NOVA SCOTIA

Environment and Labour

NOVA SCOTIA GROUNDWATER OBSERVATION WELL NETWORK

2007 REPORT

Prepared: September 2007

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EXECUTIVE SUMMARY

The Nova Scotia Groundwater Observation Well Network was established in 1965 to monitor groundwater levels across the province. The network currently monitors both groundwater levels and groundwater quality and the results are used to manage groundwater resources, assess drought conditions, evaluate the impact of human activities on groundwater and evaluate long-term groundwater trends. The size of the observation well network has varied over the years, but at the beginning of 2006 the network included 14 observation wells, with 10 additional wells being added during 2006. This report presents the monitoring results collected up to the end of 2006 for 14 of the wells.

The observation wells are monitored with telemetric dataloggers that record water levels and groundwater temperature every hour and transmit the data to a central computer. The number of years of groundwater level data available at each observation well ranges from 16 to 40 years. Groundwater samples are collected from the wells periodically and tested for a number of parameters, including: general chemistry, metals, pesticides, volatile organic compounds (VOCs), tritium and perchlorate.

The groundwater level monitoring results indicate that eight of the 14 observation wells exhibit groundwater level trends, with four having small upward trends and four having small downward trends. The downward trends tend to be larger than the upward trends, however, the size of the trends in all cases is relatively small. The maximum observed water level decline was approximately 1.4 m. The reason for the downtrends trends has not been confirmed, however, three of the wells with downward trends are located in municipal wellfields and, therefore, groundwater levels in these areas have probably been lowered due to wellfield pumping.

The groundwater quality monitoring results indicate that arsenic (at 2 wells) was the only health-based parameter to exceed drinking water guidelines. Arsenic is known to occur in groundwater in certain areas of the province due to the presence of naturally-occurring arsenic in soil and bedrock. Several other water quality parameters exceeded aesthetic drinking water guidelines, including: manganese (at 5 wells), iron (at 2 wells), pH (at 2 wells) and turbidity (at 2 wells). All of these parameters are naturally-occurring water quality problems that are routinely encountered in water wells in Nova Scotia and elsewhere.

The water quality results show that none of the observation wells exceeded drinking water guidelines for VOCs, pesticides or perchlorate. However, two VOCs were detected in two observation wells at low levels (i.e., toluene at 3.2 ug/L in one well and chloroform at 2 ug/L in another well). The source of the VOCs at these wells has not been determined and follow-up sampling is needed to confirm these initial results. Perchlorate was also detected at two observation wells at very low levels (i.e., 100 times less than the recommended Health Canada guidance value for perchlorate). The source of the perchlorate at these observation wells has not been determined. No pesticides were detected in any of the observation wells.

The tritium results used to assess the age of the groundwater indicated that most of the wells tested (i.e., 8 of 11 wells) contained either recent water (recharged after 1952), or a mix of recent and old water (recharged before and after 1952). Only three of the 11 wells tested for tritium contained purely old water (recharged before 1952). The results suggest that groundwater in these aquifers is recharged relatively quickly. This is encouraging from a water quantity point of view because it suggests the aquifers are being regularly replenished with new water. However, it also indicates that the aquifers are vulnerable to contamination because contaminants released at the surface will be carried into the aquifer relatively quickly. This emphasizes the importance of source water protection plans in the province to ensure that groundwater is kept clean.

ACKNOWLEDGMENTS

This report was prepared by staff at Nova Scotia Environment and Labour, however, both the report and the operation of the Nova Scotia Groundwater Observation Well Network have benefitted from the valuable input of many dedicated individuals. In particular, we gratefully acknowledge the cooperation of the many property owners with observation wells located on their properties. Their continued participation in the program is vital to the success of the network.

We would also like to thank Natural Resources Canada (Groundwater Program) for assistance with the groundwater level trend analysis methods used in this report, Environment Canada (National Water Research Institute) for completing the perchlorate analyses, and the Canada-Nova Scotia Water Supply Expansion Program for providing financial assistance for purchasing groundwater monitoring equipment to expand the network.

1.0 INTRODUCTION

The Nova Scotia Groundwater Observation Well Network was established in 1965 to monitor groundwater levels across the province. The size of the network has varied over the years, but at the beginning of 2006 the network included 14 observation wells, with 10 additional wells being added during 2006. The network is currently used to monitor both groundwater levels and groundwater quality and the results are used to help manage groundwater resources, assess drought conditions, evaluate the impact of human activities on groundwater and evaluate long-term groundwater trends.

This report presents the monitoring results collected up to the end of 2006 for 14 observation wells. Subsequent annual reports will present the results for the wells that were added to the network during or after 2006.

1.1 Historical Background

When the observation well network was initially established in 1965, it consisted of wells that were installed as part of the International Hydrologic Decade (1965-1974) and as part of regional groundwater resource evaluation studies undertaken in Nova Scotia during the 1960's and 1970's. Most of these wells were constructed specifically for observation purposes or drilled as test holes and then converted to observation wells. During the 1970's and 80's the network continued to expand until it included as many as 40 active wells, but many of these were abandoned in the 1990's. By 2003, the network consisted of 11 active wells.

Up until the 1990's, groundwater levels in each well were monitored using mechanical Stevens F Type chart recorders, which recorded water level changes on a paper chart that was retrieved from the field on a monthly or quarterly basis. In the late 1990's the chart recorders began to be replaced with electronic dataloggers and in 2003 an initiative began to equip the entire network with telemetric dataloggers which are capable of transmitting the monitoring results by cell phone to a central computer.

One report has been previously published on the network, entitled Groundwater Hydrographs in Nova Scotia 1965-1981 (McIntosh, 1984). The 1984 network report presents a summary of the historical groundwater data collected between 1965 and 1981. It is available on the Nova Scotia Environment and

Labour (NSEL) groundwater web page at: http://www.gov.ns.ca/enla/water/groundwater/groundwaternetwork.asp.

1.2 Description of the Current Network

At the beginning of 2006 the observation well network consisted of 14 wells. The wells are listed in Table 1.1 and the well locations are shown in Figure 1.1. Ten new observation wells were added to the network in 2006, bringing the total number of wells to 24. All of the newly added wells were existing wells that were once part of the historic network, but were no longer being actively monitored.

As shown in Table 1.1, the number of years since monitoring began at each well is variable, but ranges from 16 to 40 years and can be summarized as follows: 40 years (2 wells); 30 years (4 wells); 20 years (4 wells); and 10 years (4 wells). Note that these figures do not necessarily reflect the number of years of monitoring data available for each well because there are data gaps in the records.

Currently, all of the observation wells in the network have telemetric dataloggers that record water levels and temperature every hour and transmit the data by cell phone to a central computer. Groundwater samples are collected from the wells periodically and tested for a number of parameters, including general chemistry, metals, pesticides, volatile organic compounds, tritium and perchlorate. Most of the wells in the network have been sampled once and each well will be re-sampled at approximately two to five year intervals to monitor changes in water quality.

In 2006, a web page was launched that provides public access to the network's results. The website can be found at http://www.gov.ns.ca/enla/water/groundwater/groundwaternetwork.asp. It is currently being updated with new data on a quarterly basis. The majority of the historical hard copy water level data has been digitized and is available in spreadsheet format. The water level data spreadsheets can be downloaded from the network's web page.

In 2006, a field program was initiated to survey the wellhead elevations (i.e, top of casing elevation) of each observation well in the network. The survey was carried out with a handheld Topcon GMS-2 GPS unit using NAD83 UTM. All of the groundwater elevation data presented in this report use the 2006 wellhead elevation survey data.

Note that the observation wells listed in Table 1.1 are named based on the nearest town or water body and the observation well number that is assigned to the well when it is added to the network. For example, “Truro (014)” is located in Truro and its network well ID number is 014. The three digit observation well ID numbers have been in use since the network was developed in 1965. They are unique and are not reused, even if a well is abandoned. Some of the observation wells in this report have been renamed since the initial 1984 network report in order to adhere to a consistent naming protocol. For example, “Truro (014)” was originally named “Truro 421" in the 1984 report. The “421" was originally included in the well name because it was called “Department of Mines Test Hole 421" at the time of drilling. Because some of the original well names have changed, readers who wish to compare historical results from the 1984 network report with this report should cross-reference wells using the three digit observation well ID number.

Table 1.1: Wells in the NS Groundwater Observation Well Network.

No.	Well Name	Observation Well ID Number	County	Year Monitoring Started	Number of Years Since Monitoring Began
1	Greenwood (003)	003	Kings	1966	40
2	Fraser Brook (004)	004	Colchester	1966	40
3	Wolfville (010)	010	Kings	1969	37
4	Truro (014)	014	Colchester	1971	35
5	Monastery (028)	028	Antigonish	1976	30
6	Point Aconi (030)	030	Cape Breton	1976	30
7	Lawrencetown (043)	043	Halifax	1978	28
8	Durham (045)	045	Pictou	1979	27
9	Kentville (048)	048	Kings	1980	26
10	Sydney (050)	050	Cape Breton	1984	22
11	Charleston (058)	058	Queens	1988	18
12	Hayden Lake (059)	059	Shelburne	1988	18
13	Annapolis Royal (062)	062	Digby	1990	16
14	Hebron (063)	063	Yarmouth	1990	16

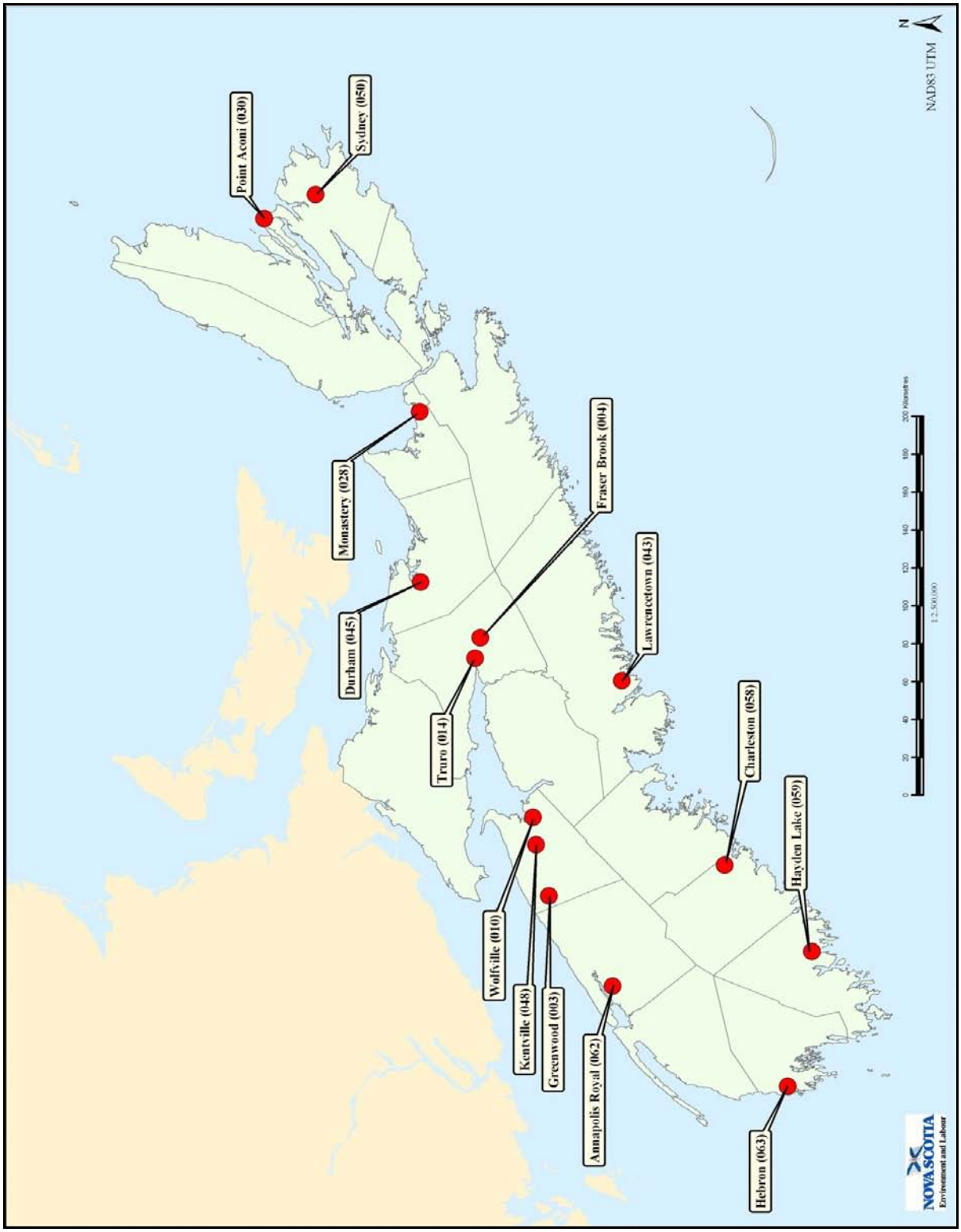

Figure 1.1: Map of Observation Well Locations

2.0 METHODS

2.1 Groundwater Level Monitoring

2.2.1 Field Methods

Each observation well in the network is equipped with a pressure transducer, temperature sensor and electronic datalogger that records water levels and water temperature every hour. There is also a second pressure transducer located above the water in each well that monitors atmospheric pressure so the water level measurements can be adjusted for atmospheric pressure changes. The wells are also equipped with telemetric systems that transmit the monitoring data by cell phone to a central computer system once a week.

The wells are visited approximately every six months for field verification of the water level data and to change the telemetric system batteries. Water levels are verified in the field with a manual electronic water level tape.

After the raw water level data is collected, it goes through several adjustments before being added to the spreadsheet database. Data corrections are applied if the field measurement differs from the pressure transducer readings by more than 2.1 cm, which is the reported accuracy of the pressure transducers. If corrections are necessary, they are made by applying a linear adjustment between two field verified water levels. Next, the hourly water level data is averaged to obtain a single average daily water level for each day. Finally, the water level data are converted to a water level elevation (relative to mean sea level) using the elevation of the top of the well casing.

2.2.1 Data Assessment Methods

The water levels at each well were assessed for changes and long-term trends for the entire period on record, up to the end of 2006. The water level assessments were carried out by visual inspection of the water level graphs and statistical tests. The Mann-Kendall trend test (Gilbert, 1987) was used to determine if there was a trend in the water level data (i.e. upward trend, downward trend or no trend). This test is one of the most commonly used statistical methods to evaluate trends in environmental data and has been used in other studies in Nova Scotia to assess groundwater level trends (Rivard et. al., in

progress). The rate of annual change at each well was determined using the Sen's slope estimator (Gilbert, 1987), a commonly-used linear slope estimator in environmental statistics.

The results of the statistical trend analyses are presented in Appendix D. Trend analyses were only completed for wells with more than 10 "usable" years of data. A year was considered usable if groundwater level data were available for at least 75% of the year. Trends were considered "statistically significant" if there was at least an 80% confidence that the trend was real. Note that "statistically significant" means there is statistical evidence that there is a trend present, but it does not necessarily mean the trend is large or important.

If groundwater level changes or trends were identified, possible reasons for the change or trend were evaluated. Several factors can cause groundwater levels to fluctuate. The most common causes of groundwater level changes in Nova Scotia include: precipitation, seasonal variations, groundwater pumping and tidal effects. Each of these factors is discussed in further detail in the following paragraphs.

Fluctuations Due to Precipitation

Precipitation, such as rainfall or melting snow, will either run off into streams and surface water bodies, be intercepted by vegetation, or seep into the ground. The portion that seeps into the ground is known as groundwater recharge. Groundwater recharge is difficult to measure, however, it has been estimated that recharge rates in Nova Scotia range from about 8 to 25% of precipitation. Groundwater recharge causes the groundwater levels in an aquifer to rise, although there is usually a delay between the precipitation event and when the groundwater level rises. The amount of precipitation and groundwater recharge varies throughout the province. Nova Scotia weather stations show the following mean annual total precipitations at selected locations between 1971 and 2000: Greenwood 1127 mm, Halifax 1452 mm, Sydney 1505 mm, and Yarmouth 1274 mm (Environment Canada, 2007).

Long-term trends in precipitation due to climate change can result in corresponding trends in groundwater levels. In cases where observation wells showed a significant groundwater level trend, the nearest climate station data was also evaluated for precipitation trends to assess whether or not climate change could be affecting groundwater levels.

Seasonal Fluctuations

In Nova Scotia, the spring and fall tend to have the highest amounts of precipitation and the summers tend to be drier. This seasonal variation is reflected in groundwater levels in the province's aquifers, which usually have higher water levels in the spring and lower levels in the summer. The lower groundwater levels in the late months of summer are the result of several factors, including: decreased precipitation, increased evaporation and the increased interception of water by vegetation. The typical seasonal variation in groundwater levels in Nova Scotia aquifers is usually less than about three metres.

Season fluctuations in groundwater levels in Nova Scotia can often be observed in the three typical patterns they produce in observation well hydrographs. These usually include two wet seasons (spring and fall) with rising groundwater levels, and a dry season in the summer with declining groundwater levels, as described below:

1. Spring Recharge - rising groundwater levels between March and May due to spring rainfall and melting snowpack . Maximum groundwater levels usually occur during this period.

2. Fall Recharge - rising groundwater levels between October and December due to fall precipitation.

3. Summer Recession - declining groundwater levels beginning in June and reaching minimum levels in September. Winter conditions of snowfall and frost can also limit recharge, resulting in a minor groundwater level recession in February.

Groundwater Pumping

The removal of water from an aquifer, by a well or wellfield, results in the lowering of the water level in the well and the surrounding aquifer. The lowering of groundwater levels as a result of pumping is referred to as drawdown. The amount of drawdown depends on how much is being pumped, the distance from the pumping well, and the characteristics of the aquifer (e.g., transmissivity, storativity, aquifer boundaries). In Nova Scotia, large wellfields in bedrock aquifers have been observed to cause groundwater drawdown in wells as far away as two to three kilometres.

Tidal Fluctuations

Aquifers and wells near the ocean can experience tidal fluctuations. Even though the water in a well may be fresh, the water level may rise and fall with the tide. The amount of water level fluctuation (i.e., amplitude) depends on the distance between the well and the ocean and aquifer properties. There is also a delay (i.e., time lag) between the rise or drop in the tide and the corresponding rise or drop in the well.

2.2 Groundwater Quality Monitoring

2.2.3 Field Methods

The majority of observation wells in the network were tested in 2004 or 2005 for general chemistry, metals, volatile organic compounds (VOC), pesticides, tritium and perchlorate. Two of the wells could not be accessed for sampling, including Truro(014) and Charleston(058). The general chemistry, metals, VOC and pesticides analyses were carried out at Maxxam Analytics in Bedford, NS; the tritium analyses were carried out at the Environmental Isotope Laboratory, University of Waterloo, Waterloo, ON; and, the perchlorate analyses were carried out by the National Water Research Institute in Burlington, ON.

The groundwater samples were collected using a submersible pump that was cleaned after each sample was collected. Prior to collecting the samples each well was purged by either removing three well volumes, or by purging until electrical conductivity (EC) and temperature (T) have become stable based on the following approach: 1) begin to purge the well; 2) record the EC and T values after purging 0.5 well volumes; 3) repeat EC and T measurements after purging 1 well volume; 4) continue purging and recording EC and T values at 0.5 well volume intervals until EC and T values are within 10% of previous values. If a well was pumped completely dry, purging was considered complete.

The groundwater samples were collected into laboratory supplied bottles, stored in a chilled cooler and delivered to the laboratory within the specified holding times. Samples for general chemistry and metals were filtered in the field using 0.45 micron filters. Samples collected for metals were also preserved in the field using nitric acid.

2.2.4 Data Assessment Methods

The groundwater sample results for general chemistry, metals, VOCs and pesticides were assessed by comparison to the Canadian Drinking Water Quality Guidelines. Tritium and perchlorate results were assessed separately, as described in the paragraphs below. Note that none of the observation wells in the network are used for drinking water, however, the drinking water guidelines are the most commonly used guidelines applied to water wells and they provide a useful reference point to judge the general water quality at each well.

Tritium is a short-lived isotope of hydrogen with a half-life of 12.43 years that is commonly used to assess the relative age of groundwater and how vulnerable an aquifer is to contamination (Clark and Fritz, 1997) . During the 1950's, hydrogen bomb testing caused tritium levels to become elevated above naturally-occurring background levels in the earth's atmosphere. The elevated tritium levels are picked up by precipitation and carried into aquifers as the precipitation infiltrates in to the ground. Groundwater with tritium levels of less than 1.0 Tritium Units (TU) is considered relatively old, being recharged before hydrogen bomb testing began in 1952. Groundwater with more than 5.0 TU is considered to be predominantly recent water, being recharged after 1952 (Clark and Fritz, 1997). Groundwater with tritium levels between 1.0 and 5.0 TU is considered to be a mix of recent and old water.

Water wells with tritium levels less than 1.0 TU are considered to be recharged by older water and, therefore, are not as vulnerable to contamination as other wells. Water wells that contain recent water, or a mix of recent and old water, are more vulnerable to contamination because rapid recharge allows contaminants to move relatively quickly from the ground surface into the aquifer. Many of the wells in the observation well network have short casing lengths (i.e., less than seven metres) and long open-hole intervals that allow both shallow and deep groundwater to enter the well and, therefore, it is likely that these wells will contain a mix of recent and old water. This type of well construction is similar to the majority of water wells in Nova Scotia , which have a minimum casing length of 6.1 m, as required by the Well Construction Regulations.

Perchlorate is an emerging contaminant that has received significant attention since 1997 when it was found in several water supplies in the United States. It is a compound consisting of one chlorine and four oxygen atoms that can exist as the solid salt of ammonium, potassium, or other metals, and it readily dissolves in water to produce the perchlorate ion (ClO_4^-). Perchlorate has been used in products such as

rocket fuels, munitions, explosives, fireworks, road flares, fertilizers and air bag inflation systems. It can also occur naturally at low levels in the environment.

Recent sampling has detected the presence of very low levels of perchlorate in some Canadian drinking water sources (Health Canada, 2007). Groundwater samples from the Nova Scotia Observation Well Network were tested for perchlorate in order to evaluate the occurrence of perchlorate in Nova Scotia groundwater. There is currently no national drinking water guideline for perchlorate either in Canada or in the United States, however, Health Canada recommends a drinking water guidance value of 6 ug/L. Therefore, the perchlorate results from the observation well network were assessed by comparison to the recommended Health Canada value of 6 ug/L.

For wells that had elevated chloride levels, an assessment of the possible source of salt was carried out by calculating the bromide (Br) to chloride (Cl) ratio. Wells were considered to have elevated chloride levels if chloride concentrations exceeded typical background levels for groundwater in coastal Nova Scotia (i.e., <50 mg/L). A commonly used guide for distinguishing salt sources in Nova Scotia is to calculate the ratio of Br(mg/L)/Cl(mg/L) x 10,000, and compare the result to the following three ranges:

1. Ratio <10 indicates road salt or halite brine;
2. Ratio >10 indicates formation brines;
3. Ratio = 35 indicates a sea water influence.

3.0 RESULTS

This section presents the monitoring results for each observation well. Please refer to the appendices for well logs, groundwater chemistry tables, groundwater temperature graphs, groundwater level trend analysis details and Piper diagram chemistry plots.

3.1 Greenwood (003)

Well Description

The Greenwood (003) observation well is located near Greenwood, Kings County. It was constructed in 1966 as part of a regional groundwater resource evaluation project (Trescott, 1968) and was originally named "Nova Scotia Department of Mines Test Hole 88". The well is completed in an overburden aquifer comprised of outwash sand. It is 7.6 m deep and has 6.6 m of casing. The well location and construction information is provided in Table 3.1 and the well log is in Appendix A.

Table 3.1: Greenwood (003) Well Construction Information

Well Name	Greenwood (003)
Observation Well ID Number	003
NSEL Well Log Number	661225
County	Kings
Nearest Community	Greenwood
UTM - Easting (m)	350680
UTM - Northing (m)	4985498
Year Monitoring Started	1966
Casing Depth (m, bgs)	6.6
Well Depth (m, bgs)	7.6
Elevation - top of casing (m, asl)	24.15
Geologic Unit	Pleistocene Outwash
Aquifer Material	Overburden - sand

Notes: bgs = below ground surface; asl = above sea level

The location of the Greenwood (003) observation well is shown in Figure 3.1. It is situated in a rural area where land use is primarily agricultural or undeveloped. The well is located in a wooded area behind a house (see Figure 3.2), with all other development at least a kilometre away. The nearest water well is a private well located approximately 120 m away.

Monitoring Results - Water Levels

The historical water level graph for Greenwood (003) is shown in Figure 3.3 and the 2006 water level graph is shown in Figure 3.4. This well has been monitored since 1966 and water levels have remained essentially the same. The average water level elevation is approximately 21.8 m above sea level and the annual water level fluctuation is about 1 m. The depth to water in this well is approximately 2.4 m below ground surface. There is no visually obvious long-term water level trend in Figure 3.3 and the statistical trend analysis for this well (Appendix D) indicates that there is no statistically significant trend present. The 2006 water levels shown in Figure 3.4 remained close to the historical high levels.

Monitoring Results - Water Chemistry

The Greenwood (003) well was last sampled in November 2005. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded iron (8,700 µg/L) and manganese (140 µg/L) were above the aesthetic drinking water guidelines of 300 µg/L and 50 µg/L, respectively. Also, turbidity and pH did not meet the aesthetic drinking water guidelines. The elevated turbidity levels are expected due to the high iron and manganese. Note that the ion balance error reported in the general chemistry analysis is 19%, which exceeds the generally acceptable level of 5% and, therefore, these results should be viewed with caution.

VOCs, pesticides and perchlorate were not detected at the Greenwood (003) well. The tritium level in this well was 5.76 TU, indicating that the water in this well relatively recent (i.e., recharged after 1952).

The average annual groundwater temperature at the Greenwood (003) well is 8 ^{o}C and fluctuates annually between 5.5 and 10 ^{o}C. A graph of hourly temperature data collected since April 2005 is presented in Appendix C.

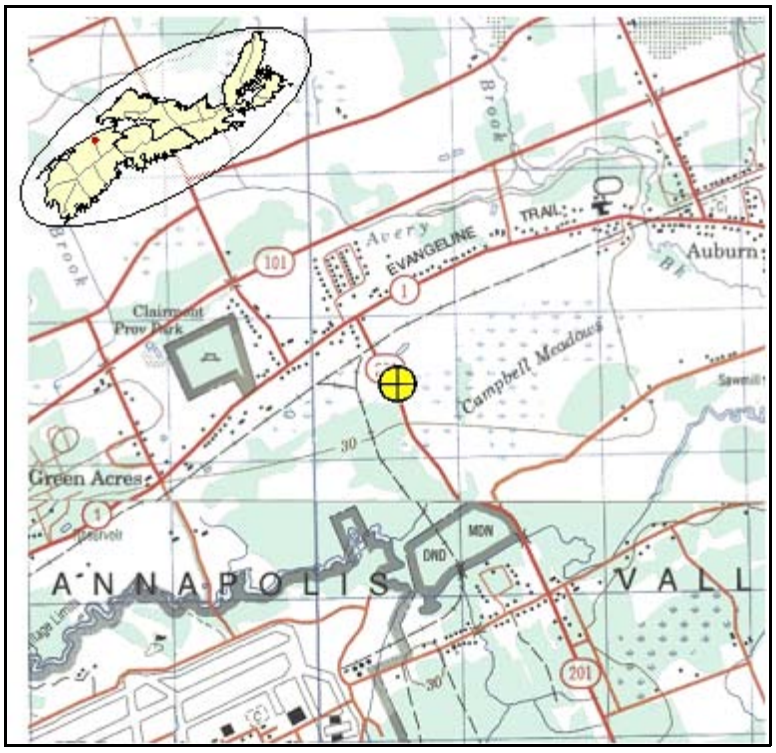

Figure 3.1: Greenwood (003) Well Location

Figure 3.2 Greenwood (003) Site Photograph

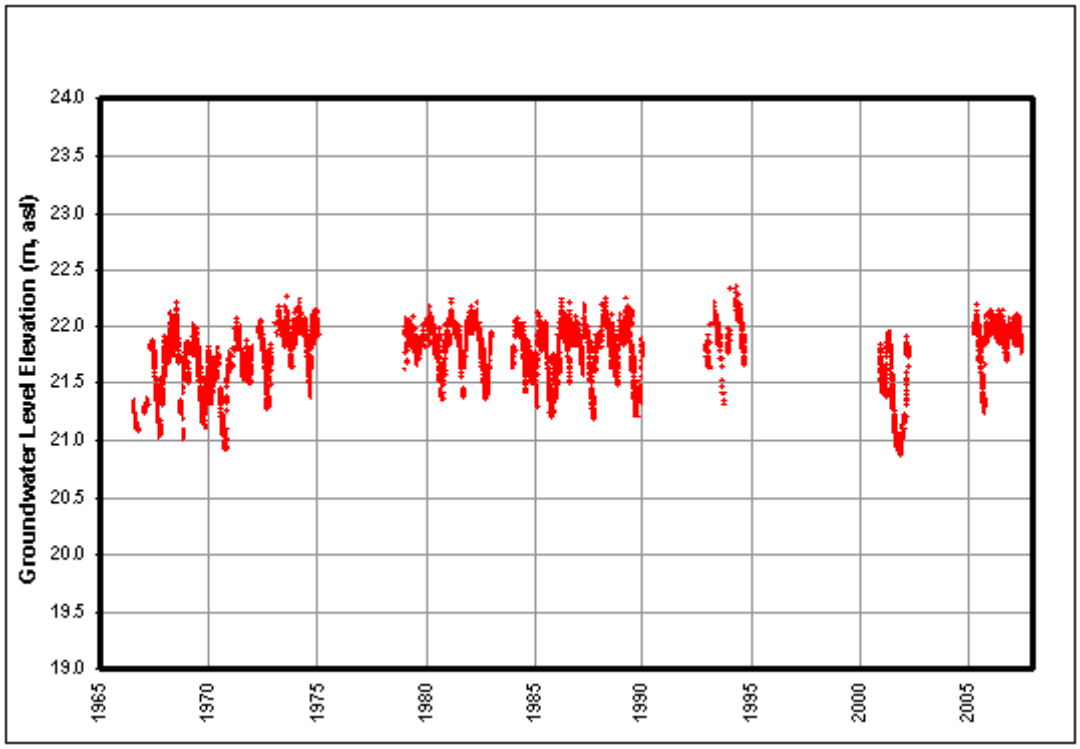

Figure 3.3: Greenwood (003) Historical Water Level Graph

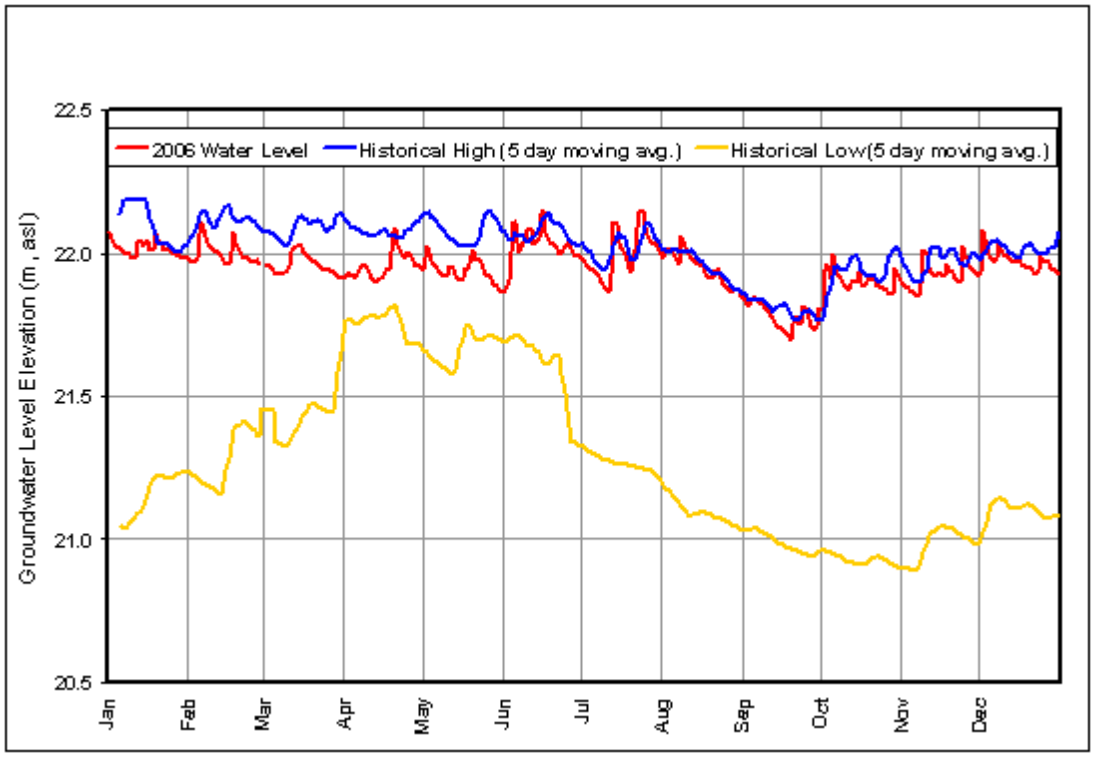

Figure 3.4: Greenwood (003) 2006 Water Level Graph

3.2 Fraser Brook (004)

Well Description

The Fraser Brook (004) observation well is located near Lower Harmony, Colchester County. It was constructed in 1966 as part of a water resources study (Hennigar, 1966) that was carried out under the International Hydrologic Decade Program. It was originally named “Test Hole 100" and was one in a series of test wells installed in the Fraser Brook watershed.

The well is completed in siltstone. It is 18.3 m deep and the casing depth is unknown. Well location and construction information is provided in Table 3.2 and the well log is provided in Appendix A. A 24-hour pump test conducted at this well indicated a transmissivity of 4.8 m^2/day (320 igpd/ft) and a safe yield of 42 m^3/day (6.5 igpm) (McIntosh, 1984).

Table 3.2: Fraser Brook (004) Well Construction Information

Well Name	Fraser Brook (004)
Observation Well IDNumber	004
NSEL Well Log Number	661226
County	Colchester
Nearest Community	Lower Harmony
UTM - Easting	486889
UTM - Northing	5021100
Year Monitoring Started	1966
Casing Depth (m, bgs)	9.3
Well Depth (m, bgs)	18.3
Elevation - top of casing (m, asl)	109.27
Geologic Unit	Canso Group
Aquifer Material	Bedrock - siltstone

Notes: bgs = below ground surface; asl = above sea level

The location of the Fraser Brook (004) observation well is shown in Figure 3.5. It is situated in a rural area where land use is primarily agricultural or undeveloped. The well was located in a wooded area (see Figure 3.6), however, in 2005 the majority of the trees were removed due to damage sustained during Hurricane Juan in 2003. The nearest water well is a domestic well, located approximately 1,000 m away.

Monitoring Results - Water Levels

The historical water level graph for Fraser Brook (004) is shown in Figure 3.7 and the 2006 water level graph is shown in Figure 3.8. This well has been monitored since 1966 and water levels have remained essentially the same. The average water level elevation at this well is approximately 105 m above sea level and the annual water level fluctuation is about 1 m. The depth to water in this well is approximately 4.4 m below ground surface. There is no visually obvious long-term water level, however, the statistical trend analysis for this well (Appendix D) indicates that there is a very small statistically significant upward trend about 0.2 cm/year. This is equivalent to a total rise of about 0.1 m since monitoring began at this well. The 2006 water levels fluctuated within the recorded historical high and low levels, although water levels remained close to historical levels throughout the month of June.

Monitoring Results - Water Chemistry

The Fraser Brook (004) well was last sampled in December 2004. Water chemistry results are presented in Appendix B. The results indicate that arsenic (14 µg/L) exceeded the drinking water guideline of 10 µg/L. No other parameters exceeded guidelines at this well. VOCs, pesticides and perchlorate were not detected. This well has not been tested for tritium.

The average annual groundwater temperature at the Fraser Brook (004) well is 7 ^{o}C and fluctuates annually between 5.5 and 8.7 ^{o}C. A graph of hourly temperature data collected since June 2004 is presented in Appendix C.

