APPENDIX - I (INNISFIL)

GENIVAR CONSULTANTS LP (FORMERLY JAGGER HIMS) TECHNICAL MEMORANDUMS

Innisfil Groundwater:

- Technical Memorandum H2 - Drinking Water Issues Evaluation

DILLON CONSULTING LIMITED: WELL HEAD TIME OF TRAVEL CAPTURE ZONE PEER REVIEW EVALUATION RESULTS

- Dillon Consulting Limited WHPA Peer Review Report Memo
- Wellhead Time of Travel Capture Zone Peer Review Evaluation Results
    - Table 1: Churchill
    - Table 2: Cookstown

GENIVAR

TECHNICAL MEMORANDUM H2

Date:	July 26, 2010
To:	Don Goodyear, P. Geo. - South Georgian Bay Lake Simcoe Protection Region
From:	Sarah Dignard/Colleen Barfoot/Lloyd Lemon, P.Geo.
Project No.:	071948.03
Subject:	Drinking Water Issues Evaluation – Innisfil Groundwater Town of Innisfil

OBJECTIVE:

To document the Drinking Water Issues Evaluation for the groundwater supply for the Town of Innisfil in the South Georgian Bay Lake Simcoe Source Protection Region.

OVERVIEW:

Work has been completed to meet the requirements of Technical Rules 114 through 117 of the Technical Rules: Assessment Report, *Clean Water Act, 2006* as provided by the Ontario Ministry of the Environment on December 12, 2008 and as amended in November 2009. The Drinking Water Issues Evaluation portion focuses on identifying recurring water quality impacts or situations with a possibility of impacting drinking water sources in the short-term. This work results in a preliminary list of identified issues.

The approach for the Drinking Water Issues Evaluation is described in more detail in "Technical Memorandum A5 - Drinking Water Issues Evaluation Methods". The steps included:

Step 1: Assemble Available Data

Step 2: Review Data and Identify Drinking Water Issues

Step 3: Evaluate Drinking Water Issues

Step 4: Identify Contributing Area for Drinking Water Issues

Step 5: Prepare List of Drinking Water Issues

Municipal Wells and Aquifers

The Town of Innisfil is supplied by six groundwater well systems in addition to the Alcona Water Treatment Plant. Some additional systems have been decommissioned recently as the Town is starting to rely more on the surface water. The well supplies include: Churchill, Cookstown, Goldcrest, Golf Haven, Innisfil Heights and Stroud.

Churchill Well Supply

The Churchill Well Supply consists of three wells. Treatment consists of chlorination. The rated capacities for the wells are: 262 m^3/day for Well 1, 295 m^3/day for Well 2, 743 m^3/day for Well 3.

Cookstown Well Supply

The Cookstown Well Supply consists of four wells. Treatment consists of chlorination. The rated capacities for the wells are: 262 m^3/day for Well 1, 720 m^3/day for Well 2, 491 m^3/day for Well 3R, 98 m^3/day for Well 4.

Goldcrest Well Supply

The Goldcrest Well Supply consists of two wells. Treatment consists of chlorination. The rated capacities for the wells are 324 m^3/day each.

Golf Haven Well Supply

The Golf Haven Well Supply consists of two wells with treatment consisting of chlorination. The rated capacity for Well 1 is 459 m^3/day. Well 2 serves as a back-up well with a maximum rated capacity of 108 m^3/day. Due to some water quantity concerns at the Golf Haven system, there are currently plans to decommission the wells and to rely on the Alcona lakeshore Water System.

Innisfil Heights Well Supply

The Innisfil Heights Well Supply consists of two wells with treatment consisting of chlorination. Well 2 and Well 3 each have a maximum rated capacity of 324 m^3/day.

Stroud Well Supply

The Stroud Well Supply consists of three wells. Treatment consists of chlorination. Well 1 has a maximum rated capacity of 677.16 m^3/day. Well 2 has a maximum rated capacity of 397.44 m^3/day. Well 3 has a maximum rated capacity of 1,637.28 m^3/day.

