			20	4			4									10	
		max					11000			8800	3700			1500									7500	
		median					225			244	301			110									140	
		25th					80			130	84			27									56	
		75th					600			597.5	725			291.5									500	
	1991-1995	n					40			36	39			39									36	
		min					12			52	10			16									30	
		max					44000			5100	7000			2900									2800	
		median					270			315	140			100									120	
		25th					100			86	82			42									75	
		75th					895			890	391			194.5									215	
E. coli	1991-1995	n					8			8	8			9									9	
		min					48			88	20			32									10	
		max					610			1000	1000			400									150	
		median					338			270	208			70									56	
		25th					160			194	70			41									27.5	
		75th					400			400	340			143									108	
	1996-2000	n																						
		min																						
		max																						
		median																						
		25th																						
		75th																						
	2001-2005	n	26	25			8		26			18		26				26						
		min	10	6			12		20			0		4				7						
		max	50000	4700			320		2300			8200		10000				2800						
		median	211	600			157		385			260		71				175						
		25th	123	163			70		150			100		28				80						
		75th	1000	1325			255		660			820		210				410						

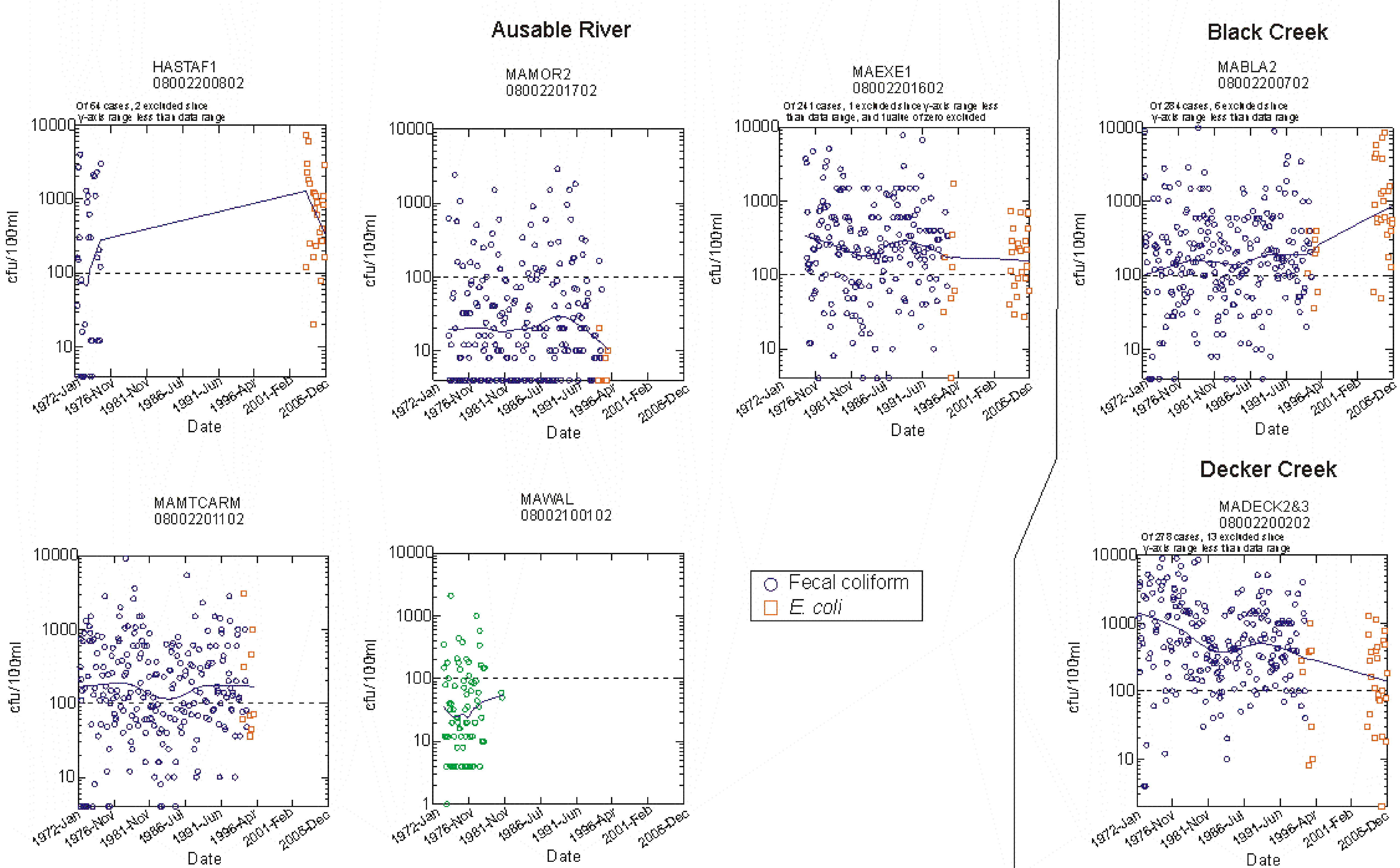
Bacteria - Ausable River

		Major Basin	Ausable															
		Tributary	Black Creek	Little Ausable River		Nairn Creek	Ausable River								Decker Creek		The Cut	
		MOE or local ID	08002200702	08002201402	08002201002	MANAIRN1	08002200802	08002201702	08002200602	08002201602	08002200502	08002201102	08002202002	08002201502	08002201902	08002200202	08002100202	08002100102
		Site Name	Black	Huron Park	Lucan	Nairn	Staffa	MAMOR2	MATHAMES	Exeter	HATRIB	MAMTCARM	Springbank	MAGLAS1	Decker	MADECK3	Thedford	MAWAL
Fecal Coliform	1964-1965	n																
		min																
		max																
		median																
		25th																
		75th																
	1966-1970	n																
		min																
		max																
		median																
		25th																
		75th																
	1971-1975	n		55				21		6								
