DRINKING WATER
SOURCE PROTECTION
ACT FOR CLEAN WATER

TRENT CONSERVATION COALITION
SOURCE PROTECTION REGION

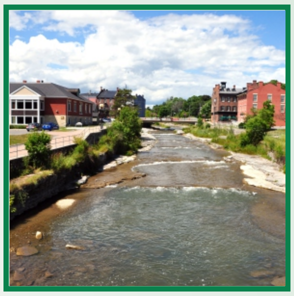
Approved

Ganaraska Assessment Report

Volume 2 of 2 (Appendices)

Approved October 1, 2014

Ganaraska Region Source Protection Area



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APPENDIX A

VARIANCES FROM TECHNICAL RULES AND TERMS OF REFERENCE

VARIANCES FROM TECHNICAL RULES AND TERMS OF REFERENCE

DIRECTOR'S APPROVAL

- Extension to Timelines for Submission of Proposed Assessment Reports (2 letters)
- Impervious surfaces (alternate grid centroid)
- Addition of Local Threat: gasoline (containing benzene) spill from pipeline rupture

VARIANCES FROM TERMS OF REFERENCE

- Regional Municipality of Durham satisfied with peer review approach (consistency among three source protection regions)
- Regional Municipality of Durham GUDI reassessment of the Orono Well

OTHER

- Documentation of deviations from provincial symbology requirements

Ministry of the Environment

Source Protection Programs Branch

8th Floor
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Toronto ON M4V 1L5

Ministère de l'Environnement

Direction des programmes de protection des sources

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Log: ENV1283MC-2009-1209

October 28, 2009

Mr. James T. Hunt
Chair, Trent Conservation Coalition Source Protection Committee
c/o Lower Trent Conservation
714 Murray Street, RR 1
Trenton ON K8V 5P4

Dear Mr. Hunt:

Thank you for your letter of October 1, 2009, in which you request a formal extension to the due date for the submission of your five assessment reports for the Kawartha-Haliburton, Otonabee-Peterborough, Crowe Valley, Ganaraska, and Lower Trent source protection areas. I appreciate the time you have taken to re-examine your workplan and provide me with this updated request, as per my June 1, 2009 letter.

I have reviewed the rationale provided in your letter and the updated workplan to complete the assessment reports. Based on the information provided, and under my authority under section 94 of the *Clean Water Act, 2006*, I am granting you and the Trent Conservation Coalition Source Protection Committee an extension to the due dates of your five assessment reports to August 30, 2010.

I recognize the scope and complexity of the work being undertaken within your region and the need for you to complete the technical work associated with 5 assessment reports. Therefore, I feel it is warranted to give you and your committee additional time to submit the assessment reports.

I have not granted you the full extension requested because I feel there is more time than necessary allotted to complete the consultation on the assessment reports. Additionally, to grant you the full extension as requested to October 2010 would risk the delivery of the source protection plans by August 20, 2012.

I encourage you and your committee to review the proposed schedule for the consultation of the assessment reports and gain some additional efficiency.

14-075

I would take this opportunity to remind you of the legislative requirement to submit your source protection plan to the Minister for review and approval no later than August 20, 2012 and trust that you will be working diligently to meet this date.

I appreciate the amount of hard work the Trent Conservation Coalition Source Protection Committee and the five Source Protection Authorities are doing to ensure that the assessment reports are completed in an efficient and timely manner. I would expect that this high level of effort would continue in order to complete the prescribed work by your new due date of August 30, 2010.

I assure you that the ministry will continue to do everything it can to support source protection committees and authorities in achieving the compliance dates.

Sincerely,

Ian Smith, Director
Source Protection Programs Branch
Ministry of the Environment

c: Jim Harrison, Chair, Lower Trent Source Protection Authority
Larry O'Connor, Chair, Kawartha-Haliburton Source Protection Authority
Suzanne Partridge, Chair, Crowe Valley Source Protection Authority
Brian Fallis, Chair, Ganaraska Region Source Protection Authority
Terry Low, Chair, Otonabee-Peterborough Source Protection Authority
Glenda Rodgers, Project Manager TCC Source Protection Region
Keith Willson, Manager, Source Protection Approvals
Wendy Lavender, Liaison Officer, Source Protection Implementation

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Log: ENV1283MC-2010-177

July 8, 2010

Mr. James T. Hunt
Chair, Trent Conservation Coalition Source Protection Committee
c/o Lower Trent Conservation
714 Murray Street, RR 1
Trenton ON K8V 5P4

Dear Mr. Hunt:

Thank you for your letter of June 11, 2010, in which you requested a second formal extension to the due date for the submission of your five assessment reports for the Kawartha-Haliburton, Otonabee-Peterborough, Crowe Valley, Ganaraska, and Lower Trent source protection areas from August 30, 2010 to October 29, 2010.

I understand that this extension is being requested to allow sufficient time to complete the consultation requirements for all 5 reports, incorporate the comments to revise and edit the documents for the second posting and then compile the comments and submit the reports to the ministry. I am also aware that this extension is being requested in order for the committee and its Source Protection Authorities to complete the assessment reports.

I have reviewed the rationale provided in your letter and the updated workplan to complete the assessment reports. Based on the information provided, I am granting you and the Trent Conservation Coalition Source Protection Committee an extension to the due dates of your five assessment reports to October 29, 2010.

Despite granting this extension, I encourage you and your committee to review the proposed schedule for the completion of the assessment reports and gain some additional efficiency where possible in order to potentially submit the reports prior to the legislated October 29, 2010 date.

...2

I appreciate the amount of hard work the Trent Conservation Coalition Source Protection Committee and the five Source Protection Authorities are doing to ensure that the assessment reports are completed in an efficient and timely manner. I would expect that this high level of effort would continue in order to complete the prescribed work by your new due date of October 29, 2010.

I assure you that the ministry will continue to do everything it can to support source protection committees and authorities in achieving the compliance dates.

Sincerely,

Ian Smith, Director
Source Protection Programs Branch
Ministry of the Environment

c: Jim Harrison, Chair, Lower Trent Source Protection Authority
Larry O'Connor, Chair, Kawartha-Haliburton Source Protection Authority
Suzanne Partridge, Chair, Crowe Valley Source Protection Authority
Brian Fallis, Chair, Ganaraska Region Source Protection Authority
Terry Low, Chair, Otonabee-Peterborough Source Protection Authority
Glenda Rodgers, Project Manager TCC Source Protection Region
Keith Willson, Manager, Source Protection Approvals
Wendy Lavender, Liaison Officer, Source Protection Implementation

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Log: ENV1174IT-2009-258

November 27, 2009

Ms. Glenda Rodgers
Project Manager, Source Protection Planning
Trent Conservation Coalition Source Protection Region
714 Murray St, RR#1
Trenton ON K8V 5P4

Dear Ms. Rodgers:

Thank you for your email request of October 30, 2009 to use an alternate method under Technical Rule 37 (5) for the completion of Assessment Reports under the Clean Water Act (CWA) for the Trent Conservation Coalition (TCC) Source Protection Region.

As set out in your correspondence, your proposal is to use an alternative grid centroid within which you determine the impervious surface percentages within each source protection area. As per your email, you are proposing to establish one grid for the complete source protection region, instead of separate grids for each source protection area as required by the assessment report technical rule 17. In our opinion the use of this alternative grid centroid within the source protection region will not impact the implementation of this rule, other than to move the grid within a 1km square area. Therefore, this approach is equivalent to the method currently required through sub-rule 16(11) and Rule 17.

In accordance with my authority under Rule 15.1 of the Technical Rules, I hereby provide Director's approval for the use of this alternate method for all 5 source protection areas within the Trent Conservation Coalition source protection region.

Your rationale for the use of an alternative grid and how it is being applied must be included in your assessment report.

.../2

We thank you for your efforts in completing the technical studies in support of the assessment report under the CWA. If you have any questions or require additional information, please contact our office.

Sincerely,

Ian Smith, Director
Source Protection Programs Branch
Ministry of the Environment

cc: James Hunt, Trent Conservation Coalition Source Protection Committee Chair
Heather Malcolmson, Manager, Source Protection Planning
Keith Willson, Manager, Source Protection Approvals
Wendy Lavender, Liaison Officer, Source Protection Implementation

Ministry of the Environment

Source Protection Programs Branch

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Log: ENV1174IT-2011-55

June 17, 2011

Ms. Jennifer Stephens
Trent Conservation Coalition Source Protection Region
Lower Trent Conservation
714 Murray Street, R. R. #1
Trenton, Ontario K8V 5P4

Dear Ms. Stephens,

As a follow up to our May 31, 2011 letter regarding the addition of fuel pipelines as a local threat, we have revised the circumstances associated with that threat as per recent discussions.

The circumstances of the original Director's approval letter have been reviewed and, as result, the original Table 1 is replaced with the following:

Table 1: A spill of gasoline (containing benzene) from a ruptured pipeline

Activity	Vulnerability Score to produce a Significant DWT	Vulnerability Score to produce a Moderate DWT	Vulnerability Score to produce a Low DWT
	IPZ-1,2,3, WHPA-E	IPZ-1,2,3, WHPA-E	IPZ-1,2,3, WHPA-E
1. The conveyance of oil by way of a pipeline that would be designated as transmitting or distributing "liquid hydrocarbons", including "crude oil", "condensate", or "liquid petroleum products", and not including "natural gas liquids" or "liquefied petroleum gas", within the meaning of the Ontario Regulation 210/01 under the *Technical Standards and Safety* Act, or is subject to the National Energy Board Act. 2. The rupture of a pipeline in an area where the pipeline crosses a body of open water and may result in the presence of BTEX in surface water.	10	7 – 9	4.8 – 6.4

As set out in my original letter, in accordance with my authority under Rules 119, 120, or 121, I am of the opinion that the hazard rating for the following activity, as defined for the purposes of this local threat is greater than 4:

- The conveyance of oil by way of a pipeline that would be designated as transmitting or distributing "liquid hydrocarbons", including "crude oil", "condensate", or "liquid petroleum products", and not including "natural gas liquids" or "liquefied petroleum gas", within the meaning of the Ontario Regulation 210/01 under the *Technical Standards and Safety* Act, or is subject to the National Energy Board Act."

- The updated Table 1 provides information on the activity, circumstance, and areas where the activity would be a significant, moderate or low drinking water threat.

The activity is approved as a local threat the vulnerable areas associated with the Port Hope, Cobourg, Newcastle, and Bowmanville surface water intakes in the Trent Conservation Coalition Source Protection Region.

Your rationale for the inclusion of these local threats along with a copy of this letter must be included in your assessment report. Work associated with these local threats can be included in your updated or amended assessment report. I understand consultation on components of your proposed updated assessment report including these local threats is already underway. The report may need to be amended to consider my directions in this letter.

I hope this has addressed your concerns, however, should you wish to discuss this matter further please feel free to contact me at (416) 212-6459.

Sincerely,

Ian Smith, Director
Source Protection Programs Branch
Ministry of the Environment

c:
Keith Willson, Manager, Source Protection Approvals
Paul Heeney, Manager, Source Protection Implementation
Heather Malcolmson, Manager, Source Protection Planning
Katie Fairman, Supervisor, Source Protection Implementation
Peter Rider, Senior Drinking Water Program Advisor, Source Protection Planning
Clara Tucker, Watershed Management Specialist, Source Protection Planning
Wendy Lavender, Liaison Officer, TCC, Source Protection Implementation

June 18, 2009

Beata Golas P. Geo., Hydrogeologist
The Regional Municipality of Durham
Works Department, Engineering Planning & Studies
PO. BOX 623
Whitby, ON L1N 6A3

Dear Beata:

Re: Peer Review Process for Assessing Vulnerability within Municipal Wellheads for TCC, SGBLS, and CTC Source Protection Regions

This is further to our previous discussions and correspondence regarding common peer review approaches for the source protection vulnerability studies for the municipal systems in Durham Region.

Our Water Resources Engineer, Shan Mugalingam, has reviewed the peer review criteria for TCC, SGBLS and CTC and has provided below a table illustrating the common elements and some unique criteria adopted by the various Source Protection Regions.

Evaluation Criteria	TCC	SGBLS	CTC
Approved Methods and Models (as per Technical Rules)	✓	✓	✓
Rationale for Model Selection	✓	✓	✓
Geological Layers/Model	✓	✓	✓
Appropriateness of Parameters used in the Model	✓	✓	✓
Model Domain/Model Boundary	✓	✓	✓
Calibration Process	✓	✓	✓
Review of Data Used	✓	✓	✓
Uncertainty Analysis	✓	✓	
Assumptions used in the Model	✓		✓
Location of Wells & Appropriate Pumping Rates		✓	
Discretization of Model Domain & Scale of Analysis			✓
Compliance with Rules (Delineation of WHPAs & Vulnerability Assessment)	✓		✓
Validity of Final Product	✓		✓
Limitations & Long-Term Recommendations	✓		✓

We are hopeful that you feel that the common criteria captures most of the critical elements and that you are satisfied that there is a common approach to satisfy the requirements in the Terms of Reference for the Ganaraska Region and Kawartha-Haliburton Source Protection Areas.

The CTC approach lists more specific items to be reviewed, which may be captured in more generalized line items in the TCC and SGBLS approaches (e.g. Discretization of Model Domain & Scale of Analysis may be included in Model Domain/Model Boundary). The CTC peer review approach also includes items that go beyond vulnerability assessment (which was not required by the TCC Terms of Reference) and also includes a review of items that may be outside of the scope of the Clean Water Act (e.g. use for PTTW). The SGBLS includes a unique scoring approach. While TCC uses a similar table, it does not rely on a scoring system. The TCC approach seeks the peer reviewer's professional opinion on the professional judgment exercised by the study consultants.

In summary, while there are unique criteria, the majority and certainly most of the important criteria are common to all three approaches.

Please let me know if this analysis satisfies your request for common peer review approaches for Durham. As discussed previously, a letter that effect, would be appreciated to provide to our Source Protection Committee.

Sincerely,

Glenda Rodgers

Glenda Rodgers, Project Manager
Project Manager, Source Protection Planning
613-394-3915

Copy: Don Goodyear, SGBLS SPR
Beverley Thorpe, CTC SPR

The Regional Municipality of Durham

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C. R. Curtis, P.Eng., MBA
Commissioner of Works

June 18, 2009

Glenda Rogers
Trent Conservation Coalition Source Protection Region
c/o Lower Trent Conservation
714 Murray Street
R.R.#1 Trenton ON, K8V 5P4

Re: **Peer Review of Groundwater Studies**
Trent Conservation Coalition Source Protection Region
Regional Municipality of Durham

Dear Ms. Rogers:

The Regional Municipality of Durham (Durham Region) is satisfied with the peer review approach being undertaken for the Trent Conservation Coalition (TCC).

We believe that the peer review approach proposed by TCC is generally consistent with the peer review approach proposed by other Source Protection Regions (SPR) located within Durham Region. The TCC approach satisfies the requirements outlined in the Terms of Reference for the Ganaraska Region and Kawartha-Haliburhton Source Protection Areas.

Should you require more information, please do not hesitate to contact Beata Golas at 905.668.4113 extension 3447.