***Step 1:* Assemble Available Data**

The data sources that were reviewed to identify potential issues included:

- Permit to Take Water Applications;
- Certificates of Approval;
- Annual Water Supply Water Quality Monitoring Reports (2003-2007);
- Municipal Raw Groundwater Quality Data (2001); and
- Operator Interview.

Mr. Don Bauerlein, Superintendent of the Water Works Operations for the Town of Innisfil was interviewed to obtain operator insight into potential issues identified in the published data as well as identifying potential issues that may not have been identified in published data to date.

Step 2: **Review Data and Identify Drinking Water Issues**

A set of tables have been prepared to document a series of potential issues from the raw and treated water at the Town of Innisfil as identified from various data sources. The tables are as follows:

Table Number	Town of Innisfil Water Works	Water Type	Water Source
H2-1A	Churchill	Raw	Well #1
H2-1B			Well #2
H2-1C		Raw and Treated*	
H2-2A	Cookstown	Raw	Well #1
H2-2B			Well #2
H2-2C			Well #3
H2-2D			Well #4
H2-2E		Raw and Treated*	
H2-3A	Goldcrest	Raw	Well #1
H2-3B			Well #2
H2-3C		Raw*	
H2-4	Golf Haven	Raw and Treated	Well #1
H2-5A	Innisfil Heights	Raw	Well #2
H2-5B			Well #3
H2-5C		Raw*	
H2-6A	Stroud	Raw	Well #1
H2-6B			Well #2
H2-6C			Well #3
H2-6D		Raw and Treated*	

* The raw and treated water system data collected may reflect the use of any or all wells in that particular water system.

The tables are designed to document:

1) The source reports or data that result in the identification of a parameter as a potential Drinking Water Issue;
2) Results of comparison of observed parameter concentrations to relevant benchmarks and situations where:
   a. Parameter concentrations exceed the primary benchmark established by the Ontario Drinking Water Quality Standard (ODWQS);
   b. Parameter concentrations exceed a locally established benchmark value (typically a background concentration);
   c. Parameter concentrations exceed the established method detection limit (MDL) [typically applied for organic chemical parameters];
3) Professional judgment on the reliability of the data based on the number of measurements and the relative consistency of the observed occurrence;
4) The nature of observed trends in parameter concentrations;

5) Input from local System Operators and other Stakeholders as to the significance of the parameter as a Drinking Water Issue;
6) Whether treatment is in place for the observed parameters and its effectiveness; and
7) The nature of the source of the parameter listed as a potential issue.

Trends were determined through graphing municipal water supply system water quality data. Parameters listed on the preliminary list of drinking water threats for each well are assessed graphically for trends. The available data has been provided between 2003 and 2007 for the treated water data and only for 2001 for the raw water. Insufficient data was available to establish trends within the raw water for Innisfil groundwater.

Step 3: **Evaluate Drinking Water Issues**

The H2 series of tables have been developed to identify Drinking Water Issues in accordance with the "Decision Process for Identification and Evaluation of Drinking Water Issues" as presented in Figure A5-1 of "Technical Memorandum A5 - Drinking Water Issues Evaluation Methods".

The positive or negative responses entered in the H2 series of tables correspond to the steps in the decision process. Professional judgment was built into the decision process in the evaluation of data reliability to identify anomalous conditions and in the consideration of operational insights. Trend analysis was used to identify parameters that are projected to exceed the ODWQS within approximately 50 years. The H2 series of tables also allow for the identification of the source of the potential Drinking Water Issue, whether treatment is in place, and its effectiveness.