		min		12				4		120								
		max		49000				2400		3700								
		median		540				12		440								
		25th		197.5				4		140								
		75th		1800				85		3300								
	1976-1980	n		51				60		60								
		min		1				4		4								
		max		5400				1500		11000								
		median		110				16		310								
		25th		50				4		106								
		75th		367.5				76		850								
	1981-1985	n						55		53								
		min						4		4								
		max						900		1500								
		median						16		180								
		25th						4		46								
		75th						67		382.5								
	1986-1990	n						52		53								
		min						4		4								
		max						2900		7800								
		median						20		280								
		25th						4		163								
		75th						126		670								
	1991-1995	n						41		36								
		min						4		10								
		max						1800		6700								
		median						20		270								
		25th						8		110								
		75th						62		400								
E. coli	1991-1995	n						8		8								
		min						4		4								
		max						20		1700								
		median						4		94								
		25th						4		40								
		75th						9		262								
	1996-2000	n																
		min																
		max																
		median																
		25th																
		75th																
	2001-2005	n		27		26	26			25			26		26			
		min		8		4	20			0			10		2			
		max		67000		1100	7300			720			1600		17000			
		median		280		185	780			200			135		170			
		25th		105		51	250			68			70		73			
		75th		697.5		380	1600			290			300		490			

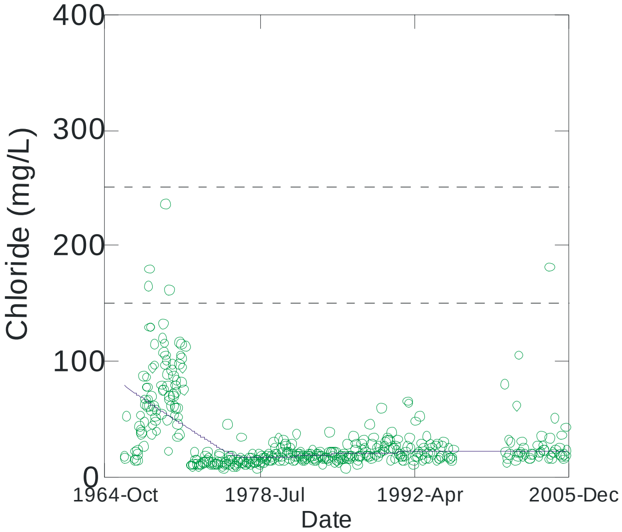

North Maitland
Harriston
08005600702
Of 212 cases, 4 excluded since y-axis range less than data range
Wroxeter
08005600402
Little Maitland
Palmer
08005600602
Of 170 cases, 21 excluded since y-axis range less than data range
Jamestown
08005603502
South Maitland
Londesborough
08005601502
Of 211 cases, 1 excluded since y-axis range less than data range
Lower Maitland
Zetland
08005600302
Nine Mile
Lucknow
08007600202
Of 229 cases, 2 excluded since y-axis range less than data range
cfu/100ml
10000
1000
100
10
Date
1972-Jan
1976-Nov
1981-Nov
1986-Jul
1991-Jun
1996-Apr
2001-Feb
2006-Dec
Fecal coliform
E. coli