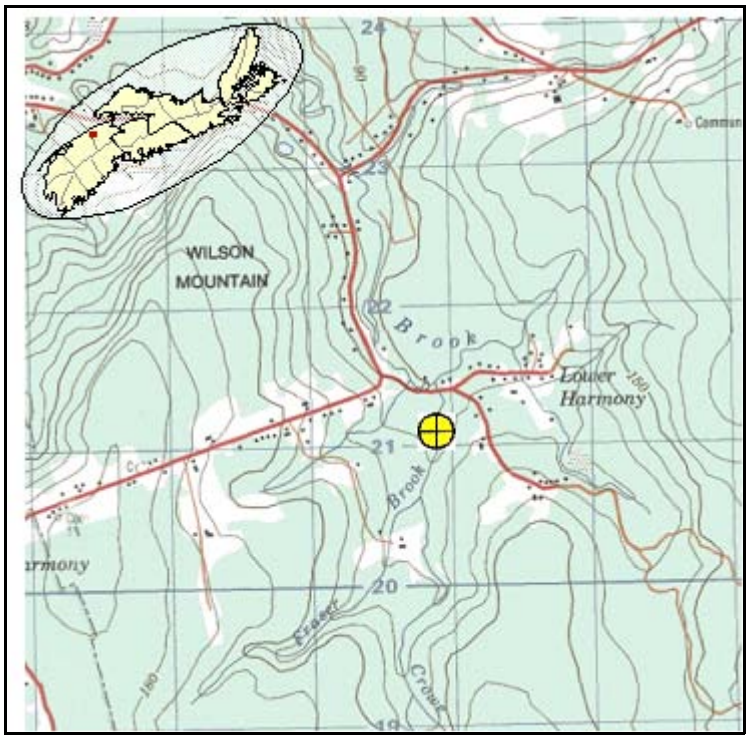

Figure 3.5: Fraser Brook (004) Well Location

Figure 3.6: Fraser Brook (004) Site Photograph

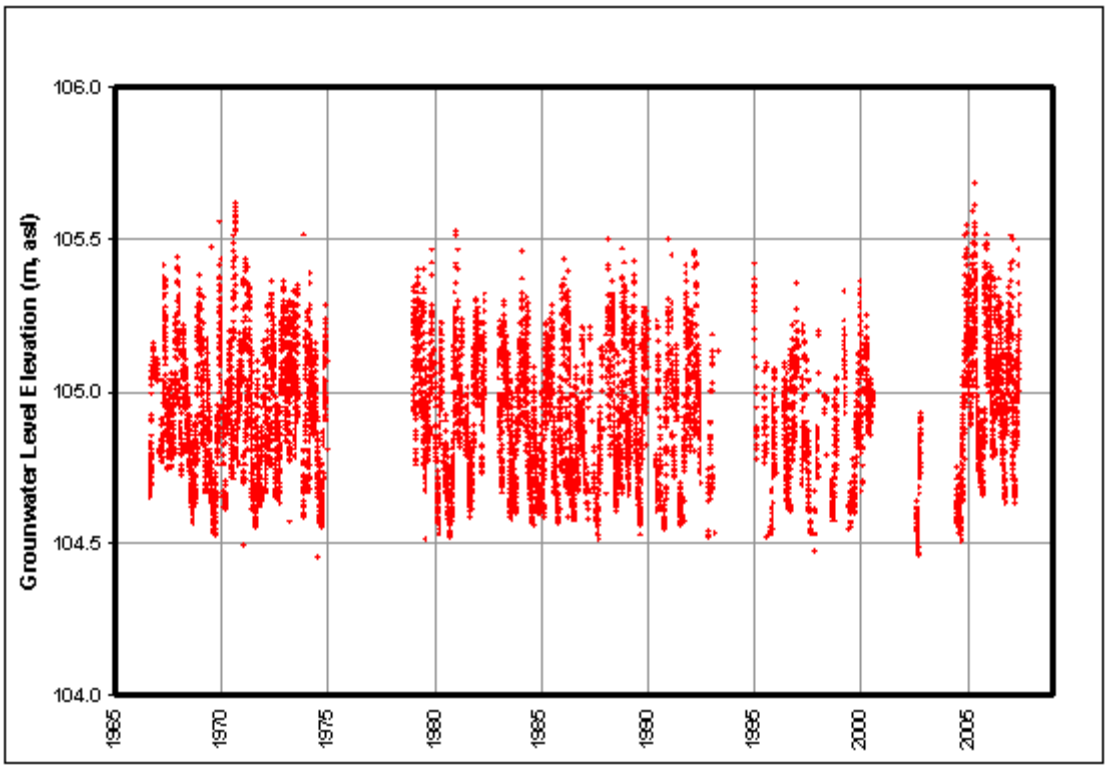

Figure 3.7: Fraser Brook (004) Historical Water Level Graph

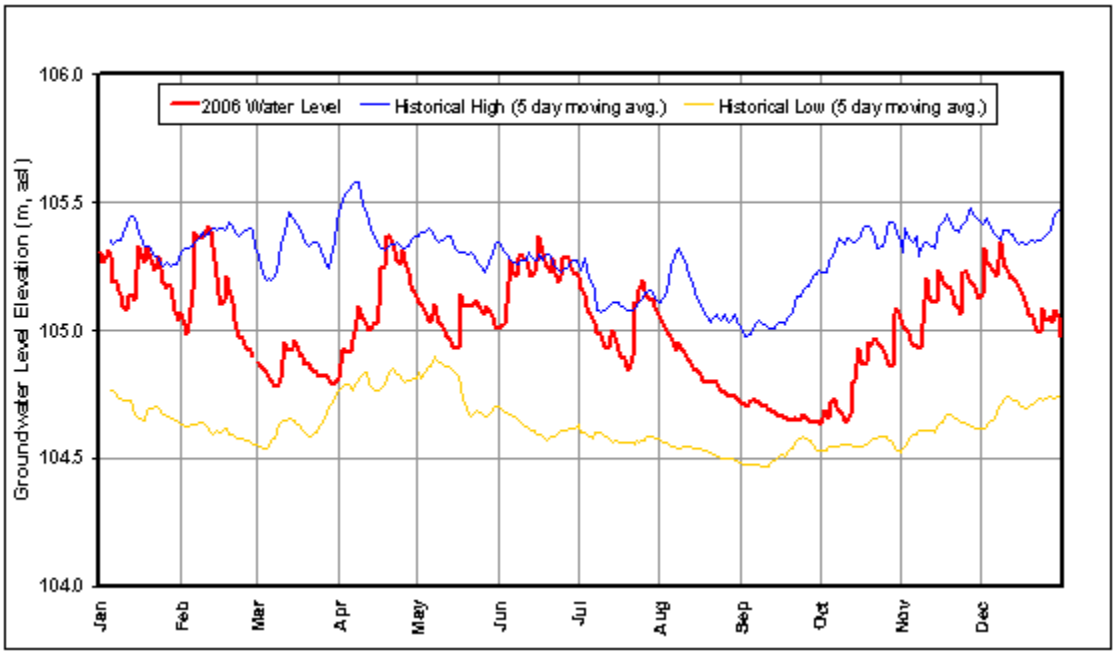

Figure 3.8: Fraser Brook (004) 2006 Water Level Graph

3.3 Wolfville (010)

Well Description

The Wolfville (010) observation well is located in Wolfville, Kings County. It was constructed in December 1968 as part of a regional groundwater resource evaluation project (Trescott, 1969) and was originally named “Nova Scotia Department of Mines Test Hole 398". This well has also been referred to as the “Wolfville 2" observation well.

The well is completed in a sandstone aquifer. It is 17.7 m deep and penetrates 7.0 m into the bedrock. The casing depth is unknown. Well location and construction information is provided in Table 3.3 and the well log is provided in Appendix A. A 29-day pump test was conducted at this well in 1969. The results indicated a transmissivity of 695 m^2/day (46,567 igpd/ft) and storativity of $3x10^{-2}$ (McIntosh, 1984).

Table 3.3: Wolfville (010) Well Construction Information

Well Name	Wolfville (010)
Observation Well ID Number	010
NSEL Well Log Number	681252
County	Kings
Nearest Community	Wolfville
UTM - Easting	392093
UTM - Northing	4993838
Year Monitoring Started	1969
Casing Depth (m, bgs)	22.7
Well Depth (m, bgs)	24.1
Elevation - top of casing (m, asl)	5.20
Geologic Unit	Wolfville Formation
Aquifer Material	Bedrock - sandstone

Notes: bgs = below ground surface; asl = above sea level

The location of the Wolfville (010) observation well is shown in Figure 3.9. The well is situated in a small park in the middle of a resdential area (see Figure 3.10). Land use in the vicinity of the well is urban. The wellfield for the Town of Wolfville, comprised of two pumping wells, is located approximately 750 m away.

Monitoring Results - Water Levels

The historical water level graph for Wolfville (010) is shown in Figure 3.11 and the 2006 water level graph is shown in Figure 3.12. This well has been monitored since 1969 and water levels appear to have declined slightly over time. From 1970 to 1995, the average water level elevation was approximately 0.6 m above sea level and the annual water level fluctuation was about 2 m. The average water level elevation for the period between 1995 and 2006 was slightly lower, at 0.4 m, and the annual water level fluctuation for this period was approximately 1 m. The depth to water in this well is approximately 4.6 m below ground surface.

The statistical trend analysis for this well (Appendix D) indicates that there is small downward trend in water levels, equivalent to approximately 2.8 cm/year. This is equivalent to a total drop of approximately 1.0 m since monitoring began. The reason for this decline has not been confirmed, however, it may be related to pumping at the Town of Wolfville's production wells which are located within 750 m from this well.

The 2006 water levels were within the typical historical range for this well.

Monitoring Results - Water Chemistry

The Wolfville (010) well was last sampled in December 2004. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded. VOCs, pesticides and perchlorate were not detected. The tritium level in this well was 4.7 TU (+/- 0.4), indicating that the water in this well is either a mix of old and recent water (i.e., recharge occurred before and after 1952) or is recent (i.e., recharged occurred after 1952).

The average annual groundwater temperature at the Wolfville (010) well is 9.2 ^{o}C and fluctuates annually between 8.0 and 10.3 ^{o}C. A graph of hourly temperature data collected since April 2005 is presented in Appendix C.

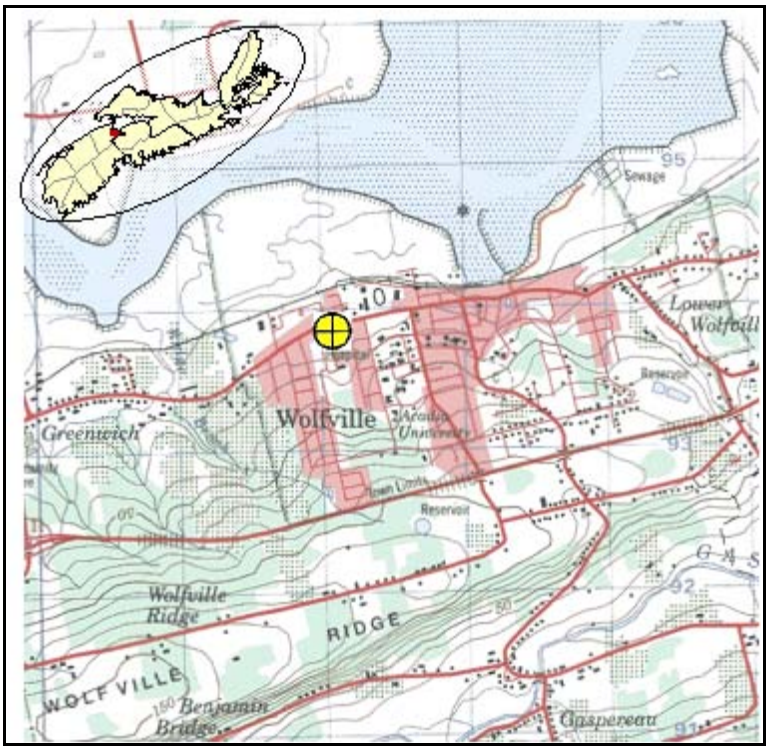

Figure 3.9: Wolfville (010) Well Location

Figure 3.10: Wolfville (010) Site Photograph

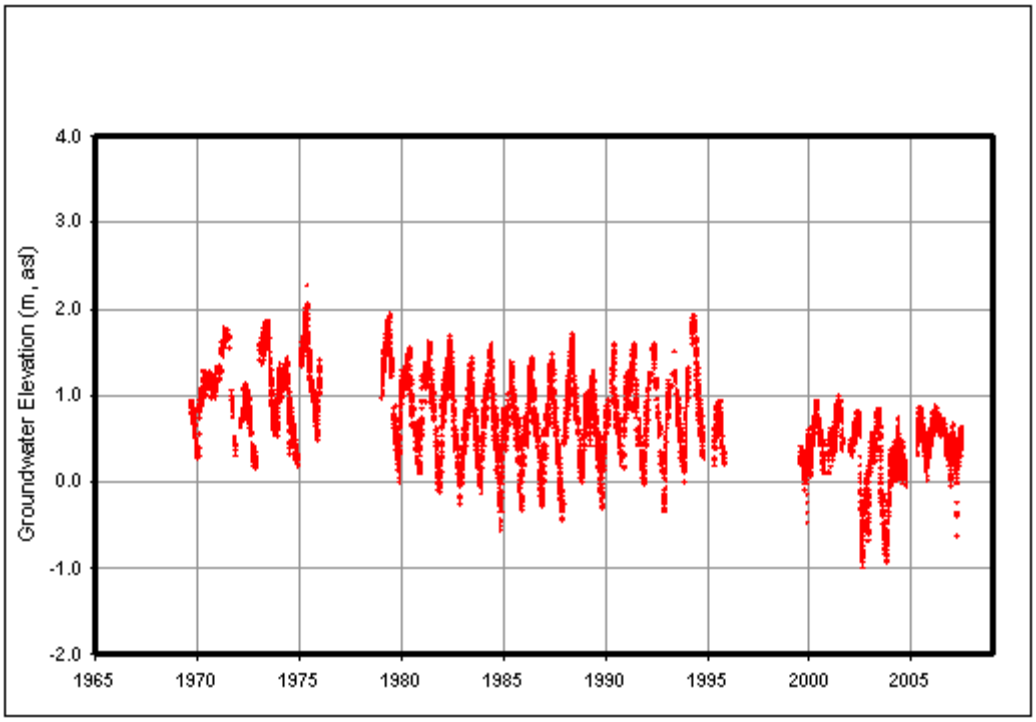

Figure 3:11: Wolfville (010) Historical Water Level Graph

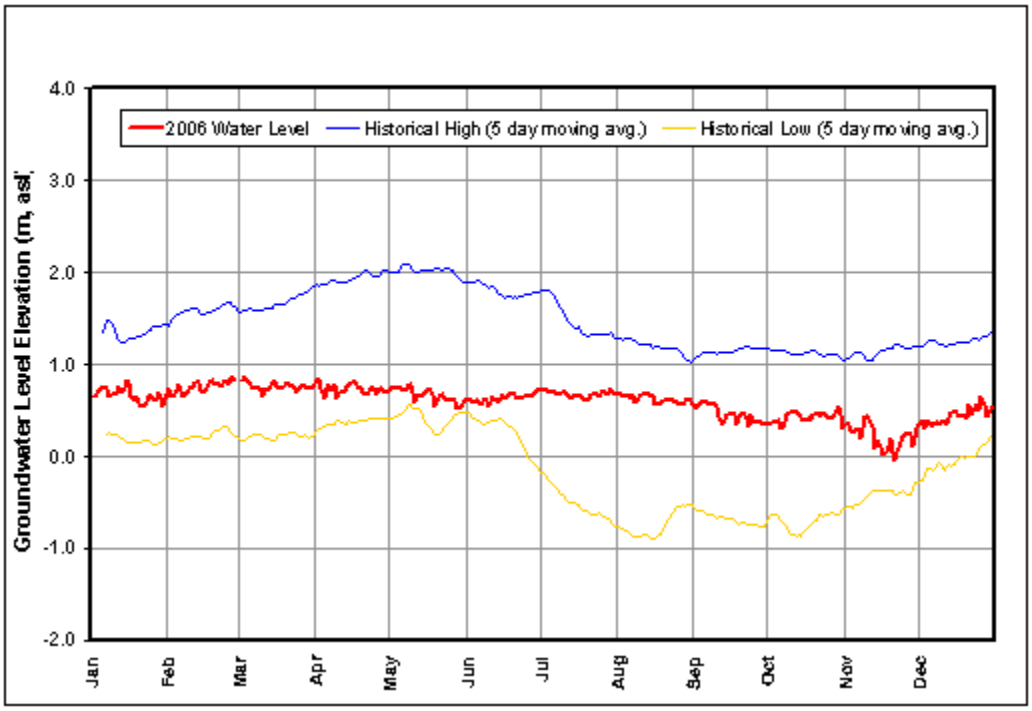

Figure 3.12: Wolfville (010) 2006 Water Level Graph

3.4 Truro (014)

Well Description

The Truro (014) observation well is located in Truro, Colchester County. It was constructed in November 1970 as part of a regional groundwater resource evaluation project (Hennigar, 1972) and was originally named “Nova Scotia Department of Mines Test Hole 421". It has also been referred to as the “Truro 421" observation well. The well is 91.4 m deep, penetrates 80.8 m into bedrock and the casing depth is 18.3 m. It is completed in a sandstone aquifer. Well location and construction information is provided in Table 3.4 and the well log is provided in Appendix A.

The location of the Truro (014) observation well is shown in Figure 3.13. It is situated in an urban area where the surrounding land is predominantly developed. The well is located within the Town of Truro Public Works yard and is adjacent to a golf course, several businesses and residences. The area is serviced by a municipal water supply and there are no other known water wells in the immediate vicinity.

Table 3.4: Truro (014) Well Construction Information

Well Name	Truro (014)
Observation Well ID Number	014
NSEL Well Log Number	701431
County	Colchester
Nearest Community	Truro
UTM - Easting	4760452
UTM - Northing	5023778
Year Monitoring Started	1971
Casing Depth (m, bgs)	18.3
Well Depth (m, bgs)	91.4
Elevation - top of casing (m, asl)	9.83
Geologic Unit	Wolfville Formation
Aquifer Material	Bedrock - sandstone

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Truro (014) is shown in Figure 3.14 and the 2006 water level graph is shown in Figure 3.15. This well has been monitored since 1971 and the groundwater levels appear to have decreased slightly between 1971 and 1993, and then increased slightly between 1993 and 2006. The average water level elevation between 1971 and 1993 ranged from about 6.5 to 7.5 m above sea level and the annual water level fluctuation was about 1.5 m. From 1993 to 2006 average water level elevation was about 7.8 m above sea level, with an annual water level fluctuation of about 1 m. The depth to water in this well has varied from approximately 2 m to 3.5 m below ground surface. Water levels in recent years, including 2006, have been higher than historical highs. The statistical trend analysis for this well (Appendix D) indicates that there is no statistically significant trend present.

Monitoring Results - Water Chemistry

The Truro (014) well has not been recently sampled and, therefore, detailed chemistry data are not available. The average annual groundwater temperature at this well is 8.5 °C and fluctuates annually between 4.0 and 13.2 °C. A graph of hourly temperature data collected since June 2004 is presented in Appendix C.

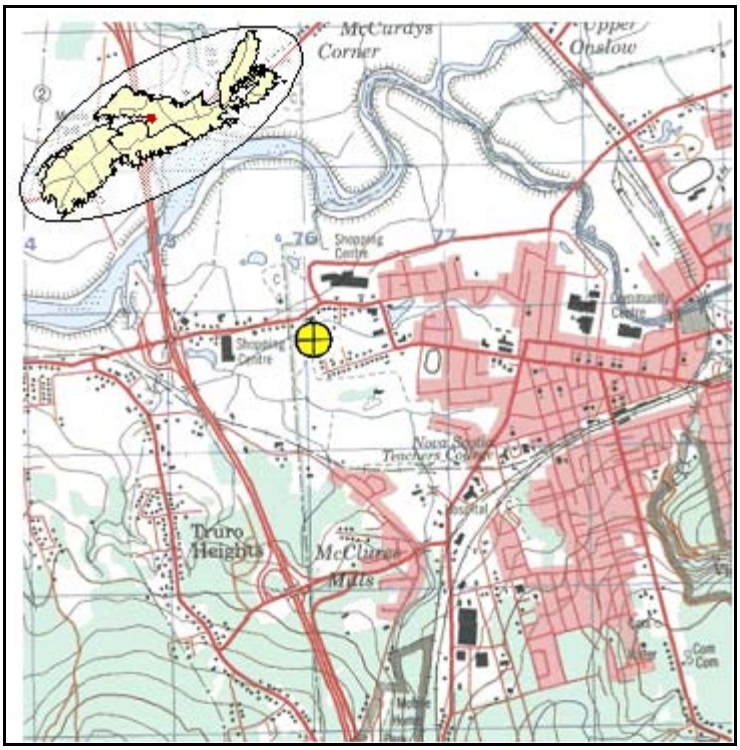

Figure 3.13: Truro (014) Well Location

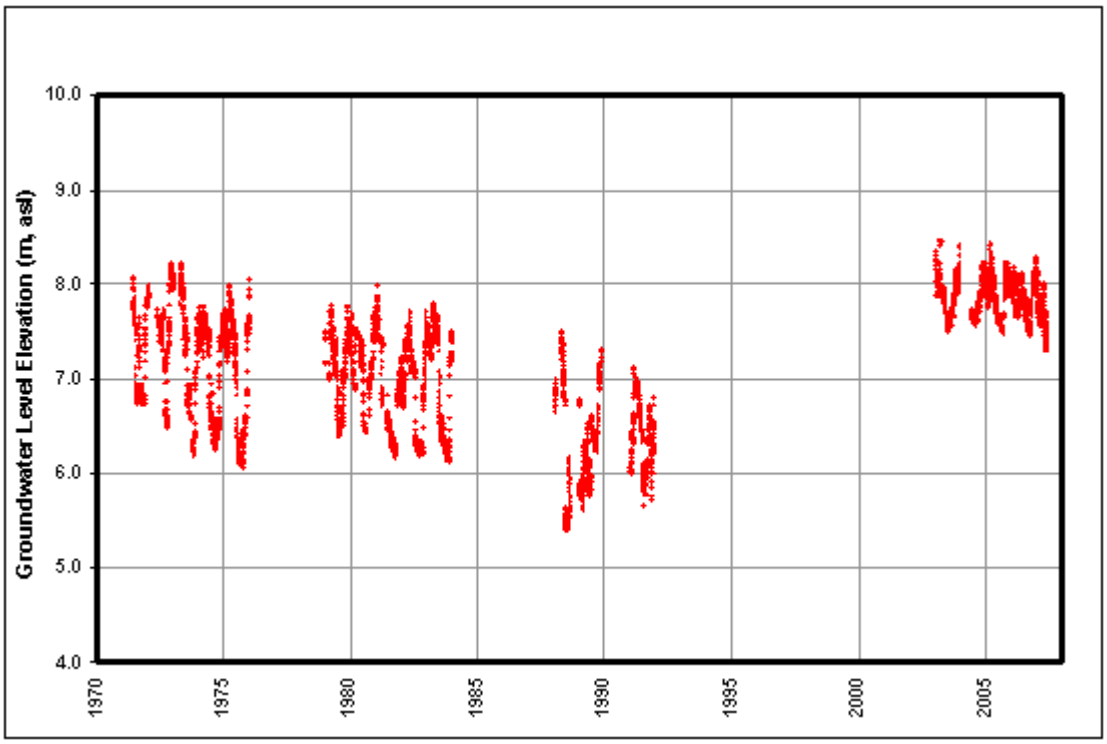

Figure 3.14: Truro (014) Historical Water Level Graph

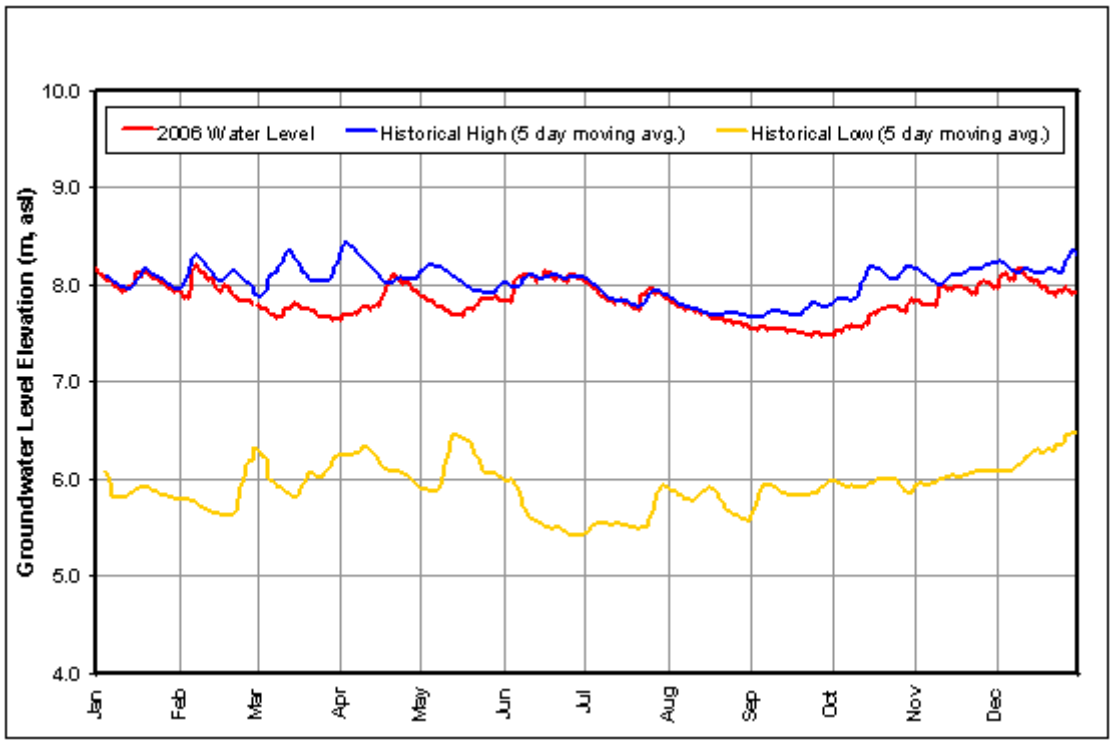

Figure 3.15: Truro (014) 2006 Water Level Graph

3.5 Monastery (028)

Well Description

The Monastery (028) observation well is located near Monastery, Antigonish County. The well was installed in January 1974 as part of a groundwater resource evaluation study (Strait of Canso Natural Environment Committee, 1975) and was originally named "Nova Scotia Department of Mines Test Hole 449". The well is completed in a sandstone aquifer. It is 158 m deep and the casing depth is unknown. Well location and construction information is provided in Table 3.5 and the well log is provided in Appendix A. A 50-hour pump test was conducted at this well in 1974, indicating a transmissivity of 9.8 m^2/day (660 igpd/ft) and a 20-year safe yield of 439 m^3/day (67 igpm) (McIntosh, 1984).

The location of the Monastery (028) well is shown in Figure 3.16. It is situated in a rural area where land use is primarily agricultural. The well is located at the end of a hayfield (see Figure 3.17), approximately 1,000 m from the ocean. The nearest water well is a domestic well located approximately 230 m away.

Table 3.5: Monastery (028) Well Construction Information

Well Name	Monastery (028)
Observation Well ID Number	028
NSEL Well Log Number	742420
County	Antigonish
Nearest Community	Monastery
UTM - Easting	606083
UTM - Northing	5052489
Year Monitoring Started	1976
Casing Depth (m, bgs)	NA
Well Depth (m, bgs)	158
Elevation - top of casing (m, asl)	23.12
Geologic Unit	Canso Group
Aquifer Material	Bedrock - sandstone

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Monastery (028) is shown in Figure 3.18 and the 2006 water level graph is shown in Figure 3.19. This well has been monitored since 1976 and the average water level elevation decreased from about 15.5 m (between 1979 and 1987) to approximately 13.5 m in 2006. The annual water level fluctuation also decreased over the same period from about 1.5 m to 1.0 m. However, the water level in this well rebounded to its 1980's elevation after the well was developed and purged during a sampling event in December 2006. Therefore, it is suspected that the long-term decline in water levels at this well during the 1990's and early 2000's may have been due to a slow decline in well efficiency, caused by biofouling, iron/manganese or siltation. Further monitoring is needed to confirm this. The depth to water in this well has varied from approximately 7.8 m to 9.8 m below ground surface The 2006 water levels were lower than historical high levels.

The statistical trend analysis for this well (Appendix D) indicates that there is a small downward trend in water levels, equivalent to about 6 cm/year. However, only nine years of usable data were available at this well and, therefore, the statistical results should be considered preliminary until a longer record of groundwater levels is available. In addition, this trend may reverse now that the well has been developed and the water level has rebounded, as discussed above.

Monitoring Results - Water Chemistry

The Monastery (028) well was last sampled in December 2006. Water chemistry results are presented in Appendix B. The results indicate that no drinking water guidelines were exceeded. VOCs, pesticides and perchlorate were not detected. The tritium level in this well was 0.94 TU, indicating that the water in this well is relatively old (i.e., recharge occurred before 1952).

The average annual groundwater temperature at this well is 8 ^{o}C and fluctuates annually between 7.8 and 8.2 ^{o}C. A graph of hourly temperature data collected since October 2003 is presented in Appendix C.

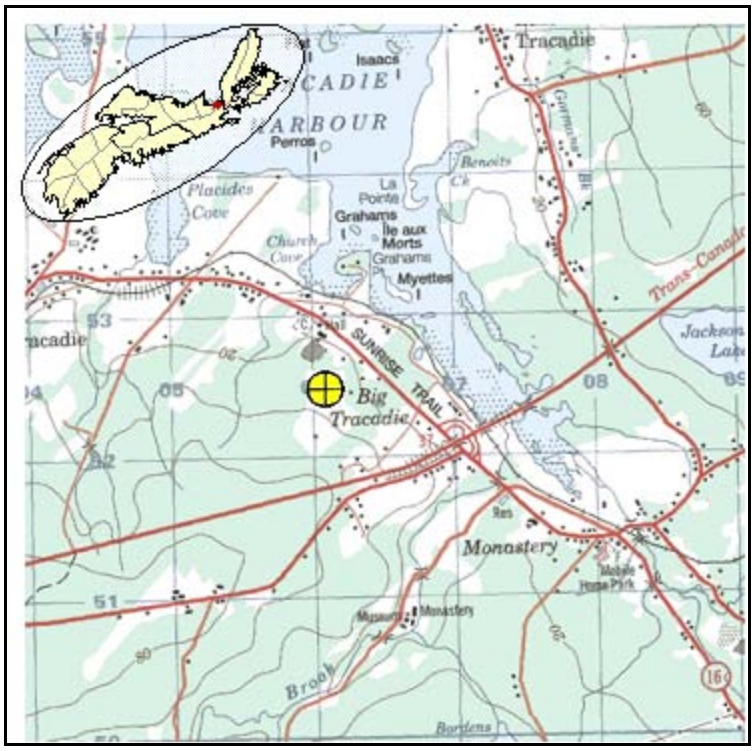

Figure 3.16: Monastery (028) Well Location

Figure 3.17: Monastery (028) Site Photograph

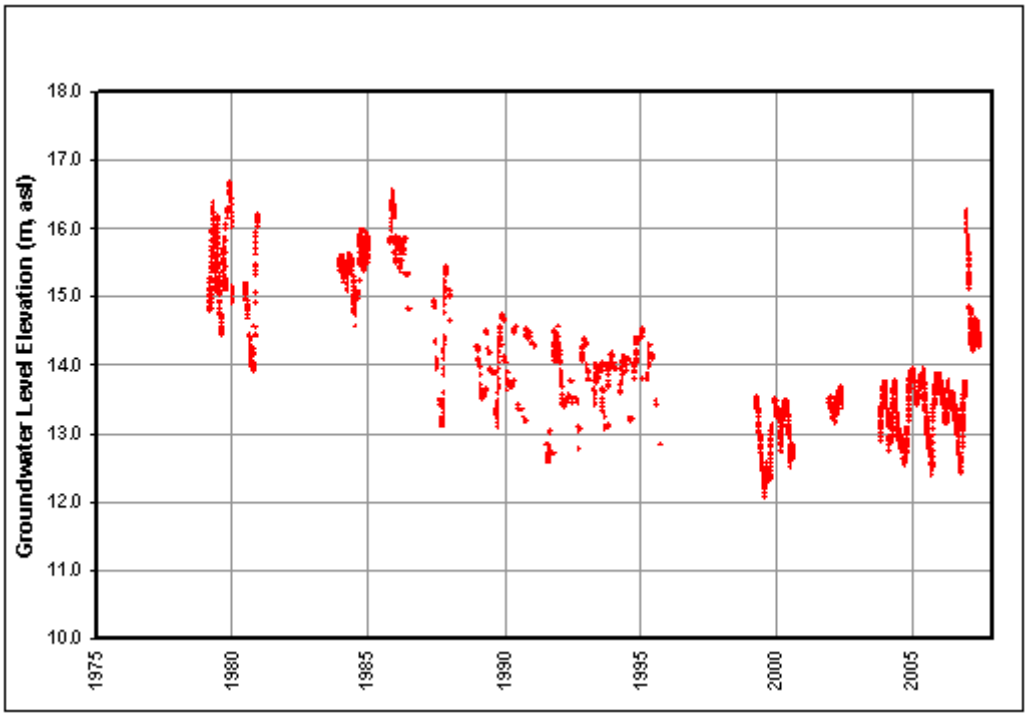

Figure 3.18: Monastery (028) Historical Water Level Graph

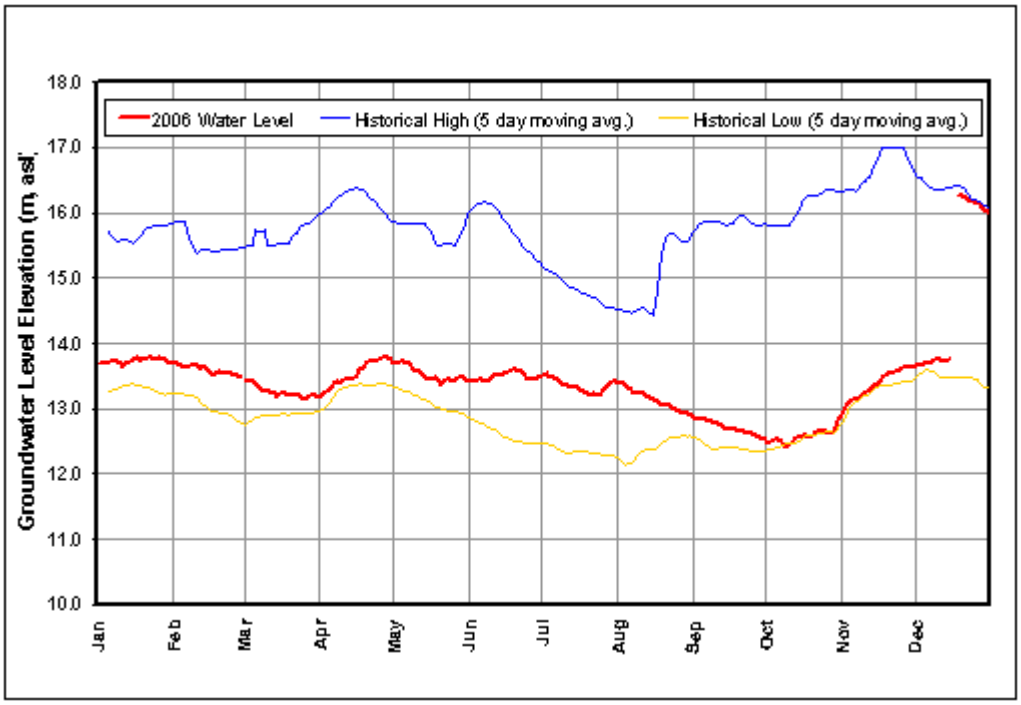

Figure 3.19: Monastery (028) 2006 Water Level Graph

3.6 Point Aconi (030)

Well Description

The Point Aconi (030) observation well is located near Point Aconi, Cape Breton County. It was constructed in August 1976 to monitor groundwater levels at the Prince Mine, located about 2 km away. The well is completed in a sandstone aquifer. It is 30.5 m deep, penetrates 26.2 m into the bedrock and the casing depth is 12.8 m. Well location and construction information is provided in Table 3.6 and the well log is provided in Appendix A.

The location of the Point Aconi (030) well is shown in Figure 3.20. It is situated in an urban area where the land use is primarily residential. There are several residences located within 300 m of the well, one of which is immediately adjacent to the well (see Figure 3.21). The nearest water well is a domestic well located approximately 18 m away.

Table 3.6: Point Aconi (030) Well Construction Information

Well Name	Point Aconi (030)
Observation Well ID Number	030
NSEL Well Log Number	761408
County	Cape Breton
Nearest Community	Point Aconi
UTM - Easting	707986
UTM - Northing	5133152
Year Monitoring Started	1976
Casing Depth (m, bgs)	12.8
Well Depth (m, bgs)	30.5
Elevation - top of casing (m, asl)	29.97
Geologic Unit	Inverness Formation
Aquifer Material	Bedrock - sandstone

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Point Aconi (030) is shown in Figure 3.22 and the 2006 water level graph is shown in Figure 3.23. This well has been monitored since 1976 and water levels appear to have remained relatively constant. The average water level elevation at the Point Aconi (030) well is approximately 27.7 m above sea level and the annual water level fluctuation is about 3 m. The depth to water in this well is approximately 2.2 m below ground surface. The statistical trend analyses for this well (Appendix D) indicates that there is a very small upward trend, equivalent to about 1.2 cm/year. This is equivalent to a total rise of about 0.4 m since monitoring began at this well.

The 2006 water levels are consistent with historical high levels, however, there was a water level drop of about 1.0 m in this well in December 2006 when two new monitoring wells were drilled within approximately 100 m of the Point Aconi observation well. These two new monitoring wells are not associated with the NS Groundwater Observation Well Network. They were installed by a private company to monitor for potential effects of a nearby coal mine. Since the nearby monitoring wells were drilled, the water level at the Point Aconi observation well appears to have stabilized at a new level which remains approximately 1.0 m below its former static level.

Monitoring Results - Water Chemistry

The Point Aconi (030) well was last sampled in September 2005. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded. Manganese (360 g/L) was above the aesthetic objective of 50 g/L. VOCs, pesticides and perchlorate were not detected. The tritium level in this well was 3.62 TU, indicating that the water in this well is a mix of old and recent water (i.e., recharge occurred before and after 1952).

The average annual groundwater temperature at the Point Aconi (030) well is 8.5 ^{o}C and fluctuates annually between 6.2 and 11 ^{o}C. A graph of hourly temperature data collected since November 2003 is presented in Appendix C.