For each of the water works systems, all of the parameters identified in the H2 tables are not considered to be Drinking Water Issues. For most parameters in the raw water for the Town of Innisfil, insufficient data was available in order to provide high confidence that observed concentrations should be considered to be more than an anomaly. Parameters common to most systems in the Town of Innisfil that were removed from consideration include:

- Coliforms are typically absent but can be observed on rare occasions in low numbers. The presence of coliforms in the raw water is not persistent or indicative of deterioration of raw water quality. Disinfection is in place and is effective.
- Colour and hardness have occasionally exceeded aesthetic or operational objectives. These are considered to be naturally-occurring parameters and insufficient data was available to determine a trend. The colour at the Stroud system may be reduced upon the implementation of iron removal. These parameters are not considered to result in the deterioration of the water quality for use as a source of drinking water.
- Concentrations of dissolved organic carbon at Well #2 in Cookstown exceeded aesthetic objectives on one known occasion. Insufficient data was available to determine a trend. This parameter is considered to be naturally-occurring and is not considered to result in the deterioration of the water quality for use as a source of drinking water.
- Concentrations of aluminum, iron, manganese, and turbidity have occasionally exceeded aesthetic or operational objectives. Insufficient data was available to determine a confident trend. Aluminum exceedances occur under very rare occurrences that are not consistent. Operators are currently looking at potentially implementing iron and manganese treatment at the Stroud system. These parameters are considered to likely be naturally-occurring and are not likely to result in the deterioration of the water quality for use as a drinking water source.

- Organic nitrogen concentrations occasionally exceed ODWQS aesthetic objectives. Insufficient data was available to determine a trend. This parameter is not considered to result in the deterioration of the water quality for use as a drinking water source.
- Lead concentrations have historically been observed to exceed ODWQS objectives at Well #1 at Golf Haven on rare occasions. These exceedances only occurred under circumstances that are inconsistent and there has been no reoccurrence of these events in the past several years. Lead is therefore not considered to result in the deterioration of the water quality for use as a source of drinking water.
- Concentrations of methane were occasionally observed above the aesthetic ODWQS guideline at Cookstown Well #2 and Well #4, and Golf Haven Well #1. Methane is considered to be naturally-occurring. There are currently plans to also decommission the Golf Haven wells. The Cookstown treatment system includes a methane stripper to help control methane concentrations. Methane is therefore not considered to result in the deterioration of the water quality for use as a source of drinking water.
- Concentrations of chloride exceeded the ODWQS on one known occasion at Well #1 at Golf Haven. The chloride concentration was 263 mg/L which is higher than the ODWQS value of 250 mg/L. Chloride concentrations are typically well below the ODWQS value. This exceedance is considered to have occurred under a circumstance that is considered to be inconsistent and is not considered to reflect a condition that will result in the deterioration of the water quality for use as a source of drinking water.
- Concentrations of sodium are consistently less than the ODWQS value of 200 mg/L in the raw and treated water from the Town of Innisfil. In most cases, insufficient data was available to determine trends. Sodium is therefore not considered to be a Drinking Water Issue at these locations but should be closely monitored. Concentrations have exceeded the guideline of 20 mg/L. Sodium is a concern at 20 mg/L as the Medical Officer of Health is to advise individuals on low-sodium diets. Observed concentrations of sodium are variable and the source has not been confirmed, but is typically related to winter de-icing or septic system effluents from water softeners. Reduction of sodium use in the contributing watershed would be beneficial to the drinking water quality.
- Organic parameters, such as trihalomethanes, are present and occasionally exceed ODWQS values within treated water at Churchill, Golf Haven and Stroud as byproducts of disinfection by chlorination. Concentrations do not display increasing trends. Although it was determined that concentrations are not contributing to the deterioration of the potable water quality, it was determined that disinfection byproducts are a major concern at the Golf Haven system and the Town of Innisfil is consequently looking at decommissioning the system.

Step 4: **Identifying Contributing Area for Drinking Water Issues**

No parameters were identified as Drinking Water Issues at the Town of Innisfil groundwater wells.

Step 5: **Prepare List of Drinking Water Issues**

No parameters were identified as Drinking Water Issues at the Town of Innisfil groundwater wells.