Middle Maitland
Boyle Drain
Listowel_NE
08005601402
Listowel
08005601302
Of 214 cases, 5 excluded since y-axis range less than data range
Trowbridge
08005600902
Of 213 cases, 1 excluded since y-axis range less than data range
Milverton
08005601002
Of 177 cases, 13 excluded since y-axis range less than data range
Ethel
08005602602
Bruss16
08005603102
Of 212 cases, 3 excluded since y-axis range less than data range
Henfryn
08005602002
cfu/100ml
10000
1000
100
10
1972-Jan
1976-Nov
1981-Nov
1986-Jul
1991-Jun
1996-Apr
2001-Feb
2005-Dec
Date
Fecal coliform
E. coli

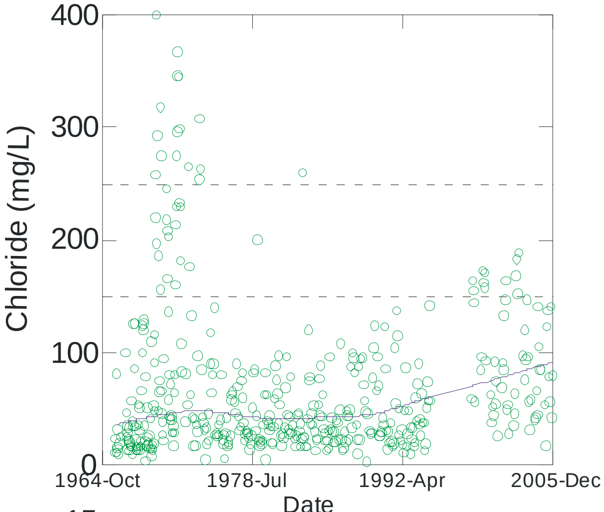

Fecal coliform
E. coli
Bayfield River
Little Ausable
Parkhill Creek
MBSILV1&2 (Silver Creek)
08004000302 (1965-1975)
08004001102 (1983-2005)
Of 178 cases, 3 excluded since
y-axis range less than data range
MBSEA1
08004000202
ABCA14
08002201402
Of 133 cases, 4 excluded since
y-axis range less than data range
HBLIF1&2
08004000402 (1965-1971)
MBHAN1
08004000902
MBCLIN2
08004000602
Of 246 cases, 1 excluded since
y-axis range less than data range
MALIT2
08002201002
Of 275 cases, 5 excluded since
y-axis range less than data range
MPGBEND1&2
08002200102 (1965-1975)
08002201302 (1974-1995)
Of 285 cases, 1 excluded since
y-axis range less than data range
cfu/100ml
Date
1972-Jan
1976-Nov
1981-Nov
1986-Jul
1991-Jun
1996-Apr
2001-Feb
2005-Dec


Ausable River
HASTAF1
08002200802
Of 64 cases, 2 excluded since y-axis range less than data range
MAMOR2
08002201702
MAEXE1
08002201602
Of 241 cases, 1 excluded since y-axis range less than data range, and 1 value of zero excluded
MAMTCARM
08002201102
MAWAL
08002100102
Black Creek
MABLA2
08002200702
Of 284 cases, 6 excluded since y-axis range less than data range
Decker Creek
MADECK2&3
08002200202
Of 278 cases, 13 excluded since y-axis range less than data range
cfu/100ml
Date
1972-Jan
1976-Nov
1981-Nov
1986-Jul
1991-Jun
1996-Apr
2001-Feb
2005-Dec
Fecal coliform
E. coli