Yours truly,

Beata Golas

Beata Golas, M.Sc. P. Geo.
Hydrogeologist
BG

cc

John Presta, Director of Environmental Services
Jim McGilton, Manager, Engineering Planning and Studies
Ian McIlwham, Compliance Manager
Christine Drimmie, Policy Development

DURHAM REGION

The Regional Municipality of Durham

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C. R. Curtis, P.Eng., MBA
Commissioner of Works

November 19, 2009

Drinking Water Source Protection
c/o Lower Trent Conservation
714 Murray Street, RR #1
Trenton, ON
K8V 5P4

Attention: Glenda Rodgers, B.Sc., M.Sc.
Project Manager

Re: GUDI Reassessment of the Orono Well

Enclosed please find the letter from the Ministry of Environment (MOE) regarding the reassessment of GUDI (Groundwater Under Direct Influence of Surface Water) status for the Orono Water Supply System. The Orono wells have been re-classified by MOE to groundwater (non-GUDI), from GUDI with in situ filtration (see highlighted portion of the attached letter).

Should you have any questions, please do not hesitate to contact me at (905) 668-7711 ext. 3447.

Yours truly,

Beata Golas, M.Sc., P.Geo.
Hydrogeologist
Engineering Planning and Studies

Encl.

CC: Mark Peacock, Director, Watershed Services, Ganaraska Conservation
Magdi Widaatalla, Manager Watershed Services, Ganaraska Conservation
John Presta, Director of Environmental Services, ROD
Jim McGilton, Manager of Engineering Planning and Studies, ROD
Thom Sloley, Manager of Plant Operations, ROD
Jacquie Korsten, District Supervisor North WSP, ROD
Wayne Prouse, Maintenance Operator, ROD
Greg Lymer, Manager Technical Support, ROD

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Téléc: (416) 326-6345

Ontario

November 12, 2009

Region of Durham Work Department
605 Rossland Road East
P.O. Box 263
Whitby, Ontario
L1N 6A3

Attention: Ms. Beata Golas, P. Geo.

RE: GUDI REASSESSMENT OF THE ORONO WELL FIELD

Dear Ms. Golas:

The Region of Durham (Durham) requested that the Ministry of the Environment (MOE) review the Groundwater Under the Influence of Surface Water (GUDI) status of their Community of Orono (Orono) municipal wells. Hydraulic data along with water quality results and bacteriological testing conducted between 2003 and 2009 exhibited water more characteristic of groundwater rather than GUDI. In response, Durham and their consultants, Jagger Hims, initiated a reassessment the GUDI status of the Orono wells. The GUDI designation falls under responsibilities of the MOE's Safe Drinking Water Branch, which asked the Technical Support Section (Central Region) to review the hydrogeological aspects of Durham's GUDI reassessment.

The Orono municipal well field consists of three wells, MW3, MW4, and MW5 (installed in 2009) and is located within the flood plain of Wilmot Creek. Within the Wilmot Creek valley, the bulk of the Newmarket Till has been eroded exposing a medium grained sand and gravel aquifer at surface. The current permitted pumping rate is 1308.96 m^3/day. The average water taking for 2006, considered a "typical" year by Durham, was 340 m^3/day. Durham projects the average daily water taking in 2021 will be 399 m^3/day base on the Region's Official Plan

The initial GUDI assessment in 2003 concluded that water quality in the Orono well field was good, resembled groundwater and found no physical evidence of surface water influence. However, hydraulic testing of MW3 and MW4 demonstrated a hydraulic response in the shallow drivepoints in Wilmot Creek. To be conservative, MW3 and MW4 were determined to be GUDI with effective in-situ filtration and an ultraviolet (UV) transmitter was installed.

Previous investigations including the initial GUDI assessment in 2003 indicated that there is a hydraulic connection between the well field and Wilmot Creek at pumping rates greater than 1,774 m^3/day. Additionally, a potential for a hydraulic connection at a pumping rate of 1,309 m^3/day, the current permitted maximum, was identified based on the area of capture defined by a 50-day travel time. The results of the 2009 GUDI reassessment suggest that at pumping rates less than 873 m^3/day there no hydraulic connection between the well field and Wilmot Creek based on the modelled area of capture for 50-day travel time. Considering the average pumping rate in a "typical" year is 399 m^3/day, there should be enough safety in the system. An amended Permit To Take Water (PTTW) will be issued MOE by the end of November 2009 reducing the maximum daily taking to 873 m^3/day.

The historical chemical and bacteriological data along with increased distance to Wilmot Creek of the modelled 50 day capture area supports the Region of Durham's request for change of GUDI status for the Orono well field from GUDI with in situ filtration to groundwater.

Sincerely,

Kathryn Baker, M.Sc., P.Geo.
Hydrogeologist, Central Region Technical Support

DOCUMENTATION OF DEVIATIONS FROM PROVINCIAL MAPPING SYMBOLOGY REQUIREMENTS

Data Set Description	Symbology Specification	TCC Specification	Rational for Change
Waterbody	Blue line around polygon	Take off blue outline	Outline makes the map difficult to read in the northern areas and colour is too similar to gray when printed
Watercourse	Not included in symbology document	Same colour as Waterbody	At regional scale lines help visibility
Roads	Gray colour	Same thickness but change colour to red	Too much grey on map
Municipal Boundaries	Dashed Grey line	Solid grey	When both upper tier and lower tier boundary used the line turns into a solid gray and not dashed
Watershed Boundary	Blue	Black	To make more visible
Settlements	Black outline	Black square for base layer in Region maps and Salmon colour with no outline for areas of settlement	For Visibility
Drinking Water Symbols – Large and Small Municipal	Gray symbol	Symbol same, but changed color to yellow and green	To distinguish between surface and groundwater
Drinking Water systems 3-8	Gray symbol	Symbol same but changed from gray to yellow	To illustrate differences
Monitoring stations	Hollow Triangles	Changed to filled triangles	To be visible on regional maps
Dams	Black line polygons	Red Squares point file	Black line was not showing up at regional scale
Surface Water Systems Intakes	Yellow circle	Yellow Square	For more visibility on map
Ground Water Well	Green circle	Green Square	For more visibility on map
Private Water Well	Size 12	Size 4	To have more wells be visible
Climate Stations EC	None in document	Pentagon colour in red	
Climate Stations CA	None in document	Pentagon colour in Solar Yellow	

APPENDIX B

OTHER DRINKING WATER SYSTEMS

OTHER DRINKING WATER SYSTEMS

- Tables of Other Drinking Water Systems

Appendix B1: Large Non-municipal Non-residential Drinking Water Systems

System Name	Drinking Water System Number	City	County District	Operating Authority
ESSO Port Hope Service Centre Well Supply	260004813	Port Hope	Port Hope	Envirosearch Operations Inc.

Appendix B2: Non-municipal Seasonal Residential Drinking Water Systems

System Name	Drinking Water System Number	City	County District	Operating Authority
Lakeshore Pentecostal Camp Water Treatment Plant	260074126	Cobourg	Cobourg	Lakeshore Pentecostal Camp
R252 Lakeview Terrace Colony Well Supply	260079417	Bewdley	Hamilton Township	551180 Ontario Ltd.

Appendix B3: Non-municipal Year-round Residential Drinking Water Systems

System Name	Drinking Water System Number	City	County District	Operating Authority
Lougheed Mobile Home Park Well Supply	260035282	Cobourg	Cobourg	Parkbridge Lifestyle Communities Incorporated
Wilmot Creek Distribution System	260066664	Newcastle	Clarington	Envirosearch Operations Inc.
Dale Road Apartments Well Supply	260072475	Cobourg	Hamilton Township	Dale Road Apartments
Pioneer Village Well Supply	260074074	Cobourg	Hamilton Township	Lakeshore Pentecostal Camp
5438 Front Street Well Supply	260074815	Harwood	Hamilton Township	Drusille Holloway

Appendix B4: Small Municipal Non-residential Drinking Water Systems

System Name	Drinking Water System Number	City	County District	Operating Authority
Alex Carruthers Memorial Park Well Supply	260037180	Port Hope	Port Hope	The Corporation of the Municipality of Port Hope
Canton Municipal Office Well Supply	260037193	Port Hope	Port Hope	The Corporation of the Municipality of Port Hope
Garden Hill Library/Fire Hall Well Supply	260037206	Port Hope	Port Hope	The Corporation of the Municipality of Port Hope
Welcome Recreational Park Well Supply	260037219	Port Hope	Port Hope	The Corporation of the Municipality of Port Hope
Kendal Community Centre Well Supply	260063726	Kendal	Clarington	Municipality of Clarington
Brownsdale Community Centre Well Supply	260063739	Newcastle	Clarington	Municipality of Clarington
Clarke Museum Well Supply	260063765	Orono	Clarington	Municipality of Clarington

Appendix B5: Small Non-municipal Non-residential Drinking Water Systems

System Name	Drinking Water System Number	City	County District	Operating Authority
Oriole Acres Well Supply	260008762	Baltimore	Cobourg	Unknown Operator
Camborne Public School Well Supply	260010829	Hamilton Township	Hamilton Township	Kawartha Pine Ridge District School Board
Clarke High School Well Supply	260010920	Clarington	Clarington	Kawartha Pine Ridge District School Board
Dale Road Senior Public School Well Supply	260010959	Hamilton Township	Hamilton Township	Kawartha Pine Ridge District School Board
George Hamilton Public School Well Supply	260010985	Port Hope	Port Hope	Kawartha Pine Ridge District School Board
North Hope Central Public School Well Supply	260011128	Port Hope	Port Hope	Kawartha Pine Ridge District School Board
Plainville Public School Well Supply	260011154	Hamilton Township	Hamilton Township	Kawartha Pine Ridge District School Board
Cobourg Alliance Church Well Supply	260018733	Hamilton Township	Hamilton Township	Cobourg Alliance Church
Emmanuel B.A.Y. Well Supply	260023127	Campbellcroft	Port Hope	Unknown Operator
Northumberland Children’s House Well Supply	260024167	Cobourg	Hamilton Township	Northumberland Children's House
Northumberland Christian School Well Supply	260026533	Cobourg	Cobourg	Northumberland Christian School Society Incorporated
Baltimore United Church Well Supply	260047177	Baltimore	Hamilton Township	Baltimore United Church
Beaver Fuels Newcastle Location	260048113	Bowmanville	Clarington	Shell Canada Products
Forum Restaurant Well Supply	260050830	Newcastle	Clarington	Forum Restaurant
Bewdley Legion Well Supply	260051207	Bewdley	Hamilton Township	Bewdley Legion #577
Noone’s Restaurant Well Supply	260051571	Orono	Clarington	762224 Ontario Ltd
Dalewood Golf and Curling Well Supply	260051987	Cobourg	Hamilton Township	Dalewood Golf And Curling
Ash Brook Golf Club & Restaurant Well Supply	260058110	Port Hope	Port Hope	491323 Ontario Limited O/A Ash Brook Golf Club
Plank Road Cottages and Marina Well Supply	260060541	Gore’s Landing	Hamilton Township	Plank Road Cottages And Marina
Country Style Donuts #326 Well Supply	260061672	Newcastle	Clarington	1098431 Ontario Limited
Ganaraska Forest Centre Well Supply	260062348	Campbellcroft	Port Hope	Ganaraska Forest Centre
Ganaraska Administrative Office Well Supply	260064025	Port Hope	Port Hope	Ganaraska Region Conservation Authority
McDonald’s Restaurant – Newcastle Well Supply	260066118	Newcastle	Clarington	Wilson Foods Newcastle Limited
1802 Bed and Breakfast Well Supply	260067106	Newtonville	Clarington	1802 Bed And Breakfast
New Dutch Oven Well Supply	260067366	Orono	Clarington	1638351 Ontario Inc.
Old Burrison Homestead Tourist Camp Well Supply	260072553	Gore’s Landing	Hamilton Township	Old Burrison Homestead Tourist Camp
Herma’s Fine Food & Gifts Well Supply	260081406	Port Hope	Port Hope	Herma's Fine Foods & Gifts
Bon Voyage Motel Well Supply	260083915	Orono	Clarington	Bon Voyage Motel

APPENDIX C

SUMMARY OF PEER REVIEW

SUMMARY OF PEER REVIEW

- Water Budget
- Significant Groundwater Recharge Areas
- Surface Water Vulnerability (for municipal systems)
- Groundwater Vulnerability (for municipal systems)

WATER BUDGET PEER REVIEW PROCESS

A rigorous peer review process was set out for the water budget component of the Assessment Report technical studies. The purpose of the peer review process was to ensure a scientifically defensible water budget and to ensure consistency with the provincial guidance and *Technical Rules*.

The peer review process was an ongoing, continuous approach from study initiation through completion. Input was solicited at various decision points through the use of technical memorandums, draft reports and committee meetings. Peer review comments were recorded and responses documented in a peer review report. The peer reviewers were required to sign-off on the final product.

The peer review committee was selected by source protection authority staff and is comprised of experts from the scientific and engineering communities. The committee included professionals with both surface water and groundwater expertise. The members are listed below:

CONCEPTUAL WATER BUDGETS

- Harold Belore, CCL/IBI Group
- Jim Buttle, Trent University
- Steve Davies, Conservation Authorities Moraine Coalition
- Bruce Kitchen , Trent Severn Waterway (retired)
- Ken Raven, Intera Engineering Ltd.
- Wayne Stiver , Peterborough Public Utilities

Ministry of Natural Resources and Forestry reviewers were:

- Mike Garraway

TIER 1 WATER BUDGET

- Harold Belore, CCL/IBI Group
- Jim Buttle, Trent University
- Steve Davies, Gartner Lee
- Bruce Kitchen, Trent-Severn Waterway (retired)
- Ken Raven, Intera Engineering Ltd.
- Wayne Stiver , Peterborough Public Utilities

Ministry of Natural Resources and Forestry reviewers were:

- Mike Garraway
- Lynne Milford

PEER REVIEW SUMMARY

The methodology and data utilized in the water budget studies were well scrutinized by the peer reviewers. The peer reviewers ensured that all model set-ups used for these studies were of very good quality. Generally, the water budget studies received 5-7 rounds of peer review comments and corresponding responses from the study team, before the final “sign-offs” from the peer reviewers were obtained. In addition to the technical comments from the peer reviewers, the Ministry of Natural Resources and Forestry also provided comments at the final stages of each study pertaining to the adequacy and relevance of the process followed with respect to the provincial requirements, which were also addressed by the study team. With the satisfactory conclusion of the studies and after the submission of the mandated "Peer Review Record" by the region, the province issued a "draft acceptance memo" for these studies.

The province has issued "draft acceptance memos" for the conceptual and tier-1 water budget studies as well as for the significant groundwater recharge areas study.

SIGNIFICANT GROUNDWATER RECHARGE AREAS

The Significant Groundwater Recharge Area peer review was a component of the water budget peer review process. Ongoing peer review input was solicited and sign-off from the peer reviewers was required. Instead of involving the entire peer review committee, a sub-committee comprised of the two hydrogeologist was formed.

The peer reviewers were:

- Steve Davies, Gartner Lee
- Ken Raven, Intera Engineering Ltd.

Ministry of Natural Resources and Forestry reviewers were:

- Mike Garraway
- Lynne Milford

SURFACE WATER VULNERABILITY (FOR MUNICIPAL SYSTEMS)

A peer review was undertaken to assess whether the delineation of IPZs 1 and 2 and associated vulnerability scoring for Newcastle, Cobourg and Municipality of Port Hope Municipal Water Treatment Plant (WTP) intakes in Lake Ontario were completed in accordance with the Assessment Report *Technical Rules* made under the *Clean Water Act*, *2006*.

