

**Letters, Memos, Minutes, and Email Correspondence is included in the Remainder of this Appendix.**

# Minutes of Meeting #15 Source Protection Peer Review Cataraqui

**Held at Cataraqui Region Conservation Authority  
December 16, 2010 9:00 AM**

**Present:**

Name	Agency	Name	Agency
Sean Watt	CRCA	Mike Garraway	MNR
Bryon Keene	Quinte Conservation	Scott Bates	MNR
Colin Clarke	XCG Consulting	Igor Iskra	Dillon Consulting
Ed Watt	XCG Consulting	Michel Kearney	City of Ottawa
Mark Boone	Quinte Conservation	Dru Heagle	Intera Engineering
Kimberly Denison	CRCA		

**Regrets:**

Name	Agency	Name	Agency
Michel Robin	University of Ottawa	Bill Hogg	Consultant (Retired Climatologist)
Darin Burr	Dillon Consulting	Sean Sterling	Intera Engineering

Sean chaired the meeting.

*Introductions* were heard around the table.

***Sydenham Tier 3 Study Presentation***

Colin presented an update on the Sydenham Tier 3 study. He reviewed the subwatershed, and the general work done for the study.

He noted that there have been significant changes to the text of the report due to changes needed as per “Technical Bulletin: Part IX Local Area Risk Level”, an update to the Technical Rules prepared by the Province. The science and results of the report did not change, but the manner in which they are presented was updated to reflect the requirements of the technical bulletin.

Igor asked about how/whether groundwater considerations were considered for the Tier 3 study. At the Tier 1 level, groundwater in vs. out was balanced, where minimal groundwater in was expected, and that assumption has remained in the Tier 2 and Tier 3 reports. It was agreed that on the Precambrian Shield, this was probably true. It was also noted that a sentence or two could be added to the report to reflect this assumption.

It was asked that the pump schematic drawing be added to the report. Sean noted that he would check with the plant operator to make sure that was OK, and the figure would be added, or a close representation would be added.

The question was asked “Are the log settings constant for the drought scenarios?” Yes, the average log settings/changes for the period of record were used for the drought scenarios.

There was a question as to whether there was any data missing from the CRCA's log setting/water level records. The answer is yes, however the model appears to correct for that fact. The number of logs in the bays typically ranges from 3-3 to 4.5-4.5 over the course of the year.

The Peer Review team felt that the report was sufficient, but would provide additional details/comments, if warranted.

### ***Lansdowne Tier 2 Study Presentation***

Dru Heagle presented an update on the Lansdowne study. He started with a general review of the study overall, and then went into some details on the Water Budget portion of the study.

There was a discussion on what each term on the initial equation included, and whether something was missing, or mislabelled, or misrepresented.

$$P + G_{in} = AET + Q + \Delta S$$

It appeared that the  $G_{in}$  term included  $R$  (recharge) when perhaps it should not have, and  $R$  should be on its own on the right side of the equation instead. Intera would verify and correct this.

There was some discussion as to whether an assumption of 60 mm of recharge was too high. That would potentially mean an underestimate of stress.

It was noted that the term "MOE wells" did not mean wells owned or operated by the MOE, but rather the MOE database of well records, the Water Well Information System (WWIS).

It was noted that table 6.1 (monthly data) needed a revision in the  $G_{in}$  column, from 6.25 to 1.25 for each month. This could further change, as  $G_{net}$  could be represented here, just not in the stress assessment portion of the report. There was also a question as to whether the  $\Delta S$  total was too high at 10%. This would include  $G_{out}$ , and may fall with the change to  $G_{net}$ , rather than  $G_{in}$ .

There was a question about wetlands in relation to  $G_{net}$ , and whether there were any in the subwatershed. There are some, but they are small, and at the very downstream end of the subwatershed.

There was a question about the water use numbers, and whether an average between 2007/2008 values was appropriate. This would depend on whether the average was more representative of the longer term use, and whether something happened in those years to throw the numbers off. This will be checked for Lansdowne. It may have something to do with the bacteria found in one well, and the switching between wells as the source.

Igor had a question about the consumptive demand values used, and whether that was acceptable to the province. In this case, the value used was based on looking at records of water produced

at the wells, and received at the lagoons, and there is the potential for leakage in the pipes, or watering of lawns/gardens, to be bringing water back to the ground, where the rest goes to the lagoons, and to surface water outside the watershed. This was acceptable.

There was some discussion about the potential water level decline in the wells over time, and whether the pumping rate could be added to the figure, so the two could be compared, as one influences the other.

\*\*It should be noted that at a meeting with OCWA the week after the WB meeting, the values previously presented may in fact not be correct, as the measuring unit may have been drifting over time. In fact the water levels may not be changing much at all in the wells. The recommendation for long term monitoring to confirm this is still relevant.

This wrapped up Dru's presentation. However, there were some specific suggestions/comments after that.

Ed noted Table 5.2 on page 20 of the report, calibration statistics. He wondered whether it was standard output for a groundwater model, and felt that it might be mis-representing the data, and showing too little information on the variation of the values, while highlighting outliers of the data. A suggestion was made that a box-whisker plot would be a better representation, as it would show all the data, and whether most was clustered together, with just a few outliers, or not. It was also suggested that colour coding points based on quality of the data, or confidence in the data, may be appropriate.

There was some discussion on the size of the subwatershed, and the surface vs. groundwatershed knowledge, and it was noted that in the future the existing Technical Rules could change to reflect these known inconsistencies with the science.

It was also noted that there is a mention of Figure 5-1a on page 17 referring to boundary conditions. Perhaps it is only Figure 5-1 that is meant to be noted there.

It was also noted that a check on Significant Groundwater Recharge Areas should be made, and whether any changes from the Tier 1 assumptions are needed due to this work. A few sentences of description may be all that is needed here.

***Timeline for reception of Comments***

Comments need to be received by Friday January 14<sup>th</sup>.

***Next Meeting***

There may not be a next meeting. Hopefully, this meeting will wrap up the review of these two studies.

The meeting was adjourned at 12:00 PM

Date: February 25, 2010

From: Scott Bates  
Water Budget Program Analyst  
Ontario Ministry of Natural Resources

To: Cataraqui Source Water Protection Team

Subject: Review of Wellhead Protection Area (WHPA) and Tier 2 Water Budget Study Lansdowne, Ontario. Revision 0A (Draft)  
Cataraqui Region Conservation Authority  
Draft report dated February 1, 2010  
Received February 2, 2010

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I have reviewed the report entitled, Wellhead Protection Area (WHPA) and Tier 2 Water Budget Study Lansdowne, Ontario, dated February 1, 2010 produced by the Cataraqui Region Conservation Authority. This document is a good first draft towards fulfilling the Water Budgeting requirements of the Assessment Report Technical Rules and is generally well written and well organized. There are several components of this document that will require revision to make it consistent with other reports being produced across the province. Please accept these comments as a constructive critique for the purposes of improving the content and clarity of the document.

#### Comments

- 1) General: For the purposes of receiving separate deliverables under the MNR's transfer payment program and the MOE's technical studies program please consider preparing two separate reports for the Tier 2 Water Budget assessment and the Groundwater Vulnerability assessment. Having these two assessments combined in one report is somewhat confusing for the reader.
- 2) General: At several points in the report the Assessment Report Technical Rules are referenced. Please make a minor correction to indicate that the assessments were undertaken in accordance with the most recent release of the Assessment Report Technical Rules dated November 16, 2009. There were only minor changes made to the Water Budget portion of the technical rules which should not change your methodology or results.
- 3) Page iii: The Executive Summary will require rewording based on a number of the comments provided below.
- 4) Page 12: In the report it states, "*Important assumptions made during the Tier 1 WB study included: Municipal Well consumptive factor = 1.0 (i.e. 100% of water that is pumped leaves subwatershed)*". Please make a minor clarification in the wording for this assumption to state that consumptive factors are based on the 'source' from which the water is pumped (e.g. an aquifer) and not the subwatershed. For example the determination of consumption is not evaluated in relation to the water leaving the subwatershed, but rather the water being taken from the subsurface and not returned to the subsurface within a reasonable time.
- 5) Page 28: On this page of the report the water budget term  $G_{NET}$  is discussed and used in the water budget equation. As discussed further below, the calculation of the water supply term ( $Q_{SUPPLY}$ ) should be undertaken using only the groundwater recharge ( $Q_{RECHARGE}$ ) and the groundwater flow in ( $Q_{IN}$ ) to each subwatershed. The primary reason for not using the  $G_{NET}$  approach is that the stress thresholds for the stress assessment have been designed and tested to work using the approach outlined in the Water Budget Guidance and Technical Rules. Using the  $Q_{NET}$  approach would require redesigning the stress thresholds (on a monthly basis) and would contribute to inconsistent results when compared to other stress assessments being undertaken across the province. Please update the text in the report and the water budget equation to reflect these technical requirements.