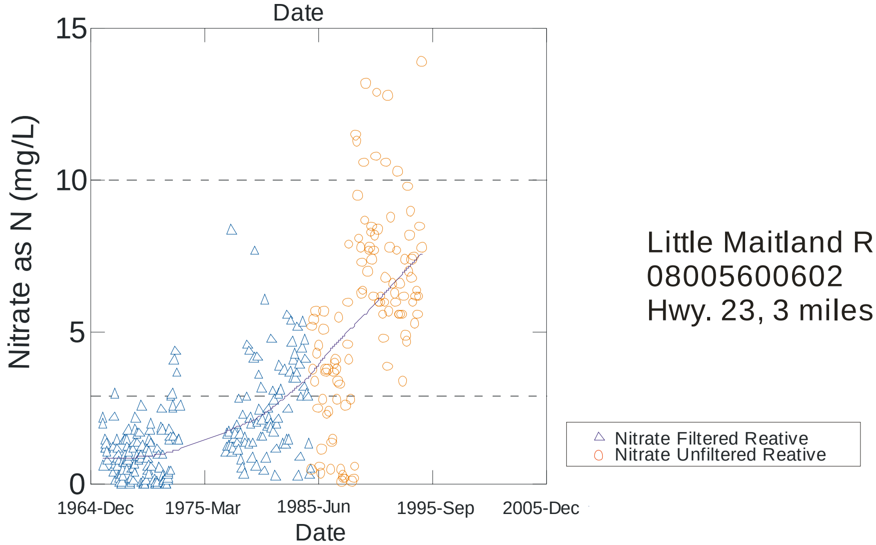
Appendix B: Selected Historic PWQNM sites with Different or Significant Trends