This Peer Review included the following components:

- Review of the LOC Phase 1 Reports issued by Stantec Consulting in January 2008:
    - Final Phase 1 Report (Module 4) for the Town of Cobourg
    - Final Phase 1 Report (Module 4) for the Municipality of Port Hope
    - Final Phase 1 Report (Module 4) for the Regional Municipality of Durham
- Review of Addendum Reports to the Phase 1 Report Reports, issued by Stantec on May 6, 2010:
    - Addendum to the Intake Protection Zone Delineation and Vulnerability Assessment Study for the Port Hope Water Treatment Plant
    - Addendum to the Intake Protection Zone Delineation and Vulnerability
    - Assessment Study for the Regional Municipality of Durham – Newcastle Water Treatment Plant
    - Addendum to the Intake Protection Zone Delineation and Vulnerability Assessment Study for the Cobourg Water Treatment Plant
- Review of the *Technical Rules: Assessment Report Clean Water Act, 2006*, November 20, 2008 (as amended).

- Discussions and correspondence with Stantec Consulting.
- Review of Ganaraska Region Conservation Authority. (January 25, 2011). Engineering Memo: Source Water Protection 2-hour Travel Time Delineation by Kawartha Region Conservation Authority and Otonabee Region Conservation Authority.

PEER REVIEW SUMMARY

The peer review determined the following:

- Delineations of IPZs 1 and 2 meet the *Assessment Report Technical Rules*.
- Vulnerability Assessment and Scoring have been completed in accordance with the *Assessment Report Technical Rules*.
- Spill Scenario modeling to identify any significant threats (and associated delineation of IPZ-3) is on-going for all LOC intakes; anticipated completion in late Fall 2010.

GROUNDWATER VULNERABILITY (FOR MUNICIPAL SYSTEMS)

A peer review of the draft consultant reports was conducted for the wellhead protection area delineation and vulnerability assessment for the 31 municipal groundwater systems and one planned system in the Trent source protection areas.

The peer review focused on the following:

a) Compliance with the *Technical Rules*

b) Appropriateness of model selection and or assessment technique

c) Appropriateness of geological model/version used in the construction of the groundwater flow model

d) Reasonableness of the decisions made while developing, calibrating, and running the models

- appropriateness of the data sets used to characterize hydrogeologic conditions
- appropriateness of the boundary conditions established for each model domain
- appropriateness of the calibration technique employed given the availability of information

e) Overall reasonableness of the results

A written response was provided in tabular form. The peer reviewer was asked to provide follow up comments on major issues identified. The Municipality or Conservation Authority leading the technical study being peer reviewed were required to indicate in writing that the peer review comments were satisfactorily addressed.

A request for proposals was released to solicit proposals from consultants to undertake the peer review. The following consultant was selected to undertake the review:

HARDEN ENVIRONMENTAL LTD.:

Stan Denhoed, Engineer/Hydrogeologist

PEER REVIEW SUMMARY

Groundwater Vulnerability

The peer reviewers found that reasonable efforts were made to determine groundwater vulnerability. The variety of methods used to determine vulnerability across the Trent source protection areas and their modifications resulted in non-standardized results across the SPA and also Province-wide. Despite this inconsistency, the Director's Rules were followed. Vulnerability of the aquifer is generally only known at specific locations (wells) and interpolation is required to determine thickness of geological layers at points elsewhere. Improvements to vulnerability assessments can only be improved through detailed geological characterization around the wellhead.

Wellhead Protection Area Delineation

The significant geological diversity within the Source Protection Area presents challenges to those preparing WHPA delineations and groundwater vulnerability determinations. The main challenge is the availability of good quality geological and hydrogeological information. The main source of information regarding subsurface geological formations is the Ministry of the Environment and Climate Change's water well record database. In addition to potential inaccuracy of the information available from this source, where population is scarce, the data availability from this source is also scarce. The scarcity of information leads to assumptions/interpolations needed for the characterization of, nature of and thickness of aquifers local to the wellfields. These assumptions directly influence the size and shape of well head protection areas and their vulnerabilities.

Time of travel calculations depend on estimates of aquifer characteristics such as recharge values, porosity and hydraulic conductivity. In general there are few actual determinations of these characteristics as measured by field testing or laboratory testing. The values assigned to these parameters are estimated and tested via a trial and observe process as the groundwater model is developed. This 'calibration' process does not always lead to a unique solution, thereby allowing for a different set of parameters to produce a similar and possibly improved solution to the groundwater flow system.

Summary

In summary, the peer review process contributed to significantly better model set-ups and assumptions, resulting in more credible model predictions (including the estimates of the components of water balance cycle). It also ensured that the consultants adhered to the *Technical Rules*.

APPENDIX D

LIST OF BACKGROUND REPORTS

LIST OF BACKGROUND REPORTS

- List of Background Reports
  - Watershed Characterization
  - Water Budget and Water Quantity Stress Assessment
  - Surface Water Systems: Water Quality Risk Assessment
  - Groundwater Systems: Water Quality Risk Assessment
  - Landscape-Scale Groundwater Analyses
  - Potential Climate Change Implications

APPENDIX D

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  - Groundwater Systems: Water Quality Risk Assessment
  - Landscape-Scale Groundwater Analyses
  - Potential Climate Change Implications

WATERSHED CHARACTERIZATION

Watershed Characterization Report: Ganaraska Region Source Protection Area (2008)

WATER BUDGET AND WATER QUANTITY STRESS ASSESSMENT

Conceptual Understanding - Water Budget Watersheds Draining to Lake Ontario, Final Draft Report (Ganaraska Region Conservation Authority, March 2007)

Conceptual Water Budget: Trent River Watershed (March 2007)

Tier 1 Water Budget and Stress Assessment, Version 1.4, Draft Report (Ganaraska Region Conservation Authority, August 2010)

Tier 1 Water Budget and Water Quantity Stress Assessment: Trent River Basin, Lake Ontario and Bay of Quinte tributaries (XCG Consultants Ltd, March 2010)

SURFACE WATER SYSTEMS: WATER QUALITY RISK ASSESSMENT

VULNERABILITY ASSESSMENT

Engineering Memo: Source Water Protection 2-hour Travel Time Delineation (Ganaraska Region Conservation Authority, January 25, 2011).

HCCL Coastal & River Engineering, Lake Ontario Collaborative In-Water Intake Protection Zone (IPZ-2) Delineation Hydrotechnical Analyses for Cobourg Intake, Final Report (HCCL, 2007)

HCCL Coastal & River Engineering, Lake Ontario Collaborative In-Water Intake Protection Zone (IPZ-2) Delineation Hydrotechnical Analyses for Port Hope Intake, Final Report (HCCL, 2007)

Intake Protection Zone Delineation and Vulnerability Assessment Study for the Ajax, Whitby, Oshawa, Bowmanville and Newcastle Water Treatment Plants (Stantec Consulting Limited, January 2007)

Issues Evaluation, Threats Inventory, a Water Quality Risk Assessment for the Newcastle Water Treatment Plant (Stantec Consulting Limited, December 2007)

Intake Protection Zone Delineation and Vulnerability Assessment Study for the Port Hope Water Treatment Plant (Stantec Consulting Limited, January 2008)

Intake Protection Zone Delineation and Vulnerability Assessment Study for the Cobourg Water Treatment Plant (Stantec Consulting Limited, January 2008)

Addendum to the Intake Protection Zone Delineation and Vulnerability Assessment Study for the Regional Municipality of Durham, Newcastle Water Treatment Plant (Stantec Consulting Limited. March 2010)

Addendum to the Intake Protection Zone Delineation and Vulnerability Assessment Study for the Port Hope Water Treatment Plant (Stantec Consulting Limited, April 2010)

Addendum to the Intake Protection Zone Delineation and Vulnerability Assessment Study for the Cobourg Water Treatment Plant (Stantec Consulting Limited, March 2010)

Memo, Reference: Ganaraska Region IPZ-3 (Stantec Consulting Limited, April 2011)

Preliminary In-lake Intake Protection Zone Delineation Region of Peel, City of Toronto, and Durham Region (W.F. Baird and Associates Coastal Engineers Limited, January 2007)

ISSUES ASSESSMENT

Issues Evaluation for Newcastle WTP, Cobourg WTP and Port Hope WTP. Public Works File Number 07-1590 (Region of Peel, 2010)

GROUNDWATER SYSTEMS: WATER QUALITY RISK ASSESSMENT

VULNERABILITY ASSESSMENT

Assessment of Drinking Water Threats, Municipal Groundwater Supplies, the Regional Municipality of Durham, DRAFT. File # 960754.09 (Genivar Consultants LP, 2010)

Community of Orono Wellhead Protection Area Program Numerical Model Development (Jagger Hims Limited, 2003)

GUDI Investigations, Community of Orono Municipal Wells MW3 and MW4 (Jagger Hims Limited, 2003)

Groundwater Study Creighton Heights and Camborne Municipal Wellfields, Township of Hamilton. Prepared for Township of Hamilton and Ganaraska Region Conservation Authority. File # 061851.00 (Jagger Hims Limited, 2007)

Assessment of Drinking Water Threats, Creighton Heights and Camborne Municipal Wellfields, Township of Hamilton (DRAFT). Prepared for Township of Hamilton and Ganaraska Region Conservation Authority. File # 061851.01 (Jagger Hims Limited, 2009)

Construction of New Municipal Well MW5, and GUDI Assessment Community of Orono. File # 021346.11 (Jagger Hims Limited, 2009)

ISSUES ASSESSMENT

Assessment of Drinking Water Threats: Municipal Groundwater Supplies: The Regional Municipality of Durham (Genivar Consultants LP, 2010)

Assessment of Drinking Water Threats, Creighton Heights and Camborne Municipal Wellfields, Township of Hamilton (Jagger Hims Limited, 2009)

THREATS ASSESSMENT

Assessment of Drinking Water Threats: Municipal Groundwater Supplies: The Regional Municipality of Durham (Genivar Consultants LP, 2010)

Assessment of Drinking Water Threats, Creighton Heights and Camborne Municipal Wellfields, Township of Hamilton (Jagger Hims Limited, 2009)

LANDSCAPE-SCALE GROUNDWATER ANALYSES

Trent Conservation Coalition Groundwater Vulnerability Assessment – TCC Source Protection Region (AECOM, December 2009)

Trent Source Water Protection Study Recharge Study: Final Report (CAMC-YPDT, November 2009)

POTENTIAL CLIMATE CHANGE IMPLICATIONS

Tier 1 Water Budget and Stress Assessment Climate Change Scenario. Draft Version 1.1. (Ganaraska Region Conservation Authority, 2008)

APPENDIX E

WATER BUDGETS AND WATER QUANTITY STRESS ASSESSMENTS:

TABULAR DATA

WATER BUDGETS AND WATER QUANTITY STRESS ASSESSMENTS:

TABULAR DATA

- Tier 1 Long-term Monthly Water Budgets and Stress Calculations by Subwatershed (Gauged Subwatersheds for the purpose of the Tier 1 Water Budget)
  - Wilmot Creek
  - Ganaraska River

- Tier 1 Long-term Monthly Water Budgets and Stress Calculations by Subwatershed (Ungauged Subwatersheds for the purpose of the Tier 1 Water Budget)
  - Graham Creek
  - Cobourg Creek
  - Gages Creek
  - West Lake Ontario subwatershed
  - East of Gages Creek subwatershed
  - East Lake Ontario subwatershed

The following represents results from the Tier 1 water budget of the Ganaraska Region Source Protection Area subwatersheds that drain to Lake Ontario. Table numbers shown are identical to those found within the Ganaraska Region Conservation Authority, 2010, Tier 1 Water Budget and Stress Assessment, Version 1.4, Draft Report and can be used for easy reference to the original document.

TIER 1 LONG-TERM MONTHLY WATER BUDGETS & STRESS CALCULATIONS BY SUBWATERSHED (GAUGED SUBWATERSHEDS)

WILMOT CREEK

LONG-TERM AVERAGE ANNUAL WATER BUDGETS

Table 4.1-1: Wilmot Creek under Existing Land Use Scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	63.2	1.0	0	30.2	32.0
February	45.2	1.6	0	31.8	11.8
March	65.5	8.5	-5	63.6	-1.6
April	76.4	31.8	5	49.8	-10.2
May	74.3	75.6	-5	27.8	-24.1
June	73.7	102.2	0	20.3	-48.8
July	62.7	117.8	3	14.1	-72.2
August	87.1	88.7	0	14.9	-16.5
September	94.7	57.4	5	19.1	13.2
October	84.8	32.9	-3	22.3	32.6
November	96.8	9.4	-5	28.7	63.7
December	69.9	2.4	0	29.3	38.2
Annual	894.3	529.3	-5	351.9	18.1

Table 4.1-2: Wilmot Creek under Future Land Use Scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	63.2	1.0	0	30	32.2
February	45.2	1.6	0	31.9	11.7
March	65.5	8.5	-5	64.3	-2.3
April	76.4	31.8	5	49.6	-10.0
May	74.3	75.6	-5	27.3	-23.6
June	73.7	102.2	0	20	-48.5
July	62.7	117.8	3	13.9	-72.0
August	87.1	88.6	0	14.8	-16.3
September	94.7	57.4	5	19	13.3
October	84.8	32.9	-3	22.3	32.6
November	96.8	9.4	-5	29.6	62.8
December	69.9	2.4	0	29.5	38.0
Annual	894.3	529.2	-5	352.2	17.9

Table 4.1-4: Wilmot Creek existing water demand estimation

Subwatershed Area 98.2 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	553,168	2,055	1,707	1,950	1,868	51,726	86,044	109,736	109,810	85,442	51,357	49,620	1854
Groundwater	365,952	2,055	1,707	1,950	1,868	51,726	50,448	51,724	51,798	49,846	51,357	49,620	1854
Surface Water	187,216	0	0	0	0	0	35,596	58,012	58,012	35,596	0	0	0
Non-Residential (G)	64,618.6	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5,385	5385
Non-Agriculture (S)	40,219	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3352
Total	658,006	10,791	10,443	10,686	10,604	60,463	94,781	118,473	118,546	94,179	60,093	58,356	10590
Groundwater	430,571	7,440	7,091	7,335	7,253	57,111	55,833	57,109	57,183	55,231	56,742	55,004	7239
Surface Water	227,435	3,352	3,352	3,352	3,352	3,352	38,948	61,363	61,363	38,948	3,352	3,352	3352

Unit: mm

PTTW	5.60	0.02	0.02	0.02	0.02	0.52	0.87	1.11	1.11	0.86	0.52	0.50	0.02
Groundwater	3.70	0.02	0.02	0.02	0.02	0.52	0.51	0.52	0.52	0.50	0.52	0.50	0.02
Surface Water	1.89	0.00	0.00	0.00	0.00	0.00	0.36	0.59	0.59	0.36	0.00	0.00	0.00
Non-Residential	0.65	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Non-Agriculture	0.41	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total	6.66	0.11	0.11	0.11	0.11	0.61	0.96	1.20	1.20	0.95	0.61	0.59	0.11
Groundwater	4.36	0.08	0.07	0.07	0.07	0.58	0.56	0.58	0.58	0.56	0.57	0.56	0.07
Surface Water	2.30	0.03	0.03	0.03	0.03	0.03	0.39	0.62	0.62	0.39	0.03	0.03	0.03