LAL/SJD:nah

Table H2-1A **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Churchill
Drinking Water Source: Well #1
Issues Review Date: June 3, 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Organic Nitrogen				Y				Y				N				Y	Y	Y	Y			Y	N	N	NO			Y		
Sodium				Y						Y		N				Y	Y	Y	Y			Y	N	N	NO			Y		

Table H2-1B **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Churchill
Drinking Water Source: Well #2
Issues Review Date: June 3, 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years						
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable								Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Hardness				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO	Y				
Organic Nitrogen				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO			Y		
Turbidity				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-1C **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Churchill
Drinking Water Source: System: Raw and Treated
Issues Review Date: June 3 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2003-2007
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Pathogens																														
Coliforms			Y					Y				Y			Y		Y	N	Y			Y	N	N	NO			Y	Y	Y
Chemicals																														
Trihalomethanes			Y						Y			Y		Y			N	Y	Y			Y	N	N	NO		Y			

Table H2-2A **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Cookstown
Drinking Water Source: Well #1
Issues Review Date: June 3 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Hardness				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO	Y				
Organic Nitrogen				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-2B **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Cookstown
Drinking Water Source: Well #2
Issues Review Date: June 3 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Colour				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO	Y				
Dissolved Organic Carbon				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO	Y				
Hardness				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO	Y				
Methane				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO			Y		
Organic Nitrogen				Y				Y				Y				Y	Y	N	Y			Y	N	N	NO			Y		
Sodium				Y						Y		Y				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-2C **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Cookstown
Drinking Water Source: Well #3
Issues Review Date: June 3 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Organic Nitrogen				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-2D **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Cookstown
Drinking Water Source: Well #4
Issues Review Date: June 3 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Methane				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		
Organic Nitrogen				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-2E **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Cookstown
Drinking Water Source: System: Raw and Treated
Issues Review Date: June 3 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Pathogens																														
Coliforms			Y					Y				Y				Y	Y	N	Y			Y	N	N	NO			Y	Y	Y
Chemicals																														
Sodium			Y							Y		Y	Y				N	Y	Y			Y	N	N	NO			Y		
Turbidity			Y						Y			Y			Y		N	Y	Y			Y	N	N	NO			Y		

Table H2-3A **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Goldcrest
Drinking Water Source: Well #1
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Iron				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Turbidity				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-3B **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Goldcrest
Drinking Water Source: Well #2
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Iron				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Organic Nitrogen				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		
Turbidity				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-3C **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Goldcrest
Drinking Water Source: System: Raw
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2003-2007
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Pathogens																														
Coliforms			Y					Y				N				Y	Y	N	Y			Y	N	N	NO			Y	Y	Y

Table H2-4 **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Golf Haven
Drinking Water Source: Well #1 and System Treated Water
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001-2007
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Pathogens																														
Coliforms			Y					Y				Y				Y	Y	N	Y			Y	N	N	NO			Y	Y	Y
Chemicals																														
Chloride				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Lead				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Methane				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		
Sodium				Y						Y		Y				Y	N	Y	Y			Y	N	N	NO			Y		
Trihalomethane			Y						Y			Y				Y	N	Y	Y			Y	N	N	NO			Y		
Turbidity			Y						Y			Y				Y	N	Y	Y			Y	N	N	NO			Y		

Table H2-5A **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Innisfil Heights
Drinking Water Source: Well #2
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years						
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable								Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Iron				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				

Table H2-5B **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Innisfil Heights
Drinking Water Source: Well #3
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence						Trend Reviewed											
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Iron				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Organic Nitrogen				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		
Turbidity				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-5C **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Innisfil Heights
Drinking Water Source: System: Raw
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2003-2007
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years						
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable								Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Pathogens																														
Coliforms			Y					Y				Y				Y	N	Y	Y			Y	N	N	NO			Y	Y	Y

Table H2-6A **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Stroud
Drinking Water Source: Well #1
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years						
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable								Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Colour				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Manganese				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Organic Nitrogen				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-6B **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Stroud
Drinking Water Source: Well #2
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years						
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable								Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Aluminum				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Colour				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Manganese				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Organic Nitrogen				Y				Y				N				Y	Y	N	Y			Y	N	N	NO			Y		