Black Creek
08002200702
Airport Line, West of Hensall

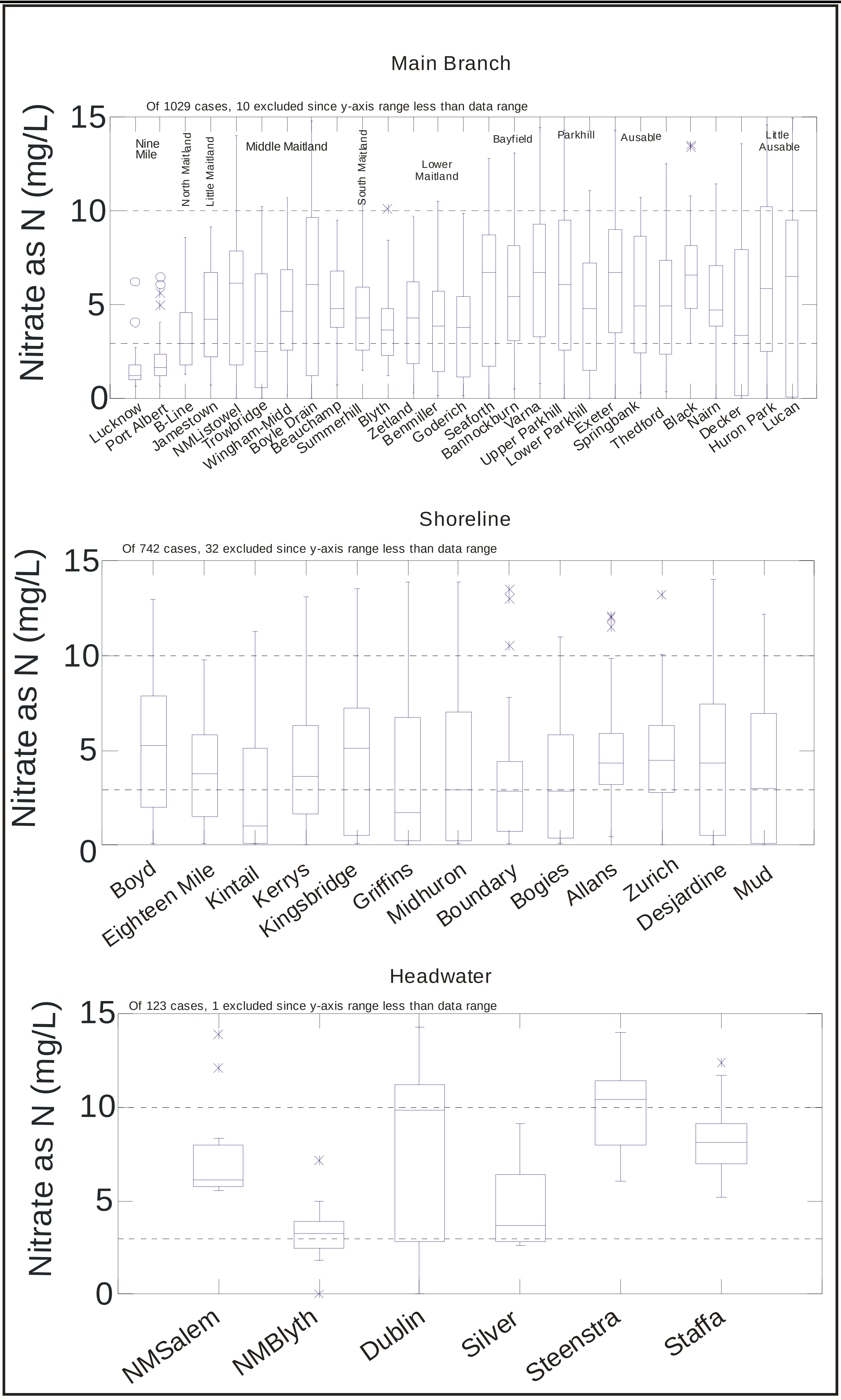


Middle Maitland River
08005600902
Trowbridge

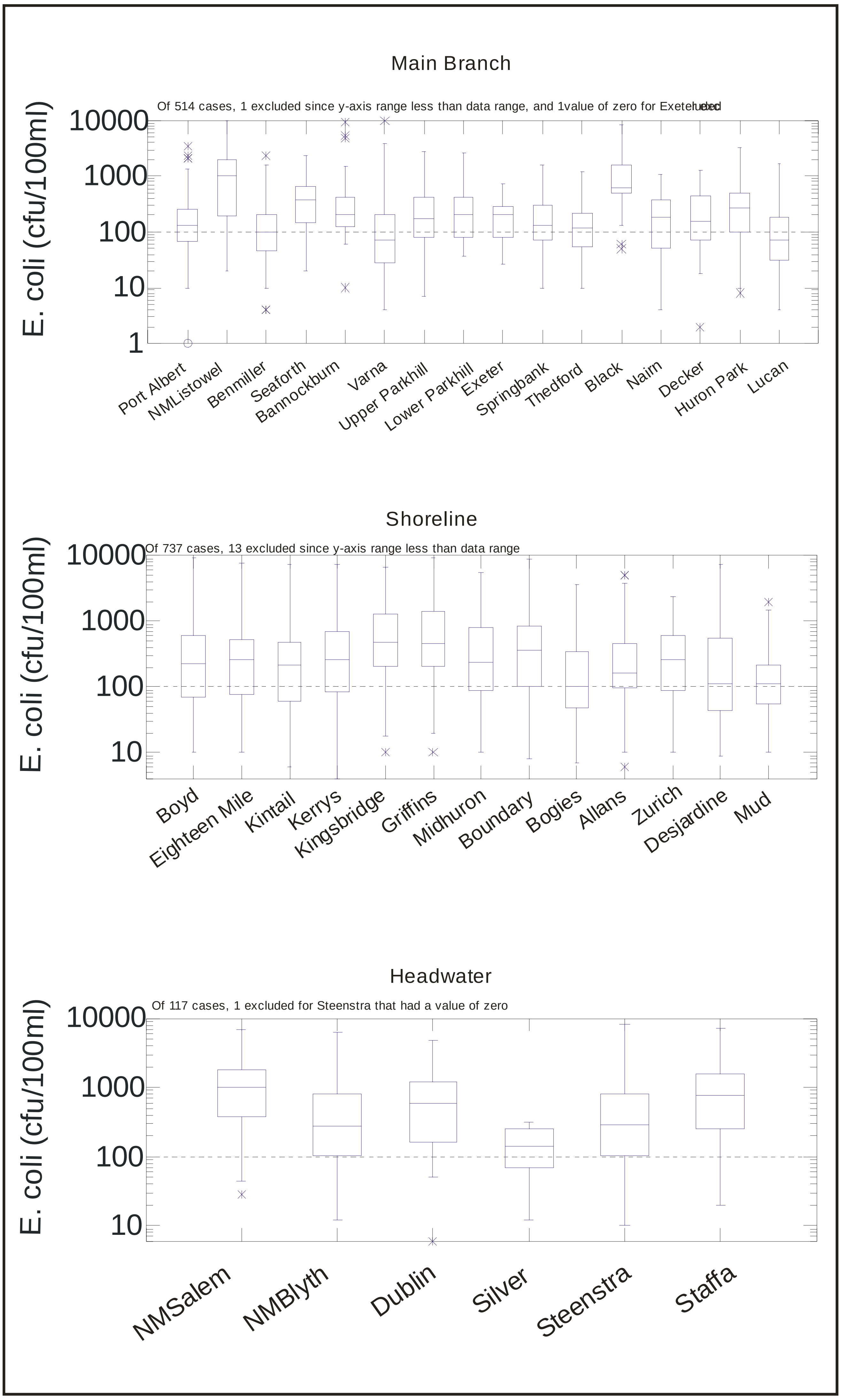