- 6) Page 30: Please make a minor modification to the text to clarify that the future scenario is not based on a fixed 25-year time horizon but rather should be based on local municipal Official Plan population projections out to their existing time horizon whatever it may be (e.g. 2015, 2020, etc.). Using this method we ensure that the future scenario is based on an officially approved municipal document rather than other estimated projections. Demand should be determined using a per capital rate with appropriate consumptive factors applied.
- 7) Page 33: In Section 7.5.1 it states, "*The average annual municipal water pumping rate is approximately 71,000 m<sup>3</sup>/yr and this value was used in the WHPA modelling for current conditions.*" Please revise the calculation of municipal demand for water budgeting purposes to reflect pumping during the "Study Year" as defined in the Technical Rules. Rather than using the 10-year average between 1998-2008 the Technical Rules require the use of pumping rates during the study year. This requirement is primarily to ensure we are using the most recent and representative pumping from the municipal system.
- 8) Page 36: Please consider removing the terminology "super drought" from the report, it is not a common term used in either the Water Budget Guidance or the Assessment Report Technical Rules.
- 9) Page 37: In the report it states, "*This results in a moderate stress with respect to both current and future pumping rates, further emphasizing the high level of uncertainty in the percent water demand classification.*" Please be cautious with the use of language related to the uncertainty in the report. Using statements like "*further emphasizing the high level of uncertainty*" runs the risk of having the assessment dismissed/diminished technically or scientifically. While the percent water demand calculations do have their inherent uncertainties, they do use the most recent information in a technically and scientifically defensible manner. You may wish to consider adding a section that discusses your overall certainty with assigning a specific stress level (e.g. how certain are you that you have assigned the stress level correctly). The Source Protection Teams and Source Protection Committees may also wish to consider both the benefits and risks associated with the use of this language in the reports.
- 10) Page 38: Please remove the discussion in Section 7.8.3 of the report related to the use of  $G_{NET}$  versus  $G_{IN}$  for the reasons stated above in Comment 5. Additionally, the argument that, "*if the subwatershed upstream consumed all of the water that laterally flowed into it, there would be no lateral groundwater flow into the Lansdowne subwatershed.*" is not particularly valid because if this was actually the case it would be incorporated into the groundwater model and be evident in the MODFLOW calculations. The fact that the subwatershed upstream currently does not consume this water confirms that the  $G_{IN}$  is available as additional supply for the Lansdowne subwatershed. As new water takings or land use changes occur in and around the subwatershed they will be built into the model and proportionately affect the  $G_{IN}$  calculations.
- 11) Page 38: Please remove Section 7.8.4 from the report as there is no requirement to undertake this evaluation in the Assessment Report Technical Rules. Similar to reasons stated above, using this approach would require redesigning the stress thresholds (on a monthly basis) and would contribute to inconsistent results when compared to other stress assessments being undertaken across the province. This being said, it may be useful for CRCA to receive this information in a separate supplementary report for their consideration in other programs.
- 12) Page 40: The discussion and determination of the groundwater stress level on this page is not consistent with Technical Rule 35(2)(h) that requires all three sub-clauses to be true. Specifically the percent water demand calculation does not meet the requirement of 35(2)(h)(i) where the annual percent water demand must be between 8% and 10% inclusive.
- 13) Page 165: Although Appendix H "Percent Groundwater Demand – Alternate Approach" is useful in demonstrating the calculations of the water budget components and the percent water demand using an alternative approach it should be removed from the final water budget report because there is no requirement to undertake this evaluation in the Assessment Report Technical Rules. This being said, it may be useful for CRCA to receive this information in a separate supplementary report for their consideration in other programs.

**DRAFT**

**Wellhead Protection Area (WHPA) and**

**Tier 2 Water Budget Study**

**Lansdowne, Ontario**

**(Dated February 1, 2010)**

**General Comments**

1. I found the Executive Summary and Main Report to be generally well-written and nicely presented.
2. There are a few places where corrections of an editorial nature are required. These include spelling mistakes (e.g. “great Lakes” and “Village”), typos (see paragraph 2 of section 2.1), departures from convention (e.g. the SI abbreviation for hour is h, not hr or hrs) and poor form (the equations are barely legible).
3. I fully agree with the discussion in section 7.8.3 regarding the use of  $G_{net}$  for supply.

**Specific Comments**

<b>Section</b>	<b>Comment</b>
5.1.4	<ul style="list-style-type: none"><li>• I realize that some groundwater modellers use the term residual to denote the difference between modelled and observed heads or water levels, but will leave a discussion of the appropriateness of this terminology to another day.</li><li>• In order to evaluate the success of the calibration (mean of absolute differences = 3.4 - 5.4 m), it would be helpful to have an estimate of the error in top of casing elevations for two categories of well: 1) those that have been leveled in and 2) those for which casing elevation have been taken from a DEM or topographic map, and how many of the 153 observation are in each category.</li><li>• However, for category 2 wells, one would not expect a bias in ground elevation estimates by an experienced geologist or engineer, so without additional information, I must conclude that the cause of the difference between modelled and observed heads is modelling error.</li><li>• If this is the case, and if there is a bias towards “over-prediction”, why would one not vary another parameter (such as specific storage) to eliminate this bias, insofar as possible? Maybe just address this point!</li><li>• Finally, the correlation coefficient is not the appropriate statistic in this case.</li></ul>
7.3	I agree with the ‘professional judgment’ approach to estimating monthly values of recharge.
7.4.2	Table 7-3. Wow, 7 significant figures for annual supply! Are you confident that the supply is not 1,095,878 rather than 1,095,879? I don’t think so.
7.5.4	Table 7-4. 5 significant figures are still a bit much.
7.6	Table 7-5. Wow, again.
References	Check the date for the technical rules. I think that it should be 2009.



**REVIEW COMMENTS ON LANSDOWNE TIER 2 WATERBUDGET STUDY = REVISION 0A (DRAFT)**

**By: Darin Burr**

**Date: February 25, 2010**

**General Comments**

Overall, the report is well written, technically complete and easy to follow.

**Specific comments**

<b>Location</b>	<b>Comment/Suggestions</b>
Pg 11, 1 <sup>st</sup> paragraph and other locations	<p>In many locations within the report, reference is made to the well being “potentially” GUDI. This conclusion is based on the observation of cascading water in the well around 6 mbgs, and bacteriological problems. However, a GUDI study has been conducted previously, and the system declared non-GUDI.</p> <p>Based on the data in the report, it appears that the problem is more of an impacted shallow groundwater problem /poor well casing seal than a connection with nearby surface water, especially considering that no surface water is reported to be in the nearby area. Therefore, I suggest that the report’s reference to “GUDI” in numerous locations be reviewed, and that comments on the GUDI status of the system not be included in the water budget report, as it is outside of the reports purpose (such issues could be raised separately)</p>
Pg 20, Section 5.1.2, 1 <sup>st</sup> paragraph	The paragraph states that no-flow boundaries were assigned to the exterior of the model domain. Were any boundaries assigned constant head? How were the lagoons included in the model?
Pg 22, Section 5.1.4 1 <sup>st</sup> paragraph	The sentence “The corresponding simulated hydraulic heads were interpolated .....” is not clear. The way the sentence reads, it appears that observed heads were compared to waterfound elevations in the domestic wells (rather than static elevations). If this was done, more rationale is needed, as model calibration is usually performed to the static heads (not water found elevations). Perhaps the water found elevations were used to identify which layer the static elevations applied to?