Table H2-6C **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Stroud
Drinking Water Source: Well #3
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence																	
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable	Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years			Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Chemicals																														
Colour				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Hardness				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				
Manganese				Y				Y				N				Y	Y	N	Y			Y	N	N	NO	Y				

Table H2-6D **Evaluation of Drinking Water Issues**

Municipality: Town of Innisfil
Community: Stroud
Drinking Water Source: System: Raw and Treated
Issues Review Date: June 4 2009

Information Sources:
Watershed Characterization:
Annual Water Quality Reports: 2001
Interview (person/title/date): Don Bauerlein / Superintendent of the Water Works Operations / August 27 2009

Parameter	Identified From							Compare Water Quality Data to Benchmarks				Confirm Data Reliability							Evaluate Trends					Operational Consideration	Drinking Water Issue	Source of Issue			Treatment	
													Confirm Presence						Trend Reviewed	Increasing	Reducing	Constant/Uncertain	Will Exceed ODWQS within 50 Years						
	Watershed Characterization	Operator Interview	Annual Water Quality Reports	Raw Water Quality Data	Treated Water Quality Data	PGMN Data	Other	Raw Water Quality Exceeds ODWQS	Treated Water Quality Exceeds ODWQS	Above Detection Limit	Above Local Background	Sufficent Data	Persistent (Always, <90%)	Majority of Tests (40-90%)	Occasionally (5 - 40%)	Rarely (<5%)	Anomalous Circumstance	Data Reliable								Natural	Threat (Known)	Threat (Unknown)	In Place	Effective Mitigation
Pathogens																														
Coliforms			Y					Y				Y				Y	Y	N	Y			Y	N	N	NO			Y	Y	Y
Chemicals																														
Sodium			Y							Y		Y				Y	Y	N	Y			Y	N	N	NO			Y		
Trihalomethane			Y						Y			Y			Y		N	Y	Y			Y	N	N	NO			Y		

July 29, 2010

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Attention: Mr. Don Goodyear, Source Protection Manager

WHPA Peer Review Report

Dear Mr. Goodyear:

Dillon Consulting Limited (Dillon) was retained by the Lake Simcoe Region Conservation Authority (LSRCA) to conducted Peer Reviews of well head protection area (WHPA) mapping for 86 municipal groundwater systems. These systems are located in the South Georgian Bay Lake Simcoe Source Protection Region. External management of the project was conducted by Mr. Dave Ketcheson, P.Eng of Azimuth Environmental Consulting Inc. The results of the peer review are issued in the form of digital spreadsheet files that are attached to this letter. The project scope and peer review methodology is summarized in the letter herein.

PROJECT SCOPE

LSRCA retained Dillon to conduct a 'high level' peer review of the WHPAs that were largely delineated as part of previous WHPA or regional groundwater studies, at a time prior to the finalization of the Director Rules. In general, WHPA delineation was based on an assortment of different model types, including fixed radius, 2-D analytical solutions and numerical 3-D flow modeling. In general, more sophisticated models were applied to those systems where more data was available. The focus of the peer review was on whether the methodologies were consistent with those outlined in the Directors Rules, rather than a more traditional technical modeling critique. Evaluations also identified critical issues or deficiencies that would have implications on subsequent steps in the source protection process, so that these may be addressed as part of the Assessment Report. The review also identify long-term opportunities for improvement in subsequent rounds of the process, recognizing the various levels of effort applied in WHPA delineation across the region (i.e., analytical vs. numerical methods), and the availability of data in the various WHPA settings.

Peer reviewers were Rob Kell, M.A.Sc., P.Eng, P.Geo.; Jeff Hachey, M.Sc. and Darin Burr, M.Sc. P.Geo, all hydrogeologists with Dillon.