Table 4.1- 5: Wilmot Creek future water demand estimation

Subwatershed Area 98.2 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	554,337	2,322	1,928	2,204	2,111	52,026	86,385	110,036	110,119	83,649	51,609	49,853	2,095
Groundwater	367,121	2,322	1,928	2,204	2,111	52,026	50,789	52,024	52,107	48,053	51,609	49,853	2,095
Surface Water	187,216	0	0	0	0	0	35,596	58,012	58,012	35,596	0	0	0
Non-Residential (G)	73,226	6,102	6,102	6,102	6,102	6,102	6,102	6,102	6,102	6,102	6,102	6,102	6,102
Non-Agriculture(S)	40,219	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352	3,352
Total	667,782	11,776	11,382	11,657	11,564	61,480	95,839	119,490	119,573	93,103	61,062	59,307	11,549
Groundwater	440,347	8,424	8,031	8,306	8,213	58,128	56,891	58,126	58,210	54,155	57,711	55,955	8,197
Surface Water	227,435	3,352	3,352	3,352	3,352	3,352	38,948	61,363	61,363	38,948	3,352	3,352	3,352

Unit: mm

	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PTTW	5.61	0.02	0.02	0.02	0.02	0.53	0.87	1.11	1.11	0.85	0.52	0.50	0.02
Groundwater	3.72	0.02	0.02	0.02	0.02	0.53	0.51	0.53	0.53	0.49	0.52	0.50	0.02
Surface Water	1.89	0.00	0.00	0.00	0.00	0.00	0.36	0.59	0.59	0.36	0.00	0.00	0.00
Non-Residential	0.74	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Non-Agriculture	0.41	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total	6.76	0.12	0.12	0.12	0.12	0.62	0.97	1.21	1.21	0.94	0.62	0.60	0.12
Groundwater	4.46	0.09	0.08	0.08	0.08	0.59	0.58	0.59	0.59	0.55	0.58	0.57	0.08
Surface Water	2.30	0.03	0.03	0.03	0.03	0.03	0.39	0.62	0.62	0.39	0.03	0.03	0.03

Table 4.1- 6(a): Wilmot Creek surface water stress calculation (Tessman) existing scenario

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.82	25.73	0.39	12.34	0.43	13.39	3351.61	0.034	0.25	Low	Low
February	0.89	27.83	0.46	14.37	0.43	13.46	3351.61	0.034	0.25	Low	Low
March	1.89	59.15	0.82	25.88	1.06	33.27	3351.61	0.034	0.10	Low	Low
April	1.52	47.70	0.66	20.56	0.86	27.14	3351.61	0.034	0.12	Low	Low
May	0.89	27.82	0.39	12.34	0.49	15.48	3351.61	0.034	0.22	Low	Low
June	0.63	19.61	0.39	12.34	0.23	7.27	38947.7	0.394	5.42	Low	Low
July	0.52	16.32	0.39	12.34	0.13	3.97	61363.5	0.621	15.62	Low	Low
August	0.51	16.00	0.39	12.34	0.12	3.66	61363.5	0.621	16.96	Low	Low
September	0.64	19.94	0.39	12.34	0.24	7.60	38947.7	0.394	5.19	Low	Low
October	0.72	22.56	0.39	12.34	0.33	10.22	3351.61	0.034	0.33	Low	Low
November	0.96	30.11	0.40	12.46	0.56	17.65	3351.61	0.034	0.19	Low	Low
December	0.95	29.84	0.39	12.34	0.56	17.50	3351.61	0.034	0.19	Low	Low

Table 4.1- 6(b): Wilmot Creek surface water stress calculation (Q_{p90}) existing scenario

Month	Water Supply (Q_{p50})		Water Reserve (Q_{p90})		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.82	25.73	0.40	12.60	0.42	13.13	3351.61	0.034	0.26	Low	Low
February	0.89	27.83	0.44	13.83	0.45	14.01	3351.61	0.034	0.24	Low	Low
March	1.89	59.15	1.15	35.96	0.74	23.19	3351.61	0.034	0.15	Low	Low
April	1.52	47.70	1.08	33.92	0.44	13.78	3351.61	0.034	0.25	Low	Low
May	0.89	27.82	0.70	22.02	0.18	5.80	3351.61	0.034	0.58	Low	Low
June	0.63	19.61	0.49	15.31	0.14	4.30	38947.7	0.394	9.17	Low	Low
July	0.52	16.32	0.35	10.89	0.17	5.43	61363.5	0.621	11.44	Low	Low
August	0.51	16.00	0.43	13.61	0.08	2.39	61363.5	0.621	25.93	Moderate	Low
September	0.64	19.94	0.43	13.43	0.21	6.51	38947.7	0.394	6.05	Low	Low
October	0.72	22.56	0.57	17.92	0.15	4.64	3351.61	0.034	0.73	Low	Low
November	0.96	30.11	0.65	20.46	0.31	9.65	3351.61	0.034	0.35	Low	Low
December	0.95	29.84	0.61	19.30	0.34	10.55	3351.61	0.034	0.32	Low	Low

Table 4.1- 7(a): Wilmot Creek surface water stress calculation (Tessman) future scenario

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	% Water Demand		
January	1.00	26.22	0.47	12.35	0.53	13.87	3352	0.034	0.24	Low	Low
February	1.05	27.66	0.50	13.11	0.55	14.55	3352	0.034	0.23	Low	Low
March	2.50	65.65	0.99	26.07	1.51	39.58	3352	0.034	0.09	Low	Low
April	1.84	48.34	0.77	20.16	1.07	28.18	3352	0.034	0.12	Low	Low
May	1.11	29.07	0.46	11.97	0.65	17.10	3352	0.034	0.20	Low	Low
June	0.84	22.00	0.46	11.97	0.38	10.03	38948	0.394	3.93	Low	Low
July	0.61	16.07	0.46	11.97	0.16	4.10	61363	0.621	15.14	Low	Low
August	0.63	16.46	0.46	11.97	0.17	4.49	61363	0.621	13.83	Low	Low
September	0.75	19.58	0.46	11.97	0.29	7.61	38948	0.394	5.18	Low	Low
October	0.80	20.94	0.46	11.97	0.34	8.97	3352	0.034	0.38	Low	Low
November	1.24	32.58	0.46	12.18	0.78	20.41	3352	0.034	0.17	Low	Low
December	1.05	27.54	0.46	12.13	0.59	15.41	3352	0.034	0.22	Low	Low

Table 4.1- 7(b): Wilmot Creek surface water stress calculation (Q_{p90}) future scenario

Month	Water Supply (Q_{p50})		Water Reserve (Q_{p90})		Water Supply -Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	% Water Demand		
January	1.00	26.22	0.190	4.98	0.81	21.24	3352	0.034	0.16%	Low	Low
February	1.05	27.66	0.473	12.42	0.58	15.25	3352	0.034	0.22%	Low	Low
March	2.50	65.65	1.323	34.70	1.18	30.96	3352	0.034	0.11%	Low	Low
April	1.84	48.34	0.811	21.26	1.03	27.08	3352	0.034	0.13%	Low	Low
May	1.11	29.07	0.587	15.40	0.52	13.67	3352	0.034	0.25%	Low	Low
June	0.84	22.00	0.335	8.79	0.50	13.21	38948	0.394	2.98%	Low	Low
July	0.61	16.07	0.214	5.60	0.40	10.47	61363	0.621	5.93%	Low	Low
August	0.63	16.46	0.364	9.56	0.26	6.90	61363	0.621	9.00%	Low	Low
September	0.75	19.58	0.470	12.32	0.28	7.25	38948	0.394	5.43%	Low	Low
October	0.80	20.94	0.570	14.96	0.23	5.98	3352	0.034	0.57%	Low	Low
November	1.24	32.58	0.616	16.17	0.63	16.42	3352	0.034	0.21%	Low	Low
December	1.05	27.54	0.335	8.79	0.71	18.75	3352	0.034	0.18%	Low	Low

Table 4.1- 8: Wilmot Creek groundwater stress calculation existing scenario

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.52	39.37	0.152	3.94	1.36	35.43	7440	0.075	0.21	Low	Low
February	1.52	39.37	0.152	3.94	1.36	35.43	7091	0.072	0.20	Low	Low
March	1.52	39.37	0.152	3.94	1.36	35.43	7335	0.074	0.21	Low	Low
April	1.52	39.37	0.152	3.94	1.36	35.43	7253	0.073	0.21	Low	Low
May	1.52	39.37	0.152	3.94	1.36	35.43	57111	0.578	1.63	Low	Low
June	1.52	39.37	0.152	3.94	1.36	35.43	55833	0.565	1.59	Low	Low
July	1.52	39.37	0.152	3.94	1.36	35.43	57109	0.578	1.63	Low	Low
August	1.52	39.37	0.152	3.94	1.36	35.43	57183	0.579	1.63	Low	Low
September	1.52	39.37	0.152	3.94	1.36	35.43	55231	0.559	1.58	Low	Low
October	1.52	39.37	0.152	3.94	1.36	35.43	56742	0.574	1.62	Low	Low
November	1.52	39.37	0.152	3.94	1.36	35.43	55004	0.557	1.57	Low	Low
December	1.52	39.37	0.152	3.94	1.36	35.43	7239	0.073	0.21	Low	Low
Annual	18.19	472.38	1.819	47.24	16.37	425.14	430571	4.357	1.02	Low	Low

Table 4.1- 9: Wilmot Creek groundwater stress calculation future scenario

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.49	38.71	0.149	3.87	1.34	34.84	8157	0.085	0.24	Low	Low
February	1.49	38.71	0.149	3.87	1.34	34.84	7809	0.081	0.23	Low	Low
March	1.49	38.71	0.149	3.87	1.34	34.84	8052	0.084	0.24	Low	Low
April	1.49	38.71	0.149	3.87	1.34	34.84	7970	0.083	0.24	Low	Low
May	1.49	38.71	0.149	3.87	1.34	34.84	57828	0.588	1.69	Low	Low
June	1.49	38.71	0.149	3.87	1.34	34.84	56550	0.576	1.65	Low	Low
July	1.49	38.71	0.149	3.87	1.34	34.84	57827	0.588	1.69	Low	Low
August	1.49	38.71	0.149	3.87	1.34	34.84	57900	0.589	1.69	Low	Low
September	1.49	38.71	0.149	3.87	1.34	34.84	55948	0.548	1.57	Low	Low
October	1.49	38.71	0.149	3.87	1.34	34.84	57459	0.584	1.68	Low	Low
November	1.49	38.71	0.149	3.87	1.34	34.84	55722	0.566	1.63	Low	Low
December	1.49	38.71	0.149	3.87	1.34	34.84	7956	0.083	0.24	Low	Low
Annual	17.89	464.48	1.79	46.45	16.10	418.03	439178	4.456	1.07	Low	Low

GANARASKA RIVER

LONG-TERM AVERAGE ANNUAL WATER BUDGETS

Table 4.2-1: Ganaraska River under existing land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1.0	-4	28.9	35.2
February	49.0	1.6	-5	30.6	21.8
March	64.7	7.6	-19	68.3	7.8
April	74.5	34.7	-8	55.1	-7.3
May	73.8	72.3	5	33.3	-36.8
June	70.1	105.3	8	23.6	-66.8
July	62.3	105.8	7	20.6	-71.1
August	85.0	69.8	3	21.4	-9.2
September	86.0	54.6	-3	25.1	9.3
October	78.1	32.4	-6	27.3	24.4
November	89.5	11.1	-11	34.1	55.3
December	70.5	2.2	-10	34.5	43.8
Annual	864.6	498.4	-43	402.8	6.4

Table 4.2-2: Ganaraska River under future land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1.0	-4	29.0	35.1
February	49.0	1.6	-5	30.7	21.7
March	64.7	7.6	-19	68.6	7.5
April	74.5	34.7	-8	55.2	-7.4
May	73.8	72.3	5	33.1	-36.6
June	70.1	105.3	8	23.5	-66.7
July	62.3	105.8	7	20.5	-71.0
August	85.0	69.8	3	21.4	-9.2
September	86.0	54.6	-3	25.1	9.3
October	78.1	32.4	-6	27.3	24.4
November	89.5	11.1	-11	34.1	55.3
December	70.5	2.2	-10	34.1	44.2
Annual	864.6	498.4	-43	402.6	6.6

Table 4.2- 4: Ganaraska River existing water demand estimation

Subwatershed Area 277.95 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	118,8976	121,016	109,305	80,959	7,8347	80,959	78,347	140,687	140,687	78,347	80,959	78,347	12,1016
Groundwater	771,778	66,252	59,840	65,318	63,211	65,318	63,211	65,318	65,318	63,211	65,318	63,211	66,252
Surface Water	417,198	54,764	49,464	15,641	15,136	15,641	15,136	75,369	75,369	15,136	15,641	15,136	54,764
Non-Residential (G)	106,273	8,856	8,856	8,856	8,856	8,856	8,856	8,856	8,856	8,856	8,856	8,856	8,856
Non-Agriculture (S)	223,944	9,684	9,684	9,684	9,684	9,684	9,684	63,554	63,554	9,684	9,684	9,684	9,684
Total	1,519,194	139,556	127,844	99,499	96,887	99,499	96,887	213,097	213,097	96,887	99,499	96,887	139,556
Groundwater	878,052	75,108	68,697	74,174	72,067	74,174	72,067	74,174	74,174	72,067	74,174	72,067	75,108
Surface Water	641,142	64,448	59,148	25,325	24,820	25,325	24,820	138,923	138,923	24,820	25,325	24,820	64,448

Unit: mm

PTTW	4.28	0.44	0.39	0.29	0.28	0.29	0.28	0.51	0.51	0.28	0.29	0.28	0.44
Groundwater	2.78	0.24	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24
Surface Water	1.50	0.20	0.18	0.06	0.05	0.06	0.05	0.27	0.27	0.05	0.06	0.05	0.20
Non-Residential (G)	0.38	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Non-Agriculture (S)	0.81	0.03	0.03	0.03	0.03	0.03	0.03	0.23	0.23	0.03	0.03	0.03	0.03
Total	5.47	0.50	0.46	0.36	0.35	0.36	0.35	0.77	0.77	0.35	0.36	0.35	0.50
Groundwater	3.16	0.27	0.25	0.27	0.26	0.27	0.26	0.27	0.27	0.26	0.27	0.26	0.27
Surface Water	2.31	0.23	0.21	0.09	0.09	0.09	0.09	0.50	0.50	0.09	0.09	0.09	0.23

Table 4.2- 5: Ganaraska River future water demand estimation

Subwatershed Area 277.95 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	118,8976	121,016	109,305	80,959	78,347	80,959	78,347	140,687	140,687	78,347	80,959	78,347	121,016
Groundwater	711,778	66,252	59,840	65,318	63,211	65,318	63,211	65,318	65,318	63,211	65,318	63,211	66,252
Surface Water	417,198	54,764	49,464	15,641	15,136	15,641	15,136	75,369	75,369	15,136	15,641	15,136	54,764
Non-Residential (G)	131,237	10,936	10,936	10,936	10,936	10,936	10,936	10,936	10,936	10,936	10,936	10,936	10,936
Non-Agriculture (S)	223,944	9,684	9,684	9,684	9,684	9,684	9,684	63,554	63,554	9,684	9,684	9,684	9,684
Total	1,544,157	141,636	129,925	101,579	98,967	101,579	98,967	215,177	215,177	98,967	10,1579	98,967	141,636
Groundwater	903,015	77,188	70,777	76,254	74,147	76,254	74,147	76,254	76,254	74,147	76,254	74,147	77,188
Surface Water	641,142	64,448	59,148	25,325	24,820	25,325	24,820	138,923	138,923	24,820	25,325	24,820	64,448