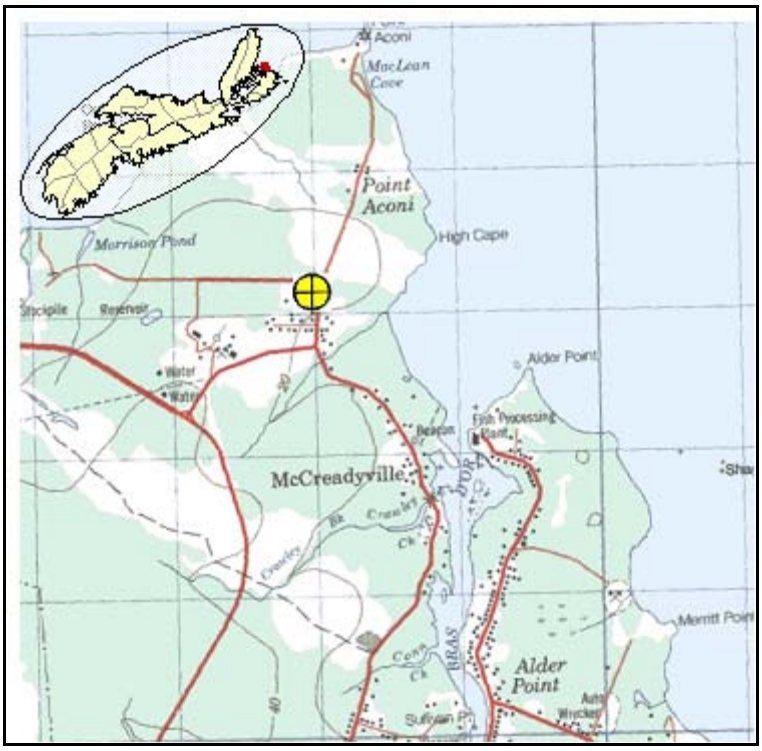

Figure 3.20: Point Aconi (030) Well Location

Figure 3.21: Point Aconi (030) Site Photograph

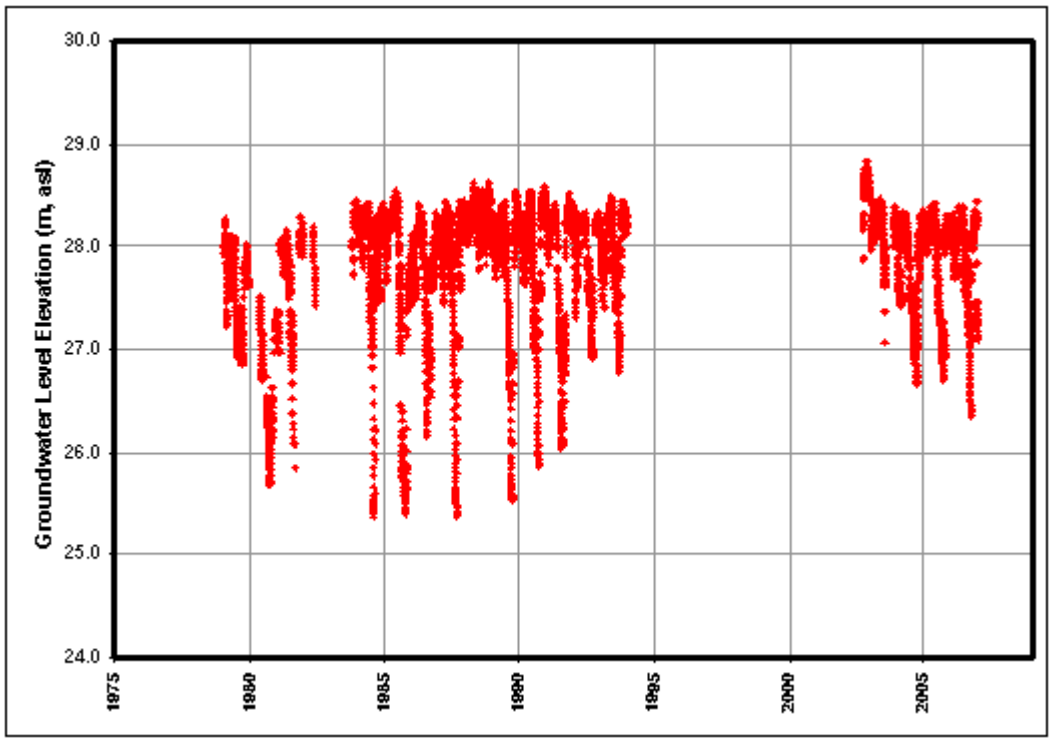

Figure 3.22: Point Aconi (030) Historical Water Level Graph

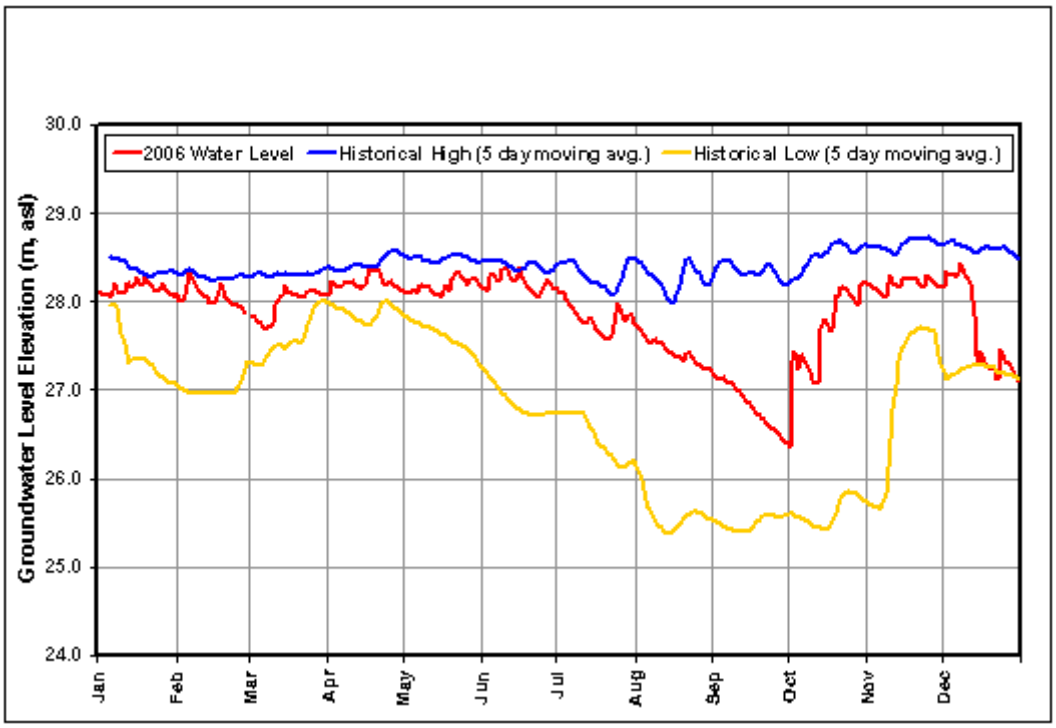

Figure 3.23: Point Aconi (030) 2006 Water Level Graph

3.7 Lawrencetown (043)

Well Description

The Lawrencetown (043) observation well is located near Upper Lawrencetown, Halifax County. It was constructed in March 1977 as part of a saltwater intrusion investigation in the Lawrencetown area (Cross, 1980) and was originally named "Nova Scotia Department of the Environment, Test Hole L3". It has also been referred to as the "Lawrencetown L3" observation well. Three other test wells that were drilled near this well (i.e., Lawrencetown L1, L2 and L4) were decommissioned in August 1994 by sealing the entire length of the wells with alternating layers of bentonite and sand.

The Lawrencetown (043) well is completed in a fractured bedrock aquifer comprised of quartzite. It is 53.0 m deep, penetrates 49.4 m into the bedrock and the casing depth is 44.2 m. Well location and construction information is provided in Table 3.7 and the well log is provided in Appendix A. A 1.5-hour pump test was conducted at this well in 1977 and the results indicated a transmissivity of 2.8 m^2/day (185.3 igpd/ft) a safe yield rate of 95 m^3/day (14.5 igpm) (McIntosh, 1984).

Table 3.7: Lawrencetown (043) Well Construction Information

Well Name	Lawrencetown (043)
Observation Well ID Number	043
NSEL Well Log Number	771538
County	Halifax
Nearest Community	Upper Lawrencetown
UTM - Easting	464172
UTM - Northing	4947712
Year Monitoring Started	1978
Casing Depth (m, bgs)	44.2
Well Depth (m, bgs)	53
Elevation - top of casing (m, asl)	4.73
Geologic Unit	Goldenville Formation
Aquifer Material	Bedrock - quartzite

Notes: bgs = below ground surface; asl = above sea level

The location of the Lawrencetown (043) observation well is shown in Figure 3.24. It is situated in a rural area where land use is primarily residential. The well is located within 100 m of the ocean (see Figure 3.25) and the there are two domestic wells nearby, both located approximately 50 m away.

Monitoring Results - Water Levels

The historical water level graph for Lawrencetown (043) is shown in Figure 3.26 and the 2006 water level graph is shown in Figure 3.27. This well has been monitored since 1978 and water levels appear to have declined by approximately 1.0 m. The decline in water level at this well is most likely due to pumping at a nearby domestic well (located 50 m away). The statistical trend analyses for this well (Appendix D) indicate that there is a small downward trend, equivalent to about 2.0 cm/year.

The average water level elevation at the Lawrencetown (043) well for the monitoring period 1978-1992 was approximately 3.6 m above sea level and the annual water level fluctuation was about 0.6 m. Between 2002 and 2006, the average water level declined to approximately 2.6 m above sea level, with a 1.0 m annual fluctuation. The depth to water in this well has varied from 1.1 m to 1.6 m below ground surface and the hourly water level data shows tidal fluctuations of approximately 0.3 m. There is also a daily drawdown and subsequent recovery of approximately 0.8 m at this well, which likely reflects domestic water use patterns associated with a nearby domestic well. The 2006 water levels at this observation well remained near historical lows.

Monitoring Results - Water Chemistry

The Lawrencetown (043) well was last sampled in November 2004. The water chemistry results are presented in Appendix B. The results indicate that arsenic concentrations (56 µg/L) exceeded the health-based drinking water guideline of 10 µg/L. The well has not been sampled for VOCs, pesticides or perchlorate. Tritium results reported from a previous study (Bottomley, 1983) were non-detect, indicating this water is relatively old (i.e., recharged prior to 1952).

It should also be noted that the chloride level in this well (150 mg/L) is elevated above the typical background level for groundwater in coastal Nova Scotia (<50 mg/L), although it is below the aesthetic objective of 250 mg/L. The ocean is less than about 100 m from this well and, therefore, the elevated chloride level is probably due to sea water influence. The bromide/chloride ratio at this well also indicates a sea water influence. The bromide/chloride ratio at the Lawrencetown (043) observation well was 35 (i.e., 0.53 mg/L/150 mg/L x 10,000 = 35). Please see Section 2.2.4 for a discussion of how this ratio is used to assess salt sources.

The average annual groundwater temperature at the Lawrencetown (043) well is 8.5 ^{o}C and fluctuates between 6.0 and 11.0 ^{o}C. A graph of hourly temperature data collected from April 2004 is presented in Appendix C.

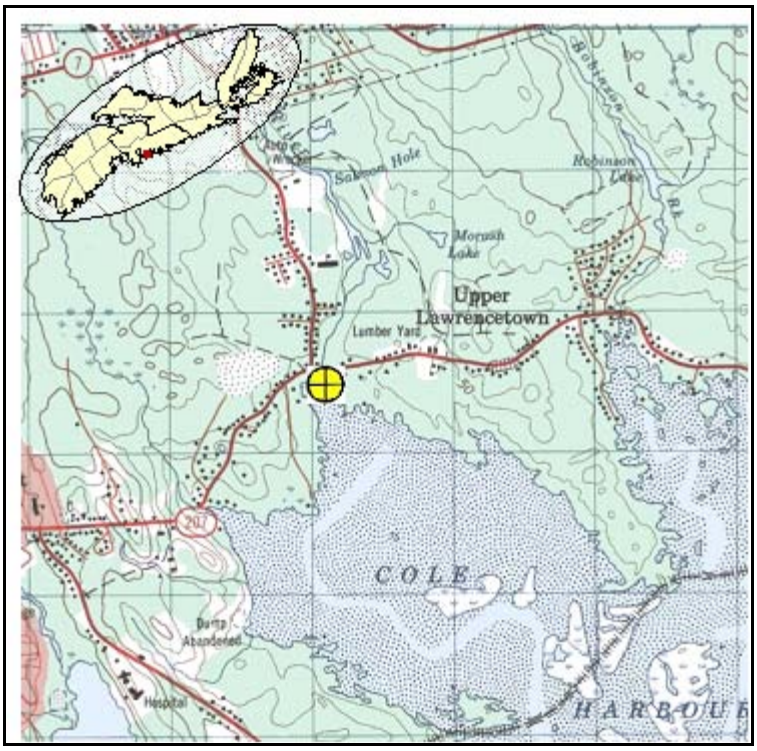

Figure 3.24: Lawrencetown (043) Well Location

Figure 3.25: Lawrencetown (043) Site Photograph

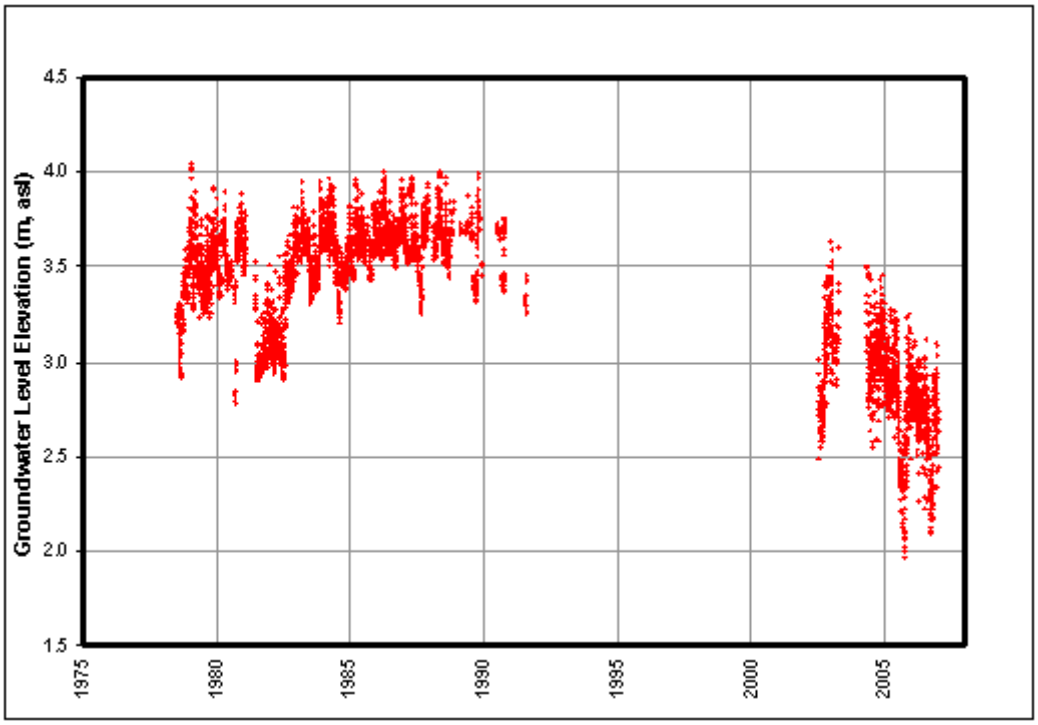

Figure 3.26: Lawrencetown (043) Historical Water Level Graph

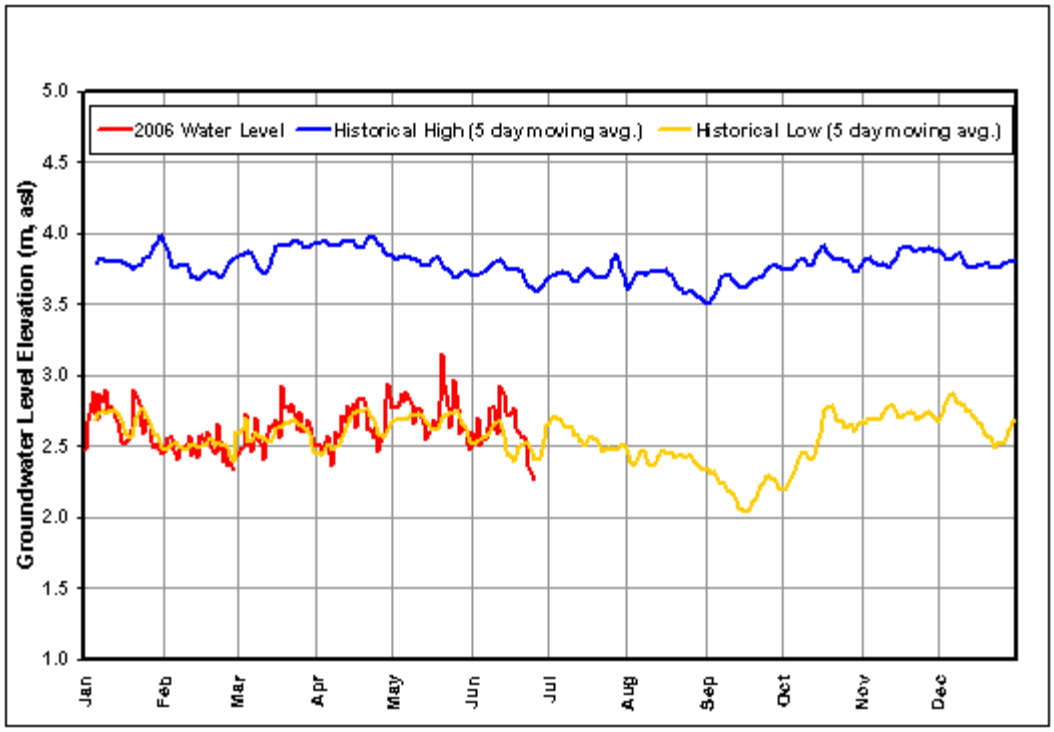

Figure 3.27: Lawrencetown (043) 2006 Water Level Graph

3.8 Durham (045)

Well Description

The Durham (045) observation well is located near Durham, Pictou County. It was constructed in July 1978 as part of a regional groundwater resource evaluation project (Gibb and McMullin, 1980) and was originally named "Nova Scotia Department of the Environment Test Hole Durham 3". The well is completed in a sandstone and shale aquifer. It is 75.3 m deep, penetrates 69.2 m into the bedrock and the casing depth is unknown. Well location and construction information is provided in Table 3.8 and the well log is provided in Appendix A. A 72-hour pump test was conducted at this well in 1978, indicating a transmissivity of 14 m^2/day (971 igpd/ft) and storativity of 3.2 x 10^{-4} (McIntosh, 1984).

The location of the Durham (045) observation well is shown in Figure 3.28. It is situated in a rural area, where the land use is primarily agricultural. The well is located in a wooded area, about 3 m from the edge of a hayfield. The nearest water well is a domestic well located approximately 500 m away.

Table 3.8: Durham (045) Well Construction Information

Well Name	Durham (045)
Observation Well ID Number	045
NSEL Well Log Number	782683
County	Pictou
Nearest Community	Durham
UTM - Easting	516224
UTM - Northing	5052105
Year Monitoring Started	1979
Casing Depth (m, bgs)	NA
Well Depth (m, bgs)	75.3
Elevation - top of casing (m, asl)	14.88
Geologic Unit	Boss Point Formation
Aquifer Material	Bedrock - sandstone/shale

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Durham (045) is shown in Figure 3.29 and the 2006 water level graph is shown in Figure 3.30. This well has been monitored since 1979 and water levels appear to have risen slightly and the amount of annual water level fluctuation has varied. The statistical trend analysis for this well (Appendix D) indicates that there is a small upward trend, equivalent to about 2.4 cm/year. This is equivalent to a total rise of about 0.6 m since monitoring began at this well.

The average water level elevation at the Durham (045) well is approximately 11 m above sea level and the annual water level fluctuation is between 2 and 3 m. However, from 1989 to 2004 average water levels rose slightly, to approximately 11.5 m. The depth to water in this well is approximately 3.5 to 4 m below ground surface. The 2006 water levels were within the historically observed range at this well.

Monitoring Results - Water Chemistry

The Durham (045) well was last sampled in October 2005. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded. VOCs, pesticides and perchlorate were not detected. The tritium level in this well was 2.04 TU, indicating that the water in this well is a mix of old and recent water (i.e., recharge occurred before and after 1952).

The average annual groundwater temperature at the Durham (045) well is 7.8 ^{o}C and fluctuates annually between 6.0 and 9.2 ^{o}C. A graph of hourly temperature data collected since January 2004 is presented in Appendix C.

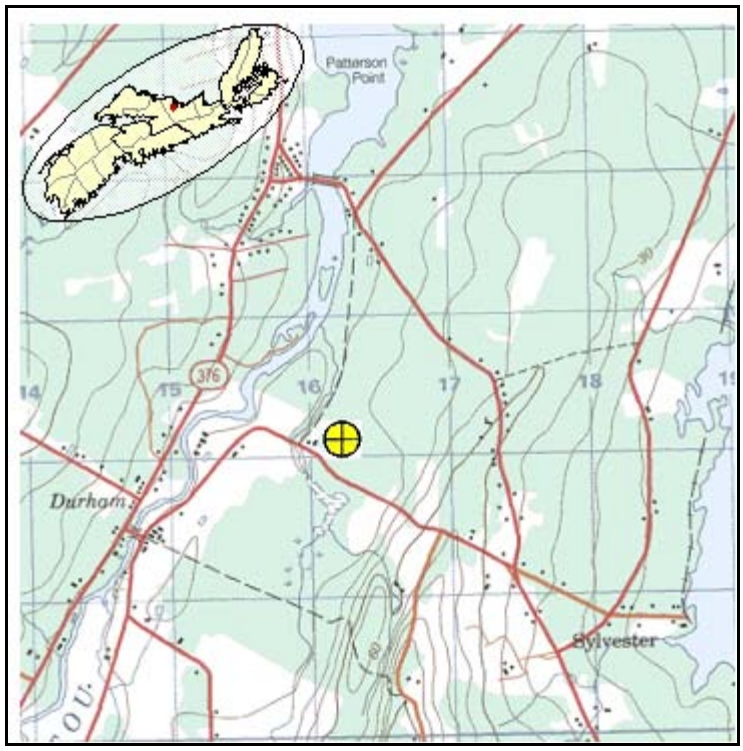

Figure 3.28: Durham (045) Well Location

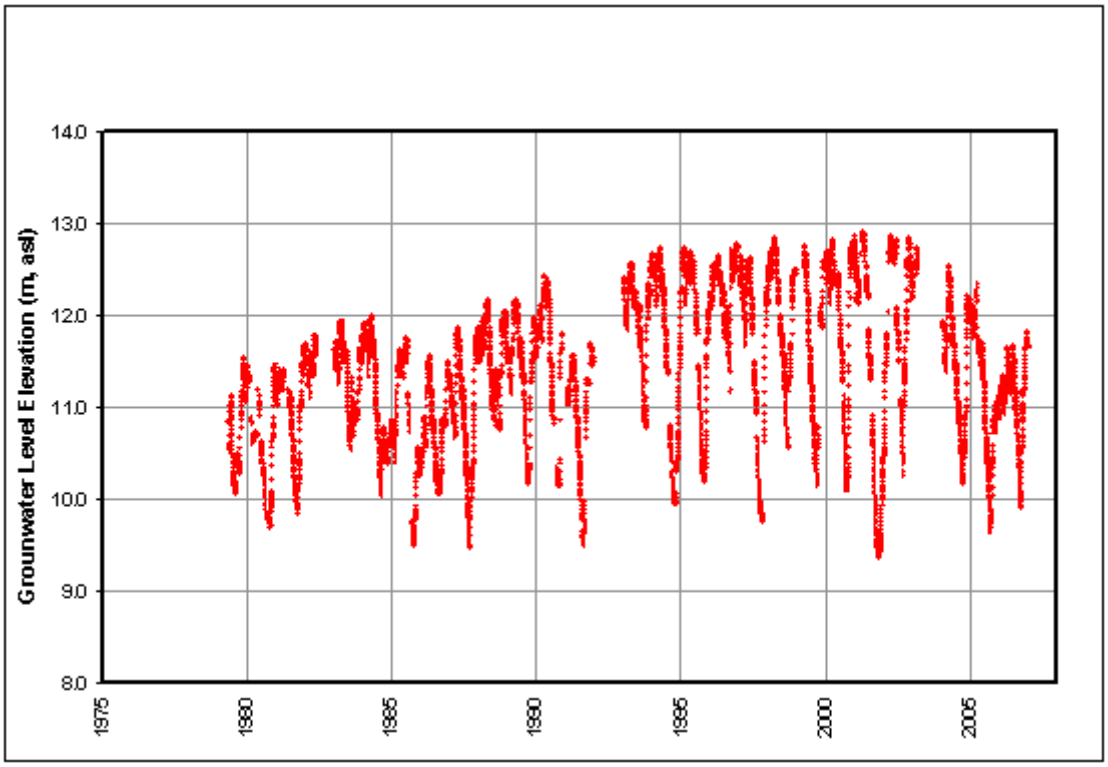

Figure 3.29: Durham (045) Historical Water Level Graph

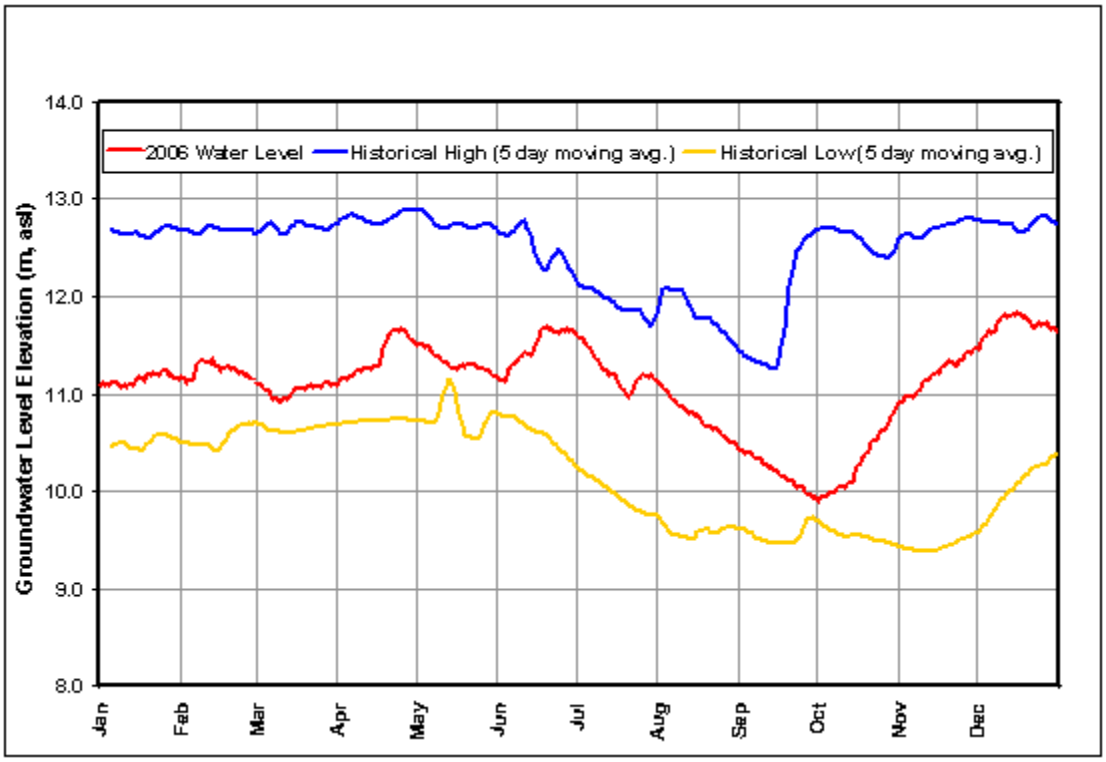

Figure 3.30: Durham (045) 2006 Water Level Graph

3.9 Kentville (048)

Well Description

The Kentville (048) observation well is located near Kentville, Kings County. The well was constructed in May 1977 as part of a water supply investigation for the Kentville Industrial Park (Callan, 1977) and was previously named the "Kentville Industrial Park" observation well. The well is completed in a sandstone aquifer. It is 106.7 m deep and the casing depth is 30.5 m. Well location and construction information is provided in Table 3.9 and the well log is in Appendix A. A 72-hour pump test was conducted at this well in June 1977 and the results indicated a transmissivity of 84 m^2/day (5,657 igpd/ft) and a storativity of 3 x 10^{-4} (Callan, 1977).

Table 3.9: Kentville (048) Well Construction Information

Well Name	Kentville (048)
Observation Well ID Number	048
NSEL Well Log Number	772021
County	Kings
Nearest Community	Kentville
UTM - Easting	377628
UTM - Northing	4992245
Year Monitoring Started	1980
Casing Depth (m, bgs)	30.5
Well Depth (m, bgs)	106.7
Elevation - top of casing (m, asl)	12.79
Geologic Unit	Wolfville Formation
Aquifer Material	Bedrock - sandstone

Notes: bgs = below ground surface; asl = above sea level

The location of the Kentville (048) observation well is shown in Figure 3.31. It is situated in a wooded area (see Figure 3.32) and the surrounding land use includes an industrial park (Annapolis Valley Regional Industrial Park), residential properties and undeveloped land. This well lies within the wellhead protection area for the Kentville Wellfield, which includes seven production wells. This

wellfield was initially developed in the late 1970's to supply the nearby industrial park and was expanded to become the primary water supply for the Town of Kentville in 2002. The nearest production well is located approximately 150 m away from the Kentville (048) observation well.

Monitoring Results - Water Levels

The historical water level graph for Kentville (048) is shown in Figure 3.33 and the 2006 water level graph is shown in Figure 3.34. This well has been monitored since 1980 and the water level appears to have dropped slightly (down approximately 0.5 m since monitoring began). The statistical trend analysis for this well (Appendix D) indicates that there is a very small downward trend, equivalent to about 0.7 cm/year.

The average water level elevation at the Kentville (048) well has ranged between 6.9 and 7.4 m above sea level and the annual water level fluctuation is approximately 0.7 m. The depth to water in this well is approximately 5.9 m below ground surface. The 2006 water levels were essentially within the historically observed water level range for this well.

Monitoring Results - Water Chemistry

The Kentville (048) well was last sampled in June 2005. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded and no pesticides were detected. The well has not been tested for VOCs. The perchlorate level in this well was 0.05 ug/L, which is well below the recommended Health Canada guidance value of 6 ug/L. The tritium level in this well was 3.8 TU, indicating that the water in this well is a mix of old and recent water (i.e., recharge occurred before and after 1952).

It should also be noted that the chloride level in this well (230 mg/L) is elevated above the typical background level for groundwater in coastal Nova Scotia (<50 mg/L), although it is below the aesthetic objective of 250 mg/L. The well is located approximately 15 km from the ocean and, therefore, the elevated chloride levels are not expected to be caused by sea water. The bromide/chloride ratio at this well indicated the salt source is either related to road salt or naturally occurring formation salt associated with the geologic formation. The bromide/chloride ratio at this well was <22 (i.e., <0.5 mg/L/230 mg/L x 10,000 = <22). Please see Section 2.2.4 for a discussion of how this ratio is used to assess salt sources. This well is located immediately adjacent to a road (within about 5 m) and, therefore, the source of the chloride is expected to be road salt.

The average annual groundwater temperature at the Kentville (048) well is 6.5 ^{o}C and fluctuates annually between 2.0 and 11.0 ^{o}C. A graph of hourly temperature data collected since April 2004 is presented in Appendix C.

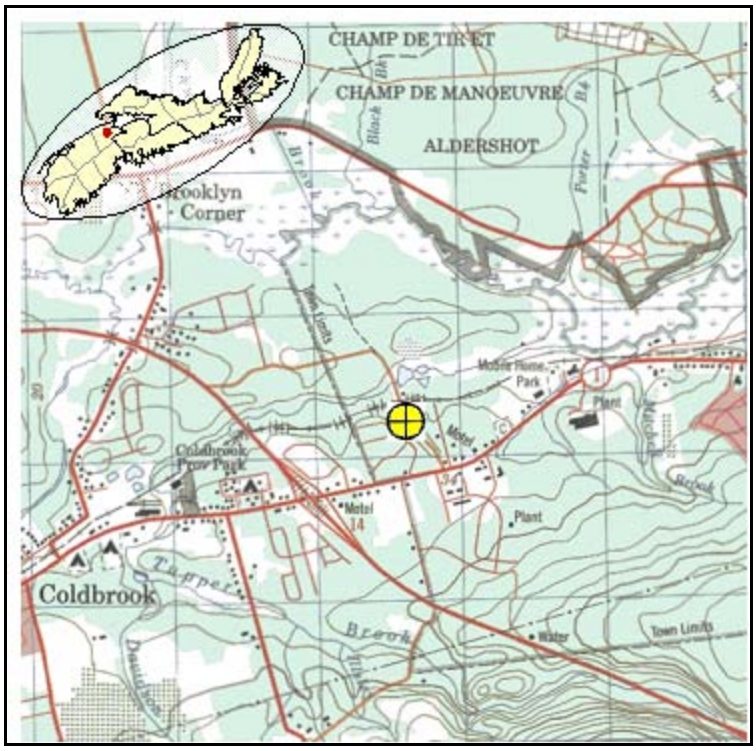

Figure 3.31: Kentville (048) Well Location

Figure 3.32: Kentville (048) Site Photograph

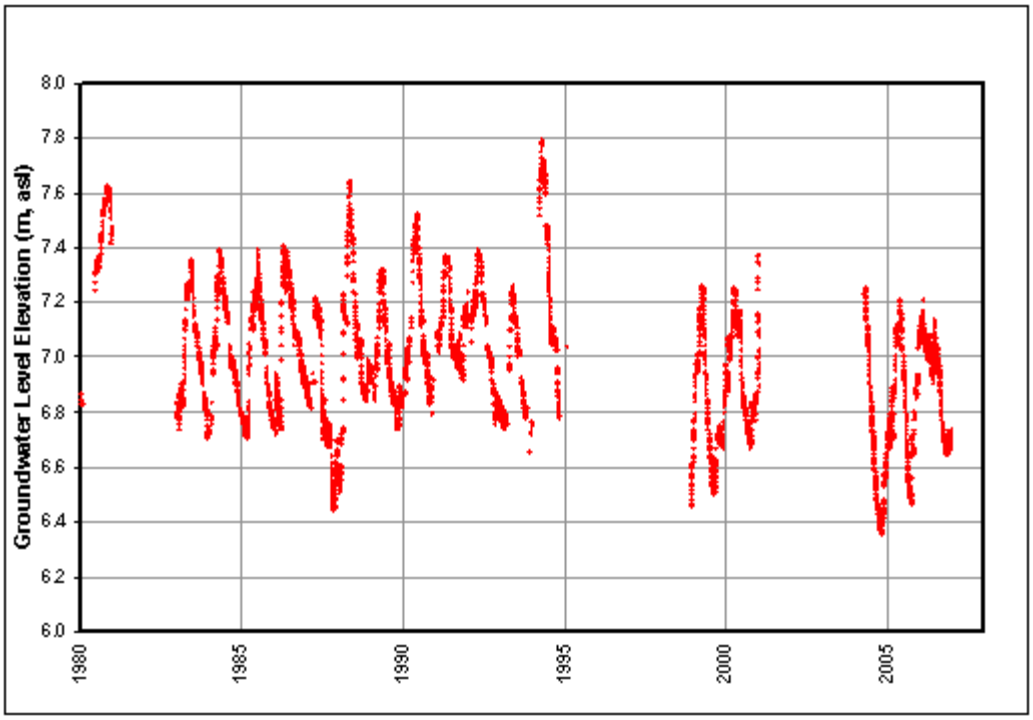

Figure 3.33: Kentville (048) Historical Water Level Graph

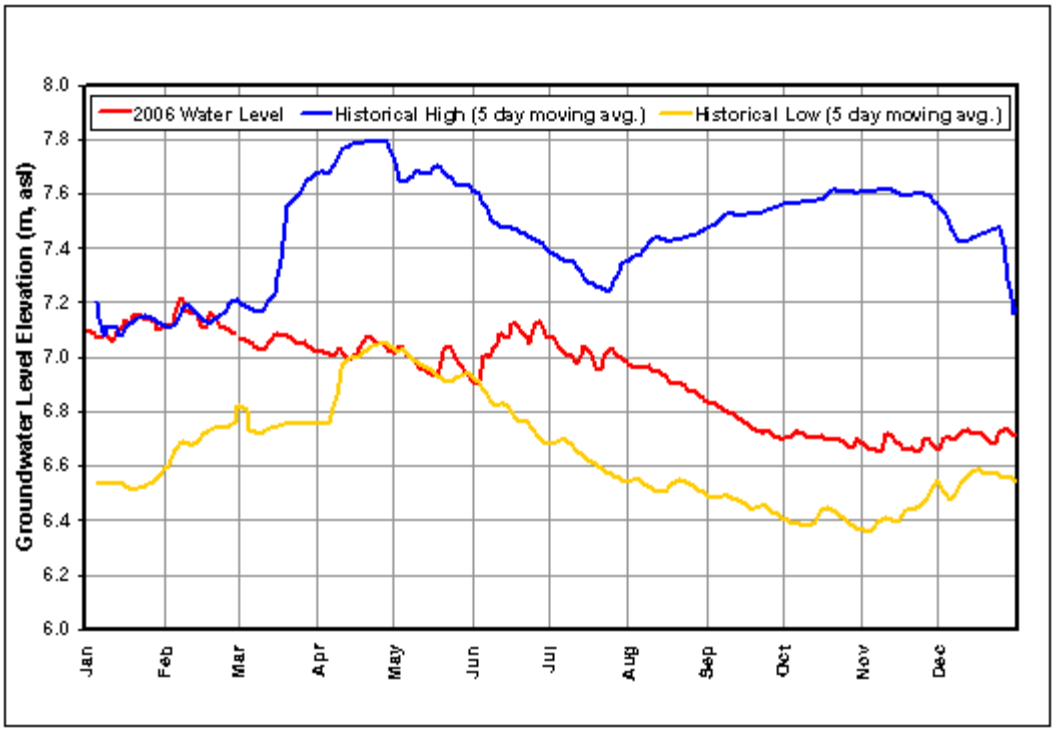

Figure 3.34: Kentville (048) 2006 Water Level Graph

3.10 Sydney (050)

Well Description

The Sydney (050) observation well is located near Sydney, Cape Breton County. It was constructed in 1977 as part of a regional water resource study in the Sydney Coalfield (Baechler, 1986) and has also been referred to as the "Sydney Watershed " observation well. The well is completed in a sandstone aquifer and is 100.6 m deep with a casing depth of 6.1 m. Well location and construction information is provided in Table 3.10 and the well log is provided in Appendix A. A 72-hour pump test was conducted at this well in the 1980's and the results indicated a transmissivity of 71 m^2/day (4,751 igpd/ft) (Baechler, 1986).