...continued

Evaluation of the WHPAs was performed in a systematic fashion following a "score card" approach. The score card contained both objective and subjective criteria that were evaluated for each system. This template approach enabled reviewers to maintain a level of consistency during the reviews, and was suited to the "high level" nature of the evaluation. The criteria that were evaluated is listed below:

Objective Criteria	**Subjective Criteria**
Was modeled pumping rate appropriate?	Complexity of geological Setting
Were approved models and methods used?	Appropriateness of Flow Model
	Reasonableness of input parameters
	Adequate incorporation of natural flow field
	Model Calibration
	Incorporation of Uncertainty

For each criterion, a score between 1 and 10 was awarded. In general, a score <5 for any of the criteria would be given if a critical concern was identified that would either significantly affect the reliability of the WHPAs, or is a contravention of the elements of the Directors Rules. An exception for this rule would be the evaluation of the uncertainty criterion. Failure to adequately incorporate uncertainty into the model results was not deemed a requirement of the Director Rules and therefore would not necessarily cause the system to "fail". Details on conditions that would cause an unacceptable evaluation at the criteria level are presented in the score card sheets.

All systems were given a "pass", "fail" or "conditional pass" result, depending upon the analysis results. A "pass" ranking was given for those systems were the methodology was generally consistent with the Director Rules, and no critical deficiencies were noted. A "conditional pass" was granted, where the potential for considerable uncertainty in the results existed, but either little data was available to improve the accuracy of the results, or it was the reviewer's opinion that the uncertainty on the results would not significantly alter the enumeration of land parcels that may contain significant threats.

...continued

Following criteria scoring, the individual scores were weighted, and summed to produce an overall system score (between 1 and 10) for the WHPA delineation. Higher the score, the more favorable are the results of the evaluation. Please note that this scoring is a relative ranking between the systems, and is not to be interpreted as any type of marking. For example, a score of 6 does not mean a 60% mark, but rather is a system whose delineated WHPAs are deemed more conservatively robust (in lieu of available data) than a system that receives a score of 5. Theoretically, a system evaluated via fixed radius that is very conservative could receive a higher system score than a detailed numerical model result that is not conservative, as the risk of under-representing the area where significant threats may be lower.

RESULTS

The results of the evaluation are presented on digital Excel™ spreadsheets for each system, and are grouped by township or separated municipality name. Rationale for the individual criteria evaluations, along with the criterion scores, overall system scores and recommendations for future improvement are presented on the individual sheets.

LIMITATIONS

This report was prepared exclusively for the purposes, project and site location(s) outlined in the report. The report is based on information provided to, or obtained by Dillon Consulting Limited ("Dillon") as indicated in the report, and applies solely to site conditions existing at the time of the assessment. Although a reasonable assessment was conducted by Dillon, Dillon's assessment was by no means exhaustive and can not be construed as a certification or acceptance of the reviewed reports. Rather, Dillon's report represents a reasonable review of available information within an agreed work scope, schedule and budget. Further review and updating of the peer review reports will be required as local and site conditions, and the regulatory and planning frameworks, change over time.

This report was prepared by Dillon for the sole benefit of our Client. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

...continued

CLOSURE

We appreciate the opportunity to work with LSCRCA on this assignment. If you have any questions about this report, please contact the undersigned.

Yours sincerely,

DILLON CONSULTING LIMITED

Darin Burr, M.Sc., P.Geo.
Project Manager

DTB:amb
Encl.

Table 1: CHURCHILL - WELL HEAD TIME OF TRAVEL CAPTURE ZONE PEER REVIEW EVALUATION RESULTS

GENERAL

System Name:	**Churchill**
Reviewed Report:	**South Simcoe Groundwater Study, WHPA-Town of Innisfil, Appendix I**
Terms of Reference:	**Ontario Ministry of the Environment and Energy, 2001; Groundwater Studies, 2001/2002, Technical Terms of Reference, November 2001.**
Model Type:	**USEPA WHPA/GPTRAC and Fixed Radius**
Score:	**5.5**
Pass:	**Yes**
Critique Ref:	**Sent to Client_Peer Review Score Card Results_043010_1**