Pg 23, 2 <sup>nd</sup> paragraph from top	<p>The paragraph states that there is no spatial bias in the calibration residuals. When I look at Figure 5-2, it appears that the orange, red and yellow dots correlate with the higher hydraulic heads on the topographic high in the NW part of the village, and that dots are more green to the SE off the topographic high. I also note that there are very few calibration wells on the topographic high. In the future, drilling of additional wells in this area would be useful to improve the calibration.</p> <p>I also note that the relatively good RMS calculations for Lansdowne can be misleading when large model domains are used where topography difference are large. For Lansdowne, the simulated vs observed hydraulic head data shows a large scatter, suggesting that calibration is not as good as the RMS calculations would appear. I suggest that the model be calibrated to the wells that are in close proximity of the pumping wells; however, this would still not remove the problem of no water level control data to the north , west and east of the pumping wells</p>
Pg 24, Section 5.2.2	It is difficult to develop WHPA E/F when no surface water is present, therefore I suggest it not be included. You may want to talk to QC about their experience with Tweed.
Pg 25, 3 <sup>rd</sup> paragraph	The report states that adjustment of vulnerability to account for transport pathways is not necessary. I understand that the Technical Rules still require transport pathways to be identified, even if the data is not used to increase vulnerability.
Pg 26, Section 5.4	I suggest that the uncertainty rating be high (not low). The rationale is provided in Section 5.5, where there is significant data gaps (geological understanding, recharge estimates, vertical K etc) that would affect the results. Even though a very thorough uncertainty analysis was done with the model, groundwater flow will still be controlled by fractures, which are largely unpredictable with the existing field data. In addition, there are few calibration wells in key locations (on topographic high north and west of village).
Pg, 33 Section 7.5.1	How was non-permitted private well demand incorporated into the model?
Pg 32, Section 7.4.1, 3 <sup>rd</sup> paragraph	<p>It would be useful to show a potentiometric surface map for Lansdowne so we can see natural flow directions.</p> <p>I presume that since there is a Gin component, than there is an ambient gradient direction? Capture zones are generally circular, suggesting there is no ambient gradient direction. Why the difference? A potentiometric map would perhaps explain this.</p>

Pg 36, Section 7.7.1	It appears that the rationale for going to the 10 year drought, rather than stopping at the 2-year drought scenario was because of the concern that the well pump efficiency would decrease, even though the stress at the 2-year drought level was okay. I don't think pump efficiency (as this is speculative) is one of the criteria in the Technical Rules, and the analysis should be based on Technical Rules criteria only. Should the pump not be able to pump at the required volumes (because of lower heads), then the municipality could change the pump.
Pg 38, Section 7.8.3 1 <sup>st</sup> paragraph	There appears to be a trend of decreasing water levels; however, comments should be made in the report on whether this is in part a result of well fouling because of bacteriological or mineralization problems. How do water levels compare to what was observed at time of initial drilling in 1975 (or perhaps these records are not available). Also, the decrease is in the pumping well, rather than data from an observation well, so the results may not be representative of actual aquifer conditions.
Pg 40, Section 7.10	Another data gap would be the lack of calibration water levels on the topographic high west and north of the village
Pg 41, Recommendation 2	<p>More data is needed prior to implementation of a Tier 3 water budget model. This information should include</p> <ul style="list-style-type: none"> <li>a) confirmation of water level decreases in the aquifer (not just the well).</li> <li>b) confirmation that reduction in water levels in the well are caused by mineralization/bacteriological buildup</li> <li>c) if a model is to be performed, reduce the model domain to be more local rather than regional, and calibrate to wells in close proximity of well field. Additional well control points are recommended to the north, west and north east of the well field</li> <li>d) performance of a pumping test to calculate average K, T and S values for aquifer</li> <li>e) confirm recharge values by looking at variations in water levels with precipitation patterns.</li> </ul>

**DATE** June 7, 2010**PROJECT No.** 07-1122-0311-3000**TO** Sean Watt  
Cataraqui Region Conservation Authority**FROM** Brian Byerley**EMAIL** bbyerley@golder.com**TECHNICAL REVIEW OF GROUNDWATER VULNERABILITY ASSESSMENT OF  
THE LANSDOWNE MUNICIPAL GROUNDWATER SUPPLY  
BY INTERA ENGINEERING LTD.**

Golder Associates Ltd. (Golder) was retained by the Cataraqui Region Conservation Authority (Cataraqui) to review and comment on the draft groundwater vulnerability assessment of the Lansdowne municipal groundwater supply by Intera Engineering Ltd. The vulnerability assessment is contained in a report titled: 'Wellhead Protection Area (WHPA) and Tier 2 Water Budget Study, Lansdowne, Ontario. Revision: 0A (Draft)', dated February 1, 2010. Golder's scope of work did not include reviewing the portion of the report related to the water budget.

As indicated by the comments below, in our opinion, refinements to the report should be made and/or clarification comments provided prior to Cataraqui accepting the current findings and implementing them as part of Source Protection Planning. Key figures are either missing or are of marginal quality, and the analysis and interpretation of the data is not reported in sufficient detail such that a third party (e.g., Golder or other hydrogeologists) can fully understand how the available data informed the development of the conceptual model or that the numerical model, and model scenarios have produced an appropriate WHPA. With respect to the WHPA, in our opinion (from the information provided) there remains a high degree of uncertainty with respect to their extent and the groundwater times of travel to the supply well. This is in contrast to the low uncertainty classification concluded by Intera on page 26 of the report.

Our review comments and questions presented below are organized under three categories:

- 1) Regarding the general size, shape and orientation of the WHPA and approach to aquifer vulnerability mapping;
- 2) Regarding the specified Terms of Reference; and,
- 3) General comments, questions and/or requests for clarification.

With one exception, we have not listed typographical errors. Reference to the relevant section of the report, figure or table is provided for most comments.

## WHPA and Vulnerability Mapping

- 1) Section 2.2, 5<sup>th</sup> paragraph: States that the sewage treatment ponds were constructed with an “impermeable clay liner”. Considering the proximity of the treatment ponds to the supply wells and their estimated capture zones, the hydraulic performance of the liners is of interest. In Section 2.3.1 Intera indicates that faecal coliform bacteria was detected in shallow overburden monitoring wells located near the ponds and attributes the presence of the bacteria in the monitoring wells to adjacent farming practices. Additional detail regarding this interpretation should be provided, and Intera should consider the possibility that the ponds are not impermeable. A discussion on the degree of confidence / uncertainty related to the treatment ponds being within the capture zone of the supply wells would be a useful addition to the report.
- 2) Section 3.5, 1<sup>st</sup> paragraph: States that there is 2 metres of overburden at the municipal wells, and that the hydraulic conductivity of the overburden is assumed to be  $1 \times 10^{-7}$  m/s. The hydraulic conductivity of glacial till can vary considerably and the hydraulic conductivity of weathered clay can be significantly higher than  $1 \times 10^{-7}$  m/s. Any data supporting the chosen hydraulic conductivity values should be referenced in the report, and variation of these values should be considered during sensitivity analysis.
- 3) Section 3.5, 2<sup>nd</sup> paragraph: States that the vertical hydraulic conductivity of the sandstone aquifer was conceptualized to be approximately  $1 \times 10^{-9}$  m/s, based on straddle packer testing, water level measurements and numerical modelling. The appendix regarding the straddle packer testing (Appendix E) does not include information on vertical hydraulic conductivity. Intera should present and discuss the data supporting the assigned vertical hydraulic conductivity.
- 4) Section 3.5, 4<sup>th</sup> paragraph: States that the porosity of the Precambrian bedrock is assumed to be 5%. Golder is aware of previous WHPA studies by Intera that have utilized Precambrian bedrock porosities of less than 1%, and it is our understanding that the effective porosity is typically on the order of 0.1 to 1%. It would be our expectation that, as part of the overall uncertainty analysis approach adopted by Intera to develop the WHPA, consideration would have been given to using lower porosity values for Precambrian bedrock.
- 5) Section 5.1.2, 2<sup>nd</sup> paragraph: A uniform recharge rate was simulated for 3 of 4 simulations. However, in Section 3.4, 3<sup>rd</sup> paragraph, Intera states that, “Near Landsdowne recharge is interpreted to be highest where the Palaeozoic sandstone exists and lowest where a significant thickness of clay is present.” The modelling approach / assumptions appear to be inconsistent with this statement. Additional clarification and/or justification should be provided to justify the uniform recharge rate used for simulations 1, 2, and 3.
- 6) Section 4.2, 6<sup>th</sup> paragraph: Intera states that, “More data is required for a more meaningful understanding of the Lansdowne subwatershed groundwater chemistry.” Is Intera recommending collection of more isotope data, and that such data may affect the extent of the WHPA?
- 7) Section 5.1.2, 5<sup>th</sup> paragraph: States that pumping from the municipal wells was not simulated during model calibration. However, recently collected groundwater levels (e.g., from the monitoring wells) may have been influenced by pumping. It is unclear as to how this may influence model calibration.
- 8) Section 5.1.4, 3<sup>rd</sup> paragraph: Intera has utilized four scenarios to encompass the potential range of uncertainty in the capture zones. It is not clear why Intera feels that these four scenarios are sufficient to bound the range of uncertainty. For example, the four scenarios considered do not reflect variability in effective porosity, or the potential influence of nearby surface water bodies (including the sewage treatment lagoons) which are two uncertainties associated with the flow system. Local flow directions and the

correlation of groundwater and surface water divides is another uncertainty that we feel might be worthy of investigation in such an approach.