Little Maitland River
08005600602
Hwy. 23, 3 miles SW Palmerston

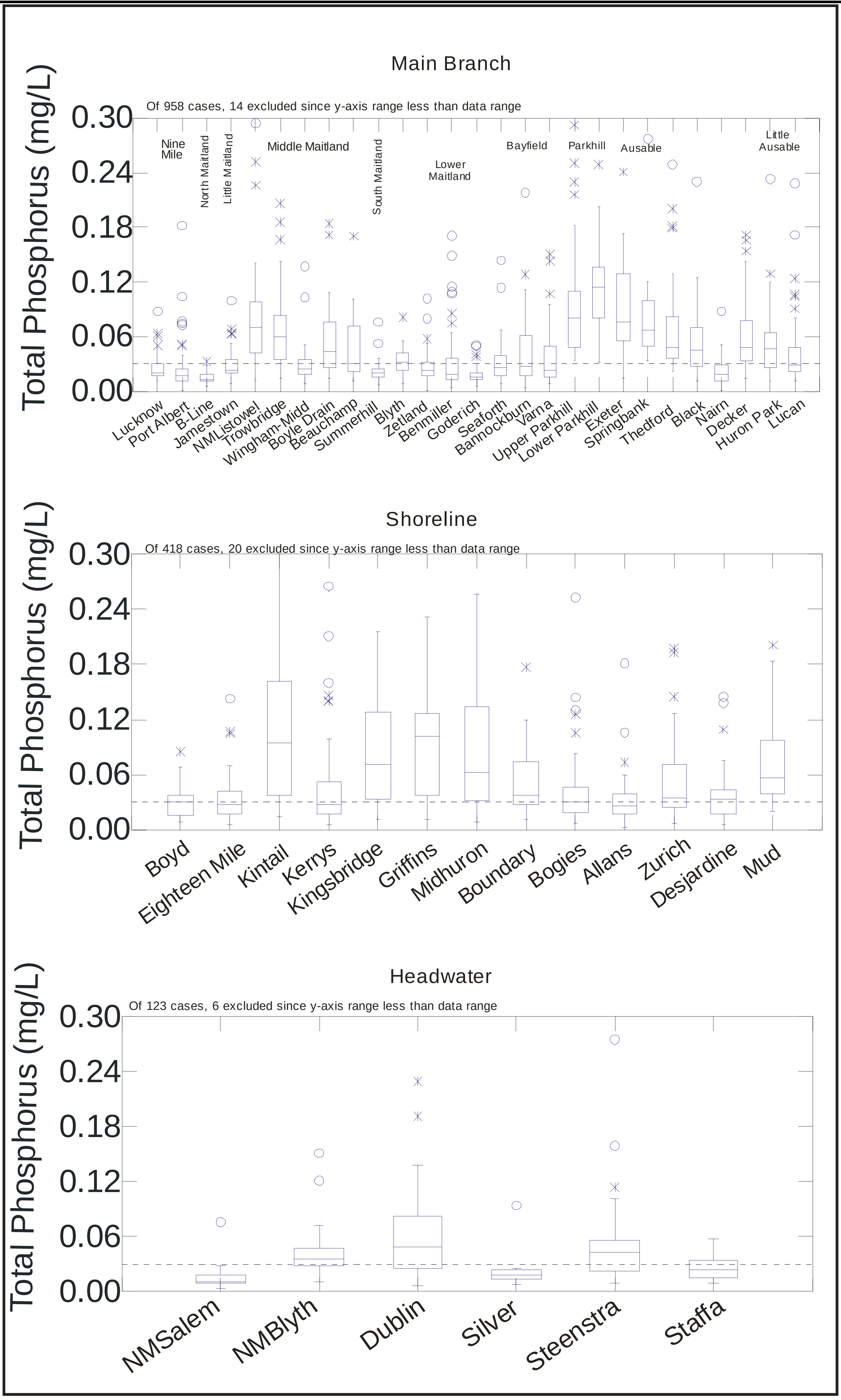
Appendix C: Spatial Trend Statistical Graphs (2001-2005) – nitrate, total phosphorus and *E. coli*