System Characteristics

Hydrogeological Complexity	medium to high, multiple aquifers pumped
Spatial variability in Aquifer Vulnerability	Medium
Known water Quality Issues	Some (iron and Organic Nitrogen)

EVALUATION RESULTS

Criterion		Awarded Score	General Comments	Comments / Recommendations	
				Critical Deficiencies	Long-term opportunities
Objective Criteria					
1. Were reasonable pumping rates used and documented?		7	Three wells (Wells 1, 2, 3) are present, and all were modelled at rates below PTTW maximum rates (262, 295 and 743 m3/d), but well above the 2001 average rates (53, 1, 84 m3/d). Well 3 was modelled at its average PTTW average rate. Modelled rates were based on max day factors of 2 to 2.75 of the PTTW max. Overall, modelled rates appear adequate; however, no documentation on future planned rates.	None	Confirm committed population requirements to ensure that it is within permitted rate. Confirm with municipality that modelled rates represent likely conditions. Should pumping regime change, then model should be updated.
2. Were rule-approved models and methods used?		Pass	2-D Analytical Solution is permitted by technical rules	None	Perform continuous updating and verification of the model data
Subjective Criteria					
3a. Is geological setting complex?	10	6	Overall, geology complexity is medium. Wells 1 and 3 pump from a deep confined overburden aquifer (A4), and is expected to be influenced by regional gradients, rather than local. Well 2 is in the confined shallow aquifer (A1) and will likely be more sensitive to local topographic driven gradients, which in this study are deemed flat. Report states that aquifer A4 is limited, and therefore the capture zones may be confined to the underlying bedrock.	None	
3b. Is Geological Model / Understanding Adequate for assessment method selected?	10	5	Numerous studies have been conducted for the aquifer, and therefore it appears that there is a fair understanding of the geology; however, considering the complexity of the multi-aquifer system being pumped at this well site, additional information may be required	None	
4. Is Flow Model Complexity Appropriate?	10	5	2-D model is deemed suitable for Well 1 and 3, as these wells tap a regional system that is predictable based on water levels from wells that tap the same aquifer. The model used for Well 2 was fixed radius, which does not take into natural gradient directions; however, the well is reported to fall in a recharge zone and no lateral gradients are assume. It is noted that the report eludes to capture zone improvements that could be gained by using a 3-D model.	None	Confirm lateral flow in aquifer A1. If horizontal gradient is present, fixed radius solution for Well 2 may not be appropriate. Update capture zone predictions using more advanced 3-D modelling as data becomes available
5. Are model input parameters (recharge, porosity, K) reasonable?	5	8	Generally yes - K values are based on numerous pumping tests, and porosity is reasonable.	None	

6. Was natural flow field adequately incorporated into model? (Numerical Model)	10	N/A		None	
7. Was natural flow field adequately incorporated into model? (Analytical Model)	10	6	Yes - Analytical model results use natural flow field as input for Wells 1 and 3 which tap the regional A4 aquifer. Lower score given because fixed radius approach used for Well 2; however, it is assumed that the gradient is flat in this area.	None	Collection of additional water level/field data may be warranted to be used as calibration input to a 3-D model
8. Was the Model Calibrated?	5	7	2-D Analytical model cannot be calibrated; however, actual data (potentiometric surface) is used in analysis for Well 1 and 3.	None	
9. Was Uncertainty considered in the analysis?	5	1	Capture zones were determined based on a single (best) model setup, and uncertainty only mapped for WHPA-D. It appears the uncertainty was incorporated into the gradient direction	None	Incorporate the results of the sensitivity analysis into capture zone development for WHPA-B and C as well.
10. What is the Uncertainty?		High	Designation not provided in report, but Dillon recommends that it be assessed as high	None	