- 9) Section 5.1.2, 1<sup>st</sup> paragraph: States that all exterior lateral boundaries are no-flow boundaries. This is in contradiction with their conceptual statement that regional flow is to the south towards the St. Lawrence River.
- 10) Section 5.2.1, 1<sup>st</sup> paragraph: Intera does not state how many particles were released and in what layers they were released. This information should be included in the report. Additional details regarding how "weighting" was used to draw the polygons should also be provided so that it can be reproduced by others.
- 11) Section 5.3.1 2<sup>nd</sup> paragraph: States that the ISI was calculated using the depth to the water table and that the ISI was determined to be 30 throughout the entire WHPA. Additional detail regarding the ISI calculation should be provided (i.e., was it calculated on a grid throughout the WHPA?). The K-factors assigned for the weathered clay (3) and the bedrock (1) are not consistent with the vertical hydraulic conductivities of these units in the numerical model. The report should include an overburden isopach map, and a map illustrating the depth to the water table from ground surface to support the ISI calculations.
- 12) Section 8, recommendation 6: Intera should expand on why straddle packer testing in the municipal wells is recommended. Would data from straddle packer testing affect the delineation of the WHPA or the vulnerability scoring within the WHPA?

### Terms of Reference

- 1) Figure 2-2: What is a "truthed well"? Are other wells not "truthed"? Were GPS coordinates obtained for all visible/accessible wells as per the terms of reference (TOR) for the WHPA?
- 2) The TOR for the WHPA study includes the identification and mapping of transport pathways (see section 4.2, Task 2.3). The report does not include this information. According to the TOR, Intera was to expand on the inventory of land use, activities and transport pathways in the Village of Lansdowne (see Section 4.2, Task 2.1 for detailed specifications). The report does not include this information.

### General Comments and Questions

- 1) Section 2.2, 3<sup>rd</sup> paragraph: States that the casing of the municipal wells is set approximately 1.5 metres into bedrock. What are the total casing lengths for the municipal wells?
- 2) Section 3.3, 1<sup>st</sup> paragraph: Includes a discussion of overburden and clay thickness, but the report does not include overburden or clay isopach maps. These maps should be included in the report.
- 3) Section 3.3, 2<sup>nd</sup> paragraph: States that, "a single fault is mapped south of Lansdowne in the Precambrian bedrock". Figure 3-3 does not show the referenced fault.
- 4) Section 4.1, 1<sup>st</sup> paragraph: States that water level data was collected at 8 locations shown on Figure 2-3. Figure 2-3 shows more than 8 locations. The specific water level monitoring locations and the data collected should be included in the report.
- 5) Section 4.1, 3<sup>rd</sup> paragraph: States that the degree of water level change in monitoring wells is dependant on the open interval of the borehole and the hydraulic properties of the screened formations. We note that other factors could also affect water level fluctuations (e.g., local recharge and proximity to the supply wells).



- 6) Section 4.2, paragraph 5: States that sample SS1 from a shallow ditch/creek is the most depleted and thus may not be representative of surface water. Is Intera suggesting a sampling or analytical error, or some other reason that SS1 does not represent surface water? If SS1 is not representative of surface water, why is this result used to interpret results from the municipal well (MUN1)? Intera also states that holding times for stable isotopes were exceeded for some samples. D and  $^{18}\text{O}$  are stable isotopes and therefore should not be affected by storage time.
- 7) Section 4.4, 3<sup>rd</sup> paragraph: Indicates that the K of the sandstone as determined by the straddle packer testing was  $1.7 \times 10^{-7}$  m/s. Elsewhere in the report the K of the sandstone is reported to be  $1 \times 10^{-6}$  m/s.
- 8) Section 4.5, 2<sup>nd</sup> paragraph 2: States that, "there is no evidence of surface water at ground surface". However, the TOR indicates that there are water courses, as well as ponded areas within the previously defined WHPA. Figure 2-3 indicates surface water within approximately 400 metres of MUN1 and within approximately 500 metres of MUN2. Therefore, Intera should clarify what area they are referring to in the section 4.5, and report what evidence they considered (i.e., OBM mapping, municipal mapping, air photos, field reconnaissance) to make their assessment of surface water.
- 9) Section 4.5, 1<sup>st</sup> paragraph: Golder notes that the MOE GUDI TOR also state that a well is potentially GUDI if the source of groundwater (i.e., water bearing zone) is within 15 metres of ground surface.
- 10) Section 5.2.1, 1<sup>st</sup> paragraph: Justification for the municipal well pumping rate used for WHPA delineation ( $85,239 \text{ m}^3/\text{year}$ ) is not clearly stated.
- 11) Section 5.3.2, 2<sup>nd</sup> paragraph: The last sentence is likely a typographical error.
- 12) Section 5.5, 1<sup>st</sup> paragraph: States that the potential GUDI status of the wells increases vulnerability due to transport pathways. However, the vulnerability scoring of Zone A is 10 and the vulnerability scoring of Zones E and F are 9, which is not higher than 10.
- 13) Figure 3-2: The legend is lacking information. For example, unit 8a is "Massive-well laminated". This is not sufficient as a description of soil type. The soil description should include the major grain size with appropriate modifiers (e.g., silty sand, or sand and gravel).
- 14) Figure 3-3: Many of the rock units in the legend do not appear on the map, and the legend is not presented in stratigraphic order (youngest on top, oldest on bottom).
- 15) Figure 5-1: Is a poor quality figure. There is a lack of detail and it is difficult to locate key features in the study area. This figure does not include a north arrow, and distance units are not indicated.
- 16) Figure 5-2: It is unclear which hydrostratigraphic unit the hydraulic head is from. Regarding Figure 5-2b, Intera should increase the size of the figure and it should include the entire model domain. A north arrow and labelling of key features would be helpful, and it would also be helpful to present this as a simple lined contour map. A similar map, generated using well records completed only within this hydrostratigraphic unit, would be helpful to review calibration. Regarding Figure 5-2a, the statistical plots shown do not provide any confidence with respect to local flow patterns around the pumping wells. The results at the monitoring wells located near the supply wells should be identified.
- 17) Figure 5-3: There is no geographic referencing and no scale or north arrow. It is difficult to assess the results without base map information.

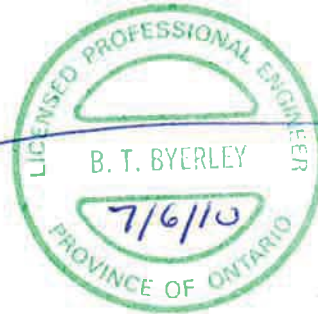
- 18) Figure 7.3: Indicates a steady decline in water levels at the Lansdowne well. Was this data considered during development of the conceptual model, and was data used for steady state calibration?
- 19) Appendix C: Includes well logs for MW3 and MW5 only. Well logs for the other monitoring wells should be included for completeness.

We trust that the above comments are beneficial to Cataraqui. Golder would be happy to review any future versions of the report produced for Cataraqui. Please contact the undersigned if you have any questions regarding the above comments.

**GOLDER ASSOCIATES LTD.**



Brian Byerley, M.Sc., P.Eng.  
Senior Hydrogeologist/Associate



BTB/SBD/am

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## COMMENTS BY ED WATT

### ON

#### INTERA REPORT ON LANSDOWNE DRAFT 1B (November 30, 2010)

January 13, 2011

Page	Para	Line	Comment
iii	2	1	village not Village.
1	4	7	CSPA not CRCA SPA.
3	1	1	Village not village to agree with page 1.
3	4	6	500 m <sup>3</sup> not 500m <sup>3</sup> .
3	3	5	m not metres.
5	1	9	I don't believe that the Raisin-South Nation folks were involved in the conceptual WB studies.
5	4	3	Replace Gin with Gnet for the WB. Gin was used for stress calculations as mandated by the rules.
7	1	5	Wilson (1946) is not in the list of references.
9	1	1	The not teh.
12	6	1	Should clarify method of solution, that is Theis method (log-log matching procedure) or Jacob approximation (semi-log method).
12	6	3	1. Why is there a difference in the number of significant figures reported for T for the two wells? An explanation is required. 2. 3.4x10 <sup>-6</sup> , 1.3x10 <sup>-6</sup> .
13	1	5	Should identify the responsible unit within Queen's University. Also, confirm that manual levels were taken to confirm that the transducer was functioning properly.
13	2	2	Delete "of".
13	4	1	Hvorslev (1951) is not in the list of references.
14	Table 4.4	1	1. m <sup>2</sup> /day not m2/day. 2. How can you justify four significant figures for S? 3. Values for S estimated from pumping tests appear to be too high by at least an order of magnitude. This should be clarified and a comment added.