Unit: mm

PTTW	4.28	0.44	0.39	0.29	0.28	0.29	0.28	0.51	0.51	0.28	0.29	0.28	0.44
Groundwater	2.78	0.24	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24
Surface Water	1.50	0.20	0.18	0.06	0.05	0.06	0.05	0.27	0.27	0.05	0.06	0.05	0.20
Non-Residential (G)	0.47	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Non-Agriculture (S)	0.81	0.03	0.03	0.03	0.03	0.03	0.03	0.23	0.23	0.03	0.03	0.03	0.03
Total	5.56	0.51	0.47	0.37	0.36	0.37	0.36	0.77	0.77	0.36	0.37	0.36	0.51
Groundwater	3.25	0.28	0.25	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28
Surface Water	2.31	0.23	0.21	0.09	0.09	0.09	0.09	0.50	0.50	0.09	0.09	0.09	0.23

Table 4.2- 6(a): Ganaraska River surface water stress calculation (Tessman) existing scenario

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	2.62	29.15	1.26	14.00	1.36	15.15	64447.5	0.232	1.53	Low	Low
February	2.79	31.04	1.34	14.93	1.45	16.10	59147.8	0.213	1.32	Low	Low
March	5.97	66.41	2.48	27.60	3.49	38.81	25324.6	0.091	0.23	Low	Low
April	5.00	55.62	2.09	23.24	2.91	32.38	24820	0.089	0.28	Low	Low
May	2.87	31.93	1.26	14.00	1.61	17.93	25324.6	0.091	0.51	Low	Low
June	2.07	23.03	1.26	14.00	0.81	9.03	24820	0.089	0.99	Low	Low
July	1.81	20.14	1.26	14.00	0.55	6.13	138923	0.500	8.15	Low	Low
August	1.82	20.25	1.26	14.00	0.56	6.25	138923	0.500	8.00	Low	Low
September	2.12	23.58	1.26	14.00	0.86	9.58	24820	0.089	0.93	Low	Low
October	2.48	27.59	1.26	14.00	1.22	13.59	25324.6	0.091	0.67	Low	Low
November	3.21	35.71	1.33	14.78	1.88	20.93	24820	0.089	0.43	Low	Low
December	2.96	32.93	1.26	14.06	1.70	18.87	64447.5	0.232	1.23	Low	Low

Table 4.2- 6(b): Ganaraska River surface water stress calculation (Q_{p90}) existing scenario

Month	Water Supply (Q_{p50})		Water Reserve (Q_{p90})		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	2.62	29.15	2.08	23.14	0.54	6.01	64447.5	0.232	3.86	Low	Low
February	2.79	31.04	1.59	17.69	1.20	13.35	59147.8	0.213	1.59	Low	Low
March	5.97	66.41	3.61	40.16	2.36	26.25	25324.6	0.091	0.35	Low	Low
April	5.00	55.62	3.28	36.49	1.72	19.13	24820	0.089	0.47	Low	Low
May	2.87	31.93	2.38	26.48	0.49	5.45	25324.6	0.091	1.67	Low	Low
June	2.07	23.03	1.60	17.80	0.47	5.23	24820	0.089	1.71	Low	Low
July	1.81	20.14	1.45	16.13	0.36	4.00	138923	0.500	12.48	Low	Low
August	1.82	20.25	1.58	17.58	0.24	2.67	138923	0.500	18.72	Low	Low
September	2.12	23.58	1.74	19.36	0.38	4.23	24820	0.089	2.11	Low	Low
October	2.48	27.59	1.92	21.36	0.56	6.23	25324.6	0.091	1.46	Low	Low
November	3.21	35.71	2.26	25.14	0.95	10.57	24820	0.089	0.84	Low	Low
December	2.96	32.93	2.10	23.36	0.86	9.57	64447.5	0.232	2.42	Low	Low

Table 4.2- 7: Ganaraska River surface water stress calculation (future scenario)

Month	Water supply (Q_{p50})		Water reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	2.74	25.57	1.42	13.27	1.32	12.30	64448	0.232	1.88%	Low	Low
February	2.93	27.35	1.42	13.27	1.51	14.08	59148	0.213	1.51%	Low	Low
March	7.63	71.13	2.94	27.45	4.68	43.68	25325	0.091	0.21%	Low	Low
April	5.94	55.44	2.37	22.09	3.58	33.34	24820	0.089	0.27%	Low	Low
May	3.64	33.94	1.42	13.27	2.22	20.67	25325	0.091	0.44%	Low	Low
June	2.46	22.90	1.42	13.27	1.03	9.63	24820	0.089	0.93%	Low	Low
July	2.28	21.22	1.42	13.27	0.85	7.95	138923	0.500	6.29%	Low	Low
August	2.41	22.50	1.42	13.27	0.99	9.23	138923	0.500	5.41%	Low	Low
September	2.72	25.32	1.42	13.27	1.29	12.05	24820	0.089	0.74%	Low	Low
October	2.92	27.25	1.42	13.27	1.50	13.98	25325	0.091	0.65%	Low	Low
November	3.37	31.46	1.47	13.71	1.90	17.75	24820	0.089	0.50%	Low	Low
December	3.57	33.26	1.47	13.71	2.10	19.55	64448	0.232	1.19%	Low	Low

Table 4.2-8: Ganaraska River groundwater stress calculation (existing scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	4.38	40.82	0.438	4.08	3.94	36.73	75108	0.270	0.74	Low	Low
February	4.38	40.82	0.438	4.08	3.94	36.73	68697	0.247	0.67	Low	Low
March	4.38	40.82	0.438	4.08	3.94	36.73	74174	0.267	0.73	Low	Low
April	4.38	40.82	0.438	4.08	3.94	36.73	72067	0.259	0.71	Low	Low
May	4.38	40.82	0.438	4.08	3.94	36.73	74174	0.267	0.73	Low	Low
June	4.38	40.82	0.438	4.08	3.94	36.73	72067	0.259	0.71	Low	Low
July	4.38	40.82	0.438	4.08	3.94	36.73	74174	0.267	0.73	Low	Low
August	4.38	40.82	0.438	4.08	3.94	36.73	74174	0.267	0.73	Low	Low
September	4.38	40.82	0.438	4.08	3.94	36.73	72067	0.259	0.71	Low	Low
October	4.38	40.82	0.438	4.08	3.94	36.73	74174	0.267	0.73	Low	Low
November	4.38	40.82	0.438	4.08	3.94	36.73	72067	0.259	0.71	Low	Low
December	4.38	40.82	0.438	4.08	3.94	36.73	75108	0.270	0.74	Low	Low
Annual	52.52	489.78	5.25	49.98	47.27	440.80	878052	3.159	0.72	Low	Low

Table 4.2- 9: Ganaraska River groundwater stress calculation (future scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	4.37	40.74	0.437	4.07	3.93	36.67	77188	0.278	0.76	Low	Low
February	4.37	40.74	0.437	4.07	3.93	36.67	70777	0.255	0.69	Low	Low
March	4.37	40.74	0.437	4.07	3.93	36.67	76254	0.274	0.75	Low	Low
April	4.37	40.74	0.437	4.07	3.93	36.67	74147	0.267	0.73	Low	Low
May	4.37	40.74	0.437	4.07	3.93	36.67	76254	0.274	0.75	Low	Low
June	4.37	40.74	0.437	4.07	3.93	36.67	74147	0.267	0.73	Low	Low
July	4.37	40.74	0.437	4.07	3.93	36.67	76254	0.274	0.75	Low	Low
August	4.37	40.74	0.437	4.07	3.93	36.67	76254	0.274	0.75	Low	Low
September	4.37	40.74	0.437	4.07	3.93	36.67	74147	0.267	0.73	Low	Low
October	4.37	40.74	0.437	4.07	3.93	36.67	76254	0.274	0.75	Low	Low
November	4.37	40.74	0.437	4.07	3.93	36.67	74147	0.267	0.73	Low	Low
December	4.37	40.74	0.437	4.07	3.93	36.67	77188	0.278	0.76	Low	Low
Annual	52.42	488.88	5.24	48.89	47.18	439.99	903015	3.249	0.74	Low	Low

TIER 1 LONG-TERM MONTHLY WATER BUDGETS & STRESS CALCULATIONS BY SUBWATERSHED (UNGAUGED SUBWATERSHEDS)

GRAHAM CREEK

LONG-TERM AVERAGE ANNUAL WATER BUDGETS

Table 4.3- 1: Graham Creek under existing land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	63.2	1.0	0	30.9	31.3
February	45.2	1.6	0	32.2	11.4
March	65.5	8.5	-5	62.4	-0.4
April	76.4	31.8	5	51.8	-12.2
May	74.3	75.6	-5	30.0	-26.3
June	73.7	102.2	0	22.0	-50.5
July	62.7	117.8	3	15.9	-74.0
August	87.1	88.8	0	16.3	-18.0
September	94.7	57.4	5	20.7	11.6
October	84.8	32.9	-3	23.4	31.5
November	96.8	9.4	-5	28.5	63.9
December	69.9	2.4	0	29.7	37.8
Annual	894.3	529.4	-5	363.8	6.1

Table 4.3- 2: Graham Creek under future land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	63.2	1	0	30.9	31.3
February	45.2	1.6	0	32.2	11.4
March	65.5	8.5	-5	62.5	-0.5
April	76.4	31.8	5	51.8	-12.2
May	74.3	75.6	-5	29.9	-26.2
June	73.7	102.2	0	22.0	-50.5
July	62.7	117.8	3	15.9	-74.0
August	87.1	88.8	0	16.3	-18.0
September	94.7	57.4	5	20.7	11.6
October	84.8	32.9	-3	23.4	31.5
November	96.8	9.4	-5	28.5	63.9
December	69.9	2.4	0	29.7	37.8
Annual	894.3	529.4	-5	363.8	6.1

Table 4.3- 3: Graham Creek existing water demand estimation

Subwatershed Area: 78.15 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	112,613	0	0	0	0	0	16,540	39,767	39,767	16,540	0	0	0
Groundwater	25,737	0	0	0	0	0	0	12,868	12,868	0	0	0	0
Surface Water	86,876	0	0	0	0	0	16,540	26,898	26,898	16,540	0	0	0
Non-Residential	26,928	2,244	2,244	2,244	2,244	2,244	2,244	2,244	2,244	2,244	2,244	2,244	2,244
Non-Agriculture	73,252	2,736	2,736	2,736	2,736	2,736	2,736	22,945	22,945	2,736	2,736	2,736	2,736
Total	212,794	4,980	4,980	4,980	4,980	4,980	21,521	64,955	64,955	21,521	4,980	4,980	4,980
Groundwater	52,665	2,244	2,244	2,244	2,244	2,244	2,244	15,113	15,113	2,244	2,244	2,244	2,244
Surface Water	160,129	2,736	2,736	2,736	2,736	2,736	19,277	49,843	49,843	19,277	2,736	2,736	2,736

Unit: mm

PTTW	1.44	0.00	0.00	0.00	0.00	0.00	0.21	0.51	0.51	0.21	0.00	0.00	0.00
Groundwater	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.00	0.00	0.00	0.00
Surface Water	1.11	0.00	0.00	0.00	0.00	0.00	0.21	0.34	0.34	0.21	0.00	0.00	0.00
Non-Residential	0.34	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Non-Agriculture	0.94	0.04	0.04	0.04	0.04	0.04	0.04	0.29	0.29	0.04	0.04	0.04	0.04
Total	2.72	0.06	0.06	0.06	0.06	0.06	0.28	0.83	0.83	0.28	0.06	0.06	0.06
Groundwater	0.67	0.03	0.03	0.03	0.03	0.03	0.03	0.19	0.19	0.03	0.03	0.03	0.03
Surface Water	2.05	0.04	0.04	0.04	0.04	0.04	0.25	0.64	0.64	0.25	0.04	0.04	0.04

Table 4.3- 4: Graham Creek future water demand estimation

Subwatershed Area: 78.15 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	112,613	0	0	0	0	0	16,540	39,767	39,767	16,540	0	0	0
Groundwater	25,737	0	0	0	0	0	0	12,868	12,868	0	0	0	0
Surface Water	86,876	0	0	0	0	0	16,540	26,898	26,898	16,540	0	0	0
Non-Residential	30,483	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540
Non-Agriculture	73,252	2,736	2,736	2,736	2,736	2,736	2,736	22,945	22,945	2,736	2,736	2,736	2,736
Total	216,349	5,277	5,277	5,277	5,277	5,277	21,817	65,252	65,252	21,817	5,277	5,277	5,277
Groundwater	56,220	2,540	2,540	2,540	2,540	2,540	2,540	15,409	15,409	2,540	2,540	2,540	2,540
Surface Water	160,129	2,736	2,736	2,736	2,736	2,736	19,277	49,843	49,843	19,277	2,736	2,736	2,736

Unit: mm

PTTW	1.44	0.00	0.00	0.00	0.00	0.00	0.21	0.51	0.51	0.21	0.00	0.00	0.00
Groundwater	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.00	0.00	0.00	0.00
Surface Water	1.11	0.00	0.00	0.00	0.00	0.00	0.21	0.34	0.34	0.21	0.00	0.00	0.00
Non-Residential	0.39	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Non-Agriculture	0.94	0.04	0.04	0.04	0.04	0.04	0.04	0.29	0.29	0.04	0.04	0.04	0.04
Total	2.77	0.07	0.07	0.07	0.07	0.07	0.28	0.83	0.83	0.28	0.07	0.07	0.07
Groundwater	0.72	0.03	0.03	0.03	0.03	0.03	0.03	0.20	0.20	0.03	0.03	0.03	0.03
Surface Water	2.05	0.04	0.04	0.04	0.04	0.04	0.25	0.64	0.64	0.25	0.04	0.04	0.04

Table 4.3- 5: Graham Creek surface water stress calculation (existing scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply-Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.84	27.80	0.34	11.25	0.50	16.55	2736	0.035	0.21	Low	High
February	0.87	28.84	0.35	11.71	0.52	17.13	2736	0.035	0.20	Low	High
March	1.95	64.69	0.69	22.74	1.26	41.95	2736	0.035	0.08	Low	High
April	1.53	50.72	0.57	18.87	0.96	31.84	2736	0.035	0.11	Low	High
May	0.90	29.82	0.33	10.91	0.57	18.91	2736	0.035	0.19	Low	High
June	0.71	23.41	0.33	10.89	0.38	12.53	19277	0.247	1.97	Low	High
July	0.51	16.96	0.33	10.89	0.18	6.07	49843	0.638	10.50	Low	High
August	0.51	16.98	0.33	10.89	0.18	6.09	49843	0.638	10.47	Low	High
September	0.60	20.00	0.33	10.89	0.27	9.11	19277	0.247	2.71	Low	High
October	0.64	21.30	0.33	10.89	0.31	10.42	2736	0.035	0.34	Low	High
November	0.90	29.72	0.33	10.89	0.57	18.84	2736	0.035	0.19	Low	High
December	0.77	25.51	0.33	10.89	0.44	14.63	2736	0.035	0.24	Low	High