Main Branch
Of 1029 cases, 10 excluded since y-axis range less than data range
Nitrate as N (mg/L)
15
10
5
0
Nine Mile
North Maitland
Little Maitland
Middle Maitland
South Maitland
Lower Maitland
Bayfield
Parkhill
Ausable
Little Ausable
Lucknow
Port Albert
B-Line
Jamestown
NMListowel
Trowbridge
Wingham-Midd
Boyle Drain
Beauchamp
Summerhill
Blyth
Zetland
Benmiller
Goderich
Seaforth
Bannockburn
Varna
Upper Parkhill
Lower Parkhill
Exeter
Springbank
Thedford
Black
Nairn
Decker
Huron Park
Lucan
Shoreline
Of 742 cases, 32 excluded since y-axis range less than data range
Nitrate as N (mg/L)
15
10
5
0
Boyd
Eighteen Mile
Kintail
Kerrys
Kingsbridge
Griffins
Midhuron
Boundary
Bogies
Allans
Zurich
Desjardine
Mud
Headwater
Of 123 cases, 1 excluded since y-axis range less than data range
Nitrate as N (mg/L)
15
10
5
0
NMSalem
NMBlyth
Dublin
Silver
Steenstra
Staffa



Main Branch
Of 514 cases, 1 excluded since y-axis range less than data range, and 1value of zero for Exeter excluded
E. coli (cfu/100ml)
10000
1000
100
10
1
Port Albert
NMListowel
Benmiller
Seaforth
Bannockburn
Varna
Upper Parkhill
Lower Parkhill
Exeter
Springbank
Thedford
Black
Nairn
Decker
Huron Park
Lucan
Shoreline
Of 737 cases, 13 excluded since y-axis range less than data range
E. coli (cfu/100ml)
10000
1000
100
10
Boyd
Eighteen Mile
Kintail
Kerrys
Kingsbridge
Griffins
Midhuron
Boundary
Bogies
Allans
Zurich
Desjardine
Mud
Headwater
Of 117 cases, 1 excluded for Steenstra that had a value of zero
E. coli (cfu/100ml)
10000
1000
100
10
NMSalem
NMBlyth
Dublin
Silver
Steenstra
Staffa


Main Branch
Of 958 cases, 14 excluded since y-axis range less than data range
Total Phosphorus (mg/L)
0.30
0.24
0.18
0.12
0.06
0.00
Nine Mile
North Maitland
Little Maitland
Middle Maitland
South Maitland
Lower Maitland
Bayfield
Parkhill
Ausable
Little Ausable
Lucknow
Port Albert
B-Line
Jamestown
NMListowel
Trowbridge
Wingham-Midd
Boyle Drain
Beauchamp
Summerhill
Blyth
Zetland
Benmiller
Goderich
Seaforth
Bannockburn
Varna
Upper Parkhill
Lower Parkhill
Exeter
Springbank
Thedford
Black
Nairn
Decker
Huron Park
Lucan
Shoreline
Of 418 cases, 20 excluded since y-axis range less than data range
Total Phosphorus (mg/L)
0.30
0.24
0.18
0.12
0.06
0.00
Boyd
Eighteen Mile
Kintail
Kerrys
Kingsbridge
Griffins
Midhuron
Boundary
Bogies
Allans
Zurich
Desjardine
Mud
Headwater
Of 123 cases, 6 excluded since y-axis range less than data range
Total Phosphorus (mg/L)
0.30
0.24
0.18
0.12
0.06
0.00
NMSalem
NMBlyth
Dublin
Silver
Steenstra
Staffa

Appendix D: Catalogue of WC Maps in the Accompanying Map Book