The location of the Sydney (050) observation well is shown in Figure 3.35. It is situated in a rural area where land use is primarily residential and undeveloped land. The well is located in the Sydney Wellfield, which consists of 11 production wells. The wellfield, which began operating in 1996, pumps an average of approximately 16,000 m^3/day and is the largest municipal wellfield in Nova Scotia. The nearest production well is located approximately 200 m from the Sydney (050) observation well.

Table 3.10: Sydney (050) Well Construction Information

Well Name	Sydney (050)
Observation Well ID Number	050
NSEL Well Log Number	771077
County	Cape Breton
Nearest Community	Sydney
UTM - Easting	720589
UTM - Northing	5106450
Year Monitoring Started	1984
Casing Depth (m, bgs)	6.7
Well Depth (m, bgs)	100.6
Elevation - top of casing (m, asl)	64.10
Geologic Unit	South Bar Formation
Aquifer Material	Bedrock - sandstone

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Sydney (050) is shown in Figure 3.36 and the 2006 water level graph is shown in Figure 3.37. This well has been monitored since 1984 and water levels have appear decreased by about 1.4 m since the Sydney Wellfield began pumping in 1996. The amount of annual water level fluctuation has also increased since the well field began pumping. The statistical trend analysis for this well (Appendix D) indicates that there is a downward trend, equivalent to approximately 5.9 cm/year.

The average water level elevation at this well from 1984 to 1994 was approximately 60 m above sea level and the annual water level fluctuation varied between 0.7 m and 1.0 m. Between 1999 and 2006 the average water level elevation was approximately 58.6 m above sea level, with the annual water level fluctuation at about 2 m. The depth to water in this well is between 4.5 and 5 m below ground surface. The 2006 water levels were within the historically observed water level range for this well.

Monitoring Results - Water Chemistry

The Sydney (050) well was last sampled in September 2005. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded. Manganese (630 g/L) was above the aesthetic drinking water guideline of 50 g/L. VOCs, pesticides and perchlorate were not detected. The tritium level in this well was 4.92 TU, indicating that the water in this well is a mix of old and recent water (i.e., recharge occurred before and after 1952).

The average annual groundwater temperature at the Sydney (050) well is 7.2 ^{o}C and fluctuates annually between 6.0 and 8.5^{o}C. A graph of hourly temperature data collected since November 2003 is presented in Appendix C.

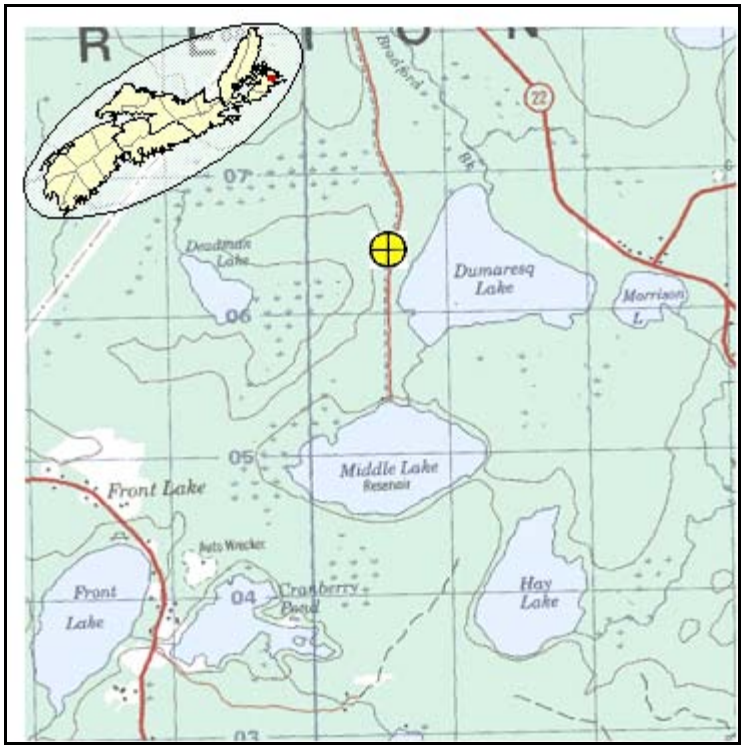

Figure 3.35: Sydney (050) Well Location

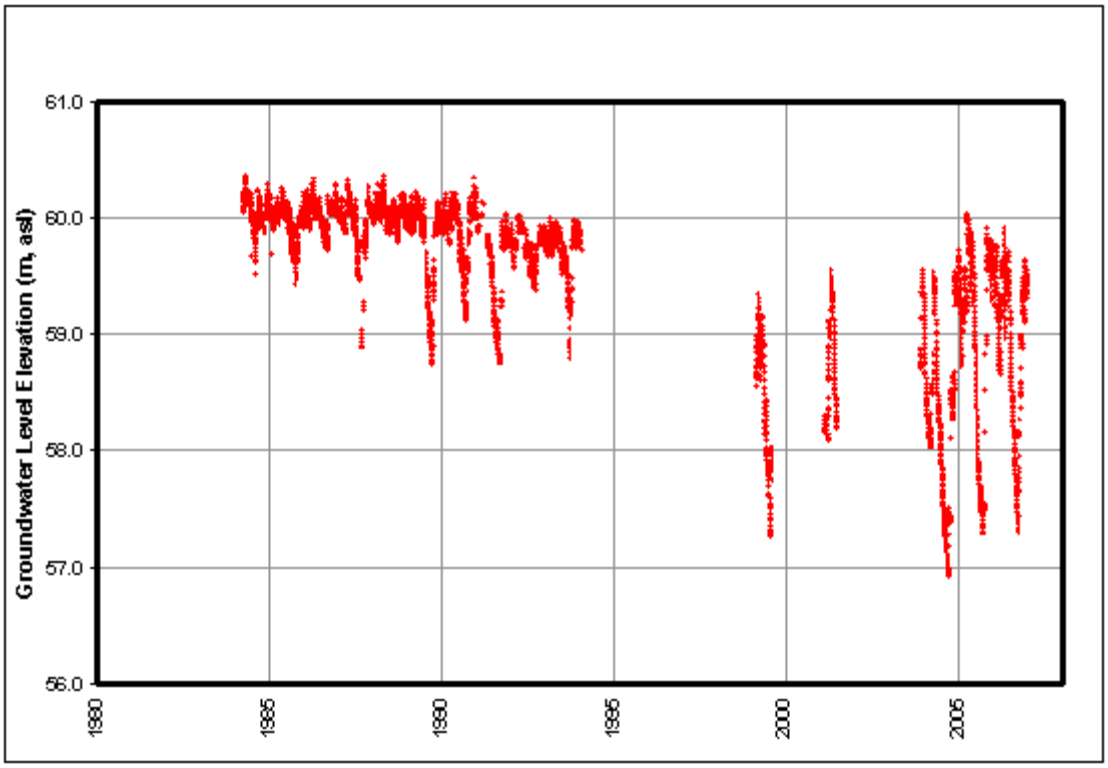

Figure 3.36: Sydney (050) Historical Water Level Graph

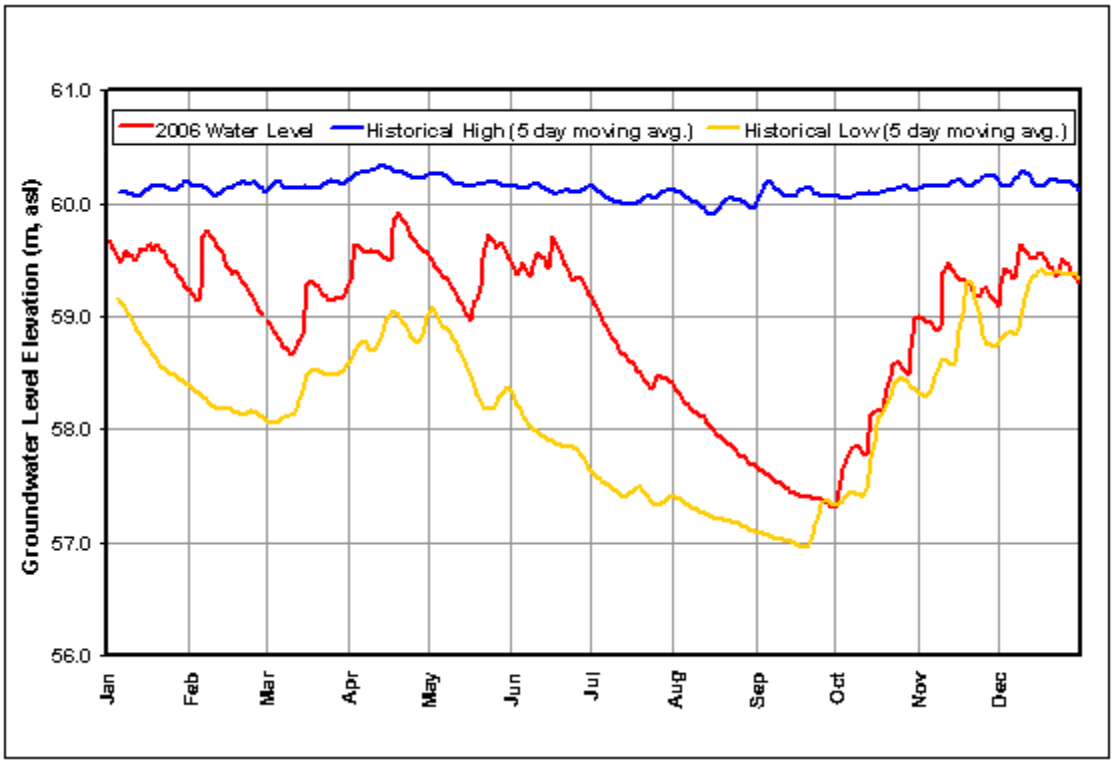

Figure 3.37: Sydney (050) 2006 Water Level Graph

3.11 Charleston (058)

Well Description

The Charleston (058) observation well is located near Riversdale, Queens County. This well was constructed in 1987 to expand the extent of the NS Groundwater Observation Well Network. The well is completed in slate and is 12.2 m deep, with an unknown casing depth. Well location and construction information is provided in Table 3.11 and the well log is provided in Appendix A.

The location of the Charleston (058) observation well is shown in Figure 3.38. It is situated in a rural area where the surrounding land is predominantly undeveloped. The well is located on a property that was used as a satellite tracking station until the mid-1990's. The nearest water well is a domestic well located approximately 150 m away.

Table 3.11: Charleston (058) Well Construction Information

Well Name	Charleston (058)
Observation Well ID Number	058
NSEL Well Log Number	870190
County	Queens
Nearest Community	Riversdale
UTM - Easting	366778
UTM - Northing	4894476
Year Monitoring Started	1988
Casing Depth (m, bgs)	NA
Well Depth (m, bgs)	12.2
Elevation - top of casing (m, asl)	15.07
Geologic Unit	Halifax Formation
Aquifer Material	Bedrock - slate

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Charleston (058) is shown in Figure 3.39 and the 2006 water level graph is shown in Figure 3.40. This well has been monitored since 1988 and water levels appears to have remained relatively constant. A statistical trend analyses could not be carried out for this well because there was insufficient water level data available. The average water level elevation at the Charleston (058) well is approximately 12.7 m above sea level and the annual water level fluctuation is about 0.5 m. The depth to water in this well is approximately 2.3 m below ground surface. The 2006 water levels were within the historically observed water level range for this well.

Monitoring Results - Water Chemistry

The Charleston (058) well has not been sampled and, therefore, water chemistry results are not available. The water temperature range between August and December 2006 at this well was between 8 and 12°C. The temperature at this well has only been monitored since August 2006 and, therefore, the average annual temperature cannot be determined. A graph of hourly temperature data since August 2006 is presented in Appendix C.

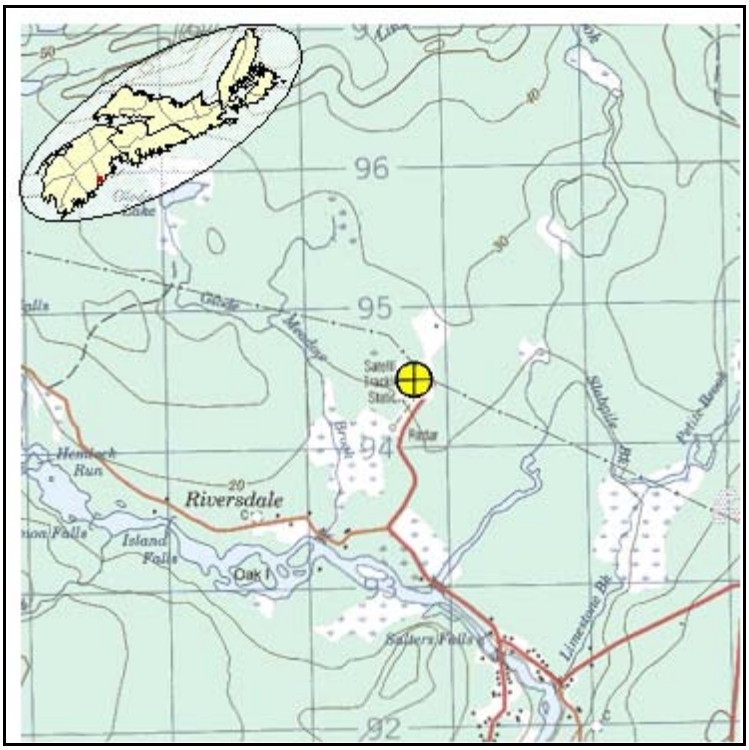

Figure 3.38: Charleston (058) Well Location

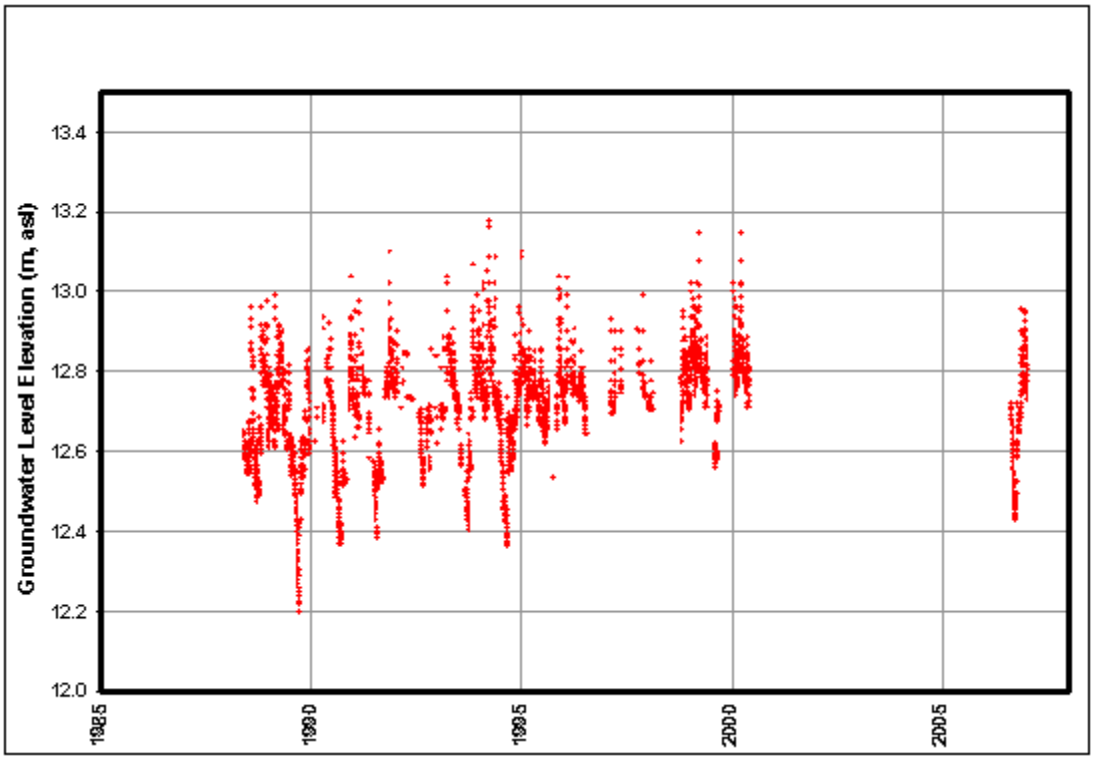

Figure 3.39: Charleston (058) Historical Water Level Graph

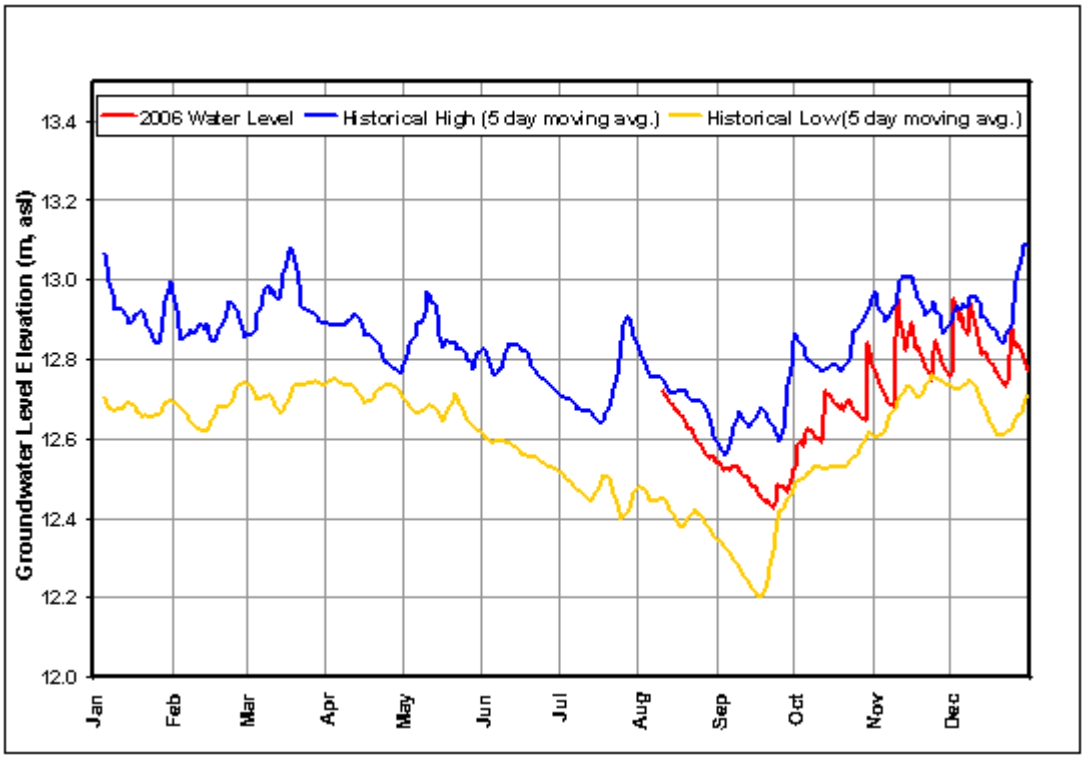

Figure 3.40: Charleston (058) 2006 Water Level Graph

3.12 Hayden Lake (059)

Well Description

The Hayden Lake (059) observation well is located near East Jordan, Shelburne County. The well was constructed in 1987 to expand the extent of the NS Groundwater Observation Well Network. It is completed in fractured bedrock comprised of greywacke. The well is 48.8 m deep and the casing depth is 6.1 m. Well location and construction information is provided in Table 3.12 and the well log is provided in Appendix A.

The location of the Hayden Lake (059) observation well is shown in Figure 3.41. It is situated in a rural area where the surrounding land is primarily undeveloped. The well is located adjacent to the Hayden Lake Water Treatment Plant, which supplies the Town of Lockeport. The nearest water well is a domestic well located approximately 300 m away.

Table 3.12: Hayden Lake (059) Well Construction Information

Well Name	Hayden Lake (059)
Observation Well ID Number	059
NSEL Well Log Number	870189
County	Shelburne
Nearest Community	East Jordan
UTM - Easting	321365
UTM - Northing	4849195
Year Monitoring Started	1988
Casing Depth (m, bgs)	6.1
Well Depth (m, bgs)	48.8
Elevation - top of casing (m, asl)	2.94
Geologic Unit	Goldenville Formation
Aquifer Material	Bedrock - greywacke

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Hayden Lake (059) is shown in Figure 3.42 and the 2006 water level graph is shown in Figure 3.43. This well has been monitored since 1988 and water levels appear to have risen slightly over time (up by about 0.3 m) and the amount of annual fluctuation appears to have decreased. The statistical trend analysis for this well (Appendix D) indicates that there is a very small upward trend, equivalent to approximately 1.8 cm/year. The average water level elevation at the Hayden Lake (059) well is approximately 1.7 m above sea level and the annual water level fluctuation is between 1.0 and 1.5 m. The depth to water in this well is approximately 1.3 m below ground surface. The 2006 water levels were within the historically observed water level range for this well.

Monitoring Results - Water Chemistry

The Hayden Lake (059) well was last sampled in June 2005. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded. One VOC, chloroform, was detected at 3.2 ug/L, but was below the drinking water guideline of 100 ug/L. Chloroform is produced when chlorine reacts with organic matter and may be present in this well as a result of chlorine use and storage at the nearby water treatment plant. Perchlorate was detected at very low levels (0.014 ug/L), but was far below the recommended Health Canada guidance value of 6 ug/L. No pesticides were detected. The tritium level in this well was 3.4 TU, indicating that the water in this well is a mix of old and recent water (i.e., recharge occurred before and after 1952).

The average annual groundwater temperature at the Hayden Lake (059) well is 8.8 ^{o}C and fluctuates annually between 6.8 and 10.8 ^{o}C. A graph of hourly temperature data collected since December 2003 is presented in Appendix C.

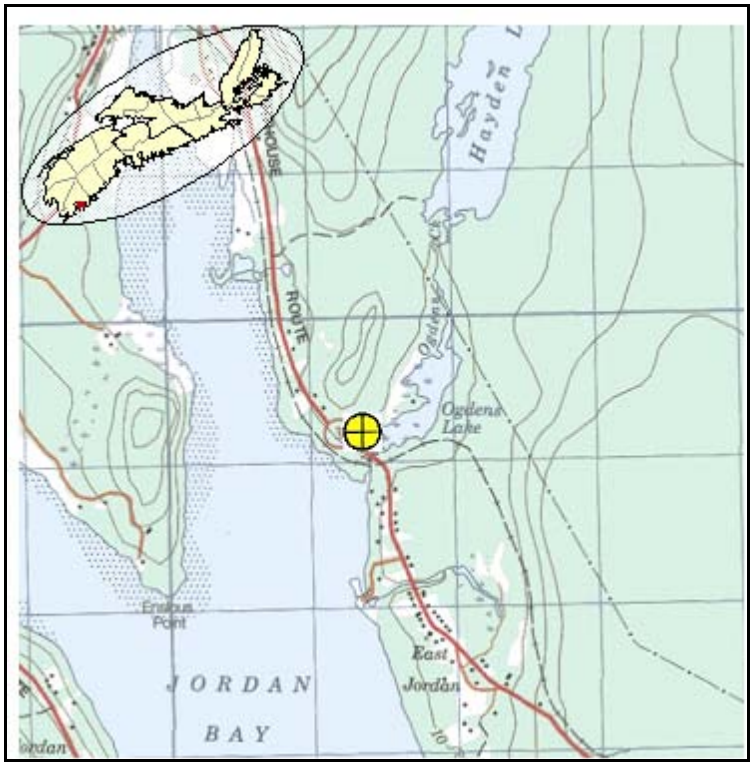

Figure 3.41: Hayden Lake (059) Well Location

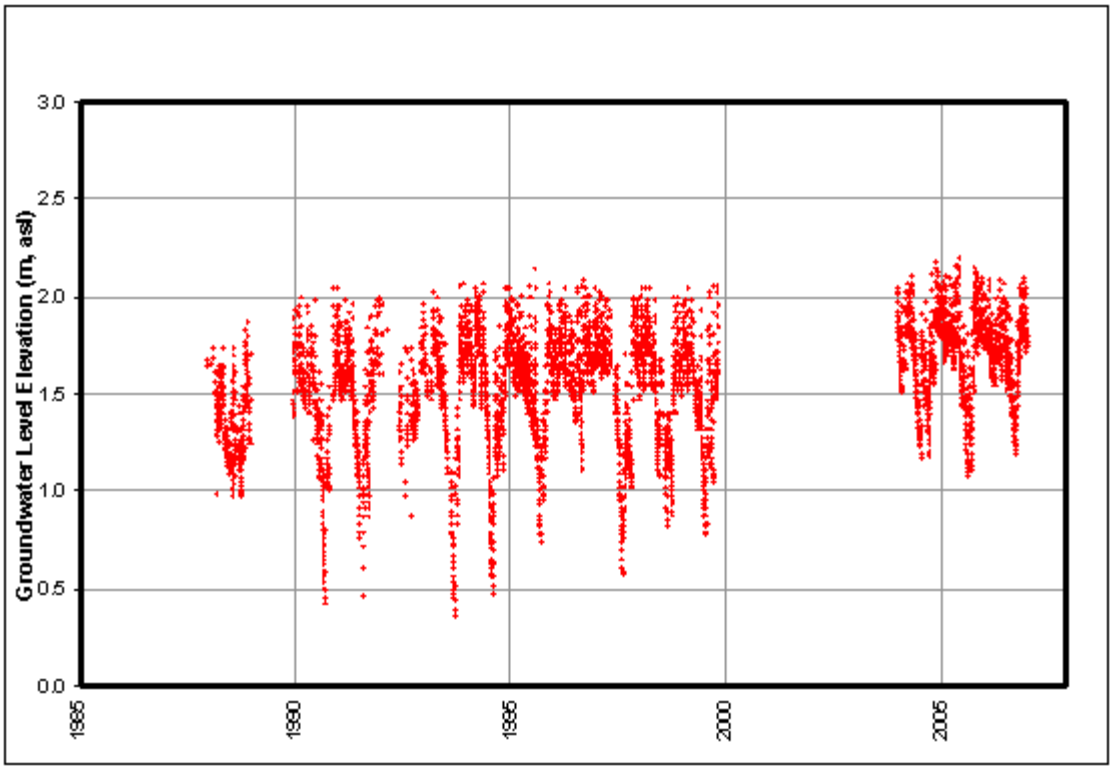

Figure 3.42: Hayden Lake (059) Historical Water Level Graph

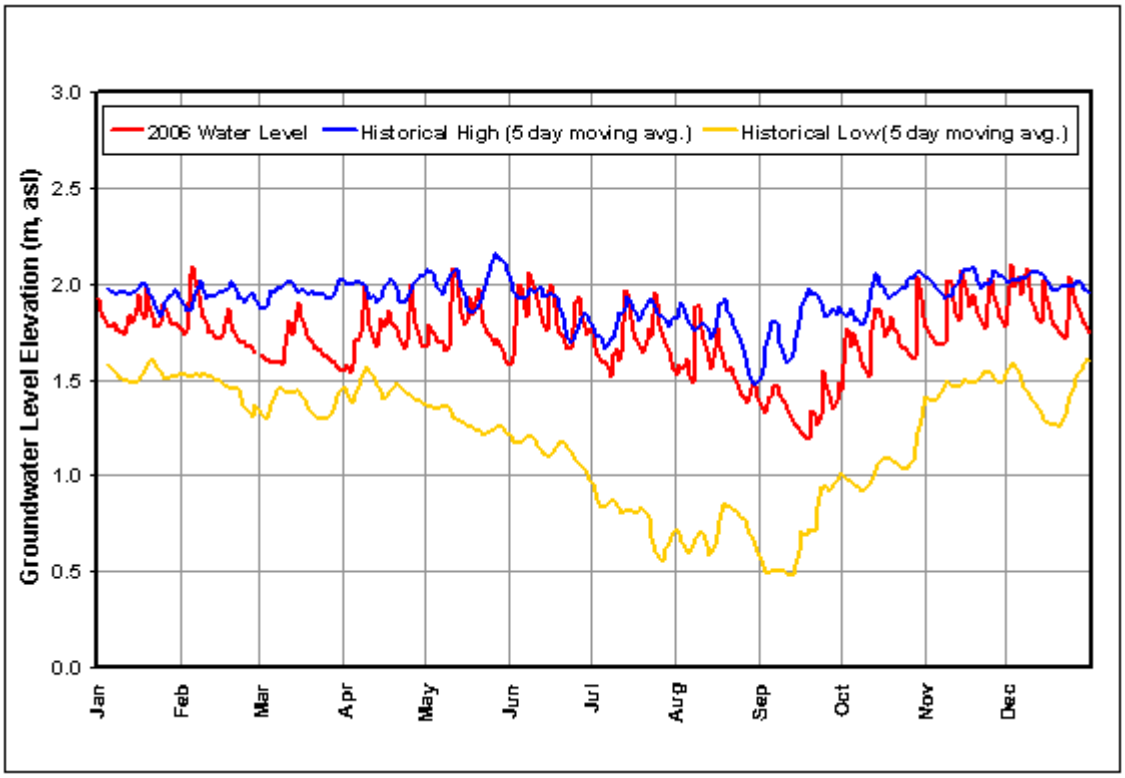

Figure 3.43: Hayden Lake (059) 2006 Water Level Graph

3.13 Annapolis Royal (062)

Well Description

The Annapolis Royal (062) observation well is located near Lake La Rose, Annapolis County. The well was constructed in December 1989 to expand the extent of the NS Groundwater Observation Well Network. The well is completed in granite. It is 62.8 m deep and the casing depth is 24.3 m. Well location and construction information is provided in Table 3.13 and the well log is provided in Appendix A.

The location of the Annapolis Royal (062) observation well is shown in Figure 3.44. It is situated in a rural area where the surrounding land is primarily undeveloped. The well is located 500 m from Lake La Rose, the former water supply for the Town of Annapolis Royal. The nearest water well is a domestic well located approximately 1,000 m away.

Table 3.13: Annapolis Royal (062) Well Construction Information

Well Name	Annapolis Royal (062)
Observation Well ID Number	062
NSEL Well Log Number	891722
County	Annapolis
Nearest Community	Lake La Rose
UTM - Easting	303029
UTM - Northing	4952588
Year Monitoring Started	1990
Casing Depth (m, bgs)	24.3
Well Depth (m, bgs)	62.8
Elevation - top of casing (m, asl)	121.06
Geologic Unit	Liscomb Complex
Aquifer Material	Bedrock - granite

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Annapolis Royal (062) is shown in Figure 3.45 and the 2006 water level graph is shown in Figure 3.46. This well has been monitored since 1990 and water levels have remained relatively constant. A statistical trend analyses could not be carried out for this well because there was insufficient water level data available. The average water level elevation at the Annapolis Royal (062) well is approximately 109.5 m above sea level and the annual water level fluctuation is about 1.3 m. The depth to water in this well is about 11.5 m below ground surface. The 2006 water levels were within the historically observed water level range for this well, although they were near historical highs for the months of June, July and August.

Monitoring Results - Water Chemistry

The Annapolis Royal (062) well was last sampled in November 2005. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded. Manganese (110 µg/L) was above the aesthetic drinking water guideline of 50 µg/L. Pesticides and perchlorate were not detected. One VOC, toluene, was detected at 2 ug/L, but was below the aesthetic drinking water guideline of 24 ug/L. This well is located beside a road and, therefore, the toluene, which is a chemical found in gasoline, may be due to runoff from the road. The tritium level in this well was 0.27 TU, indicating the water in the well is relatively old (i.e., recharge occurred before 1952). This tritium result is not consistent with the detection of low levels of toluene because old groundwater would not be expected to contain toluene contamination. Therefore, the well should be re-sampled to resolve this issue.

The average annual groundwater temperature at the Annapolis Royal (062) well is 7.8 ^{o}C and fluctuates annually between 7.7 and 7.9 ^{o}C. A graph of hourly temperature data collected since May 2004 is presented in Appendix C.

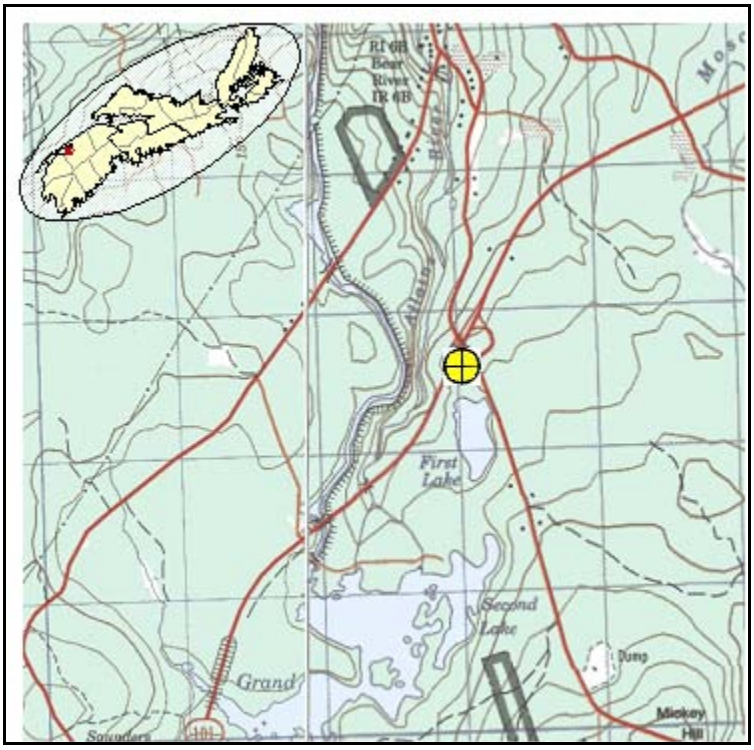

Figure 3.44: Annapolis Royal (062) Well Location

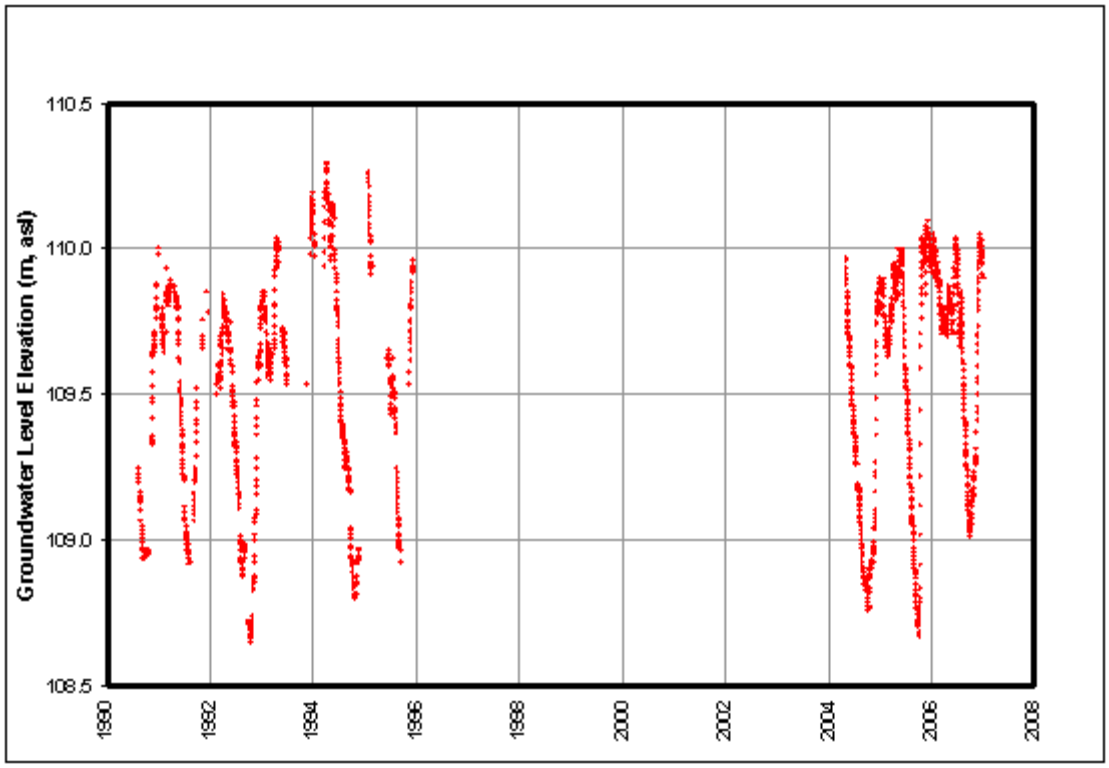

Figure 3.45: Annapolis Royal (062) Historical Water Level Graph

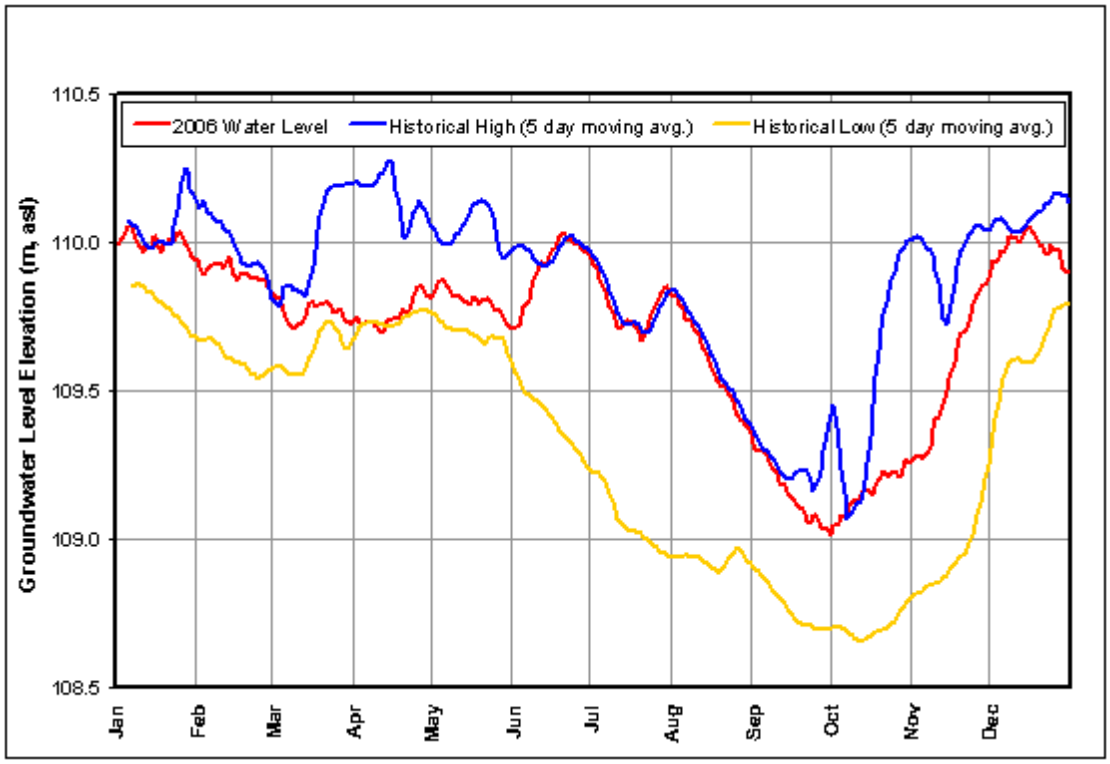

Figure 3.46: Annapolis Royal (062) 2006 Water Level Graph

3.14 Hebron (063)

Well Description

The Hebron (063) observation well is located near Dayton, Yarmouth County. The well was constructed in 1989 to expand the extent of the NS Groundwater Observation Well Network. The well is completed in slate and is 45.7 m deep with a casing depth of 12.2 m. Well location and construction information is provided in Table 3.14 and the well log is provided in Appendix A.