14	Table 4.4		Wilson (1974) and Thompson (1991) are not in the list of references.
15	5	1	Wilson (1974) is not in the list of references.
16	1	1	MOE (2001) is not in the list of references.
17	4	5, 6	Here and elsewhere, should be consistent regarding use of metres and m.
19	2	5	Delete “a”.
20	Table 5.2	6	1) Does “RMS” stand for RMS residual? 2) If so, are there not units for “RMS”?
20	2	all	This paragraph should be rewritten to justify the observations/conclusions. How does the claim that case 1 simulations are unbiased match up with a residual mean of 1.6 m? Perhaps there is a bias in the observed hydraulic head. In any event, the fact that a residual mean significantly different from zero is deemed an acceptable calibration should be addressed in the text accompanying Table 5.2. In addition, the large over-predictions should be addressed. As it stands, without explanation, the table does not tend to inspire confidence in the modeller/report writer. Could include a brief discussion of the problems with the available calibration points as well as a discussion regarding the cluster of points that are over-predicted for all cases.
21	3	2	simulations not simulation.
25	1	3	Either change $G_{in}$ to $G_{net}$ on LHS or add $G_{out}$ to RHS.
25	5	1	Either add $G_{out}$ or deal with $G_{net}$ for WB.
26	3	1, 2	Water is usually referred to as above surface, surface and subsurface storage. Some folks might take groundwater as not including the unsaturated zone.
26	Table 6.1		Change $G_{in}$ to $G_{net}$ or add $G_{out}$ , and revise numbers accordingly.
27	1	4	Font problem with QReserve?
28	3	5	metre or m, not metres.
28	4	1	In the interest of completeness, average monthly recharge rates and average monthly values of $G_{in}$ should be tabulated.
29	2	2	Cite Technical Rules, not Guidance.
29	6	1	Cite Technical Rules, not Guidance.
29	6	1, 2	This discussion applies to tables 7.3, 7.4 and 7.5. The explanation given is not the generally accepted interpretation. Reported values reflect the precision by the number of significant figures. Google “number of significant figures” to

			<p>get <u>When reporting values that were the result of a measurement or calculated using measured values, it is important to have a way to indicated the certainty of the measurement. This is accomplished through the use of significant figures. Significant figures are the digits in a value that are known with some degree of confidence. As the number of significant figures increases, the more certain the measurement. As precision of a measurement increases, so does the number of significant figures.</u></p>
30	Table 7.3		Why is Storage included in this table?
30	2	7	60,000 and 70,000 not 60K and 70K.
30	3	3	Cite Technical Rules, not Guidance.
31	2	11	Cite Technical Rules, not Guidance.
31	4	2	Cite Technical Rules, not Guidance.
31	5	2	Cite Technical Rules, not Guidance.
31	6	2	1% per year for 20 years is a 22% increase over 20 years!
34	2	1	Cite Technical Rules, not Guidance.
Fig 5.3			<ol style="list-style-type: none"> <li>1. m<sup>3</sup>/year not m3/year</li> <li>2. Figure is not very reader-friendly. Maybe replace with Box-Whisker plots for various sub-areas.</li> <li>3. Alternatively, just show plot for one case, and if possible colour code dots according to location so that the reader can determine the location of the gross over-predictions.</li> </ol>
Fig 5.4			<ol style="list-style-type: none"> <li>1. Small dots for municipal wells are not visible.</li> <li>2. The coloured dots superimposed on the coloured areas of simulated hydraulic head are somewhat difficult to interpret. The text on page 20 makes no reference to simulated hydraulic head, but refers to" particular areas". Maybe coloured dots on a white background with contours would be more reader-friendly.</li> </ol>
Fig 7.2			<ol style="list-style-type: none"> <li>1) The caption says 2001 -2010, but the points go from 1998-2008.</li> <li>2) Why are fit lines employed? Bars or stacked bars would be more appropriate.</li> </ol>
Fig 7.3			<ol style="list-style-type: none"> <li>1) The caption is not accurate; the chart shows depths below ground, not levels.</li> <li>2) Why is a linear regression line shown? It detracts from the plot and the regression accounts for only 43% of the variance. The line should be removed unless some discussion is added justifying the linear mode.</li> <li>3) How can 5 significant figures be justified for the intercept?</li> </ol>

**REVIEW COMMENTS ON LANSDOWNE TIER 2 WATERBUDGET STUDY =  
REVISION 1B (DRAFT)**

**By: Darin Burr**

**Date: January 18, 2011**

**General Comments**

Overall, the revised report is well written, technically complete and easy to follow.

**Specific Comments**

<b>Location</b>	<b>Comment/Suggestions</b>
Pg 1, Section 1.2	I understand that consideration of the GUDI issue was part of the project TOR. I suggest that if this discussion is to remain in this report, reference to the scope of this assessment should be added to this section.
Ph 9. 1 <sup>st</sup> sentence	“the” is spelled incorrectly in 1 <sup>st</sup> sentence
Pg 9, Section 4.2	Please make reference to the source of the top of casing elevation. Was it surveyed, or was it based on MOE records? If the latter, some discussion of the expected accuracy of the top of casing elevation should be added.
Pg 16, Section 4.5	<p>I suggest that any reference to GUDI in the context of the Safe Drinking Water Act be issued as a separate letter, rather than including it in this report which focuses on the Clean Water Act.</p> <p>The last sentence states that because the wells are considered “potentially” GUDI for the purpose of this assessment, that WHPA-E and WHPA-F are required. My understanding is that the need for WHPA-E/F is defined in Technical Rule 49. I don’t believe Rule 49(3) is met, and therefore WHPA-E/F is not needed. I suggest that the report authors discuss this issue with MOE. In addition, WHPA-F is only required if a water quality issue is identified and that the source of the issue is not in WHPA-A to E.</p>
Pg 21, Section 5.2.1, last paragraph	I recommend adding a map that shows contoured potentiometric surface data from wells. This map could be included/discussed in Section 4. I understand that Figure 5-4 shows the modeled results and residuals but does not show the contoured actual data. A comment should be made on whether the contoured MOE data supports the conclusion of no regional flow system being present in the portion of aquifer that is pumped by the municipal wells.
Pg 21, Section 5.2.2	See comment above for Section 4.5

Pg 23, Section 5.3.2	See comment above for Section 4.5. Since there is no surface water, I don't think WHPA-E/F can be defined, and vulnerability assessment performed. I recommend that the authors clarify the approach with the MOE.
Pg 24, Section 5.4	I suggest that some text be added that states that an increase in vulnerability is not required as the aquifer vulnerability is already set at high.
Pg 33, Section 7.7	I recommend that MOE be contacted for interpretation with respect to 35(2) ii. Can a moderate level of stress be assigned to a well for purely a mechanical reason (i.e., well pump too high?)
Pg 35, Section 7.8.3	The response to Dillon's original comments implied that there was some uncertainty in the significance of the 2 m decrease. The response stated that the wells are never allowed to fully recover when the pump is turned off. I suggest that this uncertainty be mentioned in the text of the report
Pg 38, Recommendations	I suggest you mention the need for additional monitoring wells to improve calibration of model. Key areas would be on topographically high areas west and north of village.

## OCWA Comments re: Lansdowne WHPA and Tier 2 WB Study - DRAFT

### Conclusions

- 1) *Despite a recent study concluding that the Lansdowne municipal wells are not GUDI, the recent bacteriological contamination, the shallow well casing and the cascading water suggest that the issue be re-visited.*

Lansdowne's municipal wells are being treated as GUDI. As such, treatment equivalent to chemically assisted filtration (suitable for surface water) has recently been installed.

- 2) *The Lansdowne subwatershed was classified with a low level of groundwater stress in accordance with the Technical Rules (MOE, 2009), although the groundwater stress determination has a high level of uncertainty. WHPA Zones A, B, C, D, E, and F were delineated in accordance with the Technical Rules (MOE, 2009) and the most recent Vulnerability Guidance (MOE, 2007).*

No comment.