Table 4.3- 6: Graham Creek surface water stress calculation (future scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Q_{p90})		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.84	27.83	0.34	11.26	0.50	16.57	2736	0.035	0.21	Low	High
February	0.87	28.84	0.35	11.72	0.52	17.12	2736	0.035	0.20	Low	High
March	1.95	64.69	0.69	22.76	1.26	41.93	2736	0.035	0.08	Low	High
April	1.53	50.65	0.57	18.86	0.96	31.79	2736	0.035	0.11	Low	High
May	0.90	29.81	0.33	10.90	0.57	18.91	2736	0.035	0.19	Low	High
June	0.71	23.40	0.33	10.89	0.38	12.51	19277	0.247	1.97	Low	High
July	0.51	16.94	0.33	10.89	0.18	6.05	49843	0.638	10.54	Low	High
August	0.51	16.98	0.33	10.89	0.18	6.09	49843	0.638	10.47	Low	High
September	0.60	19.99	0.33	10.89	0.27	9.10	19277	0.247	2.71	Low	High
October	0.64	21.29	0.33	10.89	0.31	10.40	2736	0.035	0.34	Low	High
November	0.90	29.71	0.33	10.89	0.57	18.82	2736	0.035	0.19	Low	High
December	0.77	25.57	0.33	10.89	0.44	14.68	2736	0.035	0.24	Low	High

Table 4.3- 7: Graham Creek groundwater stress calculation (existing scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
February	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
March	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
April	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
May	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
June	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
July	1.22	40.48	0.122	4.05	1.10	36.43	15113	0.193	0.53	Low	High
August	1.22	40.48	0.122	4.05	1.10	36.43	15113	0.193	0.08	Low	High
September	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
October	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
November	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
December	1.22	40.48	0.122	4.05	1.10	36.43	2244	0.029	0.08	Low	High
Annual	14.65	485.78	1.47	48.58	13.18	437.20	52665	0.674	0.15	Low	High

Table 4.3- 8: Graham Creek groundwater stress calculation (future scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
February	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
March	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
April	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
May	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
June	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
July	1.22	40.47	0.122	4.05	1.10	36.42	15409	0.197	0.54	Low	High
August	1.22	40.47	0.122	4.05	1.10	36.42	15409	0.197	0.09	Low	High
September	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
October	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
November	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
December	1.22	40.47	0.122	4.05	1.10	36.42	2540	0.033	0.09	Low	High
Annual	14.64	485.58	146	48.56	1318	437.02	56220	0.719	0.16	Low	High

COBOURG CREEK

LONG-TERM AVERAGE ANNUAL WATER BUDGETS

Table 4.4-1: Cobourg Creek under existing land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1.0	-6	32.3	33.8
February	49.0	1.6	0	28.3	19.1
March	64.7	7.6	-11	72.8	-4.7
April	74.5	32.8	-18	84.7	-25
May	73.8	73.1	-5	45.9	-40.2
June	70.1	91.9	0	25.4	-47.2
July	62.3	105.3	-7	25.6	-61.6
August	85.0	75.4	-5	22.5	-7.9
September	86.0	49.2	-10	27.9	18.9
October	78.1	28.9	-25	46.4	27.8
November	89.5	10.0	-20	47.0	52.5
December	70.5	2.3	-12	38.6	41.6
Annual	864.6	479.1	-119	497.4	7.1

Table 4.4-2: Cobourg Creek under future land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1	-6	33.5	32.6
February	49.0	1.6	0	29.1	18.3
March	64.7	7.6	-11	74.0	-5.9
April	74.5	32.8	-18	83.7	-24.0
May	73.8	73.1	-5	44.7	-39.0
June	70.1	91.9	0	24.8	-46.6
July	62.3	105.4	-7	25.4	-61.5
August	85.0	75.6	-5	22.3	-7.9
September	86.0	49.3	-10	27.7	19.0
October	78.1	28.9	-25	43.0	31.2
November	89.5	10	-20	46.4	53.1
December	70.5	2.3	-12	42.4	37.8
Annual	864.6	479.5	-119	497.0	7.1

Table 4.4-3: Cobourg Creek existing water demand estimation

Subwatershed Area 133.8 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	192,861	10,609	9,421	10,272	10,015	45,698	44,557	10,554	10,811	10,000	10,351	10,104	10,469
Groundwater	123,533	10,609	9,421	10,272	10,015	10,466	10,461	10,554	10,811	10,000	10,351	10,104	10,469
Surface Water	69,328	0	0	0	0	35,232	34,096	0	0	0	0	0	0
Non-Residential (G)	117,088	9,757	9,757	9,757	9,757	9,757	9,757	9,757	9,757	9,757	9,757	9,757	9,757
Non-Agriculture (S)	151,223	6,503	6,503	6,503	6,503	6,503	6,503	43,098	43,098	6,503	6,503	6,503	6,503
Total	461,172	26,869	25,681	26,532	26,275	61,958	60,817	63,410	63,666	26,260	26,611	26,364	26,729
Groundwater	240,621	20,367	19,178	20,029	19,772	20,223	20,219	20,312	20,568	19,758	20,108	19,861	20,227
Surface Water	220,551	6,503	6,503	6,503	6,503	41,735	40,598	43,098	43,098	6,503	6,503	6,503	6,503

Unit: mm

PTTW	1.44	0.08	0.07	0.08	0.07	0.34	0.33	0.08	0.08	0.07	0.08	0.08	0.08
Groundwater	0.92	0.08	0.07	0.08	0.07	0.08	0.08	0.08	0.08	0.07	0.08	0.08	0.08
Surface Water	0.52	0.00	0.00	0.00	0.00	0.26	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Non-Residential (G)	0.88	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Non-Agriculture (S)	1.13	0.05	0.05	0.05	0.05	0.05	0.05	0.32	0.32	0.05	0.05	0.05	0.05
Total	3.45	0.20	0.19	0.20	0.20	0.46	0.45	0.47	0.48	0.20	0.20	0.20	0.20
Groundwater	1.80	0.15	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Surface Water	1.65	0.05	0.05	0.05	0.05	0.31	0.30	0.32	0.32	0.05	0.05	0.05	0.05

Table 4.4-4: Cobourg Creek future water demand estimation

Subwatershed Area 133.8 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	200,879	11,512	10,155	11,006	10,763	46,529	45,528	9,506	11,814	10,741	11,124	10,896	11,302
Groundwater	131,551	11,512	10,155	11,006	10,763	11,297	11,432	9,506	11,814	10,741	11,124	10,896	11,302
Surface Water	69,328	0	0	0	0	35,232	34,096	0	0	0	0	0	0
Non-Residential (G)	176,557	14,713	14,713	14,713	14,713	14,713	14,713	14,713	14,713	14,713	14,713	14,713	14,713
Non-Agriculture (S)	151,223	6,503	6,503	6,503	6,503	6,503	6,503	43,098	43,098	6,503	6,503	6,503	6,503
Total	528,659	32,728	31,371	32,222	31,979	67,745	66,744	67,317	69,625	31,957	32,340	32,112	32,518
Groundwater	308,108	26,225	24,868	25,719	25,476	26,010	26,145	24,219	26,528	25,454	25,838	25,609	26,015
Surface Water	220,551	6,503	6,503	6,503	6,503	41,735	40,598	43,098	43,098	6,503	6,503	6,503	6,503

Unit: mm

PTTW	1.50	0.09	0.08	0.08	0.08	0.35	0.34	0.07	0.09	0.08	0.08	0.08	0.08
Groundwater	0.98	0.09	0.08	0.08	0.08	0.08	0.09	0.07	0.09	0.08	0.08	0.08	0.08
Surface Water	0.52	0.00	0.00	0.00	0.00	0.26	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Non-Residential (G)	1.32	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Non-Agriculture (S)	1.13	0.05	0.05	0.05	0.05	0.05	0.05	0.32	0.32	0.05	0.05	0.05	0.05
Total	3.95	0.24	0.23	0.24	0.24	0.51	0.50	0.50	0.52	0.24	0.24	0.24	0.24
Groundwater	2.30	0.20	0.19	0.19	0.19	0.19	0.20	0.18	0.20	0.19	0.19	0.19	0.19
Surface Water	1.65	0.05	0.05	0.05	0.05	0.31	0.30	0.32	0.32	0.05	0.05	0.05	0.05

Table 4.4-5: Cobourg Creek surface water stress calculation (existing scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.43	27.74	0.85	16.43	0.58	11.31	6503	0.049	0.43	Low	Low
February	1.27	24.57	0.85	16.43	0.42	8.14	6503	0.049	0.60	Low	Low
March	3.72	71.95	1.51	29.19	2.21	42.76	6503	0.049	0.11	Low	Low
April	4.44	85.89	1.75	33.94	2.69	51.96	6503	0.049	0.09	Low	Low
May	2.41	46.54	0.95	18.43	1.45	28.10	41735	0.312	1.11	Low	Low
June	1.31	25.34	0.85	16.43	0.46	8.91	40598	0.303	3.40	Low	Low
July	1.33	25.68	0.85	16.43	0.48	9.25	43098	0.322	3.48	Low	Low
August	1.20	23.17	0.85	16.43	0.35	6.74	43098	0.322	4.78	Low	Low
September	1.39	26.83	0.85	16.43	0.54	10.40	6503	0.049	0.47	Low	Low
October	2.36	45.72	0.96	18.65	1.40	27.07	6503	0.049	0.18	Low	Low
November	2.19	42.37	0.98	18.90	1.21	23.47	6503	0.049	0.21	Low	Low
December	1.78	34.41	0.85	16.43	0.93	17.98	6503	0.049	0.27	Low	Low

Table 4.4-6: Cobourg Creek surface water stress calculation (future scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.52	29.37	0.85	16.42	0.67	12.96	6503	0.049	0.38	Low	Low
February	1.38	26.64	0.85	16.42	0.53	10.22	6503	0.049	0.48	Low	Low
March	3.73	72.15	1.53	29.69	2.19	42.46	6503	0.049	0.11	Low	Low
April	4.39	84.95	1.73	33.56	2.66	51.40	6503	0.049	0.09	Low	Low
May	2.34	45.26	0.93	17.95	1.41	27.31	41735	0.312	1.14	Low	Low
June	1.28	24.77	0.85	16.42	0.43	8.35	40598	0.303	3.63	Low	Low
July	1.31	25.38	0.85	16.42	0.46	8.97	43098	0.322	3.59	Low	Low
August	1.18	22.91	0.85	16.42	0.34	6.50	43098	0.322	4.96	Low	Low
September	1.38	26.64	0.85	16.42	0.53	10.22	6503	0.049	0.48	Low	Low
October	2.18	42.19	0.89	17.25	1.29	24.94	6503	0.049	0.19	Low	Low
November	2.19	42.35	0.96	18.65	1.22	23.70	6503	0.049	0.21	Low	Low
December	1.96	37.94	0.88	17.02	1.08	20.92	6503	0.049	0.23	Low	Low

Table 4.4- 7: Cobourg Creek groundwater stress calculation (existing scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	2.08	40.32	0.208	4.03	1.88	36.28	20367	0.152	0.48	Low	Low
February	2.08	40.32	0.208	4.03	1.88	36.28	19178	0.143	0.45	Low	Low
March	2.08	40.32	0.208	4.03	1.88	36.28	20029	0.150	0.47	Low	Low
April	2.08	40.32	0.208	4.03	1.88	36.28	19772	0.148	0.47	Low	Low
May	2.08	40.32	0.208	4.03	1.88	36.28	20223	0.151	0.48	Low	Low
June	2.08	40.32	0.208	4.03	1.88	36.28	20219	0.151	0.48	Low	Low
July	2.08	40.32	0.208	4.03	1.88	36.28	20312	0.152	0.48	Low	Low
August	2.08	40.32	0.208	4.03	1.88	36.28	20568	0.154	0.48	Low	Low
September	2.08	40.32	0.208	4.03	1.88	36.28	19758	0.148	0.47	Low	Low
October	2.08	40.32	0.208	4.03	1.88	36.28	20108	0.150	0.47	Low	Low
November	2.08	40.32	0.208	4.03	1.88	36.28	19861	0.148	0.47	Low	Low
December	2.08	40.32	0.208	4.03	1.88	36.28	20227	0.151	0.48	Low	Low
Annual	25.00	483.78	2.50	48.38	22.50	435.40	240621	1.798	0.47	Low	Low

Table 4.4- 8: Cobourg Creek groundwater stress calculation (future scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply- Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	2.05	39.64	0.205	3.96	1.84	35.68	26225	0.196	0.63%	Low	Low
February	2.05	39.64	0.205	3.96	1.84	35.68	24868	0.186	0.60%	Low	Low
March	2.05	39.64	0.205	3.96	1.84	35.68	25719	0.192	0.62%	Low	Low
April	2.05	39.64	0.205	3.96	1.84	35.68	25476	0.190	0.61%	Low	Low
May	2.05	39.64	0.205	3.96	1.84	35.68	26010	0.194	0.62%	Low	Low
June	2.05	39.64	0.205	3.96	1.84	35.68	26145	0.195	0.63%	Low	Low
July	2.05	39.64	0.205	3.96	1.84	35.68	24219	0.181	0.58%	Low	Low
August	2.05	39.64	0.205	3.96	1.84	35.68	26528	0.198	0.64%	Low	Low
September	2.05	39.64	0.205	3.96	1.84	35.68	25454	0.190	0.61%	Low	Low
October	2.05	39.64	0.205	3.96	1.84	35.68	25838	0.193	0.62%	Low	Low
November	2.05	39.64	0.205	3.96	1.84	35.68	25609	0.191	0.62%	Low	Low
December	2.05	39.64	0.205	3.96	1.84	35.68	26015	0.194	0.62%	Low	Low
Annual	24.59	475.68	2.46	47.57	22.13	428.11	308108	2.303	0.62%	Low	Low

GAGES CREEK

LONG-TERM AVERAGE ANNUAL WATER BUDGETS

Table 4.5-1: Gages Creek under existing land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1.0	-6	32.4	33.7
February	49.0	1.6	0	28.9	18.5
March	64.7	7.6	-11	75.9	-7.8
April	74.5	32.8	-18	81	-21.3
May	73.8	73.1	-5	43.5	-37.8
June	70.1	91.9	0	23.4	-45.2
July	62.3	105.5	-7	23.7	-59.9
August	85.0	75.8	-5	20.3	-6.1
September	86.0	49.3	-10	25.8	20.9
October	78.1	28.9	-25	44.8	29.4
November	89.5	10.0	-20	46.3	53.2
December	70.5	2.3	-12	40.1	40.1
Annual	864.6	479.8	-119	486.1	17.7

Table 4.5-2: Gages Creek under future land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1	-6	32.3	33.8
February	49.0	1.6	0	28.9	18.5
March	64.7	7.6	-11	76.4	-8.3
April	74.5	32.8	-18	80.7	-21
May	73.8	73.1	-5	42.6	-36.9
June	70.1	91.9	0	23.1	-44.9
July	62.3	105.4	-7	23.6	-59.7
August	85.0	75.7	-5	20.4	-6.1
September	86.0	49.3	-10	25.9	20.8
October	78.1	28.9	-25	44.8	29.4
November	89.5	10	-20	46.8	52.7
December	70.5	2.3	-12	40.4	39.8
Annual	864.6	479.6	-119	485.9	18.1