GENERAL

System Name: Cookstown
Reviewed Report: South Simcoe Groundwater Study, WHPA-Town of Innisfil, Appendix I
Terms of Reference: Ontario Ministry of the Environment and Energy, 2001; Groundwater Studies, 2001/2002, Technical Terms of Reference, November 2001.
Model Type: USEPA WHPA/GPTRAC
Score: 5.3
Pass: Conditional Pass
Critique Ref: Sent to Client_Peer Review Score Card Results_090810_1

System Characteristics

Hydrogeological Complexity	High,, multiple discontinuous aquifers
Spatial variability in Aquifer Vulnerability	Medium
Known water Quality Issues	Some (iron and Organic Nitrogen)

EVALUATION RESULTS

Criterion		Awarded Score	General Comments	Comments / Recommendations	
				Critical Deficiencies	Long-term opportunities
Objective Criteria					
1. Were reasonable pumping rates used and documented?		10	Four wells are present, and all were modelled at rates below PTTW maximum rates, but generally at the 2001 average rates. The report states that no future growth is expected on this system, therefore modelled rate meets the planned rate.	None	Confirm committed population requirements to ensure that it is within permitted rate. Confirm with municipality that modelled rates represent likely conditions. Should pumping regime change, then model should be updated.
2. Were rule-approved models and methods used?		Pass	2-D Analytical Solution is permitted by technical rules	None	Perform continuous updating and verification of the model data
Subjective Criteria					
3a. Is geological setting complex?	10	6	High complexity. Aquifers in area include A1, A2 and A3. Report states that they are discontinuous and geology is complex, and that aquifer units correspond to erosional events that occurred during regression and transgression of pro-glacial lakes and ice sheets. All aquifers are confined in the Cookstown area; however, upper aquifer (A1) are reported to be more susceptible to surface contamination as overlying aquitard is thinner. Aquifer A2 and A3 are well confined	None	
3b. Is Geological Model / Understanding Adequate for assessment method selected?	10	5	Numerous studies have been conducted for the aquifer, and therefore it appears that there is a fair understanding of the geology; however, considering the complexity of the multi-aquifer system being pumped at this well site, additional information may be required	None	
4. Is Flow Model Complexity Appropriate?	10	5	2-D model is not ideal for the complexities of this system. Potentiometric maps of the various aquifers show different flow patterns within each aquifer. Local groundwater divides are present for the shallow aquifer A1, while a regional groundwater high in all aquifers (A1, A2 and A3) is present to the northwest. Report also states that discontinuousness of aquifers makes preparation of potentiometric surfaces difficult. A low score is given as the uncertainty in the flow is largely addressed by the uncertainty incorporated into the analysis via superposition of different capture zones in the three pumped aquifers.	Yes	3-D flow model recommended. Additional field data may need to be collected to support model
5. Are model input parameters (recharge, porosity, K) reasonable?	5	8	Generally yes - K values are based on numerous pumping tests, and porosity is reasonable.	None	

6. Was natural flow field adequately incorporated into model? (Numerical Model)	10	N/A		None	
7. Was natural flow field adequately incorporated into model? (Analytical Model)	10	5	The accuracy of this model type is highly dependant on correctly mapping gradient directions. Considering the complexity of the flow fields, and their variation in the different aquifers, the model may not be able to incorporate the actual variation in flow. Nevertheless, the authors reduced the uncertainty by superposition of various potential groundwater flow paths that may occur in the three aquifers, and therefore a conditional pass is given	Yes	Collection of additional water level/field data may be warranted to be used as calibration input to a 3-D model
8. Was the Model Calibrated?	5	7	2-D Analytical model cannot be calibrated; however, actual data (potentiometric surface) is used in analysis.	None	
9. Was Uncertainty considered in the analysis?	5	1	Capture zones were determined based on a single (best) model setup, and uncertainty only mapped for WHPA-D. It appears the uncertainty was incorporated into the gradient direction	None	Incorporate the results of the sensitivity analysis into capture zone development for WHPA-B and C as well.
10. What is the Uncertainty?		High	Designation not provided in report, but Dillon recommends that it be assessed as high	None	