- 3) *A long term annual water budget has been developed for the Lansdowne subwatershed.*

No comment.

- 4) *Long term groundwater levels in the Lansdowne municipal wells show a steady decline of approximately 2m over 9 years.*

The apparent decline in water level can be attributed to faulty instrumentation. This issue was noted in the minutes of the meeting held on December 22, 2010.

### Recommendations

- 1) *Deepen the steel casing within the municipal wells to block off any cascading water from entering the municipal system.*

Treatment equivalent to chemically assisted filtration (suitable for surface water) has been installed on the municipal water supply. As such, deepening the steel casing to block cascading water will not provide any added benefit to the system and would be costly for the municipality to implement.

- 2) *Discuss with MOE/MNR the possibility of completing the groundwater stress assessment on a "groundwater-based" catchment.*

No comment.

- 3) *Initiate a long term continuous groundwater monitoring program in accessible monitoring wells.*

New well level transducers are to be installed on Lansdowne's municipal wells as part of the upgrades to the treatment system. The transducers will be incorporated into the SCADA system which can provide historical records from the time of installation.

- 4) *Complete depth discrete hydraulic testing within municipal well when there is a scheduled pump removal for maintenance. Although not required by the Technical Rules, additional hydraulic testing is recommended to better estimate the bedrock aquifer parameters and provide an opportunity to collect groundwater samples from isolated intervals in an attempt to better understand the source of the bacteriological contamination in the municipal well. The additional hydraulic data is not expected to alter the WHPA delineation beyond that already incorporated into the sensitivity analysis but would provide an opportunity to fine tune the conceptual model and input parameters, thereby reducing uncertainty.*

This may be costly for the municipality to implement.

- 5) *Although not required by the Technical Rules, collect more groundwater and surface water samples (including a sample of the “cascading” water in the municipal wells) to allow a better understanding of the source of municipal groundwater (ie. which aquifer) and also a better understanding of the bacteriological source.*

No comment.

**Additional Notes:**

The most recent population estimate provided to us by the Township for Lansdowne (in 2008) was approximately 590.

It is noted in the study that the “Lansdowne municipal wells appear to show impact from surface contamination due to a poor well seal”. However, the attached report by Malroz Eng. from 2003 concluded there was no infiltration or leakage around the bottom of the casing of Well #2.



Teleconference with Geofirma, Golder, CRCA on Lansdowne WHPA project

Notes

Wednesday, January 19<sup>th</sup>, 2011

3 - 4 pm

Attendance - Sean Sterling (Geofirma), Anthony West (Geofirma), Brian Byerley (Golder), Sean Watt (CRCA), Rob McRae (CRCA)

Prior to the meeting, Sean W. sent around a list of topics to cover via email. The list was:

- specific agreement on modeling parameters, to ensure that the WHPA itself will not change going forward
- permeability
- porosity
- recharge
- model layers
- sensitivity
- model results
- ISI work - impacts vulnerability, and threats

Sean W. outlined the reasoning behind the request for the teleconference. CRCA staff wanted to take the findings of the study to the Source Protection Committee (SPC) at their January 20<sup>th</sup> meeting, for receipt. The findings will then be used in the updated Assessment Report (AR), which is due to be circulated for public comment in February or March. From a timeline perspective, waiting for the report to be fully wrapped up before bringing the findings to the SPC may not allow the findings to be included in the updated AR.

In particular, the delineation of the Wellhead Protection Area (WHPA) is seen as a crucial element to confirm, so that we can proceed with additional work without the WHPA changing. In addition, Rob noted that the threats work also required the WHPA to be stable.

With that introduction, Brian suggested we just run through the list of topics, and discuss each one in turn. He noted that he did not have any specific comments or questions on permeability, recharge, or sensitivity,

Porosity

- The porosity value used in the previous draft of the report was 5%, that was changed to 1% in this draft, which seems appropriate.
- Brian's comment is about how the change was presented in the report specifically, where the text seems to suggest that a value of 10%, while high, is still a reasonable value. He doesn't think this is true, but rather that 10% porosity is much too high for sandstone or precambrian rock. This statement is on page 8 of the report, last paragraph.
- Perhaps a revision to the text, stating more along the lines that 1% is an appropriate value, without implying that 10% is also an appropriate.
- It was also noted that a porosity value for precambrian bedrock could be even lower than 1%.

- The question was asked, should we use a lower value? It was discussed that it would be hard to justify a lower number.
- Sean S. used 0.1% as part of the sensitivity analysis for another eastern Ontario study.
- It was agreed that 1% porosity for sandstone and weathered precambrian bedrock is appropriate.

### Model Layers

- Brian's first comment related to the hydrostratigraphy, the bedrock geology map of Figure 3-3, and the extent of the Nepean formation. The map from the previous draft of the report had the central Nepean area divided into three pieces.
- *\*\*Sean W is checking in the details of the map layers.\*\* I was able to recreate both maps using two bedrock layers. The first shows the northern portion of the Nepean area, and identifies it as "Potsdam Gp.; Nepean Fm.; Covey Hill Fm.". The second shows the two southern portion, identifying them as "Nepean" and "Potsdam". It would appear that the grouping of these areas in the most recent version of the report is acceptable, and that they are the same formations. Attached is the metadata for the mapping files, the Bedrock Geology layer of Ontario, and the Paleozoic Geology layer of Ontario.*
- Ant noted that the geology areas are thin layers, and may not make a difference to the model overall. Ant was also going to check the details of that data.
- Brian asked about the overburden, in particular the area of clay west of town that is 20 m thick. He asked whether it was included in the model. Ant confirmed that yes, it is.
- Ant noted that the overburden in general matters very little from a GW flow perspective, as the flow is really in the bedrock, not the overburden.
- Brian also asked whether the area of sand noted on page 20 was included in the model?
- Ant noted that there are some small inconsistent layers of coarse grained materials shown in some wells, but that these were not included in all the wells, and that all overburden was made the same in terms of model parameters, instead of having small clusters of coarse grained estimations.
- Those small areas make pockets in the model, and are difficult to build in the model, and have limited effect, so basically they are ignored.
- A suggestion that maybe adding a sentence about why these coarse grained areas were not included in the model, where the sand is discussed on page 20.
- Brian also had a question about whether the sand should have been included in the ISI calculations?

### ISI

- Brian had questions about how the ISI method was done for this study.
- Brian noted that the ISI method typically looks at the thickness of all layers down to the water table. In this case, it went to the upper aquifer, and was interpolated across the area. This is an alternative method described in the Guidance Module, as noted above.
- Brian wondered why not use the water table depth, rather than aquifer itself. Ant noted that the confidence in the water table data is not as high they would like, with the variability of values over time and location.
- Ant noted that the method used was based on assumptions of thicknesses and K factor to come to the answer. Basically, rather than looking at each well, they made some general

assumptions about thickness of the clay overburden, and the K factor of that weathered clay, to come to a general estimate of ISI for the area, which was well within the range for High Vulnerability.

- This is available as an option in the GW Guidance Module, if limited information on water table is available (rather than using all materials above water table, you use layers above the aquifer layer). Page 49 in the pdf, Section 3c in Appendix 3, of the October 2006 GW guidance module.
- It was recommended to add text into the report on the alternative ISI method in the guidance, and add text to the rationale.
- It was also noted that if the coarse grained materials were included in the ISI, it only makes vulnerability higher. Ant noted that to get a medium ISI vulnerability score from an existing ISI 10 (~3 m of K=3 clay), you would need to add 20 m of K=1 bedrock, which is very improbable to expect in any areas around Lansdowne.
- On the top of page 8, the Brian noted the text states the overburden unit has high porosity, and low and isotropic hydraulic conductivity. He suggested adding maybe another sentence to explain why no others were included?
- Brian also noted that maybe not all surficial fields are present in map, and many may be above the water table too. He recommended adding that statement to the text of report. It was also noted that the overburden is generally unsaturated.
- Brian asked about including a water table contour map from the raw data, showing the well record levels, and the simulated contours on top.
- Brian asked about Figure 5-4, and whether all wells with water levels are included. And if so, why do so many more wells appear on Figure 2-2? Ant noted it must be that many of the 2-2 wells don't have water levels, so aren't shown on 5-4.
- Ant noted that they did produce a map of water levels from the wells, and that this was used to establish the model boundary.
- Brian felt that the ISI as presented seems ok, no change is needed, except perhaps some additional text included to explain, as noted above.
- It was also noted that, with respect to transport pathways in Section 5.4, the vulnerability as allowed in the Technical Rules cannot be adjusted any more than one category, from Low to Moderate or Moderate to High. In this case, with the ISI showing High vulnerability across the WHPA, each zone was raised one category. Even though there are various transport pathways across the WHPA, wells, service trenches, lagoons, etc., the vulnerability cannot be raised for the study. However, the reality is that every hole in the overburden does increase the actual vulnerability of the aquifer to contamination. It was recommended that perhaps some text along these lines could be added to the report in this section.