The location of the Hebron (063) observation well is shown in Figure 3.47. It is situated in a rural area and the surrounding land use is primarily residential. The well is located approximately 100 m from Lake Milo and 1,000 m from the ocean. The nearest water well is a domestic well located approximately 90 m away.

Table 3.14: Hebron (063) Well Construction Information

Well Name	Hebron (063)
Observation Well ID Number	063
NSEL Well Log Number	891721
County	Yarmouth
Nearest Community	Dayton
UTM - Easting	250697
UTM - Northing	4862322
Year Monitoring Started	1990
Casing Depth (m, bgs)	12.2
Well Depth (m, bgs)	45.7
Elevation - top of casing (m, asl)	23.89
Geologic Unit	Whiterock Formation
Aquifer Material	Bedrock - slate

Notes: bgs = below ground surface; asl = above sea level

Monitoring Results - Water Levels

The historical water level graph for Hebron (063) is shown in Figure 3.48 and the 2006 water level graph is shown in Figure 3.49. This well has been monitored since 1990 and water levels have been relatively constant, although there appears to be a slight increase in the average water level (up by about 0.3 m) since the 1990's. The average water level elevation at the Hebron (063) well has varied from approximately 3.0 m to 3.3 m above sea level and the annual water level fluctuation is about 1.5 m. The depth to water in this well is about 2.5 m below ground surface and the hourly water level data shows tidal fluctuations of approximately 0.05 m. The 2006 water levels were within the historically observed water level range for this well, although they were near historical highs for the months of June, July and November.

Monitoring Results - Water Chemistry

The Hebron (063) well was last sampled in June 2005. Water chemistry results are presented in Appendix B. The results indicate that no health-based drinking water guidelines were exceeded. Iron (27,000 µg/L) and manganese (440 µg/L) were above the aesthetic drinking water guidelines of 300 µg/L and 50 µg/L, respectively. In addition, turbidity and pH did not meet the aesthetic drinking water guidelines. The elevated turbidity levels are expected due to the high iron and manganese levels. Note that the ion balance error reported in the general chemistry analysis is 23%, which exceeds the generally acceptable level of 5% and, therefore, these results should be viewed with caution.

VOCs, pesticides and perchlorate were not detected at the Hebron (063) well. The tritium level in this well was 4.6 TU, indicating that the water in this well is a mix of old and recent water (i.e., recharge occurred before and after 1952).

The average annual groundwater temperature at the Hebron (063) well is 8.8 °C and fluctuates annually between 6.0 and 11.5 °C. A graph of hourly temperature data collected since December 2003 is available in Appendix C.

Figure 3.47: Hebron (063) Well Location

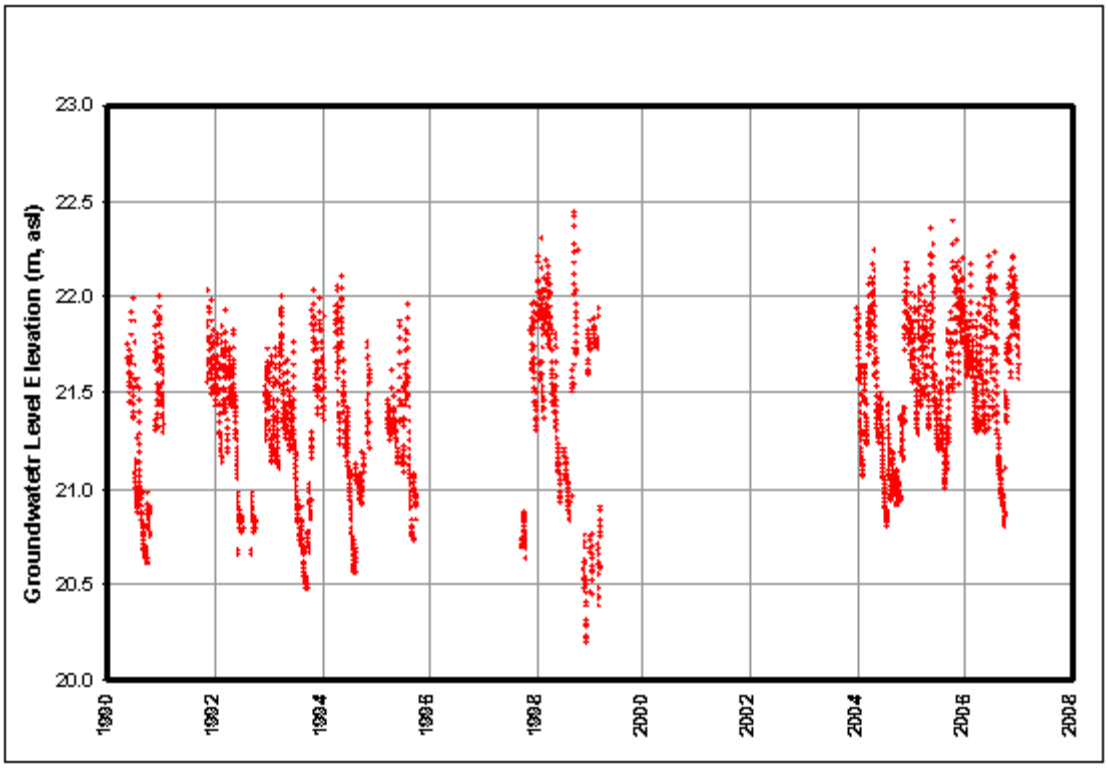

Figure 3.48: Hebron (063) Historical Water Level Graph

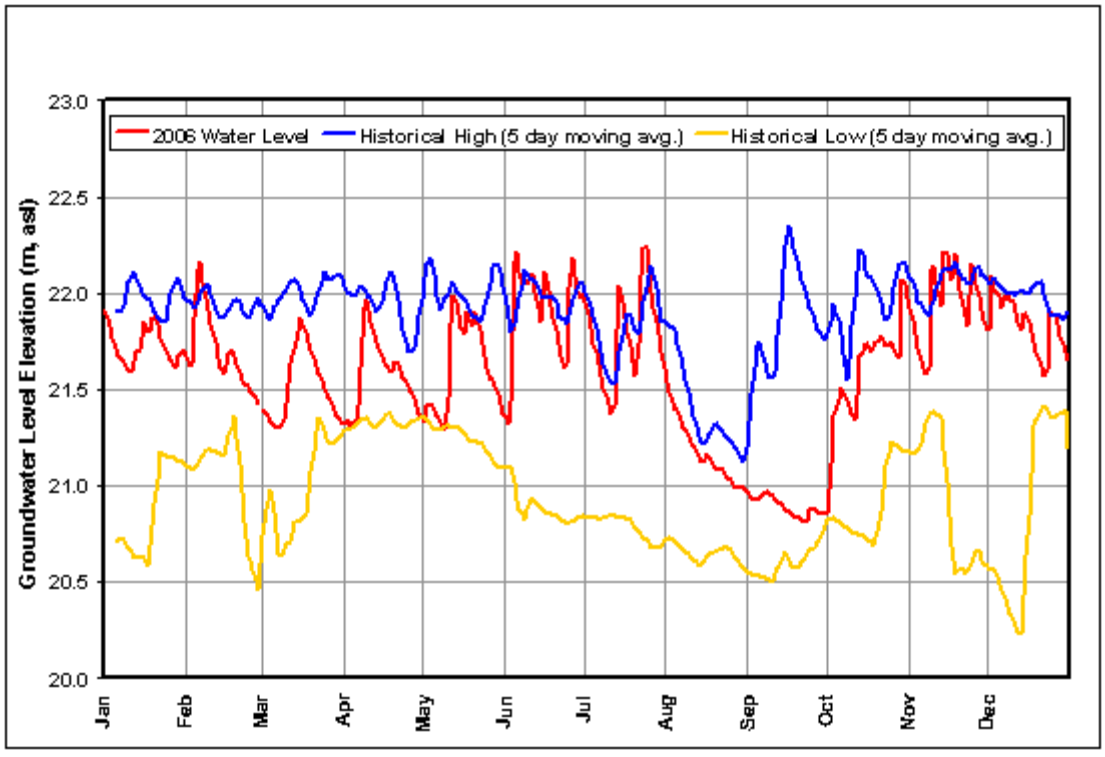

Figure 3.49 Hebron (063) 2006 Water Level Graph

4.0 SUMMARY & CONCLUSIONS

4.1 Groundwater Levels

Table 4.1 presents a summary of groundwater level trends for each of the network's observation wells. The results indicate that eight of the 14 wells exhibit groundwater level trends, with four having small upward trends and four having small downward trends. The downward trends tend to be larger than the upward trends, however, the size of the trends in all cases is relatively small. The maximum observed water level decline was 5.9 cm/year, which corresponded to a total decline of approximately 1.4 m since monitoring began.

Upward trends were observed at the following wells: Fraser Brook (004), Point Aconi (030), Durham (045) and Hayden Lake (059). The largest upward trend was 2.4 cm/year at the Durham(045) observation well, which resulted in a total rise of approximately 0.6 m over the entire monitoring period at this well. The reason for the upward trends at these wells has not been determined, however, possible reasons include: increased precipitation; greater infiltration rates due to changes in land use; and, reduction in evapotranspiration rates.

Downward trends were observed at the following wells: Wolfville (010), Lawrencetown (045), Kentville (048) and Sydney (050). The largest downward trend was 5.9 cm/year at the Sydney (050) observation well, which resulted in a total decline of approximately 1.4 m since monitoring began. The reason for the downtrends trends at these wells has not been confirmed, however, three of these observation wells are located in municipal wellfields (i.e., Wolfville (010), Kentville (048), Sydney (050)) and, therefore, groundwater levels in these areas have probably been lowered due to pumping. The fourth well, Lawrencetown (045), is not located in a municipal wellfield, but the groundwater level decline at this well is expected to be caused by pumping at a nearby domestic well, located approximately 50 m away.

Table 4.1: Summary of Groundwater Level Trend Results At All Observation Wells

Well Name	County	Year Monitoring Started	Average Yearly Water Level Change (cm/year)	Total Water Level Change Since Monitoring Began (m)	Water Level Trend
Greenwood (003)	Kings	1966	NA	NA	None
Fraser Brook (004)	Colchester	1966	0.2	0.1	Up
Wolfville (010)	Kings	1969	-2.8	-1	Down
Truro (014)	Colchester	1971	NA	NA	None
Monastery (028)	Antigonish	1976	NA	NA	Insufficient Data
Point Aconi (030)	Cape Breton	1976	1.2	0.4	Up
Lawrencetown (043)	Halifax	1978	-2	-1	Down
Durham (045)	Pictou	1979	2.4	0.6	Up
Kentville (048)	Kings	1980	-0.7	-0.5	Down
Sydney (050)	Cape Breton	1984	-5.9	-1.4	Down
Charleston (058)	Queens	1988	NA	NA	Insufficient Data
Hayden Lake (059)	Shelburne	1988	1.8	0.3	Up
Annapolis Royal (062)	Digby	1990	NA	NA	Insufficient Data
Hebron (063)	Yarmouth	1990	NA	NA	Insufficient Data

Notes: NA = Not Applicable (either because no water level trend was identified or there was insufficient data available). Positive (+) values indicate upward trends and negative (-) values indicate downward trends.

4.2 Groundwater Quality

Table 4.2 presents a summary of the groundwater quality results for each of the network's observation wells. The results indicate that arsenic (at two wells) was the only health-based parameter that exceded drinking water guidelines. Arsenic is known to occur in groundwater in certain areas of the province due to the presence of naturally-occurring arsenic in soil and bedrock. Several other water quality parameters exceeded aesthetic drinking water guidelines, as follows: manganese (at five wells), iron (at two wells), pH (at two wells) and turbidity (at two wells). All of these parameters are naturally-occurring water quality problems that are commonly encountered in water wells in Nova Scotia.

Table 4.2: Summary of Groundwater Quality Results At All Observation Wells

Well Name	County	Parameters Exceeding Health-Based Drinking Water Guidelines	Parameters Exceeding Aesthetic Drinking Water Guidelines	Comments
Greenwood (003)	Kings	None	Iron, Manganese, pH, Turbidity	None
Fraser Brook (004)	Colchester	Arsenic	None	None
Wolfville (010)	Kings	None	None	None
Truro (014)	Colchester	Not sampled	Not sampled	Not sampled
Monastery (028)	Antigonish	None	None	None
Point Aconi (030)	Cape Breton	None	Manganese	None
Lawrencetown (043)	Halifax	Arsenic	None	Chloride exceeds background levels
Durham (045)	Pictou	None	None	None
Kentville (048)	Kings	None	None	Chloride exceeds background levels; perchlorate detected below guideline.
Sydney (050)	Cape Breton	None	Manganese	None
Charleston (058)	Queens	Not sampled	Not sampled	Not sampled
Hayden Lake (059)	Shelburne	None	None	Chloroform detected below guideline; perchlorate detected below guideline.
Annapolis Royal (062)	Digby	None	Manganese	Toluene detected below guideline
Hebron (063)	Yarmouth	None	Iron, Manganese, pH, Turbidity	None

The water quality results show that none of the observation wells exceeded drinking water guidelines for VOCs, pesticides or perchlorate. However, two VOCs were detected in two observation wells at very low levels (i.e., toluene at 3.2 ug/L in one well and chloroform at 2 ug/L in another well). The source of the VOCs at these wells has not been determined and follow-up sampling is needed to confirm these initial sampling results. Perchlorate was also detected at two observation wells at very low levels (i.e., 100 times less than the recommended Health Canada guidance value for perchlorate). The source of the perchlorate at these observation wells has not been determined. No pesticides were detected in any of the observation wells.

The hourly groundwater temperature data collected at each observation well (see Appendix C) shows that all of the observation wells experience seasonal temperature fluctuations. The peak groundwater temperatures lag behind the seasonal changes, with peak highs usually occurring between September and January and peak lows usually occurring between March and June. The temperature range at each observation well is variable, however, the typical range is between 6°C and 10°C, with a typical average temperature of approximately 8°C.

The tritium results indicate that most of the wells tested (i.e., 8 of 11 wells) contained either recent water (recharged after 1952), or a mix of recent and old water (recharged before and after 1952). Only three of the 11 wells tested for tritium contained purely old water (recharged before1952). The results suggest that groundwater in these aquifers is recharged relatively quickly. While this is encouraging from a water quantity point of view, because the aquifers are being regularly replenished with new water, it also indicates that the aquifers are vulnerable to contamination (i.e., contaminants released at the surface will be carried into the aquifer relatively quickly). This emphasizes the importance of source water protection plans in the province to ensure that groundwater is kept clean.

The tritium results also suggest that wells with greater casing depths contain older water. Two of the three observation wells that were found to contain old water have casing lengths of 24 m and 44 m. The casing length at the third well is unknown. Of the wells with recent water, or a mix of recent and old water, five of the six wells have casing lengths of 13 m or less. The casing lengths at the remaining wells are unknown.

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APPENDIX A
WELL LOGS

Table A-1: Summary of Observation Well Construction Information

Well#	Address	Community	County	Date	Well Depth	Casing Depth	Depth to Bedrock	Depth to Static Level	Water Yield	Driller	Type of Well
					(ft)	(ft)	(ft)	(ft)	(igpm)		
661225	NS OBS WELL - GREENWOOD (003)	GREENWOOD	KINGS	20-Jun-66	25	21.5				1	DRILLED
661226	NS OBS WELL - FRASER BROOK (004)	LOWER HARMONY	COLCHESTER	11-Jul-66	60		2		5	1	DRILLED
681252	NS OBS WELL - WOLFVILLE (010)	WOLFVILLE	KINGS	17-Dec-68	79	74.5	35			1	DRILLED
701431	NS OBS WELL - TRURO (014)	TRURO	COLCHESTER	16-Nov-70	300	60	35			1	DRILLED
742420	NS OBS WELL - MONASTERY (028)	MONASTERY	ANTIGONISH	01-Jan-74	520				40	1	DRILLED
761408	NS OBS WELL - POINT ACONI (030	POINT ACONI	CAPE BRETON	11-Aug-76	100	42	14		10	45	DRILLED
771077	NS OBS WELL - SYDNEY (050)	SYDNEY	CAPE BRETON	09-Mar-77	330	22	13		250	45	DRILLED
771538	NS OBS WELL - LAWRENCETOWN (043)	UPPER LAWRENCETOWN	HALIFAX	16-Mar-77	175	145	10	4	8	83	DRILLED
772021	NS OBS WELL - KENTVILLE (048)	KENTVILLE	KINGS	20-May-77	400	100	95		150	20	DRILLED
782683	NS OBS WELL - DURHAM (045)	DURHAM	PICTOU	01-Jul-78	247		20		100	4	DRILLED
870189	NS OBS WELL - HAYDEN LAKE (059)	EAST JORDAN	SHELBURNE	31-Mar-87	160	20	10		3.7	210	DRILLED
870190	NS OBS WELL - CHARLESTON (058)	RIVERSDALE	QUEENS	01-Apr-87	40		20	6		210	DRILLED
891721	NS OBS WELL - HEBRON (063)	DAYTON	YARMOUTH	19-Dec-89	150	40	3		45	210	DRILLED
891722	NS OBS WELL - ANNAPOLIS ROYAL (062)	LAKE LA ROSE	ANNAPOLIS	20-Dec-89	205	80	71		0.5	210	DRILLED

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 661225
Well Type DRILLED

Certified Well Contractor

Name: MINES
Certificate No.: 1
Company: N. S. DEPARTMENT OF MINES

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF MINES
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - GREENWOOD (003)
Lot Number: Subdivision:
County: KINGS Postal Code:
Nearest Community in Altlas/Map Book: ATLAS GREENWOOD

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book:
Map Page No.:
Reference Letter:
Reference Number:
Roamer Letter:
Roamer Number:

NTS Map Reference :
Map Sheet: 21H2
Reference Map: B
Tract No.: 7
Claim: M

GPS (WGS84 UTM) :
Northing (m): 4985498
Easting (m): 350680
Property (PID):
Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	25		FINE GRAINED	SAND		COARSE GRAIN	SAND	☐

Well Construction Information

Total depth below surface (ft): 25
Depth to bedrock (ft):
Water bearing fractures encountered at (ft):
Outer Well Casing:
From (ft): 0 To (ft): 22
Diameter (in): 4.5
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm):
Method:
Rate (igpm):
Duration (hrs):
Depth to water at end of test (ft):
Total drawdown (ft):
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft):
Overflow ☐

Comments: NS OBSERVATION WELL - GREENWOOD (003)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 20-Jun-66

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 661226
Well Type DRILLED

Certified Well Contractor

Name: MINES
Certificate No.: 1
Company: N. S. DEPARTMENT OF MINES

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF MINES
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - FRASER BROOK (004)
Lot Number: Subdivision:
County: COLCHESTER Postal Code:
Nearest Community in Altlas/Map Book: ATLAS LOWER HARMONY

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book:
Map Page No.:
Reference Letter:
Reference Number:
Roamer Letter:
Roamer Number:

NTS Map Reference :
Map Sheet: 11E6
Reference Map: A
Tract No.: 81
Claim: J

GPS (WGS84 UTM) :
Northing (m): 5021100
Easting (m): 486889
Property (PID):
Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	2	REDDISH	SANDY	TILL				☐
6	60	REDDISH	LAMINATED	SILTSTONE	GRAY	LAYERS	SILTSTONE	☐

Well Construction Information

Total depth below surface (ft): 60
Depth to bedrock (ft): 2
Water bearing fractures encountered at (ft):
Outer Well Casing:
From (ft): To (ft):
Diameter (in): 6
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm): 6.5
Method: PUMP TEST
Rate (igpm): 5
Duration (hrs): 24
Depth to water at end of test (ft):
Total drawdown (ft): 29.5
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft):
Overflow ☐

Comments: NS OBSERVATION WELL - FRASER BROOK (004)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 11-Jul-66

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 681252
Well Type DRILLED

Certified Well Contractor

Name: MINES
Certificate No.: 1
Company: N. S. DEPARTMENT OF MINES

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF MINES
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - WOLFVILLE (010)
Lot Number: Subdivision:
County: KINGS Postal Code:
Nearest Community in Altlas/Map Book: ATLAS WOLFVILLE

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book:
Map Page No.:
Reference Letter:
Reference Number:
Roamer Letter:
Roamer Number:

NTS Map Reference :
Map Sheet: 21H1
Reference Map: B
Tract No.: 78
Claim: K

GPS (WGS84 UTM) :
Northing (m): 4993828
Easting (m): 392086
Property (PID):
Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	3	RED	CLAYEY	TILL				☐
3	15		FINE GRAINED	SAND			GRAVEL	☐
15	35	RED	CLAYEY	TILL				☐
35	79	RED		SANDSTONE				☐

Well Construction Information

Total depth below surface (ft): 79
Depth to bedrock (ft): 35
Water bearing fractures encountered at (ft):
Outer Well Casing:
From (ft): To (ft): 75
Diameter (in): 4.5
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm):
Method:
Rate (igpm):
Duration (hrs):
Depth to water at end of test (ft):
Total drawdown (ft):
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft):
Overflow ☐

Comments: NS OBSERVATION WELL - WOLFVILLE (010)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 17-Dec-68

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 701431
Well Type DRILLED

Certified Well Contractor

Name: MINES
Certificate No.: 1
Company: N. S. DEPARTMENT OF MINES

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF MINES
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - TRURO (014)
Lot Number: Subdivision:
County: COLCHESTER Postal Code:
Nearest Community in Altlas/Map Book: ATLAS TRURO

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book:
Map Page No.:
Reference Letter:
Reference Number:
Roamer Letter:
Roamer Number:

NTS Map Reference :
Map Sheet: 11E6
Reference Map: B
Tract No.: 99
Claim: F

GPS (WGS84 UTM) :
Northing (m): 5023778
Easting (m): 476052
Property (PID):
Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	20			GRAVEL				☐
20	35			GLACIAL TILL				☐
35	300			SHALE		SEAM	SANSTONE	☐

Well Construction Information

Total depth below surface (ft): 300
Depth to bedrock (ft): 35
Water bearing fractures encountered at (ft):
Outer Well Casing:
From (ft): 0 To (ft): 60
Diameter (in): 6
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm):
Method:
Rate (igpm):
Duration (hrs):
Depth to water at end of test (ft):
Total drawdown (ft):
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft):
Overflow ☐

Comments: NS OBSERVATION WELL - TRURO (014)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 16-Nov-70

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 742420

Well Type DRILLED

Certified Well Contractor

Name: MINES

Certificate No.: 1

Company: N. S. DEPARTMENT OF MINES

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF MINES

or Contractor/Builder/Consultant, etc.:

Civic Address of Well: NS OBS WELL - MONASTERY (028)

Lot Number: Subdivision:

County: ANTIGONISH Postal Code:

Nearest Community in Altlas/Map Book: ATLAS MONASTERY

Well Location

NS Atlas or Map Book Reference :

Atlas or Map Book:

Map Page No.:

Reference Letter:

Reference Number:

Roamer Letter:

Roamer Number:

NTS Map Reference :

Map Sheet: 11F12

Reference Map: A

Tract No.: 91

Claim:

GPS (WGS84 UTM) :

Northing (m): 5052489

Easting (m): 606083

Property (PID):

Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	1		CLAYEY	TILL				☐
1	520			SANDSTONE			SHALE & CONGLOM	☐

Well Construction Information

Total depth below surface (ft): 520

Depth to bedrock (ft):

Water bearing fractures encountered at (ft):

Outer Well Casing:

From (ft): To (ft):

Diameter (in):

Length of casing above ground :

(ft): (in):

Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):

Reservoir material:

Reservoir vol. (cu.yd):

Reservoir material size:

Apron Material:

Apron depth (ft):

Apron thickness (ft):

Apron width (ft):

Apron volume (cu.yd):

Bottom material:

Water Yield

Estimated Yield (igpm): 67

Method:

Rate (igpm): 40

Duration (hrs): 50

Depth to water at end of test (ft):

Total drawdown (ft):

Water level recovered to (ft):

Recovery time (hrs):

Depth to static level (ft):

Overflow ☐

Comments: NS OBSERVATION WELL - MONASTERY (028)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL

Water use: MONITORING

Method of drilling:

Date well completed: 01-Jan-74

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 761408

Well Type DRILLED

Certified Well Contractor

Name: MCDONALD, IAN

Certificate No.: 45

Company: ISLAND WELL DRILLERS

Well Owner/Contractor Information

Well Drilled For: Owner: CAPE BRETON DEVELOPMEN

or Contractor/Builder/Consultant, etc.:

Civic Address of Well: NS OBS WELL - POINT ACONI (030)

Lot Number: Subdivision:

County: CAPE BRETON Postal Code:

Nearest Community in Altlas/Map Book: ATLAS POINT ACONI

Well Location

NS Atlas or Map Book Reference :

Atlas or Map Book: MAP

Map Page No.: 43

Reference Letter: A

Reference Number: 1

Roamer Letter: O

Roamer Number: 13

NTS Map Reference :

Map Sheet: 11K8

Reference Map: B

Tract No.: 70

Claim:

GPS (WGS84 UTM) :

Northing (m): 5133152

Easting (m): 707986

Property (PID):

Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	14			SHALE & CLAY				☐
14	100			SANDSTONE				☐

Well Construction Information

Total depth below surface (ft): 100

Depth to bedrock (ft): 14

Water bearing fractures encountered at (ft):

70

Outer Well Casing:

From (ft): 6 To (ft): 42

Diameter (in): 6

Length of casing above ground :

(ft): (in):

Driveshoe make: UNKNOWN

Dug Well Information

Depth of liner (crock) (ft):

Reservoir material:

Reservoir vol. (cu.yd):

Reservoir material size:

Apron Material:

Apron depth (ft):

Apron thickness (ft):

Apron width (ft):

Apron volume (cu.yd):

Bottom material:

Water Yield

Estimated Yield (igpm): 10

Method: PUMPED

Rate (igpm): 10

Duration (hrs): 1

Depth to water at end of test (ft):

Total drawdown (ft):

Water level recovered to (ft):

Recovery time (hrs):

Depth to static level (ft):

Overflow ☐

Comments: NS OBSERVATION WELL - POINT ACONI (030)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL

Water use: MONITORING

Method of drilling: ROTARY

Date well completed: 11-Aug-76

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 771538

Well Type DRILLED

Certified Well Contractor

Name: EDWARDS, HARRY A.

Certificate No.: 83

Company: H. J. EDWARDS WELL DRILLING LTD.

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF ENVIRONMENT

or Contractor/Builder/Consultant, etc.:

Civic Address of Well: NS OBS WELL - LAWRENCETOWN (043)

Lot Number: Subdivision:

County: HALIFAX Postal Code:

Nearest Community in Altlas/Map Book: ATLAS UPPER LAWRENCETOWN

Well Location

NS Atlas or Map Book Reference :

Atlas or Map Book: MAP

Map Page No.: 24

Reference Letter: D

Reference Number: 3

Roamer Letter: N

Roamer Number: 11

NTS Map Reference :

Map Sheet:

Reference Map:

Tract No.:

Claim:

GPS (WGS84 UTM) :

Northing (m): 4947712

Easting (m): 464172

Property (PID):

Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	5			SAND & GRAVEL & BOU				☐
5	12			BOULDER & ROCK				☐
12	152	GRAY		QUARTZITE			SLATE	☐
152	165	DARK GRA		SLATE		QUARTZ VEINS		☑
165	174	GREENISH		QUARTZITE			SLATE	☐

Well Construction Information

Total depth below surface (ft): 175

Depth to bedrock (ft): 10

Water bearing fractures encountered at (ft): 152, 155

Outer Well Casing:

From (ft): 0 To (ft): 145

Diameter (in): 6

Length of casing above ground :

(ft): (in):

Driveshoe make: UNKNOWN

Dug Well Information

Depth of liner (crock) (ft):

Reservoir material:

Reservoir vol. (cu.yd):

Reservoir material size:

Apron Material:

Apron depth (ft):

Apron thickness (ft):

Apron width (ft):

Apron volume (cu.yd):

Bottom material:

Water Yield

Estimated Yield (igpm): 14.5

Method:

Rate (igpm): 8

Duration (hrs): 1.5

Depth to water at end of test (ft):

Total drawdown (ft):

Water level recovered to (ft):

Recovery time (hrs):

Depth to static level (ft): 4

Overflow ☐

Comments: NS OBSERVATION WELL - LAWRENCETOWN (043)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL

Water use: MONITORING

Method of drilling: ROTARY

Date well completed: 16-Mar-77

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 782683
Well Type DRILLED

Certified Well Contractor

Name: STEWART, EDMUND
Certificate No.: 4
Company: E. D. STEWART LTD.

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF ENVIRONMENT
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - DURHAM (045)
Lot Number: Subdivision:
County: PICTOU Postal Code:
Nearest Community in Altlas/Map Book: ATLAS DURHAM

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book:
Map Page No.:
Reference Letter:
Reference Number:
Roamer Letter:
Roamer Number:

NTS Map Reference :
Map Sheet: 11E10
Reference Map:
Tract No.:
Claim:

GPS (WGS84 UTM) :
Northing (m): 5052105
Easting (m): 516224
Property (PID):
Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	20		SANDY	TILL				☐
20	247	RED		SANDSTONE & SHALE	GRAY		SANDSTONE & SHA	☐

Well Construction Information

Total depth below surface (ft): 247
Depth to bedrock (ft): 20
Water bearing fractures encountered at (ft):
Outer Well Casing:
From (ft): To (ft):
Diameter (in):
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm): 100
Method: PUMPED
Rate (igpm): 100
Duration (hrs): 72
Depth to water at end of test (ft):
Total drawdown (ft):
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft):
Overflow ☐

Comments: NS OBSERVATION WELL - DURHAM (045)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 01-Jul-78

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 772021

Well Type DRILLED

Certified Well Contractor

Name HOPPER, RUSSELL

Certificate No. 20

Company HOPPER BROS. LTD.

Well Owner/Contractor Information

Well Drilled For: Owner NS DEPT. OF DEVELOPMENT

or Contractor/Builder/Consultant, etc. CBCL

Civic Address of Well NS OBS WELL - KENTVILLE (048)

Lot Number Subdivision

County KINGS Postal Code

Nearest Community in Altlas/Map Book ATLAS KENTVILLE

Well Location

NS Atlas or Map Book Reference :

Atlas or Map Book

Map Page No.

Reference Letter

Reference Number

Roamer Letter

Roamer Number

NTS Map Reference :

Map Sheet 21A2

Reference Map A

Tract No. 71

Claim

GPS (WGS84 UTM) :

Northing (m) 4992245

Easting (m) 377628

Property (PID)

Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	55		FINE GRAINED	SAND		MEDIUM GRAINE	SAND	☐
55	60		MEDIUM GRAIN	SAND		COARSE GRAIN	SAND	☐
60	95			GRAVEL				☑
95	380	GRAY		SANDSTONE		INTERBEDDED	SHALE	☑
380	400	BROWN	ARGILLACEOU	METASEDIMENT	PURPLE			☐

Well Construction Information

Total depth below surface (ft) 400

Depth to bedrock (ft) 95

Water bearing fractures encountered at (ft):

Outer Well Casing:

From (ft) 0 To (ft) 100

Diameter (in) 8

Length of casing above ground :

(ft) (in)

Driveshoe make

Dug Well Information

Depth of liner (crock) (ft)

Reservoir material

Reservoir vol. (cu.yd)

Reservoir material size

Apron Material

Apron depth (ft)

Apron thickness (ft)

Apron width (ft)

Apron volume (cu.yd)

Bottom material

Water Yield

Estimated Yield (igpm) 150

Method PUMPED

Rate (igpm) 150

Duration (hrs) 72

Depth to water at end of test (ft) 122

Total drawdown (ft) 140

Water level recovered to (ft)

Recovery time (hrs)

Depth to static level (ft)

Overflow ☐

Comments NS OBSERVATION WELL - KENTVILLE (048)

Well Status/Water Use/Date Completed

Final status of well OBSERVATION WELL

Water use MONITORING

Method of drilling

Date well completed 20-May-77

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 771077

Well Type DRILLED

Certified Well Contractor

Name: MCDONALD, IAN

Certificate No.: 45

Company: ISLAND WELL DRILLERS

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF ENVIRONMENT

or Contractor/Builder/Consultant, etc.:

Civic Address of Well: NS OBS WELL - SYDNEY (050)

Lot Number: Subdivision:

County: CAPE BRETON Postal Code:

Nearest Community in Altlas/Map Book: ATLAS SYDNEY

Well Location

NS Atlas or Map Book Reference :

Atlas or Map Book: MAP

Map Page No.: 24

Reference Letter: A

Reference Number: 5

Roamer Letter: J

Roamer Number: 13

NTS Map Reference :

Map Sheet: 11K1

Reference Map: A

Tract No.: 66

Claim:

GPS (WGS84 UTM) :

Northing (m): 5106450

Easting (m): 720589

Property (PID):

Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	13			BOULDER & GRAVEL				☐
13	330			COAL &SHALE & SANDS				☐

Well Construction Information

Total depth below surface (ft): 330

Depth to bedrock (ft): 13

Water bearing fractures encountered at (ft):

63

Outer Well Casing:

From (ft): 6 To (ft): 22

Diameter (in): 6

Length of casing above ground :

(ft): (in):

Driveshoe make: UNKNOWN

Dug Well Information

Depth of liner (crock) (ft):

Reservoir material:

Reservoir vol. (cu.yd):

Reservoir material size:

Apron Material:

Apron depth (ft):

Apron thickness (ft):

Apron width (ft):

Apron volume (cu.yd):

Bottom material:

Water Yield

Estimated Yield (igpm): 250

Method: PUMPED

Rate (igpm): 250

Duration (hrs): 1

Depth to water at end of test (ft):

Total drawdown (ft):

Water level recovered to (ft):

Recovery time (hrs):

Depth to static level (ft):

Overflow ☐

Comments: NS OBSERVATION WELL - SYDNEY (050)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL

Water use: MONITORING

Method of drilling: ROTARY

Date well completed: 09-Mar-77

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 870190
Well Type DRILLED

Certified Well Contractor

Name: MOWAT, DONALD
Certificate No.: 210
Company: MOWAT'S WELL DRILLING LTD.

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF ENVIRONMENT
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - CHARLESTON (058)
Lot Number: Subdivision:
County: QUEENS Postal Code:
Nearest Community in Altlas/Map Book: ATLAS RIVERSDALE

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book: MAP
Map Page No.: 15
Reference Letter: B
Reference Number: 5
Roamer Letter: M
Roamer Number: 12

NTS Map Reference :
Map Sheet:
Reference Map:
Tract No.:
Claim:

GPS (WGS84 UTM) :
Northing (m): 4894476
Easting (m): 366778
Property (PID):
Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	20			CLAY			BOULDER	☐
20	40			SLATE			GRANITE	☐

Well Construction Information

Total depth below surface (ft): 40
Depth to bedrock (ft): 20
Water bearing fractures encountered at (ft): 19, 35
Outer Well Casing:
From (ft): To (ft):
Diameter (in): 6
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm):
Method: AIR LIFT
Rate (igpm):
Duration (hrs):
Depth to water at end of test (ft):
Total drawdown (ft):
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft): 6
Overflow ☐

Comments: NS OBSERVATION WELL - CHARLESTON (058)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 01-Apr-87

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 870189
Well Type DRILLED

Certified Well Contractor

Name: MOWAT, DONALD
Certificate No.: 210
Company: MOWAT'S WELL DRILLING LTD.