Table 4.5- 3: Gages Creek existing water demand estimation

Subwatershed Area 48.63 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	66,8074	18,883	17,056	18,883	18,274	18,883	127,882	132,145	132,145	127,882	18,883	18,274	18,883
Groundwater	74,008	6,286	5,677	6,286	6,083	6,286	6,083	6,286	6,286	6,083	6,286	6,083	6,286
Surface Water	594,065	12,598	11,378	12,598	12,191	12,598	121,799	125,859	125,859	121,799	12,598	12,191	12,598
Non-Residential (G)	26,935	2,245	2,245	2,245	2,245	2,245	2,245	2,245	2,245	2,245	2,245	2,245	2,245
Non-Agriculture (S)	51,072	2,719	2,719	2,719	2,719	2,719	2,719	11,943	11,943	2,719	2,719	2,719	2,719
Total	746,080	23,846	22,019	23,846	23,237	23,846	132,845	146,332	146,332	132,845	23,846	23,237	23,846
Groundwater	100,943	8,530	7,922	8,530	8,327	8,530	8,327	8,530	8,530	8,327	8,530	8,327	8,530
Surface Water	645,137	15,316	14,097	15,316	14,910	15,316	124,518	137,802	137,802	124,518	15,316	14,910	15,316

Unit: mm

PTTW	13.74	0.39	0.35	0.39	0.38	0.39	2.63	2.72	2.72	2.63	0.39	0.38	0.39
Groundwater	1.52	0.13	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Surface Water	12.22	0.26	0.23	0.26	0.25	0.26	2.50	2.59	2.59	2.50	0.26	0.25	0.26
Non-Residential (G)	0.55	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Non-Agriculture (S)	1.05	0.06	0.06	0.06	0.06	0.06	0.06	0.25	0.25	0.06	0.06	0.06	0.06
Total	15.34	0.49	0.45	0.49	0.48	0.49	2.73	3.01	3.01	2.73	0.49	0.48	0.49
Groundwater	2.08	0.18	0.16	0.18	0.17	0.18	0.17	0.18	0.18	0.17	0.18	0.17	0.18
Surface Water	13.27	0.31	0.29	0.31	0.31	0.31	2.56	2.83	2.83	2.56	0.31	0.31	0.31

Table 4.5- 4: Gages Creek future water demand estimation

Subwatershed Area 48.63 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	668,074	18,883	17,056	18,883	18,274	18,883	127,882	132,145	132,145	127,882	18,883	18,274	18,883
Groundwater	74,008	6,286	5,677	6,286	6,083	6,286	6,083	6,286	6,286	6,083	6,286	6,083	6,286
Surface Water	594,065	12,598	11,378	12,598	12,191	12,598	12,1799	125,859	125,859	121,799	12,598	12,191	12,598
Non-Residential (G)	33,714	2,810	2,810	2,810	2,810	2,810	2,810	2,810	2,810	2,810	2,810	2,810	2,810
Non-Agriculture (S)	51,072	2,719	2,719	2,719	2,719	2,719	2,719	11,943	11,943	2,719	2,719	2,719	2,719
Total	752,859	24,411	22,584	24,411	23,802	24,411	133,410	146,897	146,897	133,410	24,411	23,802	24,411
Groundwater	107,722	9,095	8,487	9,095	8,892	9,095	8,892	9,095	9,095	8,892	9,095	8,892	9,095
Surface Water	645,137	15,316	14,097	15,316	14,910	15,316	124,518	137,802	137,802	124,518	15,316	14,910	15,316

Unit: mm

PTTW	13.74	0.39	0.35	0.39	0.38	0.39	2.63	2.72	2.72	2.63	0.39	0.38	0.39
Groundwater	1.52	0.13	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Surface Water	12.22	0.26	0.23	0.26	0.25	0.26	2.50	2.59	2.59	2.50	0.26	0.25	0.26
Non-Residential (G)	0.69	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Non-Agriculture(S)	1.05	0.06	0.06	0.06	0.06	0.06	0.06	0.25	0.25	0.06	0.06	0.06	0.06
Total	15.48	0.50	0.46	0.50	0.49	0.50	2.74	3.02	3.02	2.74	0.50	0.49	0.50
Groundwater	2.22	0.19	0.17	0.19	0.18	0.19	0.18	0.19	0.19	0.18	0.19	0.18	0.19
Surface Water	13.27	0.31	0.29	0.31	0.31	0.31	2.56	2.83	2.83	2.56	0.31	0.31	0.31

Table 4.5- 5: Gages Creek surface water stress calculation (existing scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.52	27.66	0.30	16.12	0.22	11.54	15316	0.315	2.73%	Low	High
February	0.46	24.55	0.30	16.12	0.16	8.44	14097	0.290	3.44%	Low	High
March	1.38	73.65	0.57	30.46	0.81	43.19	15316	0.315	0.73%	Low	High
April	1.58	84.13	0.62	33.07	0.96	51.06	14910	0.307	0.60%	Low	High
May	0.86	45.80	0.34	18.07	0.52	27.72	15316	0.315	1.14%	Low	High
June	0.47	25.16	0.30	16.12	0.17	9.04	124518	2.561	28.32%	Moderate	High
July	0.47	24.95	0.30	16.12	0.17	8.83	137802	2.834	32.10%	Moderate	High
August	0.42	22.22	0.30	16.12	0.11	6.10	137802	2.834	46.42%	Moderate	High
September	0.50	26.48	0.31	16.42	0.19	10.06	124518	2.561	25.46%	Moderate	High
October	0.85	45.51	0.35	18.59	0.51	26.92	15316	0.315	1.17%	Low	High
November	0.77	41.12	0.35	18.63	0.42	22.49	14910	0.307	1.36%	Low	High
December	0.68	36.32	0.30	16.15	0.38	20.18	15316	0.315	1.56%	Low	High

Table 4.5- 6: Gages Creek surface water stress calculation (future scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.52	27.97	0.31	16.42	0.22	11.55	15316	0.315	2.73	Low	High
February	0.48	25.61	0.31	16.42	0.17	9.19	14097	0.290	3.15	Low	High
March	1.40	74.58	0.58	30.67	0.82	43.92	15316	0.315	0.72	Low	High
April	1.56	83.07	0.62	32.97	0.94	50.10	14910	0.307	0.61	Low	High
May	0.84	44.83	0.33	17.73	0.51	27.10	15316	0.315	1.16	Low	High
June	0.46	24.74	0.31	16.42	0.16	8.32	124518	2.561	30.78	Moderate	High
July	0.47	24.95	0.31	16.42	0.16	8.53	137802	2.834	33.23	Moderate	High
August	0.42	22.32	0.31	16.42	0.11	5.90	137802	2.834	47.99	Moderate	High
September	0.50	26.48	0.31	16.42	0.19	10.06	124518	2.561	25.46	Moderate	High
October	0.85	45.51	0.35	18.59	0.51	26.92	15316	0.315	1.17	Low	High
November	0.78	41.81	0.35	18.86	0.43	22.95	14910	0.307	1.34	Low	High
December	0.68	36.29	0.31	16.42	0.37	19.87	15316	0.315	1.59	Low	High

Table 4.5- 7: Gages Creek groundwater stress calculation (existing scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply-Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.75	40.14	0.075	4.01	0.68	36.13	8530	0.175	0.49	Low	High
February	0.75	40.14	0.075	4.01	0.68	36.13	7922	0.163	0.45	Low	High
March	0.75	40.14	0.075	4.01	0.68	36.13	8530	0.175	0.49	Low	High
April	0.75	40.14	0.075	4.01	0.68	36.13	8327	0.171	0.47	Low	High
May	0.75	40.14	0.075	4.01	0.68	36.13	8530	0.175	0.49	Low	High
June	0.75	40.14	0.075	4.01	0.68	36.13	8327	0.171	0.47	Low	High
July	0.75	40.14	0.075	4.01	0.68	36.13	8530	0.175	0.49	Low	High
August	0.75	40.14	0.075	4.01	0.68	36.13	8530	0.175	0.49	Low	High
September	0.75	40.14	0.075	4.01	0.68	36.13	8327	0.171	0.47	Low	High
October	0.75	40.14	0.075	4.01	0.68	36.13	8530	0.175	0.49	Low	High
November	0.75	40.14	0.075	4.01	0.68	36.13	8327	0.171	0.47	Low	High
December	0.75	40.14	0.075	4.01	0.68	36.13	8530	0.175	0.49	Low	High
Annual	9.04	481.68	0.904	48.17	8.13	433.51	100943	2.076	0.48	Low	High

Table 4.5- 8: Gages Creek groundwater stress calculation (future scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply-Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.74	39.59	0.074	3.96	0.67	35.63	9095	0.187	0.52	Low	High
February	0.74	39.59	0.074	3.96	0.67	35.63	8487	0.175	0.49	Low	High
March	0.74	39.59	0.074	3.96	0.67	35.63	9095	0.187	0.52	Low	High
April	0.74	39.59	0.074	3.96	0.67	35.63	8892	0.183	0.51	Low	High
May	0.74	39.59	0.074	3.96	0.67	35.63	9095	0.187	0.52	Low	High
June	0.74	39.59	0.074	3.96	0.67	35.63	8892	0.183	0.51	Low	High
July	0.74	39.59	0.074	3.96	0.67	35.63	9095	0.187	0.52	Low	High
August	0.74	39.59	0.074	3.96	0.67	35.63	9095	0.187	0.52	Low	High
September	0.74	39.59	0.074	3.96	0.67	35.63	8892	0.183	0.51	Low	High
October	0.74	39.59	0.074	3.96	0.67	35.63	9095	0.187	0.52	Low	High
November	0.74	39.59	0.074	3.96	0.67	35.63	8892	0.183	0.51	Low	High
December	0.74	39.59	0.074	3.96	0.67	35.63	9095	0.187	0.52	Low	High
Annual	8.91	475.08	0.89	47.51	8.02	427.57	107722	2.215	0.52	Low	High

WEST LAKE ONTARIO SUBWATERSHED

LONG-TERM AVERAGE ANNUAL WATER BUDGETS

Table 4.6- 1: Characteristics of major streams in the West Lake Ontario subwatershed

Stream	Drainage Area (km^2)	Main Channel Length (km)	Total Fall (m)	Average Gradient (m/km)
Lovekin Creek	7.02	6.75	112.49	16.66
Bouchette Point Creek	22.87	10.77	132.67	12.32
Port Granby Creek	13.37	8.42	132.26	15.71
Chrysler Bluff Creek	1.26	2.48	69.67	28.09
Wesleyville Marsh Creek	2.12	2.69	84.81	31.53
Wesleyville Creek	8.44	5.38	114.80	21.34
Port Britain Creek	35.93	16.32	142.36	8.72
Brand's Creek	9.58	6.26	77.09	12.31
Little's Creek	4.51	3.89	79.94	20.55

Table 4.6-2: West Lake Ontario subwatershed under existing land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	$\triangle S$
January	61.1	1.0	-4	29.1	35.0
February	49.0	1.6	-5	31.1	21.3
March	64.7	7.6	-19	71.8	4.3
April	74.5	34.7	-8	54.6	-6.8
May	73.8	72.3	5	30.7	-34.2
June	70.1	105.3	8	21.6	-64.8
July	62.3	105.8	7	19	-69.5
August	85.0	69.8	3	20.2	-8.0
September	86.0	54.6	-3	24.1	10.3
October	78.1	32.4	-6	26.4	25.3
November	89.5	11.1	-11	34.3	55.1
December	70.5	2.2	-10	34.9	43.4
Annual	864.6	498.4	-43	397.8	11.4

Table 4.6- 3: West Lake Ontario subwatershed under future land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1.0	-4	29.7	34.4
February	49.0	1.6	-5	32.2	20.2
March	64.7	7.6	-19	75.4	0.7
April	74.5	34.7	-8	55.7	-7.9
May	73.8	72.3	5	27.1	-30.6
June	70.1	105.3	8	19.1	-62.3
July	62.3	105.2	7	17.3	-67.2
August	85.0	69.3	3	19.3	-6.6
September	86.0	54.4	-3	23.6	11.0
October	78.1	32.4	-6	25.9	25.8
November	89.5	11.1	-11	37.3	52.1
December	70.5	2.2	-10	36.8	41.5
Annual	864.6	497.1	-43	399.4	11.1

Table 4.6- 4: West Lake Ontario subwatershed existing water demand estimation

Subwatershed Area 117.33 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	325,862	11,836	10,691	11,836	11,455	11,836	11,455	105,085	105,085	11,455	11,836	11,455	11,836
Groundwater	153,760	11,836	10,691	11,836	11,455	11,836	11,455	19,034	19,034	11,455	11,836	11,455	11,836
Surface Water	172,101	0	0	0	0	0	0	86,051	86,051	0	0	0	0
Non-Residential (G)	29,819	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485
Non-Agriculture (S)	27,876	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323
Total	383,557	16,644	15,499	166,44	16,263	16,644	16,263	109,893	109,893	16,263	16,644	16,263	16,644
Groundwater	183,580	14,321	13,176	14,321	13,940	14,321	13,940	21,519	21,519	13,940	14,321	13,940	14,321
Surface Water	199,977	2,323	2,323	2,323	2,323	2,323	2,323	88,374	88,374	2,323	2,323	2,323	2,323

Unit: mm

PTTW	2.78	0.10	0.09	0.10	0.10	0.10	0.10	0.90	0.90	0.10	0.10	0.10	0.10
Groundwater	1.31	0.10	0.09	0.10	0.10	0.10	0.10	0.16	0.16	0.10	0.10	0.10	0.10
Surface Water	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.73	0.00	0.00	0.00	0.00
Non-Residential (G)	0.25	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Non-Agriculture (S)	0.24	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	3.27	0.14	0.13	0.14	0.14	0.14	0.14	0.94	0.94	0.14	0.14	0.14	0.14
Groundwater	1.56	0.12	0.11	0.12	0.12	0.12	0.12	0.18	0.18	0.12	0.12	0.12	0.12
Surface Water	1.70	0.02	0.02	0.02	0.02	0.02	0.02	0.75	0.75	0.02	0.02	0.02	0.02

Table 4.6- 5: West Lake Ontario subwatershed future water demand estimation

Subwatershed Area 117.33 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	325,862	11,836	10,691	11,836	11,455	11,836	11,455	105,085	105,085	11,455	11,836	11,455	11,836
Groundwater	153,760	11,836	10,691	11,836	11,455	11,836	11,455	19,034	19,034	11,455	11,836	11,455	11,836
Surface Water	172,101	0	0	0	0	0	0	86,051	86,051	0	0	0	0
Non-Residential (G)	36,007	3,001	3,001	3,001	3,001	3,001	3,001	3,001	3,001	3,001	3,001	3,001	3,001
Non-Agriculture (S)	27,876	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323	2,323
Total	389,745	17,160	16,015	17,160	16,778	17,160	16,778	110,408	110,408	16,778	17,160	16,778	17,160
Groundwater	189,767	14,837	13,692	14,837	14,455	14,837	14,455	22,035	22,035	14,455	14,837	14,455	14,837
Surface Water	199,977	2,323	2,323	2,323	2,323	2,323	2,323	88,374	88,374	2,323	2,323	2,323	2,323