#### Other

- It was noted that the broad regional aspect of some of the work could be a problem in the respect that there could be site specific inconsistencies. As noted by Sean W. and Rob, this should be fine as we move forward, and as new information and site specific information comes up. Most of the technical studies being conducted within the source water work have this same potential problem. However, it is expected that the plan will be written such that as better site specific information comes up (such as a site specific study), it could be used to change the previous delineations and planning recommendation.

After going through all the specific detail, everyone agreed that overall the study is OK, there are no expectations of any changes to the WHPA, we can go to the SPC with confidence.

\*\*It was also discussed that these notes could be used as the formal Peer Review reply from Brian to the CRCA/Consultants, and revisions to the report could commence based on the comments contained in these notes.

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>Delivered-To: [seanwatt@cataraquiregion.on.ca](mailto:seanwatt@cataraquiregion.on.ca)  
>From: "Byerley, Brian" <[Brian\\_Byerley@golder.com](mailto:Brian_Byerley@golder.com)>  
>To: Sean Watt <[seanwatt@cataraquiregion.on.ca](mailto:seanwatt@cataraquiregion.on.ca)>  
>Date: Wed, 13 Apr 2011 13:59:13 -0700  
>Subject: RE: Lansdowne Review  
>Thread-Topic: Lansdowne Review  
>Thread-Index: Acv6F0lDnbhRu1AtTtiJoz94U3U+RwAAZhjw  
>Accept-Language: en-US  
>X-MS-Has-Attach:  
>X-MS-TNEF-Correlator:  
>acceptlanguage: en-US  
>  
>Sean:  
>  
>I just began my review. Figure 3-3 has not been corrected. As per my  
>earlier comments and e-mail to you, I believe that the bedrock mapping  
>is incorrect due to problems associated with merging of multiple maps.  
>Unless you or Geofirma can convince me otherwise (i.e. that the bedrock  
>map is not incorrect), I cannot "sign off" on a report that I believe  
>contains such a fundamental error as erroneous geological data. I note  
>that both you and Anthony were to have looked into this issue (as noted  
>in your teleconference notes), but it is not mentioned in the peer  
>review comment disposition. If  
>there is something I missed in this regard, please let me know. I  
>will complete the rest of my review tomorrow, but I won't prepare a  
>memo until you respond to me regarding this mapping issue.  
>  
>Regards,  
>  
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>version of any work product may not be relied upon.  
>  
>Please consider the environment before printing this email.  
>  
>  
>-----Original Message-----  
>From: Sean Watt [<mailto:seanwatt@cataraquiregion.on.ca>]  
>Sent: April 13, 2011 4:15 PM  
>To: [bill.hogg@xplornet.com](mailto:bill.hogg@xplornet.com); [dburr@dillon.ca](mailto:dburr@dillon.ca); [iiskra@dillon.ca](mailto:iiskra@dillon.ca);  
>[Michel.robin@uottawa.ca](mailto:Michel.robin@uottawa.ca); [mmillar@conservationontario.ca](mailto:mmillar@conservationontario.ca);

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>jim.a.fraser@ontario.ca; karen.bellamy@ontario.ca;  
>bryan.sears@ontario.ca; Michel.Kearney@ottawa.ca;  
>robmcrae@cataraquiregion.on.ca; titia.praamsma@ontario.ca;  
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>[mboone@quinteconservation.ca](mailto:mboone@quinteconservation.ca); [brian.stratton@mrsourcewater.ca](mailto:brian.stratton@mrsourcewater.ca);  
>[karyn.cornfield@mrsourcewater.ca](mailto:karyn.cornfield@mrsourcewater.ca); [skunjikutty@mvc.on.ca](mailto:skunjikutty@mvc.on.ca);  
>[tdiorio@nation.on.ca](mailto:tdiorio@nation.on.ca); [shan.mugalingam@ltc.on.ca](mailto:shan.mugalingam@ltc.on.ca); [DHeagle@geofirma.ca](mailto:DHeagle@geofirma.ca);  
>[SSterling@geofirma.ca](mailto:SSterling@geofirma.ca); [colinc@XCG.com](mailto:colinc@XCG.com); [edw@xcg.com](mailto:edw@xcg.com);  
>[robmcrae@cataraquiregion.on.ca](mailto:robmcrae@cataraquiregion.on.ca); [seanwatt@cataraquiregion.on.ca](mailto:seanwatt@cataraquiregion.on.ca);  
>[kdenison@cataraquiregion.on.ca](mailto:kdenison@cataraquiregion.on.ca); [titia.praamsma@ontario.ca](mailto:titia.praamsma@ontario.ca);  
>[vanessa@townshipleeds.on.ca](mailto:vanessa@townshipleeds.on.ca); [mmorris@townshipleeds.on.ca](mailto:mmorris@townshipleeds.on.ca);  
>[bbryan@townshipleeds.on.ca](mailto:bbryan@townshipleeds.on.ca); [brucebryan@ripnet.com](mailto:brucebryan@ripnet.com);  
>[tguerrera@greergalloway.com](mailto:tguerrera@greergalloway.com); [BHenderson@ocwa.com](mailto:BHenderson@ocwa.com); [BHuskinson@ocwa.com](mailto:BHuskinson@ocwa.com);  
>Byerley, Brian; [SSterling@geofirma.ca](mailto:SSterling@geofirma.ca); [AWest@geofirma.ca](mailto:AWest@geofirma.ca);  
>[mike.ogilvie@ontario.ca](mailto:mike.ogilvie@ontario.ca); [Don.Munro@ontario.ca](mailto:Don.Munro@ontario.ca)  
>Subject: Lansdowne Review  
>  
>Good afternoon everyone, hope you're enjoying our April showers.  
>  
>Just a reminder to those reviewing the Lansdowne Wellhead Protection  
>and Tier 2 Water Budget study that I need comments, and hopefully  
>signoffs from the Water Budget reviewers, by Friday.  
>  
>And those of you reviewing the Sydenham Tier 3 Water Budget study, I  
>need those signoffs asap.  
>  
>I can't get approval from MNR until I have your signoffs.  
>  
>Thanks,  
>  
>Sean  
>  
>Sean Watt, M.Sc.(Eng.), P.Eng.  
>Water Resources Engineer  
>Source Water Protection Program  
>Cataraqui Region Conservation Authority  
>Ph: (613) 546-4228 Ext 241  
>Toll-Free:1 (877) 956-CRCA  
> in (613) 1 (877) 956-2722  
>Fx: (613) 547-6474  
>P.O. Box 160  
>1641 Perth Road  
>Glenburnie, ON  
>K0H 1S0  
>-----  
>-----

Email Correspondence between Sean Watt and Brian Byerley, Golder Associates Ltd., regarding "Wellhead Protection Area (WHPA) and Tier 2 Water Budget Study Lansdowne, Ontario Revision: 2 (Final)"

Sean:

I have reviewed the Geofirma responses and am satisfied that my comments have been addressed. I note that their response indicates that the extent of the Nepean/Potsdam Formations in the groundwater model was not the same as indicated on Figure 3-3. Also, more than one source of MOE WWIS data (i.e. different versions of the database) was used to construct/calibrate the groundwater model and to create the maps in the final report.

Finally, I recommend that the Peer Review Record in the final report (Appendix H) include all written comments by the reviewers (e.g. letters, memos and e-mails) in addition to the summary of comments produced by Geofirma, in order to ensure that the comments and responses are properly documented.

Let me know if you need anything else from me.

Regards,

**Brian Byerley (M.Sc., P.Eng.)** | Senior Hydrogeologist/Associate | **Golder Associates Ltd.**

32 Steacie Drive, Kanata, Ontario, Canada K2K 2A9

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**Please consider the environment before printing this email.**

**From:** Sean Watt [ <mailto:seanwatt@cataraquiregion.on.ca> ]

**Sent:** April 28, 2011 8:54 AM

**To:** Byerley, Brian

**Cc:** Anthony West; [robmcrae@cataraquiregion.on.ca](mailto:robmcrae@cataraquiregion.on.ca)

**Subject:** Fwd: RE: Updated Lansdowne WHPA/WB T2 Study Available

Brian,

Here is a table Ant put together on your comments. This is what would go into the Peer Review Record at the back of the report. Ant has also included some figures to help explain his responses.