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF ENVIRONMENT
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - HAYDEN LAKE (059)
Lot Number: Subdivision:
County: SHELBURNE Postal Code:
Nearest Community in Altlas/Map Book: ATLAS EAST JORDAN

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book: MAP
Map Page No.: 10
Reference Letter: C
Reference Number: 5
Roamer Letter: G
Roamer Number: 7

NTS Map Reference :
Map Sheet:
Reference Map:
Tract No.:
Claim:

GPS (WGS84 UTM) :
Northing (m): 4849195
Easting (m): 321365
Property (PID):
Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	10			CLAY			BOULDER	☐
10	160			GREYWACKE				☐

Well Construction Information

Total depth below surface (ft): 160
Depth to bedrock (ft): 10
Water bearing fractures encountered at (ft): 30
Outer Well Casing:
From (ft): 0 To (ft): 20
Diameter (in): 6
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm): 3.7
Method: AIR LIFT
Rate (igpm): 3.7
Duration (hrs):
Depth to water at end of test (ft):
Total drawdown (ft):
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft):
Overflow ☐

Comments: NS OBSERVATION WELL - HAYDEN LAKE (059)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 31-Mar-87

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 891722
Well Type DRILLED

Certified Well Contractor

Name: MOWAT, DONALD
Certificate No.: 210
Company: MOWAT'S WELL DRILLING LTD.

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF ENVIRONMENT
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - ANNAPOLIS ROYAL (062)
Lot Number: Subdivision:
County: ANNAPOLIS Postal Code:
Nearest Community in Altlas/Map Book: ATLAS LAKE LA ROSE

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book: MAP
Map Page No.: 8
Reference Letter: A
Reference Number: 4
Roamer Letter: H
Roamer Number: 14

NTS Map Reference :
Map Sheet:
Reference Map:
Tract No.:
Claim:

GPS (WGS84 UTM) :
Northing (m): 4952588
Easting (m): 303029
Property (PID):
Well Location Sketch Available ☐

Depth in feet | Primary Lithology | Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	71			CLAY			BOULDER	☐
71	205			GRANITE				☐

Well Construction Information

Total depth below surface (ft): 205
Depth to bedrock (ft): 71
Water bearing fractures encountered at (ft): 120
Outer Well Casing:
From (ft): 0 To (ft): 80
Diameter (in): 6
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm): 0.5
Method: AIR LIFT
Rate (igpm): 0.5
Duration (hrs):
Depth to water at end of test (ft):
Total drawdown (ft):
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft):
Overflow ☐

Comments: NS OBSERVATION WELL - ANNAPOLIS ROYAL (062)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 20-Dec-89

NOVA SCOTIA
Environment and Labour

Well Report

(Summary Log)

NSEL Well No. 891721
Well Type DRILLED

Certified Well Contractor

Name: MOWAT, DONALD
Certificate No.: 210
Company: MOWAT'S WELL DRILLING LTD.

Well Owner/Contractor Information

Well Drilled For: Owner: NS DEPT. OF ENVIRONMENT
or Contractor/Builder/Consultant, etc.:
Civic Address of Well: NS OBS WELL - HEBRON (063)
Lot Number: Subdivision:
County: YARMOUTH Postal Code:
Nearest Community in Altlas/Map Book: ATLAS DAYTON

Well Location

NS Atlas or Map Book Reference :
Atlas or Map Book: MAP
Map Page No.: 5
Reference Letter: A
Reference Number: 3
Roamer Letter: F
Roamer Number: 14

NTS Map Reference :
Map Sheet:
Reference Map:
Tract No.:
Claim:

GPS (WGS84 UTM) :
Northing (m): 4862322
Easting (m): 250697
Property (PID):
Well Location Sketch Available ☐

Depth in feet / Primary Lithology / Secondary Lithology

From	To	Colour 1	Description 1	Lithology 1	Colour 2	Description 2	Lithology 2	Water Found
0	3			TOPSOIL				☐
3	140			SLATE				☐
140	144			QUARTZITE				☐
144	150			SHALE				☐

Well Construction Information

Total depth below surface (ft): 150
Depth to bedrock (ft): 3
Water bearing fractures encountered at (ft): 57, 150
Outer Well Casing:
From (ft): 0 To (ft): 40
Diameter (in): 6
Length of casing above ground :
(ft): (in):
Driveshoe make:

Dug Well Information

Depth of liner (crock) (ft):
Reservoir material:
Reservoir vol. (cu.yd):
Reservoir material size:
Apron Material:
Apron depth (ft):
Apron thickness (ft):
Apron width (ft):
Apron volume (cu.yd):
Bottom material:

Water Yield

Estimated Yield (igpm): 45
Method: AIR LIFT
Rate (igpm): 45
Duration (hrs):
Depth to water at end of test (ft):
Total drawdown (ft):
Water level recovered to (ft):
Recovery time (hrs):
Depth to static level (ft):
Overflow ☐

Comments: NS OBSERVATION WELL - HEBRON (063)

Well Status/Water Use/Date Completed

Final status of well: OBSERVATION WELL
Water use: MONITORING
Method of drilling:
Date well completed: 19-Dec-89

APPENDIX B
GROUNDWATER CHEMISTRY RESULTS

Table B1. Summary of parameters which have been sampled at each well

Observation Well	General Chemistry	Metals	VOC	Pesticides	Tritium	Perchlorate
Greenwood (003)	✓	✓	✓	✓	✓	✓
Fraser Brook (004)	✓	✓	✓	✓		✓
Wolfville (010)	✓	✓	✓	✓	✓	✓
Truro (014)						
Monastery (028)	✓	✓	✓	✓	✓	✓
Point Aconi (030)	✓	✓	✓	✓	✓	✓
Lawrencetown (043)	✓	✓				
Durham (045)	✓	✓	✓	✓*	✓	✓
Kentville (048)	✓	✓		✓	✓	✓
Sydney (050)	✓	✓	✓	✓	✓	✓
Charleston (058)						
Hayden Lake (059)	✓	✓	✓	✓*	✓	✓
Annapolis Royal (062)	✓	✓	✓	✓	✓	✓
Hebron (063)	✓	✓	✓	✓*	✓	✓

Notes:
* = limited suite of pesticides analysed at this site

Table B2: General Chemistry and Metal Results

Parameter	Units	Drinking Water Guideline	Detection Limit	Greenwood (003)	Fraser Brook (004)	Wolfville (010)	Truro (014)	Monastery (028)
				23-Nov-2005	10-Dec-2004	22-Dec-2004		
General Chemistry								
Total Alkalinity (Total as CaCO3)	mg/L	-	5	ND	74	25	-	240
Chloride (Cl)	mg/L	250 AO	1	6	5	78	-	31
Colour	TCU	15 AO	5	5	ND	ND	-	ND
Hardness (CaCO3)	mg/L	500 AO		10	79.1	101	-	120
Nitrate + Nitrite	mg/L	10	0.05	ND	ND	1.9	-	ND
Nitrite (N)	mg/L	1	0.01	ND	ND	ND	-	ND
Nitrate (N)	mg/L	10	0.05	ND	ND	1.9	-	ND
Nitrogen (Ammonia Nitrogen)	mg/L	-	0.05	0.22	ND	ND	-	0.14
Total Organic Carbon (C)	mg/L	-	0.5	2	ND	ND	-	2.1
Orthophosphate (P)	mg/L	-	0.01	0.05	0.02	ND	-	ND
pH	pH	6.5 - 8.5 AO		6.41	7.6	6.5	-	8.14
Reactive Silica (SiO2)	mg/L		0.5	11	7.8	17	-	11
Sulphate (SO4)	mg/L	500 AO	2	9	5	12	-	72
Turbidity	NTU	5 AO	0.1	39	0.2	0.9	-	0.2
Conductivity	uS/cm	-		79	166	382	-	660
Anion Sum	me/L	-		0.372	1.73	3.08	-	7.13
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	1	ND	74	25	-	235
Calculated TDS	mg/L	-	1	40	94	196	-	417
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	1	ND	ND	ND	-	3
Cation Sum	me/L	-		0.549	1.78	3.3	-	7.51
Ion Balance (% Difference)	%	-		19.2	1.56	3.3	-	2.61
Langelier Index (@ 20C)	N/A	-		-	-0.68	-2.12	-	0.553
Langelier Index (@ 4C)	N/A	-		-	-1.08	-2.52	-	0.304
Saturation pH (@ 20C)	N/A	-		-	8.28	8.62	-	7.59
Saturation pH (@ 4C)	N/A	-		-	8.68	9.02	-	7.84
Calcium (Ca)	mg/L	-	0.1	2.2	19.3	27.4	-	31
Magnesium (Mg)	mg/L	-	0.1	1	7.5	7.8	-	9.3
Phosphorus (P)	mg/L	-	0.1	ND	ND	ND	-	ND
Potassium (K)	mg/L	-	0.1	2.4	1	2	-	2.3
Sodium (Na)	mg/L	200 AO	0.1	3.6	4	28.3	-	120
Bromide (Br)	mg/L	-	0.5	ND	0.03	0.06	-	ND
Fluoride (F)	mg/L	1.5	0.1	ND	ND	ND	-	0.3
Metals								
Aluminum (Al)	ug/L	-	10	47	ND	ND	-	ND
Antimony (Sb)	ug/L	6	2	ND	ND	ND	-	ND
Arsenic (As)	ug/L	10	2	2	14	ND	-	6
Barium (Ba)	ug/L	1000	5	59	5	69	-	25
Beryllium (Be)	ug/L	-	2	ND	ND	ND	-	ND
Bismuth (Bi)	ug/L	-	2	ND	ND	ND	-	ND
Boron (B)	ug/L	5000	5	ND	30	26	-	250
Cadmium (Cd)	ug/L	5	0.3	ND	ND	ND	-	ND
Chromium (Cr)	ug/L	50	2	ND	ND	ND	-	ND
Cobalt (Co)	ug/L	-	1	3	ND	ND	-	ND
Copper (Cu)	ug/L	1000 AO	2	3	ND	ND	-	7
Iron (Fe)	ug/L	300 AO	50	8700	ND	230	-	ND
Lead (Pb)	ug/L	10	0.5	1.7	ND	ND	-	ND
Manganese (Mn)	ug/L	50 AO	2	140	ND	14	-	42
Molybdenum (Mo)	ug/L	-	2	ND	ND	ND	-	3
Mercury (Hg)	ug/L		0.01					ND
Nickel (Ni)	ug/L	-	2	4	ND	ND	-	ND
Selenium (Se)	ug/L	10	2	ND	ND	ND	-	ND
Silver (Ag)	ug/L	-	0.5	ND	ND	ND	-	ND
Strontium (Sr)	ug/L	-	5	9	150	110	-	2400
Thallium (Tl)	ug/L	-	0.1	ND	ND	ND	-	ND
Tin (Sn)	ug/L	-	2	ND	ND	ND	-	ND
Titanium (Ti)	ug/L	-	2	ND	ND	ND	-	ND
Uranium (U)	ug/L	20	0.1	0.2	1.5	ND	-	0.6
Vanadium (V)	ug/L	-	2	ND	2	ND	-	ND
Zinc (Zn)	ug/L	5000 AO	5	87	ND	ND	-	34

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B2: General Chemistry and Metal Results

Parameter	Units	Drinking Water Guideline	Detection Limit	Point Aconi (030) 15-Sep-2005	Lawrencetown (043) 18-Nov-2004	Durham (045) 5-Oct-2005	Kentville (048) 15-Jun-2005	Sydney (050) 15-Sep-2005
General Chemistry								
Total Alkalinity (Total as CaCO3)	mg/L	-	5	140	82	140	20	83
Chloride (Cl)	mg/L	250 AO	1	19	150	44	230	7
Colour	TCU	15 AO	5	ND	ND	ND	ND	ND
Hardness (CaCO3)	mg/L	500 AO		140	98.9	86	150	87
Nitrate + Nitrite	mg/L	10	0.05	ND	ND	ND	1.2	0.17
Nitrite (N)	mg/L	1	0.01	ND	ND	ND	ND	ND
Nitrate (N)	mg/L	10	0.05	ND	ND	ND	1.2	0.17
Nitrogen (Ammonia Nitrogen)	mg/L	-	0.05	ND	0.19	0.11	0.06	ND
Total Organic Carbon (C)	mg/L	-	0.5	ND	ND	ND	ND	ND
Orthophosphate (P)	mg/L	-	0.01	ND	ND	ND	ND	ND
pH	pH	6.5 - 8.5 AO		8.01	7.3	8.16	6.84	8.03
Reactive Silica (SiO2)	mg/L		0.5	7.6	7.3	11	11	8.6
Sulphate (SO4)	mg/L	500 AO	2	10	ND	16	16	7
Turbidity	NTU	5 AO	0.1	ND	1	ND	5	0.3
Conductivity	uS/cm	-		380	695	410	910	210
Anion Sum	me/L	-		3.6	5.92	4.31	7.36	2.02
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	1	140	82	134	20.3	82
Calculated TDS	mg/L	-	1	207	341	243	223	115
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	1	1	ND	2	ND	ND
Cation Sum	me/L	-		4.11	6.19	4.22	8.18	2.07
Ion Balance (% Difference)	%	-		6.56	2.27	1.01	5.28	1.29
Langelier Index (@ 20C)	N/A	-		0.41	-0.85	0.382	-1.54	0.069
Langelier Index (@ 4C)	N/A	-		0.16	-1.25	0.132	-1.79	-0.182
Saturation pH (@ 20C)	N/A	-		7.6	8.15	7.78	8.38	7.96
Saturation pH (@ 4C)	N/A	-		7.85	8.55	8.03	8.63	8.21
Calcium (Ca)	mg/L	-	0.1	44	26.1	30	52	30
Magnesium (Mg)	mg/L	-	0.1	6.3	8.2	2.7	5.6	3
Phosphorus (P)	mg/L	-	0.1	ND	ND	0.1	ND (0.2)	ND
Potassium (K)	mg/L	-	0.1	4	1.9	1.6	4.9	1.7
Sodium (Na)	mg/L	200 AO	0.1	30	95.4	57	120	6.6
Bromide (Br)	mg/L	-	0.5		0.53	ND	ND	ND
Fluoride (F)	mg/L	1.5	0.1		0.11	0.3	ND	0.1
Metals								
Aluminum (Al)	ug/L	-	10	15	ND	16	ND	11
Antimony (Sb)	ug/L	6	2	ND	ND	ND	ND	ND
Arsenic (As)	ug/L	10	2	ND	56	4	ND	ND
Barium (Ba)	ug/L	1000	5	40	26	130	64	93
Beryllium (Be)	ug/L	-	2	ND	ND	ND	ND	ND
Bismuth (Bi)	ug/L	-	2	ND	ND	ND	ND	ND
Boron (B)	ug/L	5000	5	35	93	38	5.7	15
Cadmium (Cd)	ug/L	5	0.3	ND	ND	ND	ND	ND
Chromium (Cr)	ug/L	50	2	ND	ND	ND	ND	ND
Cobalt (Co)	ug/L	-	1	ND	ND	ND	ND	ND
Copper (Cu)	ug/L	1000 AO	2	6	ND	ND	ND	7
Iron (Fe)	ug/L	300 AO	50	ND	ND	ND	ND	80
Lead (Pb)	ug/L	10	0.5	0.6	ND	ND	ND	ND
Manganese (Mn)	ug/L	50 AO	2	360	16	21	ND	630
Molybdenum (Mo)	ug/L	-	2	ND	ND	8	ND	ND
Mercury (Hg)	ug/L		0.01					
Nickel (Ni)	ug/L	-	2	ND	ND	ND	ND	ND
Selenium (Se)	ug/L	10	2	ND	ND	ND	ND	ND
Silver (Ag)	ug/L	-	0.5	ND	ND	ND	ND	ND
Strontium (Sr)	ug/L	-	5	230	1100	1100	210	230
Thallium (Tl)	ug/L	-	0.1	ND	ND	ND	ND	ND
Tin (Sn)	ug/L	-	2	ND	ND	ND	ND	ND
Titanium (Ti)	ug/L	-	2	ND	ND	ND	ND	ND
Uranium (U)	ug/L	20	0.1	0.3	ND	0.7	ND	ND
Vanadium (V)	ug/L	-	2	ND	ND	ND	ND	ND
Zinc (Zn)	ug/L	5000 AO	5	18	ND	21	150	6

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B2: General Chemistry and Metal Results

Parameter	Units	Drinking Water Guideline	Detection Limit	Charleston (058)	Hayden Lake (059) 9-Jun-2005	Annapolis Royal (062) 9-Nov-2005	Hebron (063) 9-Jun-2005
General Chemistry							
Total Alkalinity (Total as CaCO3)	mg/L	-	5	-	14	52	23
Chloride (Cl)	mg/L	250 AO	1	-	9.2	6	49
Colour	TCU	15 AO	5	-	ND	ND	5.8
Hardness (CaCO3)	mg/L	500 AO		-	15	43	71
Nitrate + Nitrite	mg/L	10	0.05	-	ND	ND	ND
Nitrite (N)	mg/L	1	0.01	-	ND	ND	ND
Nitrate (N)	mg/L	10	0.05	-	ND	ND	ND
Nitrogen (Ammonia Nitrogen)	mg/L	-	0.05	-	ND	ND	ND
Total Organic Carbon (C)	mg/L	-	0.5	-	0.8	ND	1.2
Orthophosphate (P)	mg/L	-	0.01	-	ND	0.03	ND
pH	pH	6.5 - 8.5 AO		-	6.74	7.3	6.29
Reactive Silica (SiO2)	mg/L		0.5	-	5.9	14	17
Sulphate (SO4)	mg/L	500 AO	2	-	4.3	7	13
Turbidity	NTU	5 AO	0.1	-	ND	0.2	150
Conductivity	uS/cm	-		-	70	130	270
Anion Sum	me/L	-		-	0.622	1.38	2.12
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	1	-	13.6	52	23.2
Calculated TDS	mg/L	-	1	-	41.2	89	169
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	1	-	ND	ND	ND
Cation Sum	me/L	-		-	0.659	1.44	3.38
Ion Balance (% Difference)	%	-		-	2.9	2.2	22.9
Langelier Index (@ 20C)	N/A	-		-	-2.86	-1.15	-2.47
Langelier Index (@ 4C)	N/A	-		-	-3.11	-1.41	-2.72
Saturation pH (@ 20C)	N/A	-		-	9.6	8.45	8.76
Saturation pH (@ 4C)	N/A	-		-	9.85	8.71	9.01
Calcium (Ca)	mg/L	-	0.1	-	3.7	15	18
Magnesium (Mg)	mg/L	-	0.1	-	1.5	1.6	6.3
Phosphorus (P)	mg/L	-	0.1	-	ND	ND	ND
Potassium (K)	mg/L	-	0.1	-	0.9	1	1.7
Sodium (Na)	mg/L	200 AO	0.1	-	7.5	13	20
Bromide (Br)	mg/L	-	0.5	-	ND	ND	0.5
Fluoride (F)	mg/L	1.5	0.1	-	ND	0.2	ND
Metals							
Aluminum (Al)	ug/L	-	10	-	25	ND	ND
Antimony (Sb)	ug/L	6	2	-	ND	ND	ND
Arsenic (As)	ug/L	10	2	-	ND	4	ND
Barium (Ba)	ug/L	1000	5	-	7.4	52	14
Beryllium (Be)	ug/L	-	2	-	ND	ND	ND
Bismuth (Bi)	ug/L	-	2	-	ND	ND	ND
Boron (B)	ug/L	5000	5	-	6.9	12	8.8
Cadmium (Cd)	ug/L	5	0.3	-	ND	ND	ND
Chromium (Cr)	ug/L	50	2	-	ND	ND	ND
Cobalt (Co)	ug/L	-	1	-	ND	ND	ND
Copper (Cu)	ug/L	1000 AO	2	-	37	ND	ND
Iron (Fe)	ug/L	300 AO	50	-	ND	ND	27000
Lead (Pb)	ug/L	10	0.5	-	ND	ND	ND
Manganese (Mn)	ug/L	50 AO	2	-	13	110	440
Molybdenum (Mo)	ug/L	-	2	-	ND	4	ND
Mercury (Hg)	ug/L		0.01				
Nickel (Ni)	ug/L	-	2	-	ND	ND	ND
Selenium (Se)	ug/L	10	2	-	ND	ND	ND
Silver (Ag)	ug/L	-	0.5	-	ND	ND	ND
Strontium (Sr)	ug/L	-	5	-	19	59	91
Thallium (Tl)	ug/L	-	0.1	-	ND	ND	ND
Tin (Sn)	ug/L	-	2	-	ND	ND	ND
Titanium (Ti)	ug/L	-	2	-	ND	ND	ND
Uranium (U)	ug/L	20	0.1	-	ND	1.9	ND
Vanadium (V)	ug/L	-	2	-	ND	ND	ND
Zinc (Zn)	ug/L	5000 AO	5	-	21	ND	16

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B3: Volatile Organic Compound (VOC) Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Greenwood (Well 003) 23-Nov-2005	Fraser Brook (Well 004) 10-Dec-2004	Wolfville (Well 010) 22-Dec-2004	Truro (Well 014)	Monastery (Well 028)
CHLOROBENZENES							
1,2-Dichlorobenzene	200	0.5	ND	ND	ND	-	ND
1,3-Dichlorobenzene	-	1	ND	ND	ND	-	ND
1,4-Dichlorobenzene	5	1	ND	ND	ND	-	ND
Chlorobenzene	80	1	ND	ND	ND	-	ND
VOLATILES							
1,1,1-Trichloroethane	-	1	ND	ND	ND	-	ND
1,1,2,2-Tetrachloroethane	-	1	ND	ND	ND	-	ND
1,1,2-Trichloroethane	-	1	ND	ND	ND	-	ND
1,1-Dichloroethane	-	2	ND	ND	ND	-	ND
1,1-Dichloroethylene	14	2	ND	ND	ND	-	ND
1,2-Dichloroethane	5	1	ND	ND	ND	-	ND
1,2-Dichloropropane	-	1	ND	ND	ND	-	ND
Benzene	-	1	ND	ND	ND	-	ND
Bromodichloromethane	16	1	ND	ND	ND	-	ND
Bromoform	100	1	ND	ND	ND	-	ND
Bromomethane	-	8	ND	ND	ND	-	ND
Carbon Tetrachloride	5	1	ND	ND	ND	-	ND
Chloroethane	-	8	ND	ND	ND	-	ND
Chloroform	100	1	ND	ND	ND	-	ND
Chloromethane	-	8	ND	ND	ND	-	ND
cis-1,2-Dichloroethylene	-	2	ND	ND	ND	-	ND
cis-1,3-Dichloropropene	-	2	ND	ND	ND	-	ND
Dibromochloromethane	100	1	ND	ND	ND	-	ND
Ethylbenzene	2.4 AO	1	ND	ND	ND	-	ND
Ethylene Dibromide	-	1	ND	ND	ND	-	ND
Methylene Chloride(Dichloromethane)	-	3	ND	ND	ND	-	ND
o-Xylene	300 AO	1	ND	ND	ND	-	ND
p+m-Xylene	300 AO	2	ND	ND	ND	-	ND
Styrene	-	1	ND	ND	ND	-	ND
Tetrachloroethylene	30	1	ND	ND	ND	-	ND
Toluene	24 AO	1	ND	ND	ND	-	ND
trans-1,2-Dichloroethylene	-	2	ND	ND	ND	-	ND
trans-1,3-Dichloropropene	-	1	ND	ND	ND	-	ND
Trichloroethylene	50	1	ND	ND	ND	-	ND
Trichlorofluoromethane (FREON 11)	-	8	ND	ND	ND	-	ND
Vinyl Chloride	2	1	ND	ND	ND	-	ND

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B3: Volatile Organic Compound (VOC) Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Point Aconi (Well 030) 15-Sep-2005	Lawrencetown (Well 043) 18-Nov-2004	Durham (Well 045) 5-Oct-2005	Kentville (Well 048) 15-Jun-2005	Sydney (Well 050) 15-Sep-2005
CHLOROBENZENES							
1,2-Dichlorobenzene	200	0.5	ND	-	ND	-	ND
1,3-Dichlorobenzene	-	1	ND	-	ND	-	ND
1,4-Dichlorobenzene	5	1	ND	-	ND	-	ND
Chlorobenzene	80	1	ND	-	ND	-	ND
VOLATILES							
1,1,1-Trichloroethane	-	1	ND	-	ND	-	ND
1,1,2,2-Tetrachloroethane	-	1	ND	-	ND	-	ND
1,1,2-Trichloroethane	-	1	ND	-	ND	-	ND
1,1-Dichloroethane	-	2	ND	-	ND	-	ND
1,1-Dichloroethylene	14	2	ND	-	ND	-	ND
1,2-Dichloroethane	5	1	ND	-	ND	-	ND
1,2-Dichloropropane	-	1	ND	-	ND	-	ND
Benzene	-	1	ND	-	ND	-	ND
Bromodichloromethane	16	1	ND	-	ND	-	ND
Bromoform	100	1	ND	-	ND	-	ND
Bromomethane	-	8	ND	-	ND	-	ND
Carbon Tetrachloride	5	1	ND	-	ND	-	ND
Chloroethane	-	8	ND	-	ND	-	ND
Chloroform	100	1	ND	-	ND	-	ND
Chloromethane	-	8	ND	-	ND	-	ND
cis-1,2-Dichloroethylene	-	2	ND	-	ND	-	ND
cis-1,3-Dichloropropene	-	2	ND	-	ND	-	ND
Dibromochloromethane	100	1	ND	-	ND	-	ND
Ethylbenzene	2.4 AO	1	ND	-	ND	-	ND
Ethylene Dibromide	-	1	ND	-	ND	-	ND
Methylene Chloride(Dichloromethane)	-	3	ND	-	ND	-	ND
o-Xylene	300 AO	1	ND	-	ND	-	ND
p+m-Xylene	300 AO	2	ND	-	ND	-	ND
Styrene	-	1	ND	-	ND	-	ND
Tetrachloroethylene	30	1	ND	-	ND	-	ND
Toluene	24 AO	1	ND	-	ND	-	ND
trans-1,2-Dichloroethylene	-	2	ND	-	ND	-	ND
trans-1,3-Dichloropropene	-	1	ND	-	ND	-	ND
Trichloroethylene	50	1	ND	-	ND	-	ND
Trichlorofluoromethane (FREON 11)	-	8	ND	-	ND	-	ND
Vinyl Chloride	2	1	ND	-	ND	-	ND

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in bra
All guidelines are health-based MACs or IMACs, unless otherw
Shaded values exceed guidelines.

Table B3: Volatile Organic Compound (VOC) Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Charleston (Well 058)	Hayden Lake (Well 059)	Annapolis Royal (Well 062)	Hebron (Well 063)
				9-Jun-2005	9-Nov-2005	9-Jun-2005
CHLOROBENZENES						
1,2-Dichlorobenzene	200	0.5	-	ND	ND	ND
1,3-Dichlorobenzene	-	1	-	ND	ND	ND
1,4-Dichlorobenzene	5	1	-	ND	ND	ND
Chlorobenzene	80	1	-	ND	ND	ND
VOLATILES						
1,1,1-Trichloroethane	-	1	-	ND	ND	ND
1,1,2,2-Tetrachloroethane	-	1	-	ND	ND	ND
1,1,2-Trichloroethane	-	1	-	ND	ND	ND
1,1-Dichloroethane	-	2	-	ND	ND	ND
1,1-Dichloroethylene	14	2	-	ND	ND	ND
1,2-Dichloroethane	5	1	-	ND	ND	ND
1,2-Dichloropropane	-	1	-	ND	ND	ND
Benzene	-	1	-	ND	ND	ND
Bromodichloromethane	16	1	-	ND	ND	ND
Bromoform	100	1	-	ND	ND	ND
Bromomethane	-	8	-	ND	ND	ND
Carbon Tetrachloride	5	1	-	ND	ND	ND
Chloroethane	-	8	-	ND	ND	ND
Chloroform	100	1	-	3.2	ND (2)	ND
Chloromethane	-	8	-	ND	ND	ND
cis-1,2-Dichloroethylene	-	2	-	ND	ND	ND
cis-1,3-Dichloropropene	-	2	-	ND	ND	ND
Dibromochloromethane	100	1	-	ND	ND	ND
Ethylbenzene	2.4 AO	1	-	ND	ND	ND
Ethylene Dibromide	-	1	-	ND	ND	ND
Methylene Chloride(Dichloromethane)	-	3	-	ND	ND	ND
o-Xylene	300 AO	1	-	ND	ND	ND
p+m-Xylene	300 AO	2	-	ND	ND	ND
Styrene	-	1	-	ND	ND	ND
Tetrachloroethylene	30	1	-	ND	ND	ND
Toluene	24 AO	1	-	ND	2	ND
trans-1,2-Dichloroethylene	-	2	-	ND	ND	ND
trans-1,3-Dichloropropene	-	1	-	ND	ND	ND
Trichloroethylene	50	1	-	ND	ND	ND
Trichlorofluoromethane (FREON 11)	-	8	-	ND	ND	ND
Vinyl Chloride	2	1	-	ND	ND	ND

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in bra
All guidelines are health-based MACs or IMACs, unless otherw
Shaded values exceed guidelines.

Table B4: Pesticide Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Greenwood (Well 003) 23-Nov-2005	Fraser Brook (Well 004) 10-Dec-2004	Wolfville (Well 010) 22-Dec-2004	Truro (Well 014)	Monastery (Well 028)
Herbicides							
Atrazine	5	0.2	ND	ND	ND	-	ND
De-ethyl Atrazine		0.3	ND	ND	ND	-	ND
Butylate		0.5	ND	ND	ND	-	ND
Cyanazine	10	0.5	ND	ND	ND	-	ND
Desmetryn		0.3	ND	ND	ND	-	ND
Diphenylamine		0.1	ND	ND	ND	-	ND
Eptam		0.5	ND	ND	ND	-	ND
Ethalfluralin		0.5	ND	ND	ND	-	ND
Hexazinone		0.1	ND	ND	ND	-	ND
Metalaxyl		0.3	ND	ND	ND	-	ND
Metribuzin	80	0.3	ND	ND	ND	-	ND
Metolachlor	50	0.2	ND	ND	ND	-	ND
Pirimicarb		0.5	ND	ND	ND	-	ND
Profluralin		0.5	ND	ND	ND	-	ND
Prometryn		0.2	ND	ND	ND	-	ND
Propazine		0.1	ND	ND	ND	-	ND
Simazine	10	0.5	ND	ND	ND	-	ND
Terbuthylazine		0.1	ND	ND	ND	-	ND
Terbutryn		0.2	ND	ND	ND	-	ND
Triallate		0.3	ND	ND	ND	-	ND
Triadimefon		0.3	ND	ND	ND	-	ND
Trifluralin	45	0.2	ND	ND	ND	-	ND
Organochlorine Pesticides							
Alachlor		0.5	ND	ND	ND	-	ND
Aldrin + Dieldrin	0.7	0.5	ND	ND	ND	-	ND
BHC, alpha-		0.3	ND	ND	ND	-	ND
BHC, beta-		0.3	ND	ND	ND	-	ND
Captan		1	ND	ND	ND	-	ND
Chlorbenside		0.1	ND	ND	ND	-	ND
Chlordane, alpha-		0.5	ND	ND	ND	-	ND
Chlordane, gamma-		0.5	ND	ND	ND	-	ND
Chlorfenson (Ovex)		0.2	ND	ND	ND	-	ND
Chlorothalonil (Daconil)		1	ND	ND	ND	-	ND
Chlorpropham		0.2	ND	ND	ND	-	ND
Dacthal (DCPA)		0.1	ND	ND	ND	-	ND
4,4'-DDE		0.01	ND (0.1)	ND (0.1)	ND (0.1)	-	ND (0.1)
DDT - orthopara (2,4')		0.01	ND (0.2)	ND (0.2)	ND (0.2)	-	ND (0.2)
DDT - parapara (4,4')		0.01	ND (0.2)	ND (0.2)	ND (0.2)	-	ND (0.2)
Diallate(e/z)		0.5	ND	ND	ND	-	ND
Dichlobenil		0.2	ND	ND	ND	-	ND
Dichloran		0.5	ND	ND	ND	-	ND
Dichlofluanid		0.5	ND	ND	ND	-	ND
Dicofol		0.2	ND	ND	ND	-	ND
Endosulfan I		0.5	ND	ND	ND	-	ND
Endosulfan II		0.5	ND	ND	ND	-	ND
Endosulfan Sulphate		0.5	ND	ND	ND	-	ND
Endrin		0.5	ND	ND	ND	-	ND
Folpet		1	ND	ND	ND	-	ND
Heptachlor		0.5	ND	ND	ND	-	ND
Lindane (BHC), gamma-		0.5	ND	ND	ND	-	ND
Methidathion		0.3	ND	ND	ND	-	ND
Methoxychlor	900	0.1	ND	ND	ND	-	
Mirex		0.3	ND	ND	ND	-	ND
Nitrofen		0.2	ND	ND	ND	-	ND
Permethrin-cis/trans		0.5	ND	ND	ND	-	ND
Procymidone		0.2	ND	ND	ND	-	ND
Pronamide		0.2	ND	ND	ND	-	ND
Quintozene (Pentachloronitrobenzene)		0.5	ND	-	-	-	
Tecnazene		0.5	ND	ND	ND	-	ND
Tetradifon		0.2	ND	ND	ND	-	ND
Tolylfluanid		0.5	ND	ND	ND	-	ND
Vinclozolin		0.5	ND	ND	ND	-	ND

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B4: Pesticide Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Point Aconi (Well 030) 15-Sep-2005	Lawrencetown (Well 043) 18-Nov-2004	Durham (Well 045) 5-Oct-2005	Kentville (Well 048) 15-Jun-2005	Sydney (Well 050) 15-Sep-2005
Herbicides							
Atrazine	5	0.2	ND	-	ND	ND (1)	ND
De-ethyl Atrazine		0.3	ND	-	ND	-	ND
Butylate		0.5	ND	-	ND	-	ND
Cyanazine	10	0.5	ND	-	ND	-	ND
Desmetryn		0.3	ND	-	ND	-	ND
Diphenylamine		0.1	ND	-	ND	-	ND
Eptam		0.5	ND	-	ND	-	ND
Ethalfluralin		0.5	ND	-	ND	-	ND
Hexazinone		0.1	ND	-	ND	-	ND
Metalaxyl		0.3	ND	-	ND	-	ND
Metribuzin	80	0.3	ND	-	ND	-	ND
Metolachlor	50	0.2	ND	-	ND	-	ND
Pirimicarb		0.5	ND	-	ND	-	ND
Profluralin		0.5	ND	-	ND	-	ND
Prometryn		0.2	ND	-	ND	-	ND
Propazine		0.1	ND	-	ND	-	ND
Simazine	10	0.5	ND	-	ND	-	ND
Terbuthylazine		0.1	ND	-	ND	-	ND
Terbutryn		0.2	ND	-	ND	-	ND
Triallate		0.3	ND	-	ND	-	ND
Triadimefon		0.3	ND	-	ND	-	ND
Trifluralin	45	0.2	ND	-	ND	-	ND
Organochlorine Pesticides							
Alachlor		0.5	ND	-	ND	-	ND
Aldrin + Dieldrin	0.7	0.5	ND	-	ND	-	ND
BHC, alpha-		0.3	ND	-	ND	-	ND
BHC, beta-		0.3	ND	-	ND	-	ND
Captan		1	ND	-	ND	-	ND
Chlorbenside		0.1	ND	-	ND	-	ND
Chlordane, alpha-		0.5	ND	-	ND	-	ND
Chlordane, gamma-		0.5	ND	-	ND	-	ND
Chlorfenson (Ovex)		0.2	ND	-	ND	-	ND
Chlorothalonil (Daconil)		1	ND	-	ND	-	ND
Chlorpropham		0.2	ND	-	ND	-	ND
Dacthal (DCPA)		0.1	ND	-	ND	-	ND
4,4'-DDE		0.01	ND (0.1)	-	ND (0.1)	ND	ND (0.1)
DDT - orthopara (2,4')		0.01	ND (0.2)	-	ND (0.2)	ND	ND (0.2)
DDT - parapara (4,4')		0.01	ND (0.2)	-	ND (0.2)	ND	ND (0.2)
Diallate(e/z)		0.5	ND	-	ND	-	ND
Dichlobenil		0.2	ND	-	ND	-	ND
Dichloran		0.5	ND	-	ND	-	ND
Dichlofluanid		0.5	ND	-	ND	-	ND
Dicofol		0.2	ND	-	ND	-	ND
Endosulfan I		0.5	ND	-	ND	-	ND
Endosulfan II		0.5	ND	-	ND	-	ND
Endosulfan Sulphate		0.5	ND	-	ND	-	ND
Endrin		0.5	ND	-	ND	-	ND
Folpet		1	ND	-	ND	-	ND
Heptachlor		0.5	ND	-	ND	-	ND
Lindane (BHC), gamma-		0.5	ND	-	ND	-	ND
Methidathion		0.3	ND	-	ND	-	ND
Methoxychlor	900	0.1	ND	-	ND	-	ND
Mirex		0.3	ND	-	ND	-	ND
Nitrofen		0.2	ND	-	ND	-	ND
Permethrin-cis/trans		0.5	ND	-	ND	-	ND
Procymidone		0.2	ND	-	ND	-	ND
Pronamide		0.2	ND	-	ND	-	ND
Quintozene (Pentachloronitrobenzene)		0.5	ND	-	ND	-	ND
Tecnazene		0.5	ND	-	ND	-	ND
Tetradifon		0.2	ND	-	ND	-	ND
Tolylfluanid		0.5	ND	-	ND	-	ND
Vinclozolin		0.5	ND	-	ND	-	ND

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B4: Pesticide Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Charleston (Well 058)	Hayden Lake (Well 059)	Annapolis Royal (Well 062)	Hebron (Well 063)
				9-Jun-2005	9-Nov-2005	9-Jun-2005
Herbicides						
Atrazine	5	0.2	-	ND (2.5)	ND	ND (2.5)
De-ethyl Atrazine		0.3	-	-	ND	-
Butylate		0.5	-	-	ND	-
Cyanazine	10	0.5	-	-	ND	-
Desmetryn		0.3	-	-	ND	-
Diphenylamine		0.1	-	-	ND	-
Eptam		0.5	-	-	ND	-
Ethalfluralin		0.5	-	-	ND	-
Hexazinone		0.1	-	-	ND	-
Metalaxyl		0.3	-	-	ND	-
Metribuzin	80	0.3	-	-	ND	-
Metolachlor	50	0.2	-	-	ND	-
Pirimicarb		0.5	-	-	ND	-
Profluralin		0.5	-	-	ND	-
Prometryn		0.2	-	-	ND	-
Propazine		0.1	-	-	ND	-
Simazine	10	0.5	-	-	ND	-
Terbuthylazine		0.1	-	-	ND	-
Terbutryn		0.2	-	-	ND	-
Triallate		0.3	-	-	ND	-
Triadimefon		0.3	-	-	ND	-
Trifluralin	45	0.2	-	-	ND	-
Organochlorine Pesticides						
Alachlor		0.5	-	-	ND	-
Aldrin + Dieldrin	0.7	0.5	-	-	ND	-
BHC, alpha-		0.3	-	-	ND	-
BHC, beta-		0.3	-	-	ND	-
Captan		1	-	-	ND	-
Chlorbenside		0.1	-	-	ND	-
Chlordane, alpha-		0.5	-	-	ND	-
Chlordane, gamma-		0.5	-	-	ND	-
Chlorfenson (Ovex)		0.2	-	-	ND	-
Chlorothalonil (Daconil)		1	-	-	ND	-
Chlorpropham		0.2	-	-	ND	-
Dacthal (DCPA)		0.1	-	-	ND	-
4,4'-DDE		0.01	-	ND	ND (0.1)	ND
DDT - orthopara (2,4')		0.01	-	ND	ND (0.2)	ND
DDT - parapara (4,4')		0.01	-	ND	ND (0.2)	ND
Diallate(e/z)		0.5	-	-	ND	-
Dichlobenil		0.2	-	-	ND	-
Dichloran		0.5	-	-	ND	-
Dichlofluanid		0.5	-	-	ND	-
Dicofol		0.2	-	-	ND	-
Endosulfan I		0.5	-	-	ND	-
Endosulfan II		0.5	-	-	ND	-
Endosulfan Sulphate		0.5	-	-	ND	-
Endrin		0.5	-	-	ND	-
Folpet		1	-	-	ND	-
Heptachlor		0.5	-	-	ND	-
Lindane (BHC), gamma-		0.5	-	-	ND	-
Methidathion		0.3	-	-	ND	-
Methoxychlor	900	0.1	-	-	ND	-
Mirex		0.3	-	-	ND	-
Nitrofen		0.2	-	-	ND	-
Permethrin-cis/trans		0.5	-	-	ND	-
Procymidone		0.2	-	-	ND	-
Pronamide		0.2	-	-	ND	-
Quintozene (Pentachloronitrobenzene)		0.5	-	-	ND	-
Tecnazene		0.5	-	-	ND	-
Tetradifon		0.2	-	-	ND	-
Tolylfluanid		0.5	-	-	ND	-
Vinclozolin		0.5	-	-	ND	-

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B4: Pesticide Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Greenwood (Well 003) 23-Nov-2005	Fraser Brook (Well 004) 10-Dec-2004	Wolfville (Well 010) 22-Dec-2004	Truro (Well 014)	Monastery (Well 028)
Organophosphorus Pesticides							
Aspon		0.2	ND	ND	ND	-	ND
Azinphos ethyl		0.5	ND	ND	ND	-	ND
Azinphos methyl	20	1	ND	ND	ND	-	ND
Bromacil		0.1	ND	ND	ND	-	ND (1)
Benfluralin		0.1	ND	ND	ND	-	ND
Bromophos		0.1	ND	ND	ND	-	ND
Bromophos-ethyl		0.3	ND	ND	ND	-	ND
Carbophenothion		0.3	ND	ND	ND	-	ND
Chlorfenvinphos(e/z)		0.1	ND	ND	ND	-	ND
Chlormephos		0.5	ND	ND	ND	-	ND
Chlorpyrifos	90	0.2	ND	ND	ND	-	ND
Chlorpyriphos-methyl		0.1	ND	ND	ND	-	ND
Chlorthiophos		0.3	ND	ND	ND	-	ND
Cyanophos		0.2	ND	ND	ND	-	ND
Demeton		1	ND	ND	ND	-	ND
Diazinon	20	0.3	ND	ND	ND	-	ND
Dichlofenthion		0.2	ND	ND	ND	-	ND
Dichlorvos/Naled		0.1	ND	ND	ND	-	ND
Dicrotophos		0.5	ND	ND	ND	-	ND
Dimethoate	20	0.5	ND	ND	ND	-	ND
Dioxathion		1	ND	ND	ND	-	ND
Disulfoton (Di-Syston)		1	ND	ND	ND	-	ND
EPN		0.5	ND	ND	ND	-	ND
Ethion		0.2	ND	ND	ND	-	ND
Fenchlorphos (Ronnel)		0.1	ND	ND	ND	-	
Fenitrothion		0.5	ND	ND	ND	-	ND
Fensulfothion		0.1	ND	ND	ND	-	ND
Fenthion		0.1	ND	ND	ND	-	ND
Fonofos		0.1	ND	ND	ND	-	ND
Iodofenphos		0.1	ND	ND	ND	-	ND
Isofenphos		0.3	ND	ND	ND	-	ND
Malaoxon		1	ND	ND	ND	-	ND
Malathion	190	0.5	ND	ND	ND	-	ND
Mevinphos-cis/trans (Phosdrin)		0.1	ND	ND	ND	-	ND
Omethoate		1	ND	ND	ND	-	ND
Parathion	50	0.5	ND	ND	ND	-	ND
Parathion methyl		0.5	ND	ND	ND	-	ND
Phorate (Thimet)	2	0.5	ND	ND	ND	-	ND
Phosalone		0.2	ND	ND	ND	-	ND
Phosmet		0.2	ND	ND	ND	-	ND
Phosphamidon		0.2	ND	ND	ND	-	ND
Pirimiphos-ethyl		0.5	ND	ND	ND	-	ND
Pirimiphos-methyl		0.2	ND	ND	ND	-	ND
Profenophos		0.5	ND	ND	ND	-	ND
Pyrazophos		0.1	ND	ND	ND	-	ND
Quinalphos		0.3	ND	ND	ND	-	ND
Sulfotep		0.1	ND	ND	ND	-	ND
Terbufos	1	0.3	ND	ND	ND	-	ND
Tetrachlorvinphos (Stirophos)		0.2	ND	-	-	-	
Other							
Hexachlorobenzene		0.2	ND	ND	ND	-	ND

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B4: Pesticide Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Point Aconi (Well 030) 15-Sep-2005	Lawrencetown (Well 043) 18-Nov-2004	Durham (Well 045) 5-Oct-2005	Kentville (Well 048) 15-Jun-2005	Sydney (Well 050) 15-Sep-2005
Organophosphorus Pesticides							
Aspon		0.2	ND	-	ND	-	ND
Azinphos ethyl		0.5	ND	-	ND	-	ND
Azinphos methyl	20	1	ND	-	ND	-	ND
Bromacil		0.1	ND	-	ND	-	ND
Benfluralin		0.1	ND	-	ND	-	ND
Bromophos		0.1	ND	-	ND	-	ND
Bromophos-ethyl		0.3	ND	-	ND	-	ND
Carbophenothion		0.3	ND	-	ND	-	ND
Chlorfenvinphos(e/z)		0.1	ND	-	ND	-	ND
Chlormephos		0.5	ND	-	ND	-	ND
Chlorpyrifos	90	0.2	ND	-	ND	-	ND
Chlorpyriphos-methyl		0.1	ND	-	ND	-	ND
Chlorthiophos		0.3	ND	-	ND	-	ND
Cyanophos		0.2	ND	-	ND	-	ND
Demeton		1	ND	-	ND	-	ND
Diazinon	20	0.3	ND	-	ND	ND (2)	ND
Dichlofenthion		0.2	ND	-	ND	-	ND
Dichlorvos/Naled		0.1	ND	-	ND	-	ND
Dicrotophos		0.5	ND	-	ND	-	ND
Dimethoate	20	0.5	ND	-	ND	-	ND
Dioxathion		1	ND	-	ND	-	ND
Disulfoton (Di-Syston)		1	ND	-	ND	-	ND
EPN		0.5	ND	-	ND	-	ND
Ethion		0.2	ND	-	ND	-	ND
Fenchlorphos (Ronnel)		0.1	ND	-	ND	-	ND
Fenitrothion		0.5	ND	-	ND	-	ND
Fensulfothion		0.1	ND	-	ND	-	ND
Fenthion		0.1	ND	-	ND	-	ND
Fonofos		0.1	ND	-	ND	-	ND
Iodofenphos		0.1	ND	-	ND	-	ND
Isofenphos		0.3	ND	-	ND	-	ND
Malaoxon		1	ND	-	ND	-	ND
Malathion	190	0.5	ND	-	ND	ND (2)	ND
Mevinphos-cis/trans (Phosdrin)		0.1	ND	-	ND	-	ND
Omethoate		1	ND	-	ND	-	ND
Parathion	50	0.5	ND	-	ND	ND (2)	ND
Parathion methyl		0.5	ND	-	ND	ND (2)	ND
Phorate (Thimet)	2	0.5	ND	-	ND	-	ND
Phosalone		0.2	ND	-	ND	-	ND
Phosmet		0.2	ND	-	ND	-	ND
Phosphamidon		0.2	ND	-	ND	-	ND
Pirimiphos-ethyl		0.5	ND	-	ND	-	ND
Pirimiphos-methyl		0.2	ND	-	ND	-	ND
Profenophos		0.5	ND	-	ND	-	ND
Pyrazophos		0.1	ND	-	ND	-	ND
Quinalphos		0.3	ND	-	ND	-	ND
Sulfotep		0.1	ND	-	ND	-	ND
Terbufos	1	0.3	ND	-	ND	-	ND
Tetrachlorvinphos (Stirophos)		0.2	ND	-	ND	-	ND
Other							
Hexachlorobenzene		0.2	ND	-	ND	-	ND

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B4: Pesticide Results (ug/L)

Parameter	Drinking Water Guideline	Detection Limit	Charleston (Well 058)	Hayden Lake (Well 059)	Annapolis Royal (Well 062)	Hebron (Well 063)
				9-Jun-2005	9-Nov-2005	9-Jun-2005
Organophosphorus Pesticides						
Aspon		0.2	-	-	ND	-
Azinphos ethyl		0.5	-	-	ND	-
Azinphos methyl	20	1	-	-	ND	-
Bromacil		0.1	-	-	ND	-
Benfluralin		0.1	-	-	ND	-
Bromophos		0.1	-	-	ND	-
Bromophos-ethyl		0.3	-	-	ND	-
Carbophenothion		0.3	-	-	ND	-
Chlorfenvinphos(e/z)		0.1	-	-	ND	-
Chlormephos		0.5	-	-	ND	-
Chlorpyrifos	90	0.2	-	-	ND	-
Chlorpyriphos-methyl		0.1	-	-	ND	-
Chlorthiophos		0.3	-	-	ND	-
Cyanophos		0.2	-	-	ND	-
Demeton		1	-	-	ND	-
Diazinon	20	0.3	-	ND (5)	ND	ND (5)
Dichlofenthion		0.2	-	-	ND	-
Dichlorvos/Naled		0.1	-	-	ND	-
Dicrotophos		0.5	-	-	ND	-
Dimethoate	20	0.5	-	-	ND	-
Dioxathion		1	-	-	ND	-
Disulfoton (Di-Syston)		1	-	-	ND	-
EPN		0.5	-	-	ND	-
Ethion		0.2	-	-	ND	-
Fenchlorphos (Ronnel)		0.1	-	-	ND	-
Fenitrothion		0.5	-	-	ND	-
Fensulfothion		0.1	-	-	ND	-
Fenthion		0.1	-	-	ND	-
Fonofos		0.1	-	-	ND	-
Iodofenphos		0.1	-	-	ND	-
Isofenphos		0.3	-	-	ND	-
Malaoxon		1	-	-	ND	-
Malathion	190	0.5	-	ND (5)	ND	ND (5)
Mevinphos-cis/trans (Phosdrin)		0.1	-	-	ND	-
Omethoate		1	-	-	ND	-
Parathion	50	0.5	-	ND (5)	ND	ND (5)
Parathion methyl		0.5	-	ND (5)	ND	ND (5)
Phorate (Thimet)	2	0.5	-	-	ND	-
Phosalone		0.2	-	-	ND	-
Phosmet		0.2	-	-	ND	-
Phosphamidon		0.2	-	-	ND	-
Pirimiphos-ethyl		0.5	-	-	ND	-
Pirimiphos-methyl		0.2	-	-	ND	-
Profenophos		0.5	-	-	ND	-
Pyrazophos		0.1	-	-	ND	-
Quinalphos		0.3	-	-	ND	-
Sulfotep		0.1	-	-	ND	-
Terbufos	1	0.3	-	-	ND	-
Tetrachlorvinphos (Stirophos)		0.2	-	-	ND	-
Other						
Hexachlorobenzene		0.2	-	-	ND	-

Notes:
AO = Aesthetic Objective.
ND = not detected
ND( ) = not detected at the elevated detection limit shown in brackets ( )
All guidelines are health-based MACs or IMACs, unless otherwise indicated.
Shaded values exceed guidelines.

Table B5: Tritium Results

Observation Well	Date Sampled	Tritium Level (TU)	Accuracy (+/- TU)	Age Estimate (Recent is >1952)
Greenwood (003)	23-Nov-05	5.76	0.47	Recent
Wolfville (010)	22-Dec-04	4.7	0.4	Mix/Recent
Monastery (028)	15-Dec-06	0.94	0.17	Old
Point Aconi (030)	15-Sep-05	3.62	0.34	Mix
Durham (045)	05-Oct-05	2.04	0.28	Mix
Kentville (048)	15-Jun-05	3.8	0.3	Mix
Sydney (050)	15-Sep-05	4.92	0.43	Mix/Recent
Hayden Lake (059)	09-Jun-05	3.4	0.3	Mix
Annapolis Royal (062)	09-Nov-05	0.27	0.17	Old
Hebron (063)	09-Jun-05	4.6	0.4	Mix/Recent

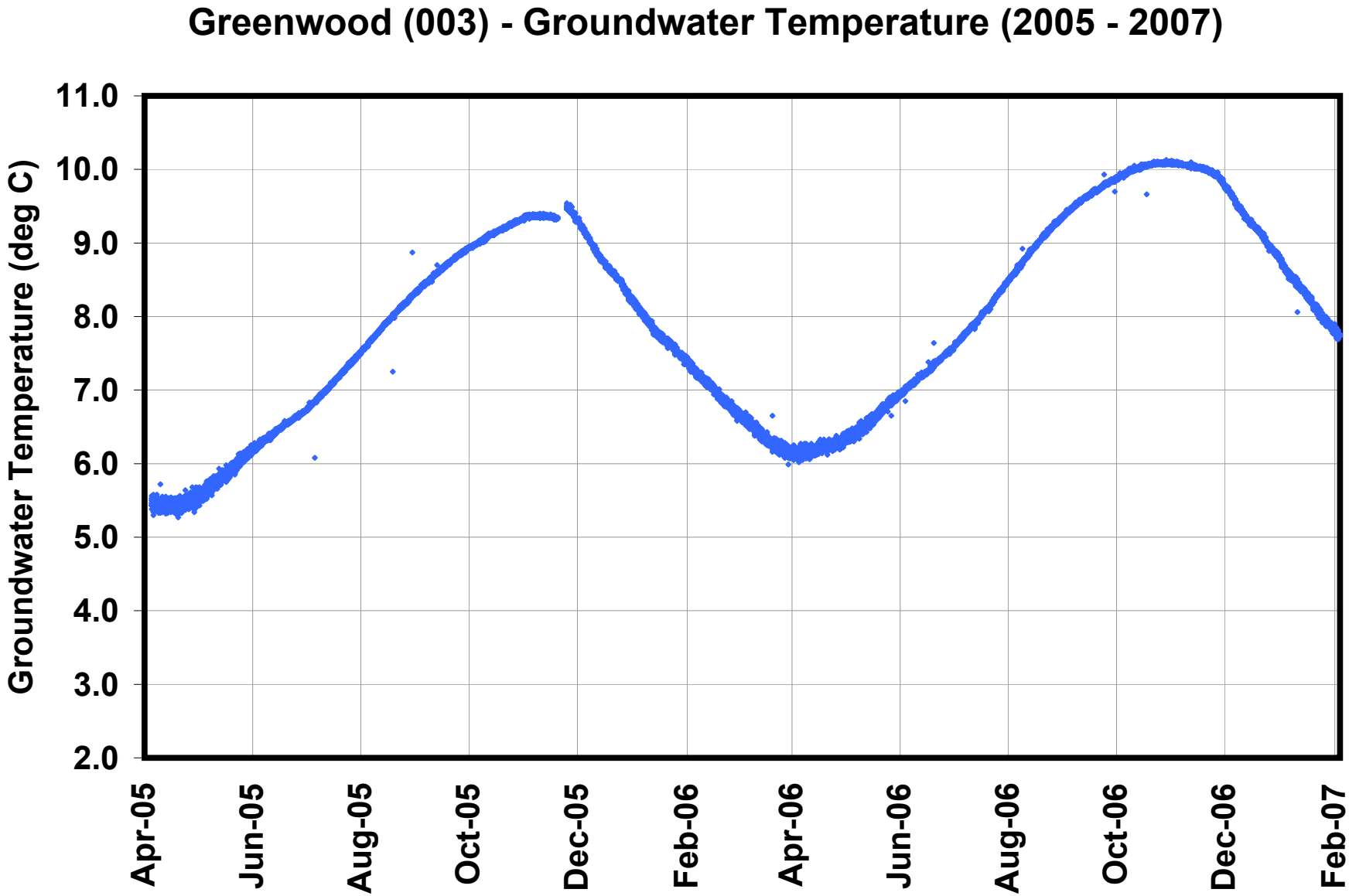
Age Estimate Guide	Tritium Level (TU)
Recent (recharged after 1952) =	>5
Mixture of recent and old =	1 to 5
Old (recharged before 1952) =	<1
Source: Clark and Fritz, 1997	

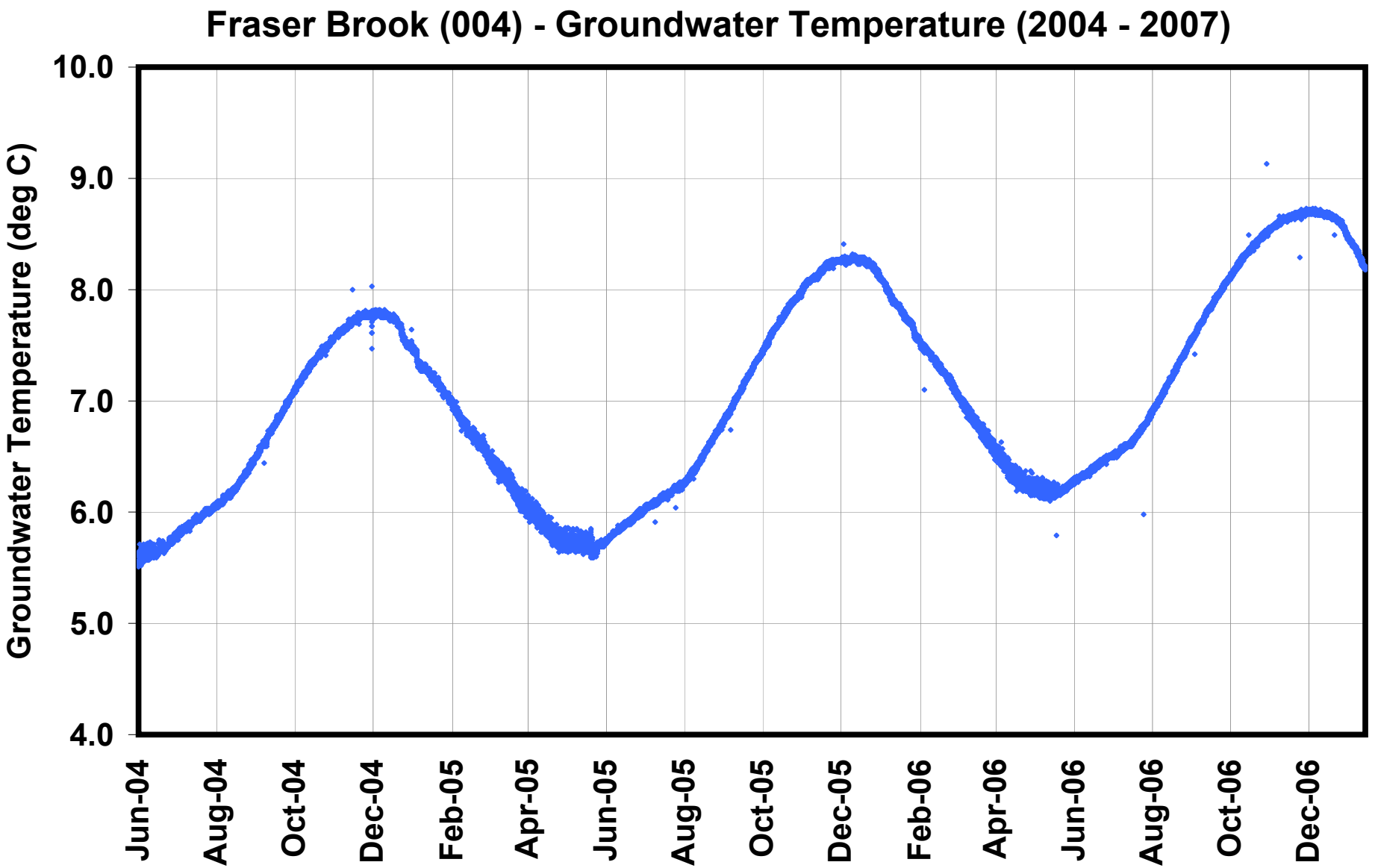
Table B6: Perchlorate Results

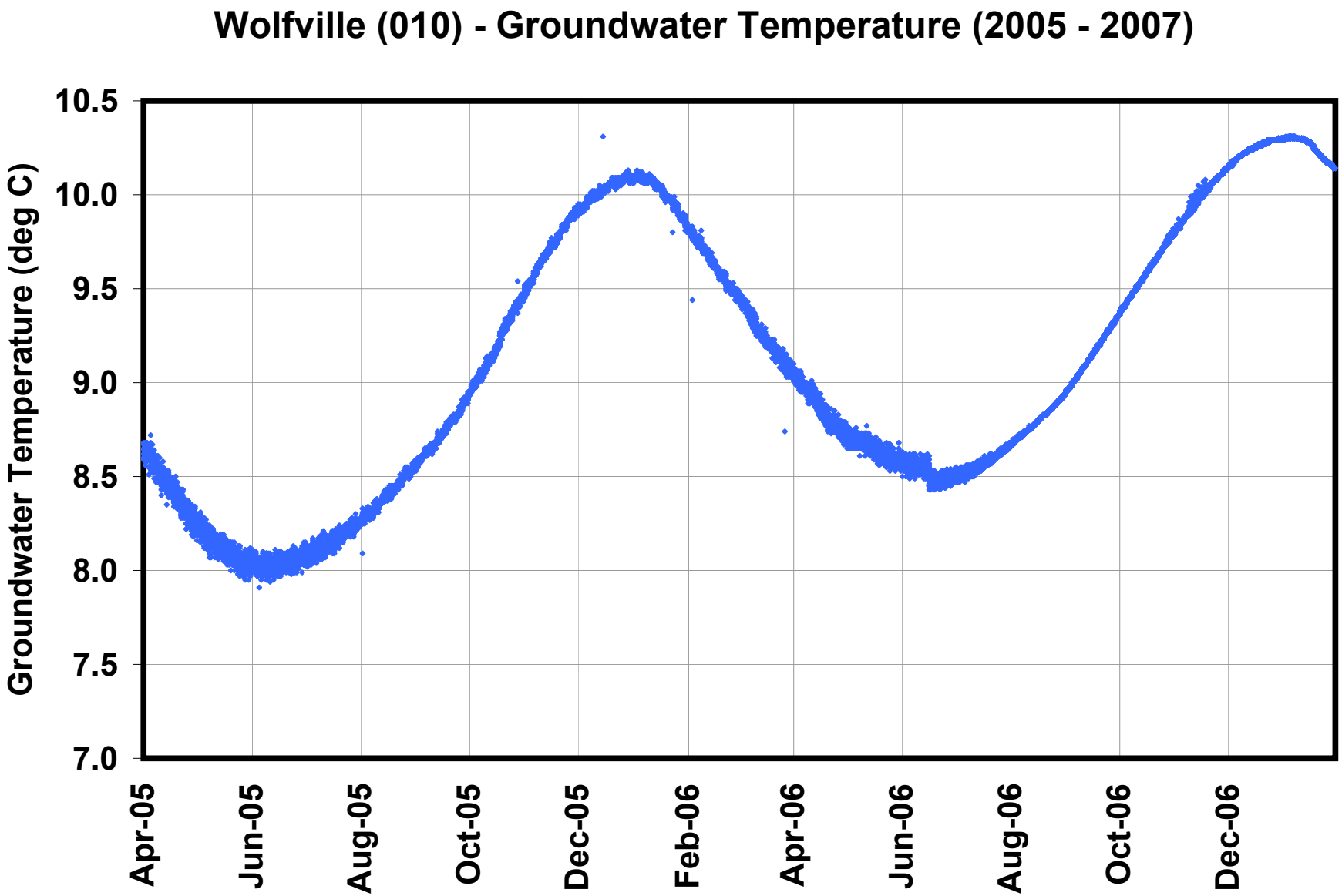
Observation Well	Date Sampled	Recommended Guidance Value (Health Canada, 2007) (ug/L)	Detection Limit (ug/L)	Perchlorate Result (ug/L)
Greenwood (003)	23-Nov-2005	6	0.011	ND
Fraser Brook (004)	10-Dec-2004	6	0.2	ND
Wolfville (010)	22-Dec-2004	6	0.2	ND
Monastery (028)	15-Dec-2006	6	0.011	ND
Point Aconi (030)	15-Sep-2005	6	0.011	ND
Durham (045)	5-Oct-2005	6	0.011	ND
Kentville (048)	15-Jun-2005	6	0.011	0.05
Sydney (050)	15-Sep-2005	6	0.011	ND
Hayden Lake (059)	9-Jun-2005	6	0.011	0.014
Annapolis Royal (062)	9-Nov-2005	6	0.011	ND
Hebron (063)	9-Jun-2005	6	0.011	ND

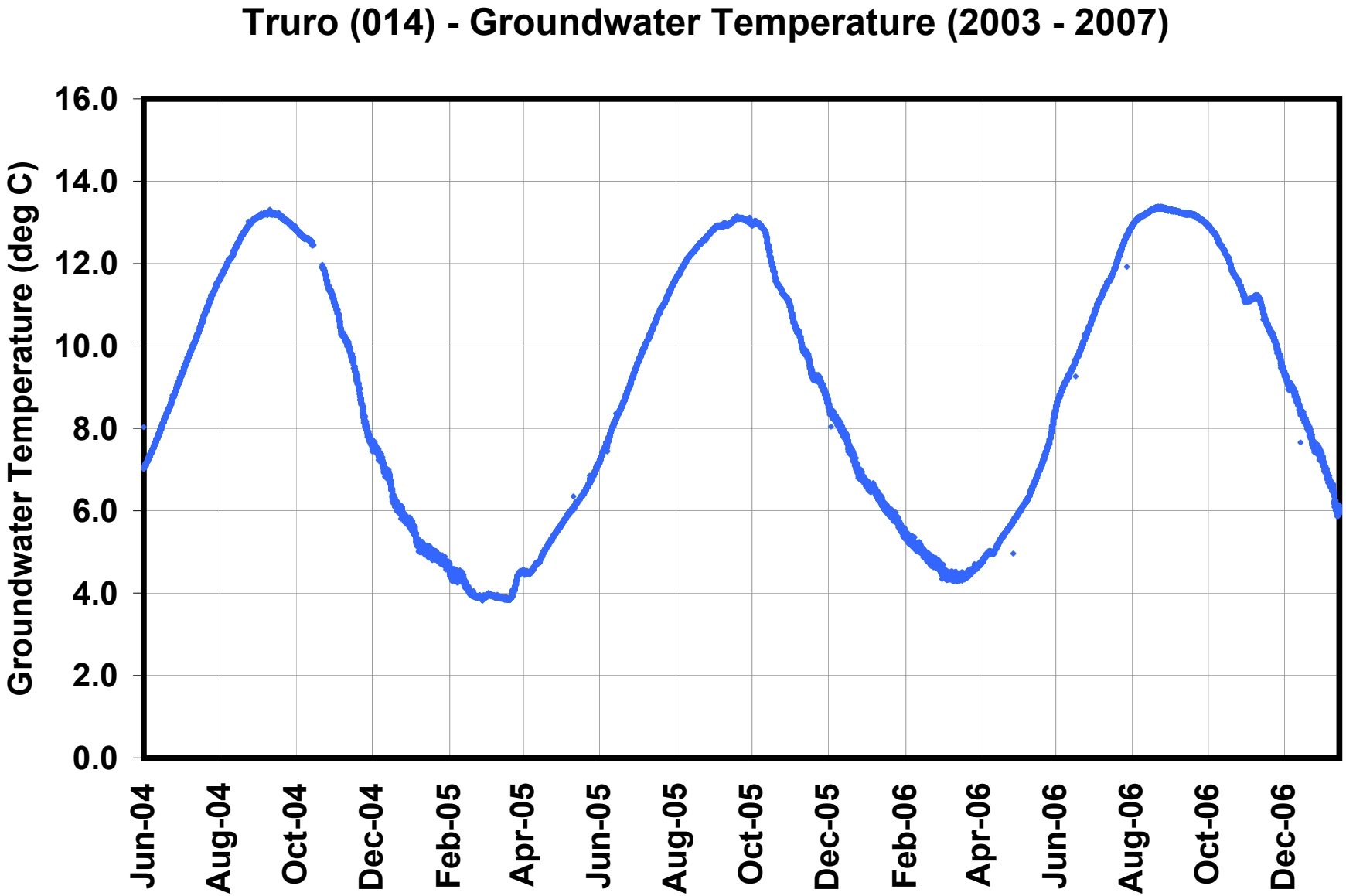
ND = Not Detected

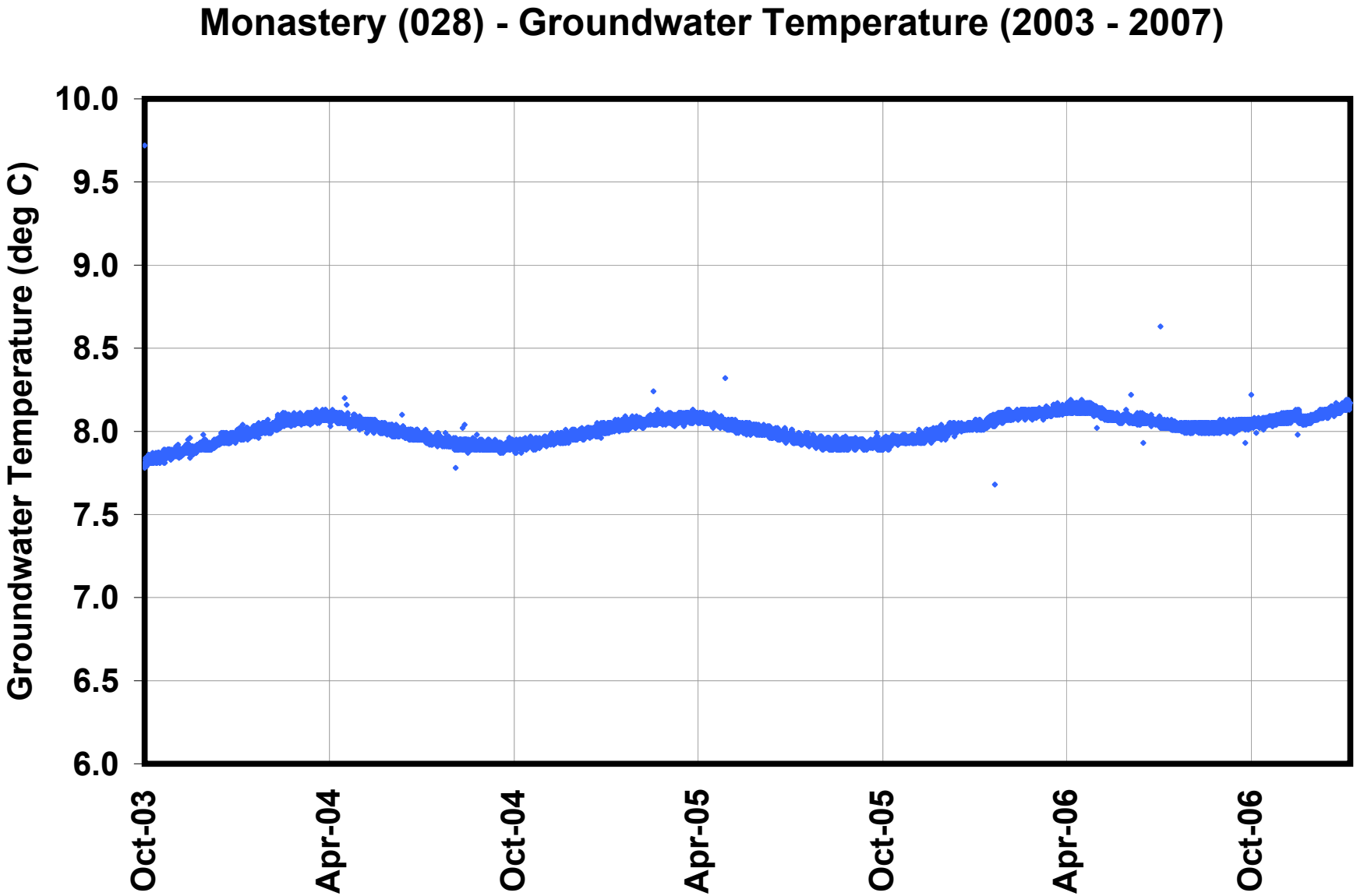
APPENDIX C
GROUNDWATER TEMPERATURE GRAPHS

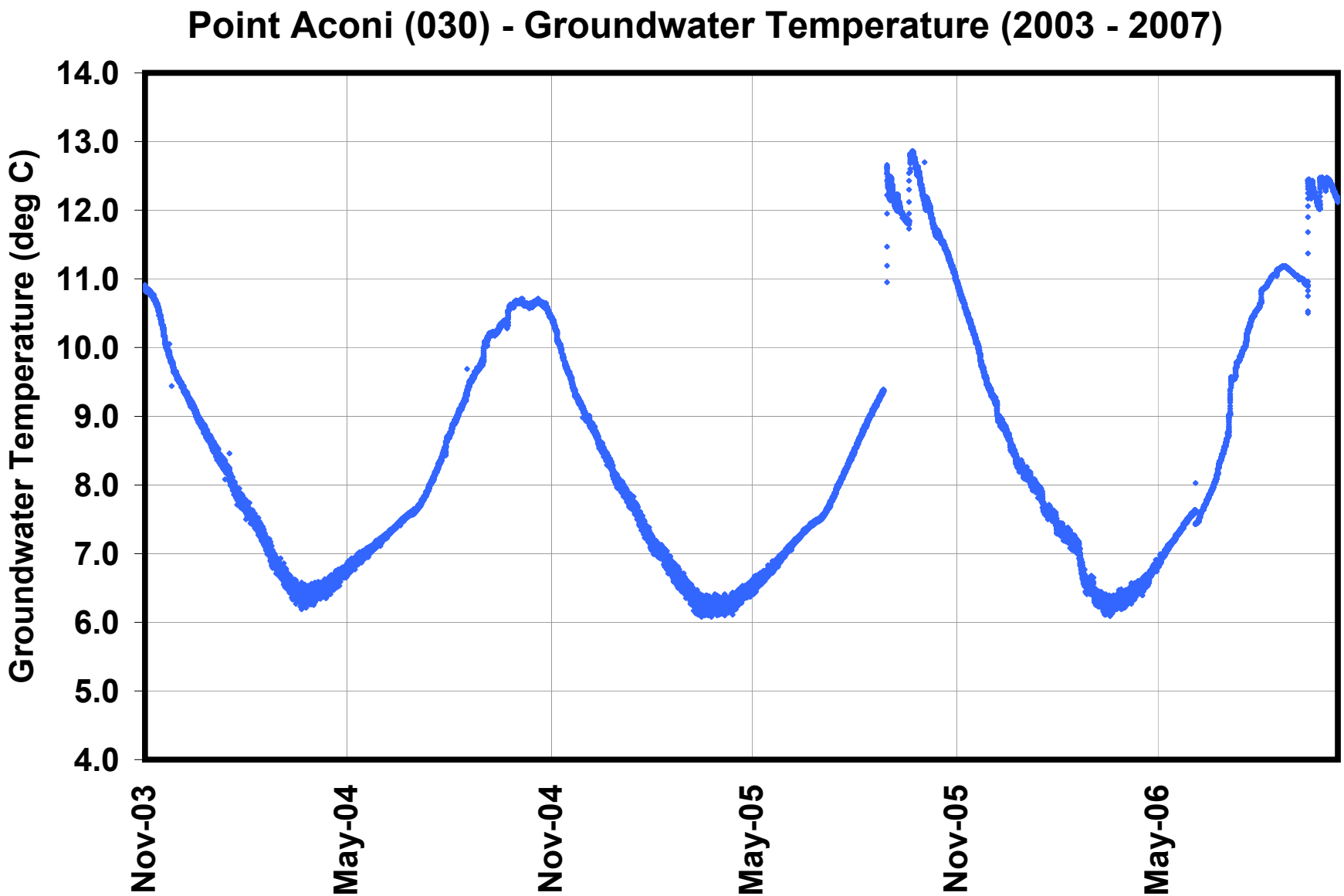

Greenwood (003) - Groundwater Temperature (2005 - 2007)
Groundwater Temperature (deg C)
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06
Feb-07