Hopefully this will cover off all your comments and concerns.

Thanks,

Sean



From: Anthony West <[AWest@geofirma.com](mailto:AWest@geofirma.com)>  
To: Sean Watt <[seanwatt@cataraquiregion.on.ca](mailto:seanwatt@cataraquiregion.on.ca)>  
CC: "[robmcrae@cataraquiregion.on.ca](mailto:robmcrae@cataraquiregion.on.ca)" <[robmcrae@cataraquiregion.on.ca](mailto:robmcrae@cataraquiregion.on.ca)>  
Date: Thu, 21 Apr 2011 16:43:08 -0400  
Subject: RE: Updated Lansdowne WHPA/WB T2 Study Available

Hi Sean,

Please find attached a word document containing responses to the 9 comments listed below, and a pdf of a supporting figure (referred to as Figure 2, the word document contains Figure 1). I stress that this word document and the attached figure are intended to be part of the ongoing conversation between CRCA, Geofirma and Golder with respect to Lansdowne. That is to say, the formatting of the text and figures is not intended to be of report quality, and the intent is to find an inexpensive way to transmit information which I think Brian needs to finish his review and provide his sign off. It is intended in the spirit of the three way cooperation which will result in a higher quality final report than could otherwise have been prepared.

You will note that our response to Comment #3 will necessitate some changes to the text. Also, with Brian's OK, I would intend to reformat this material and add it to the Appendix H Peer Review Record, along with whatever memo Brian provides in response.

You will also note that our response to Comment #2 does not include any modifications to the bedrock geology map. This is based on your review of the data, on my review of the data, and on maintaining consistency with other CRCA reports (e.g. Dillon Cross Section Report).

I sincerely hope that this latest information is sufficient for Brian to provide his final sign off on the report.

Regards,

Anthony (Ant) West, Ph.D., P.Eng.  
Senior Engineer & Director of Marketing  
Geofirma Engineering Ltd.  
1 Raymond Street., Suite 200, Ottawa, ON, K1R 1A2  
Phone: (613) 232-2525 x 329 Fax: (613) 232-7149 Cell: (613) 292-8804  
[www.geofirma.com](http://www.geofirma.com)

**From:** Sean Watt [ <mailto:seanwatt@cataraquiregion.on.ca> ]  
**Sent:** April 21, 2011 2:18 PM  
**To:** Byerley, Brian  
**Cc:** Anthony West; [robmcrae@cataraquiregion.on.ca](mailto:robmcrae@cataraquiregion.on.ca)  
**Subject:** RE: Updated Lansdowne WHPA/WB T2 Study Available

Hi Brian,

Sorry for the delay in getting back to you, I wanted to wait to receive all the comments from the reviewers, as well as talk to Ant about how to go back and fully address your comments.

So I've done that, and Ant is putting together some additional details to address all the comments. I think (hope) we can work out appropriate solutions for all the comments.

There should be something ready early next week.

Have a good weekend, hopefully the forecast changes, and we get a little more sunshine than rain.

Thanks,

Sean

At 05:25 PM 4/15/2011, you wrote:

Sean:

I looked at the Geofirma responses to my comments. Based on your memo (which I endorsed) there were 9 comments from me that should have been addressed. Geofirma only listed and addressed 6 of my comments.

My comments were:

1. Porosity: 2<sup>nd</sup> bullet
2. Model Layers: 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> bullet
3. Model Layers 9<sup>th</sup> bullet
4. ISI: 6<sup>th</sup> bullet
5. ISI: 8<sup>th</sup> bullet
6. ISI: 9<sup>th</sup> bullet
7. ISI: 10<sup>th</sup> bullet
8. ISI: 11<sup>th</sup> bullet
9. ISI: 14<sup>th</sup> bullet

I have not read the complete report. However, I note that my comment #2 was not listed or addressed (as per my earlier e-mail). Also, the response to comment #5 (which Geofirma combined with their response to comment #3) is not satisfactory. It appears that Geofirma did not understand the intent of the comment. I am looking for a written explanation regarding why the model only includes one overburden type, whereas the surficial geology mapping indicates a variety of soil types. Comment #6 (related to comment #5) was not listed or addressed. Comment #8 was not listed or addressed, and it also appears that there is one well (at least) on the new Figure 5-1, that is not on Figure 2-2 (look in the area about 2 kilometers directly north of the municipal wells).

Let me know what you want me to do next.

Cheers,

**Brian Byerley (M.Sc., P.Eng.)** | Senior Hydrogeologist/Associate | **Golder Associates Ltd.**

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**From:** Sean Watt [<mailto:seanwatt@cataraquieregion.on.ca>]

**Sent:** April 1, 2011 10:44 AM

**To:** [bill.hogg@xplornet.com](mailto:bill.hogg@xplornet.com); [dburr@dillon.ca](mailto:dburr@dillon.ca); [iiskra@dillon.ca](mailto:iiskra@dillon.ca); [Michel.robin@uottawa.ca](mailto:Michel.robin@uottawa.ca);

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[bryan.sears@ontario.ca](mailto:bryan.sears@ontario.ca); [Michel.Kearney@ottawa.ca](mailto:Michel.Kearney@ottawa.ca); [robmcrae@cataraquiregion.on.ca](mailto:robmcrae@cataraquiregion.on.ca);  
[titia.praamsma@ontario.ca](mailto:titia.praamsma@ontario.ca); [seanwatt@cataraquiregion.on.ca](mailto:seanwatt@cataraquiregion.on.ca); [kdenison@cataraquiregion.on.ca](mailto:kdenison@cataraquiregion.on.ca);  
[ktaylor@quinteconservation.ca](mailto:ktaylor@quinteconservation.ca); [bkeene@quinteconservation.ca](mailto:bkeene@quinteconservation.ca); [mboone@quinteconservation.ca](mailto:mboone@quinteconservation.ca);  
[brian.stratton@mrsourcewater.ca](mailto:brian.stratton@mrsourcewater.ca); [karyn.cornfield@mrsourcewater.ca](mailto:karyn.cornfield@mrsourcewater.ca); [skunjikutty@mvc.on.ca](mailto:skunjikutty@mvc.on.ca);  
[tdiiorio@nation.on.ca](mailto:tdiiorio@nation.on.ca); [shan.mugalingam@ltc.on.ca](mailto:shan.mugalingam@ltc.on.ca); [DHeagle@geofirma.ca](mailto:DHeagle@geofirma.ca); [SSterling@geofirma.ca](mailto:SSterling@geofirma.ca);  
[colinc@XCG.com](mailto:colinc@XCG.com); [edw@xcg.com](mailto:edw@xcg.com); [robmcrae@cataraquiregion.on.ca](mailto:robmcrae@cataraquiregion.on.ca); [seanwatt@cataraquiregion.on.ca](mailto:seanwatt@cataraquiregion.on.ca);  
[kdenison@cataraquiregion.on.ca](mailto:kdenison@cataraquiregion.on.ca); [titia.praamsma@ontario.ca](mailto:titia.praamsma@ontario.ca); [vanessa@townshipleeds.on.ca](mailto:vanessa@townshipleeds.on.ca);  
[mmorris@townshipleeds.on.ca](mailto:mmorris@townshipleeds.on.ca); [bbryan@townshipleeds.on.ca](mailto:bbryan@townshipleeds.on.ca); [brucebryan@ripnet.com](mailto:brucebryan@ripnet.com);  
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**Subject:** Updated Lansdowne WHPA/WB T2 Study Available

Good morning everyone, hope you're enjoying the last day before the weekend. Hopefully some sun will come out.

The updated Lansdowne study report is now available from Geofirma's ftp site. Yes, in case you didn't hear, the consultant working on the study has changed names from Intera to Geofirma. Same people, some capabilities, new name.

No April Fool's joke, it is ready, and their name did change. :-)

You can download the report by:

Please visit <ftp://ftp.geofirma.com> to access the final report. You will be prompted for a user id (lansdowne) and password (cataraqui). I had no trouble getting in and downloading the report.

The peer review record detailing comments and how they were addressed is included at the end of the report.

We're under a very tight timeline to get all our information into the next version of the Assessment Report, so I ask that you please review the report and (hopefully) send your signoff notes to me before Friday April 15th.

I'm also still waiting for signoffs for the Sydenham Tier 3 Report. Please get those to me asap. Those are needed immediately.

Thanks,

Sean

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