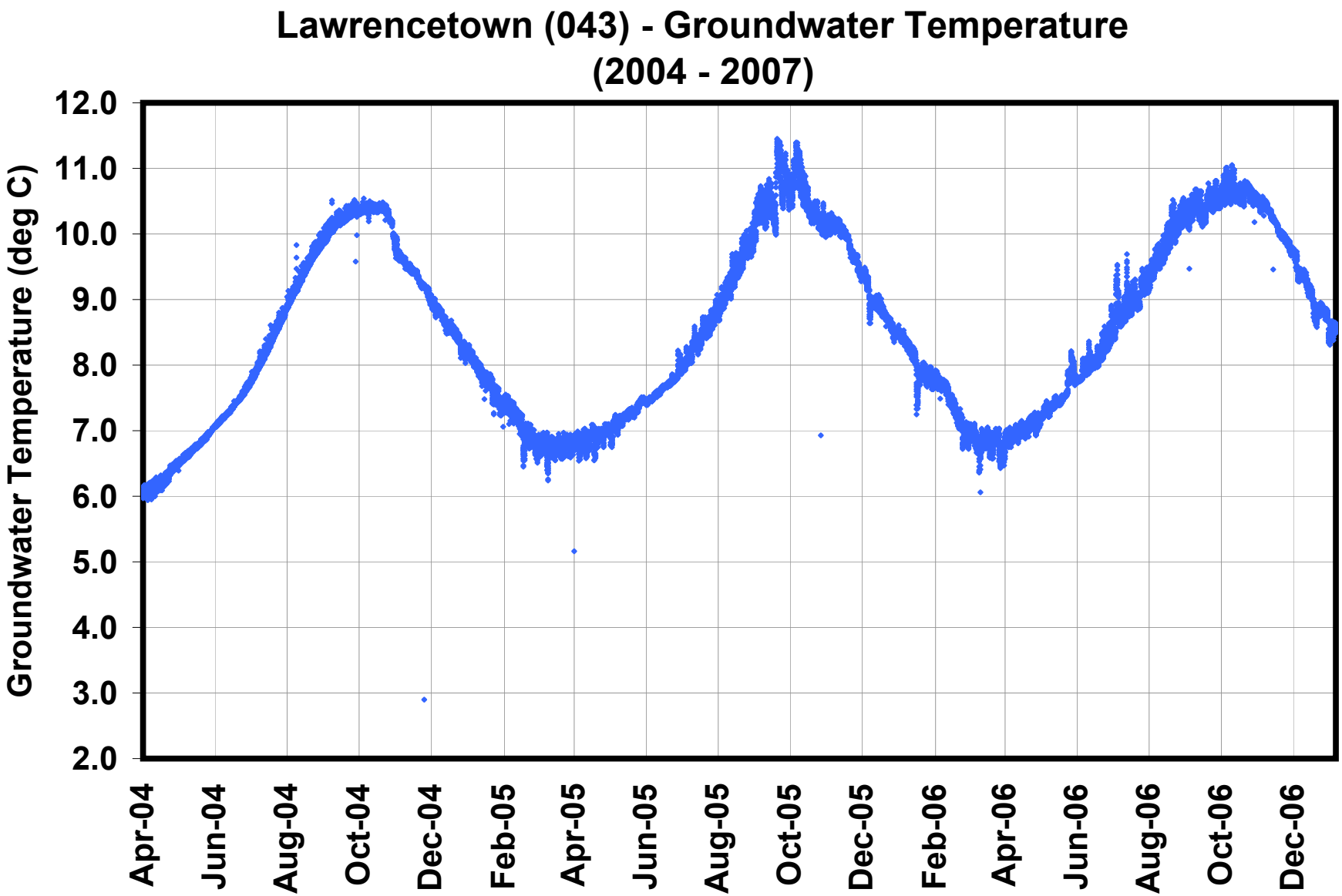

Fraser Brook (004) - Groundwater Temperature (2004 - 2007)
Groundwater Temperature (deg C)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06

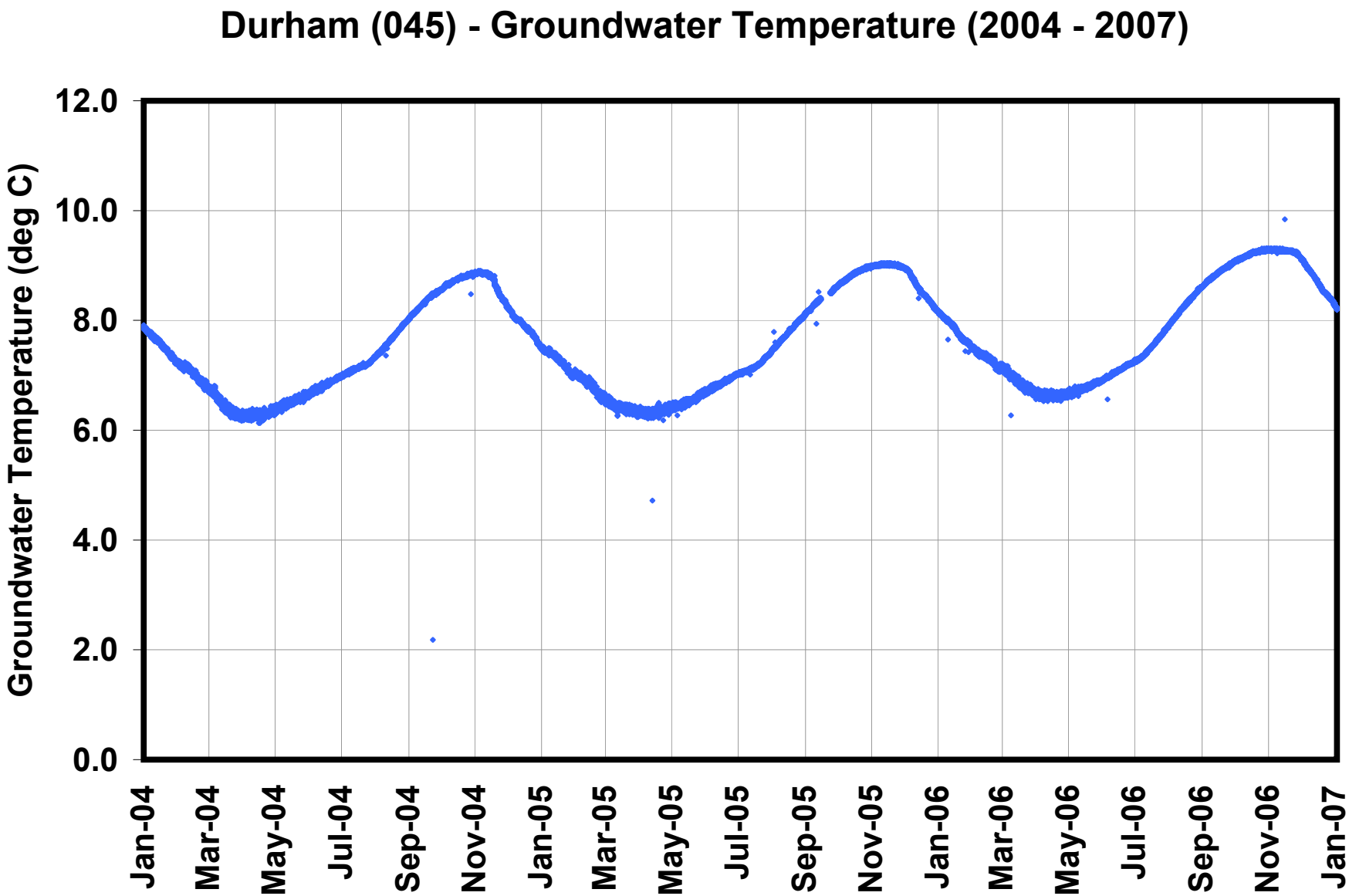

Wolfville (010) - Groundwater Temperature (2005 - 2007)
Groundwater Temperature (deg C)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06

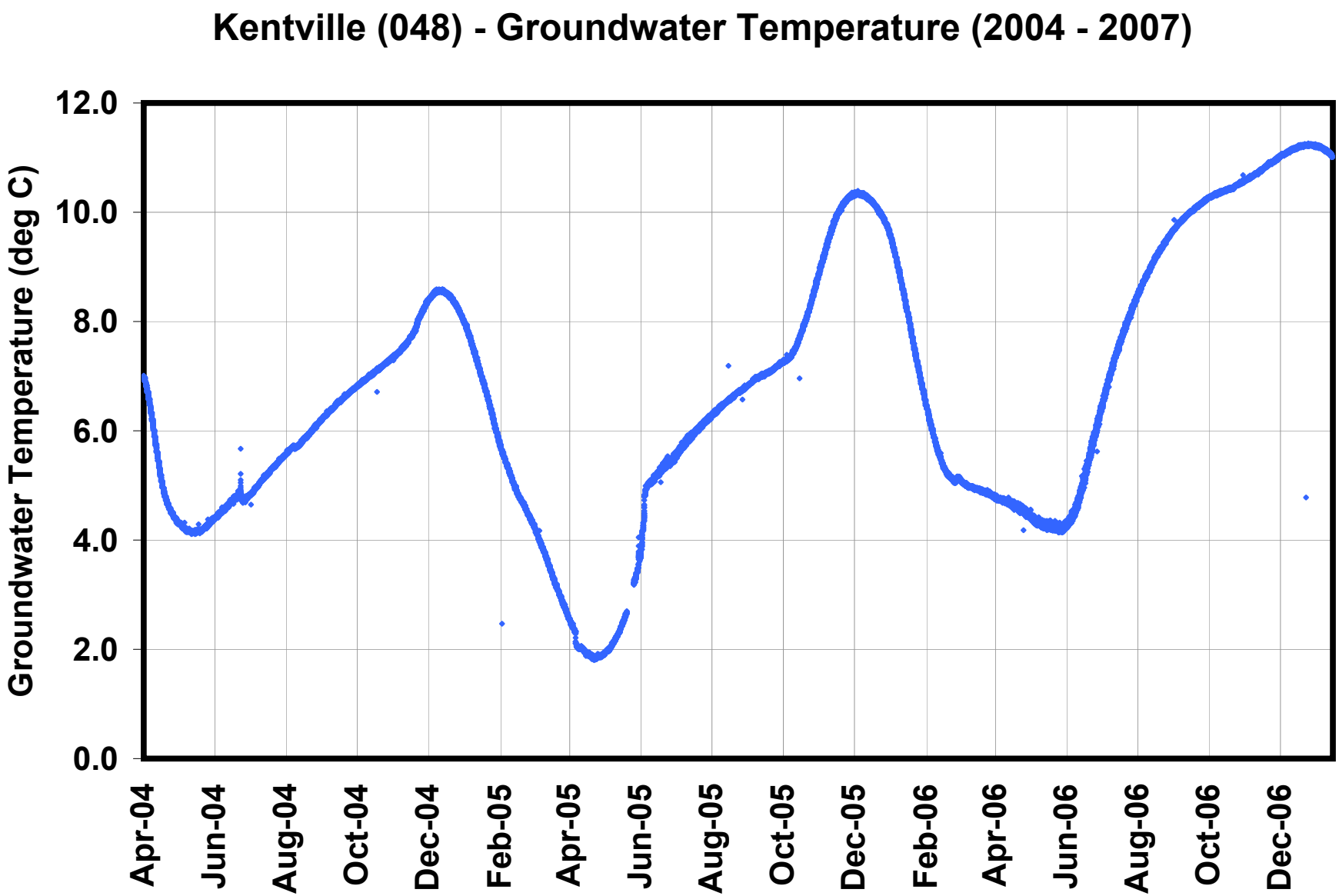

Truro (014) - Groundwater Temperature (2003 - 2007)
Groundwater Temperature (deg C)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06

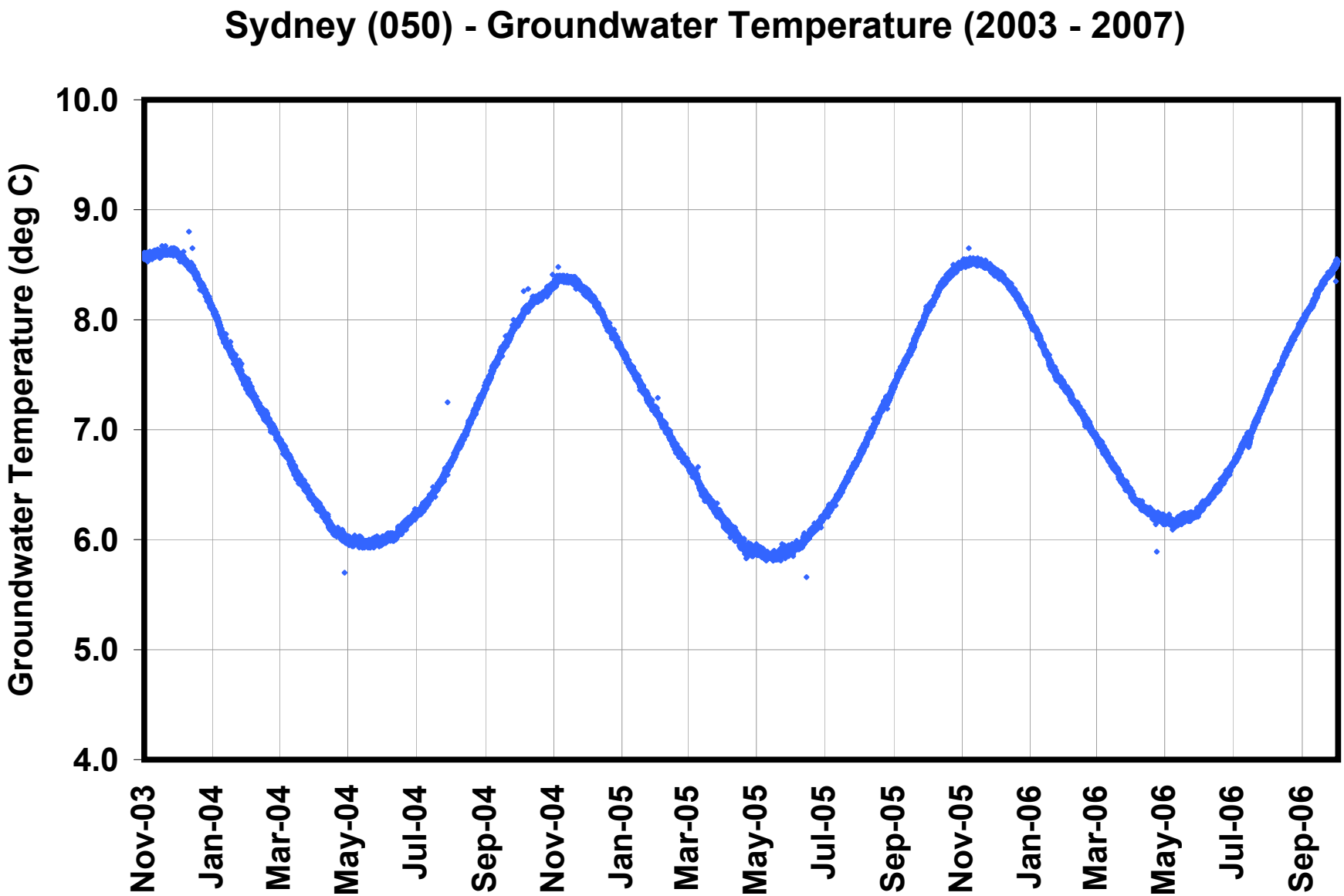

Monastery (028) - Groundwater Temperature (2003 - 2007)
Groundwater Temperature (deg C)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06

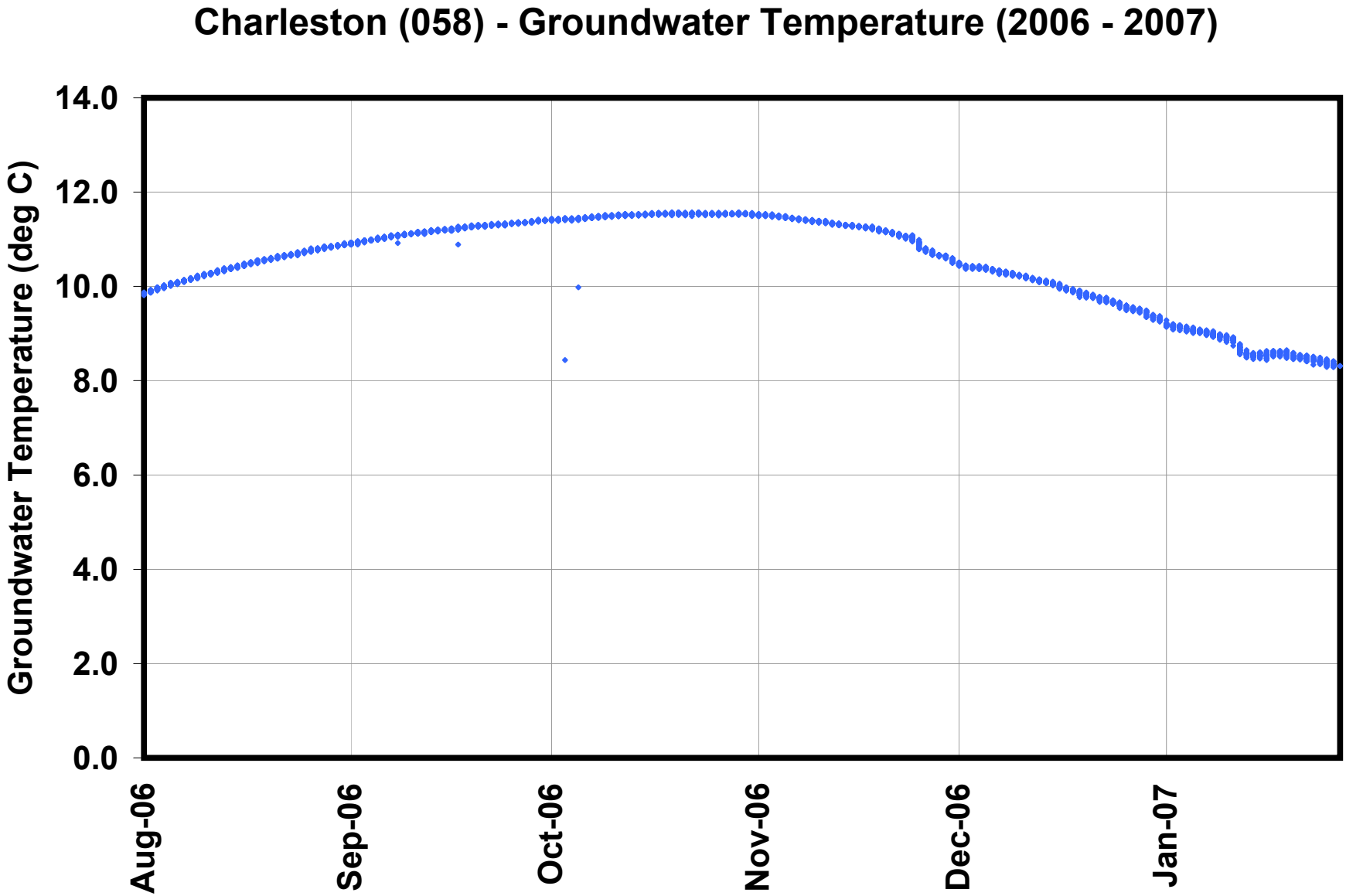

Point Aconi (030) - Groundwater Temperature (2003 - 2007)
Groundwater Temperature (deg C)
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
Nov-03
May-04
Nov-04
May-05
Nov-05
May-06

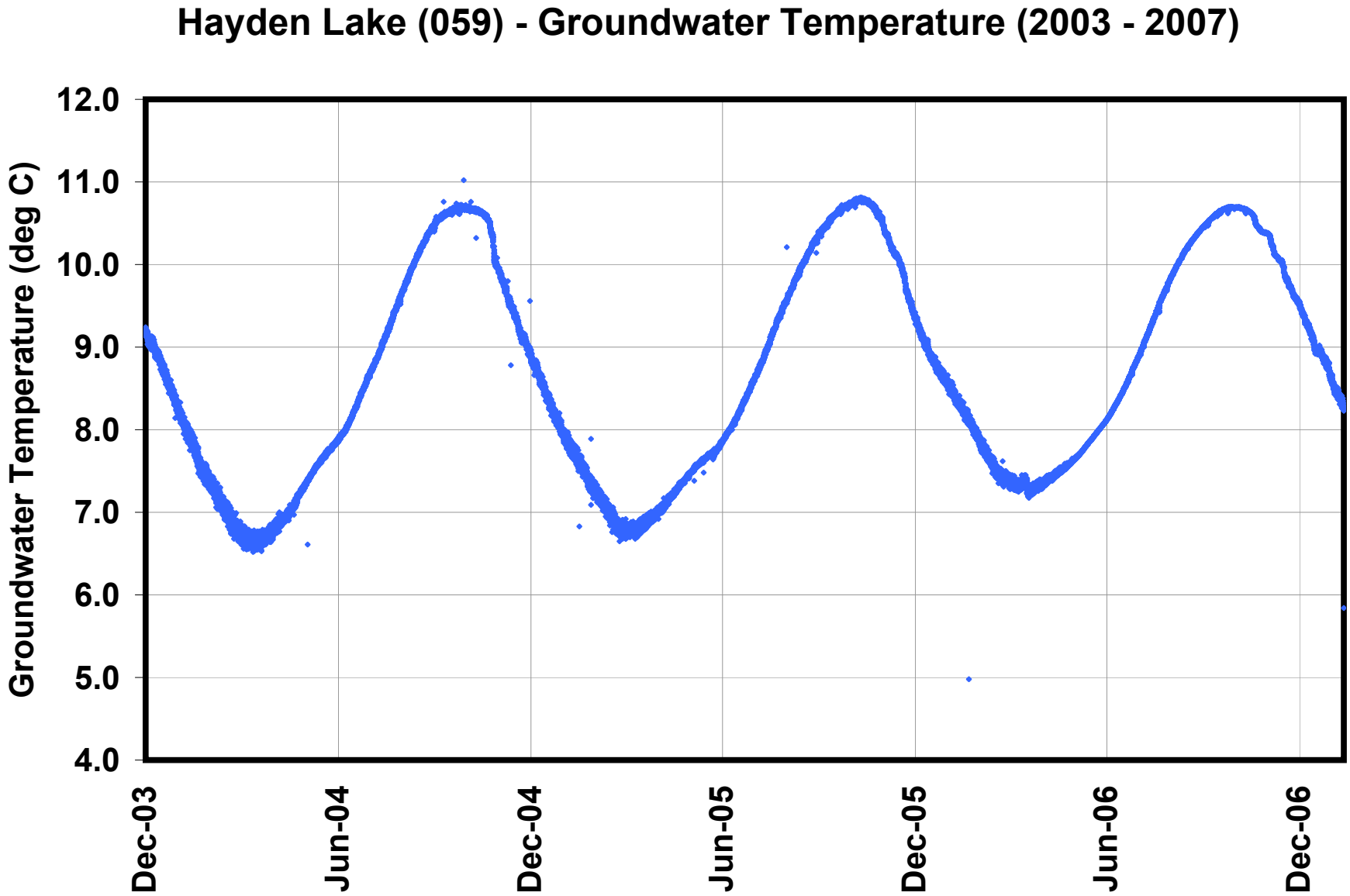

Lawrencetown (043) - Groundwater Temperature
(2004 - 2007)
Groundwater Temperature (deg C)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06

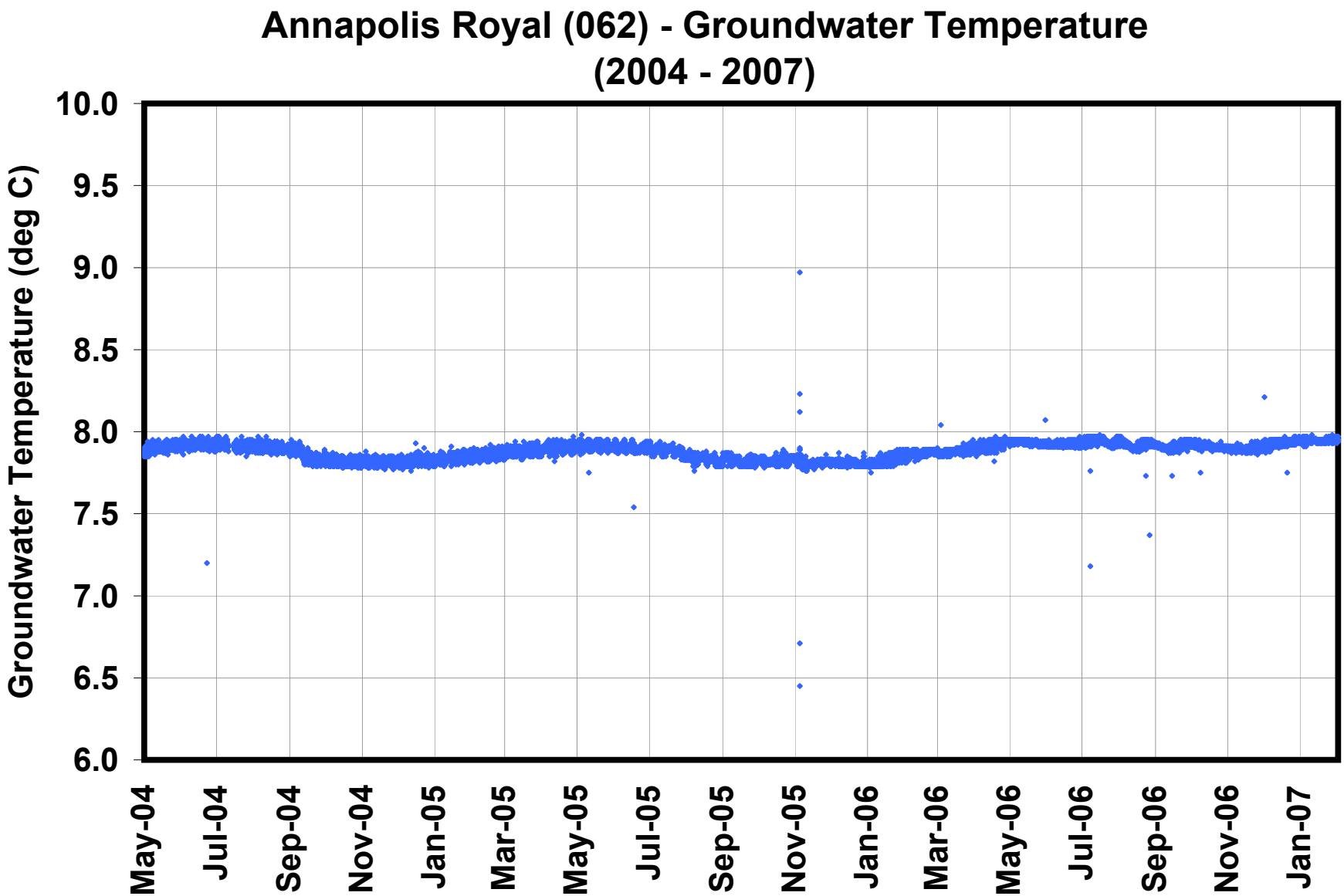

Durham (045) - Groundwater Temperature (2004 - 2007)
Groundwater Temperature (deg C)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07

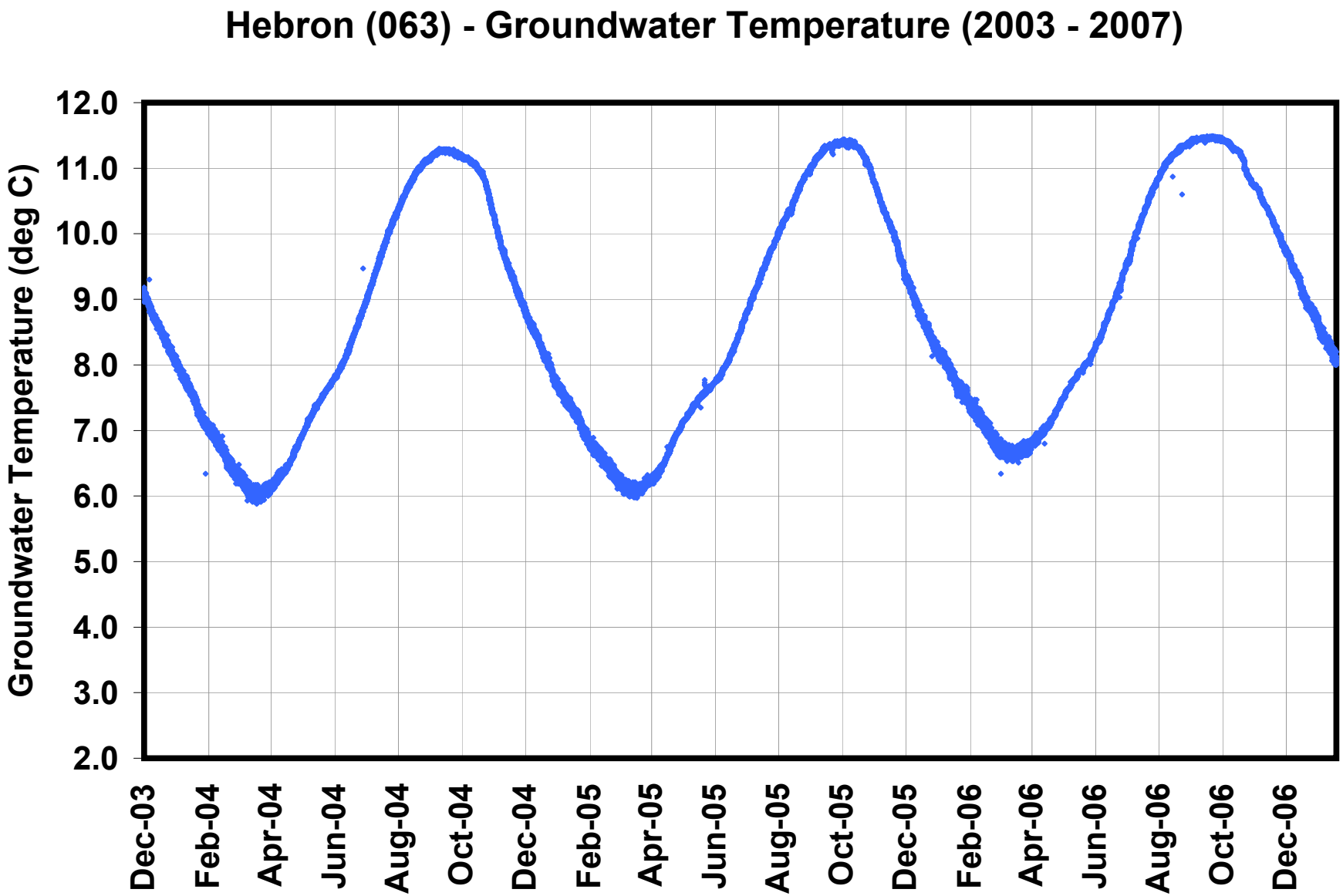

Kentville (048) - Groundwater Temperature (2004 - 2007)
Groundwater Temperature (deg C)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06


Sydney (050) - Groundwater Temperature (2003 - 2007)
Groundwater Temperature (deg C)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06


Charleston (058) - Groundwater Temperature (2006 - 2007)
Groundwater Temperature (deg C)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07


Hayden Lake (059) - Groundwater Temperature (2003 - 2007)
Groundwater Temperature (deg C)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06


Annapolis Royal (062) - Groundwater Temperature
(2004 - 2007)
Groundwater Temperature (deg C)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
May-04
Jul-04
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07


Hebron (063) - Groundwater Temperature (2003 - 2007)
Groundwater Temperature (deg C)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
Dec-03
Feb-04
Apr-04
Jun-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06

APPENDIX D
WATER LEVEL TREND ANALYSIS

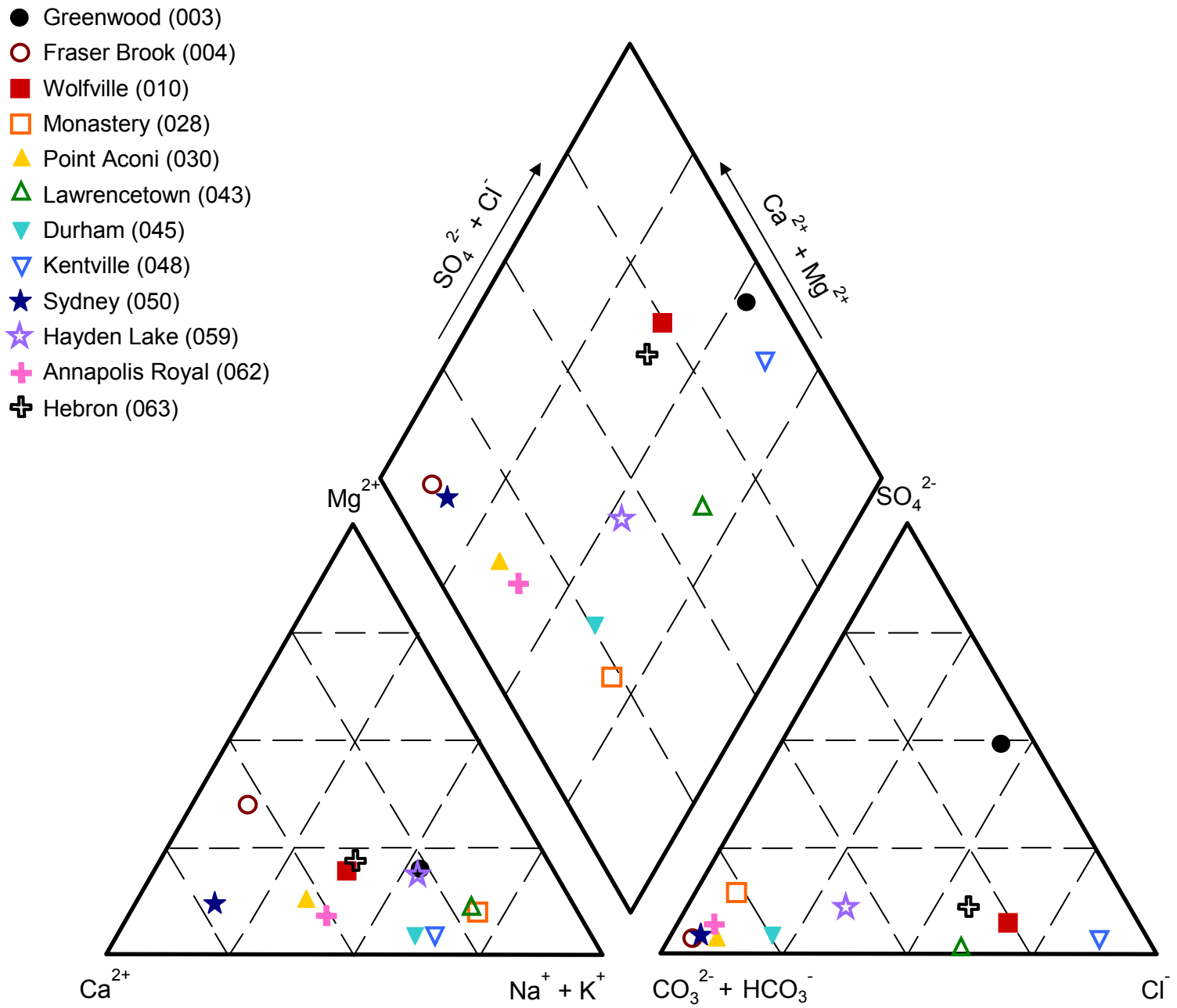
Table D1. Water Level Statistical Trend Analyses

Observation Well Name	First year	Last year	n[1]	Mann-Kendall Statistics		Confidence level[4]
				S[2]	Q (cm/year)[3]	
Greenwood (003)	1968	2006	19	-15	-0.2	70%
Fraser Brook (004)	1968	2006	18	41	0.2	90%
Wolfville (010)	1970	2006	18	-111	-2.8	99%
Truro (014)	1974	2006	14	-5	-1.1	60%
Monastery (028)	1979	2006	9	NA	NA	NA
Point Aconi (030)	1979	2006	14	35	1.2	95%
Lawrencetown (043)[5]	1979	2006	11	-11	-2.0	80%
Durham (045)	1980	2006	21	68	2.4	95%
Kentville (048)	1983	2006	13	-26	-0.7	90%
Sydney (050)	1985	2006	12	-46	-5.9	99%
Charleston (058)	1989	2006	5	NA	NA	NA
Hayden Lake (059)	1988	2006	14	69	1.8	99%
Annapolis Royal (062)	1992	2006	4	NA	NA	NA
Hebron (063)	1993	2006	5	NA	NA	NA

Notes:

1. n is the number of "usable" years. For a year of data to be considered "usable", data must be available for at least 75% of the year, unless otherwise noted. Trend analyses were not completed for wells with less than 10 years of usable data.
2. S is the Mann-Kendall statistic. Positive values indicate upward trends and negative values indicate downward trends (Gilbert, 1987).
3. Q is Sen's estimator of slope. Positive values indicate upward trends and negative values indicate downward trends (Gilbert, 1987).
4. The trend is considered to be statistically significant is the confidence level is at least 80%.
5. n (number of usable years) for this observation well is based on data collected for 69% of the year.
6. NA = Not Applicable (there were insufficient data to complete a trend analysis at this well)

APPENDIX E
PIPER DIAGRAM CHEMISTRY PLOTS


Greenwood (003)
Fraser Brook (004)
Wolfville (010)
Monastery (028)
Point Aconi (030)
Lawrencetown (043)
Durham (045)
Kentville (048)
Sydney (050)
Hayden Lake (059)
Annapolis Royal (062)
Hebron (063)
SO4 2- + Cl-
Ca 2+ + Mg 2+
Mg2+
SO4 2-
Ca2+
Na+ + K+
CO3 2- + HCO3 -
Cl-