Unit: mm

PTTW	2.78	0.10	0.09	0.10	0.10	0.10	0.10	0.90	0.90	0.10	0.10	0.10	0.10
Groundwater	1.31	0.10	0.09	0.10	0.10	0.10	0.10	0.16	0.16	0.10	0.10	0.10	0.10
Surface Water	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.73	0.00	0.00	0.00	0.00
Non-Residential (G)	0.31	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Non-Agriculture (S)	0.24	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	3.32	0.15	0.14	0.15	0.14	0.15	0.14	0.94	0.94	0.14	0.15	0.14	0.15
Groundwater	1.62	0.13	0.12	0.13	0.12	0.13	0.12	0.19	0.19	0.12	0.13	0.12	0.13
Surface Water	1.70	0.02	0.02	0.02	0.02	0.02	0.02	0.75	0.75	0.02	0.02	0.02	0.02

Table 4.6- 6: West Lake Ontario subwatershed surface water stress calculation (existing scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.19	26.26	0.60	13.27	0.59	12.98	2323	0.020	0.15	Low	High
February	1.32	29.06	0.60	13.27	0.71	15.78	2323	0.020	0.13	Low	High
March	3.35	74.05	1.31	28.91	2.04	45.14	2323	0.020	0.04	Low	High
April	2.40	53.01	1.00	22.04	1.40	30.97	2323	0.020	0.06	Low	High
May	1.43	31.67	0.60	13.27	0.83	18.40	2323	0.020	0.11	Low	High
June	0.98	21.62	0.60	13.27	0.38	8.35	2323	0.020	0.24	Low	High
July	0.91	20.01	0.60	13.27	0.30	6.74	88374	0.753	11.18	Low	High
August	0.98	21.64	0.60	13.27	0.38	8.36	88374	0.753	9.00	Low	High
September	1.12	24.67	0.60	13.27	0.52	11.40	2323	0.020	0.17	Low	High
October	1.21	26.78	0.60	13.27	0.61	13.50	2323	0.020	0.15	Low	High
November	1.42	31.42	0.63	13.93	0.79	17.49	2323	0.020	0.11	Low	High
December	1.58	34.83	0.64	14.16	0.94	20.66	2323	0.020	0.10	Low	High

Table 4.6- 7: West Lake Ontario subwatershed surface water stress calculation (future scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.28	28.19	0.60	13.33	0.67	14.86	2323	0.020	0.13	Low	High
February	1.28	28.30	0.60	13.33	0.68	14.96	2323	0.020	0.13	Low	High
March	3.45	76.19	1.37	30.37	2.07	45.82	2323	0.020	0.04	Low	High
April	2.35	51.93	1.02	22.48	1.33	29.44	2323	0.020	0.07	Low	High
May	1.27	27.97	0.60	13.33	0.66	14.63	2323	0.020	0.14	Low	High
June	0.87	19.31	0.60	13.33	0.27	5.98	2323	0.020	0.33	Low	High
July	0.83	18.27	0.60	13.33	0.22	4.94	88374	0.753	15.25	Low	High
August	0.90	19.79	0.60	13.33	0.29	6.45	88374	0.753	11.67	Low	High
September	1.06	23.51	0.60	13.33	0.46	10.18	2323	0.020	0.19	Low	High
October	1.18	26.01	0.60	13.33	0.57	12.68	2323	0.020	0.16	Low	High
November	1.71	37.82	1.31	29.02	0.40	8.80	2323	0.020	0.23	Low	High
December	1.69	37.32	1.21	26.82	0.48	10.50	2323	0.020	0.19	Low	High

Table 4.6- 8: West Lake Ontario subwatershed groundwater stress calculation (existing scenario)

Month	Water supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.79	39.65	0.79	3.96	1.62	35.68	14321	0.122	0.34	Low	High
February	1.79	39.65	0.79	3.96	1.62	35.68	13176	0.112	0.31	Low	High
March	1.79	39.65	0.79	3.96	1.62	35.68	14321	0.122	0.34	Low	High
April	1.79	39.65	0.79	3.96	1.62	35.68	13940	0.119	0.33	Low	High
May	1.79	39.65	0.79	3.96	1.62	35.68	14321	0.122	0.34	Low	High
June	1.79	39.65	0.79	3.96	1.62	35.68	13940	0.119	0.33	Low	High
July	1.79	39.65	0.79	3.96	1.62	35.68	21519	0.183	0.51	Low	High
August	1.79	39.65	0.79	3.96	1.62	35.68	21519	0.183	0.51	Low	High
September	1.79	39.65	0.79	3.96	1.62	35.68	13940	0.119	0.33	Low	High
October	1.79	39.65	0.79	3.96	1.62	35.68	14321	0.122	0.34	Low	High
November	1.79	39.65	0.79	3.96	1.62	35.68	13940	0.119	0.33	Low	High
December	1.79	39.65	0.79	3.96	1.62	35.68	14321	0.122	0.34	Low	High
Annual	21.54	475.78	2.15	47.58	19.38	428.20	183580	1.565	0.37	Low	High

Table 4.6- 9: West Lake Ontario subwatershed groundwater stress calculation (future scenario)

Month	Water supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	1.70	37.46	0.17	3.75	1.53	33.71	14837	0.126	0.38	Low	High
February	1.70	37.46	0.17	3.75	1.53	33.71	13692	0.117	0.35	Low	High
March	1.70	37.46	0.17	3.75	1.53	33.71	14837	0.126	0.38	Low	High
April	1.70	37.46	0.17	3.75	1.53	33.71	14455	0.123	0.37	Low	High
May	1.70	37.46	0.17	3.75	1.53	33.71	14837	0.126	0.38	Low	High
June	1.70	37.46	0.17	3.75	1.53	33.71	14455	0.123	0.37	Low	High
July	1.70	37.46	0.17	3.75	1.53	33.71	22035	0.188	0.56	Low	High
August	1.70	37.46	0.17	3.75	1.53	33.71	22035	0.188	0.56	Low	High
September	1.70	37.46	0.17	3.75	1.53	33.71	14455	0.123	0.37	Low	High
October	1.70	37.46	0.17	3.75	1.53	33.71	14837	0.126	0.38	Low	High
November	1.70	37.46	0.17	3.75	1.53	33.71	14455	0.123	0.37	Low	High
December	1.70	37.46	0.17	3.75	1.53	33.71	14837	0.126	0.38	Low	High
Annual	20.35	449.48	2.04	44.95	18.31	404.53	189767	1.617	0.40	Low	High

EAST OF GAGES CREEK SUBWATERSHED

LONG-TERM AVERAGE ANNUAL WATER BUDGETS

Table 4.7- 1: Characteristics of streams in the East of Gage Creek Watershed

Stream/Tributary	Drainage Area (km^2)	Main Channel Length (km)	Total Fall (m)	Average Gradient (m/km)
Hamilton Unnamed 9	3.19	3.66	50.43	13.78
Hamilton Unnamed 8	1.17	1.45	23.44	16.17
Hamilton Unnamed 7	6.90	4.96	63.48	12.80

Table 4.7-2: East of Gages Creek subwatershed under existing land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	$\triangle S$
January	61.1	1.0	0	26.5	33.6
February	49.0	1.6	0	29.5	17.9
March	64.7	7.6	0	69.4	-12.3
April	74.5	32.8	0	62.5	-20.8
May	73.8	73.1	0	38.1	-37.4
June	70.1	91.9	0	24.3	-46.1
July	62.3	105.3	0	18.0	-61.0
August	85.0	75.9	0	16.7	-7.6
September	86.0	49.3	0	17.3	19.4
October	78.1	28.9	0	21.4	27.8
November	89.5	10.0	0	26.6	52.9
December	70.5	2.3	0	30.0	38.2
Annual	864.6	479.7	0	380.3	4.6

Table 4.7-3: East of Gages Creek subwatershed under future land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	$\triangle S$
January	61.1	0.7	0	27.5	32.9
February	49	1.2	0	30.4	17.4
March	64.7	5.7	0	71.9	-12.9
April	74.5	24.6	0	65.1	-15.2
May	73.8	65.5	0	40.2	-31.9
June	70.1	87	0	26.1	-43
July	62.3	107.8	0	19.4	-64.9
August	85	77.4	0	17.6	-10
September	86	49.8	0	17.9	18.3
October	78.1	28.9	0	22.2	27
November	89.5	8.9	0	29.9	50.7
December	70.5	1.9	0	32.4	36.2
Annual	864.6	459.4	0	400.6	4.6

Table 4.7- 4: East of Gages Creek subwatershed existing water demand estimation

Subwatershed Area: 12.52 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Residential (G)	5,662	472	472	472	472	472	472	472	472	472	472	472	472
Non-Agriculture(S)	13,148	700	700	700	700	700	700	3,075	3,075	700	700	700	700
Total	18,810	1,172	1,172	1,172	1,172	1,172	1,172	3,546	3,546	1,172	1,172	1,172	1,172
Groundwater	5,662	472	472	472	472	472	472	472	472	472	472	472	472
Surface Water	13,148	700	700	700	700	700	700	3,075	3,075	700	700	700	700

Unit: mm

PTTW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Residential (G)	0.45	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Non-Agriculture(S)	1.05	0.06	0.06	0.06	0.06	0.06	0.06	0.25	0.25	0.06	0.06	0.06	0.06
Total	1.50	0.09	0.09	0.09	0.09	0.09	0.09	0.28	0.28	0.09	0.09	0.09	0.09
Groundwater	0.45	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Surface Water	1.05	0.06	0.06	0.06	0.06	0.06	0.06	0.25	0.25	0.06	0.06	0.06	0.06

Table 4.7- 5: East of Gages Creek subwatershed future water demand estimation

Subwatershed Area: 12.52 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Residential (G)	7,087	591	591	591	591	591	591	591	591	591	591	591	591
Non-Agriculture(S)	13,148	700	700	700	700	700	700	3,075	3,075	700	700	700	700
Total	20,235	1,290	1,290	1,290	1,290	1,290	1,290	3,665	3,665	1,290	1,290	1,290	1,290
Groundwater	7,087	591	591	591	591	591	591	591	591	591	591	591	591
Surface Water	13,148	700	700	700	700	700	700	3075	3,075	700	700	700	700

Unit: mm

PTTW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Residential (G)	0.57	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Non-Agriculture(S)	1.05	0.06	0.06	0.06	0.06	0.06	0.06	0.25	0.25	0.06	0.06	0.06	0.06
Total	1.62	0.10	0.10	0.10	0.10	0.10	0.10	0.29	0.29	0.10	0.10	0.10	0.10
Groundwater	0.57	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Surface Water	1.05	0.06	0.06	0.06	0.06	0.06	0.06	0.25	0.25	0.06	0.06	0.06	0.06

Table 4.7- 6: East of Gages Creek subwatershed surface water stress calculation (existing scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.10	21.48	0.06	12.50	0.04	8.98	700	0.056	0.62	Low	High
February	0.12	25.32	0.06	12.50	0.06	12.82	700	0.056	0.44	Low	High
March	0.32	67.08	0.13	27.75	0.19	39.33	700	0.056	0.14	Low	High
April	0.29	60.93	0.12	25.01	0.17	35.91	700	0.056	0.16	Low	High
May	0.19	38.69	0.07	15.25	0.11	23.44	700	0.056	0.24	Low	High
June	0.12	24.72	0.06	12.50	0.06	12.22	700	0.056	0.46	Low	High
July	0.08	17.22	0.06	12.50	0.02	4.72	3075	0.246	5.21	Low	High
August	0.08	16.71	0.06	12.50	0.02	4.21	3075	0.246	5.83	Low	High
September	0.08	16.29	0.06	12.50	0.02	3.79	700	0.056	1.48	Low	High
October	0.10	20.49	0.06	12.50	0.04	7.99	700	0.056	0.70	Low	High
November	0.10	21.07	0.06	12.50	0.04	8.57	700	0.056	0.65	Low	High
December	0.12	25.67	0.06	12.50	0.06	13.17	700	0.056	0.42	Low	High

Table 4.7- 7: East of Gages Creek subwatershed surface water stress calculation (future scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.11	22.84	0.06	13.17	0.05	9.67	700	0.056	0.58	Low	High
February	0.13	27.52	0.06	13.17	0.07	14.35	700	0.056	0.39	Low	High
March	0.34	69.37	0.14	28.76	0.20	40.61	700	0.056	0.14	Low	High
April	0.31	63.60	0.13	26.04	0.18	37.56	700	0.056	0.15	Low	High
May	0.20	40.64	0.08	16.07	0.12	24.57	700	0.056	0.23	Low	High
June	0.13	26.18	0.06	13.17	0.06	13.01	700	0.056	0.43	Low	High
July	0.09	19.11	0.06	13.17	0.03	5.94	3075	0.246	4.13	Low	High
August	0.09	17.87	0.06	13.17	0.02	4.70	3075	0.246	5.23	Low	High
September	0.08	17.01	0.06	13.17	0.02	3.84	700	0.056	1.46	Low	High
October	0.10	20.65	0.06	13.17	0.04	7.48	700	0.056	0.75	Low	High
November	0.11	23.35	0.06	13.17	0.05	10.18	700	0.056	0.55	Low	High
December	0.14	29.97	0.06	13.17	0.08	16.80	700	0.056	0.33	Low	High

Table 4.7- 8: East of Gages Creek subwatershed groundwater stress calculation (existing scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
February	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
March	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
April	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
May	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
June	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
July	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
August	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
September	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
October	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
November	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
December	0.19	39.17	0.019	3.92	0.17	35.25	472	0.038	0.11	Low	High
Annual	2.27	469.98	0.23	47.00	2.04	422.98	5662	0.452	0.11	Low	High

Table 4.7- 9: East of Gages Creek subwatershed groundwater stress calculation (future scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
February	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
March	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
April	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
May	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
June	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
July	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
August	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
September	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
October	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
November	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
December	0.19	39.41	0.019	3.94	0.17	35.47	591	0.047	0.13	Low	High
Annual	2.28	472.88	0.23	47.29	2.06	425.59	7087	0.566	0.13	Low	High

EAST LAKE ONTARIO SUBWATERSHED

LONG-TERM AVERAGE ANNUAL WATER BUDGETS

Table 4.8- 1: Characteristics of major streams in the East Lake Ontario Watershed

Stream/Tributary	Drainage Area (km^2)	Main Channel Length (km)	Total Fall (m)	Average Gradient (m/km)
Brook Creek	15.45	10.47	207.26	19.80
Massey Creek	6.50	7.43	165.30	22.25
Spicer Creek	11.55	9.05	207.27	22.90

Table 4.8-2: East Lake Ontario subwatershed under existing land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1.0	-6	33.7	32.4
February	49.0	1.6	0	29.1	18.3
March	64.7	7.6	-11	73.4	-5.3
April	74.5	32.8	-18	84.2	-24.5
May	73.8	73.1	-5	46.1	-40.4
June	70.1	91.9	0	25.4	-47.2
July	62.3	105.4	-7	25.6	-61.7
August	85.0	75.7	-5	22.2	-7.9
September	86.0	49.3	-10	27.6	19.1
October	78.1	28.9	-25	43	31.2
November	89.5	10.0	-20	45.4	54.1
December	70.5	2.3	-12	42.1	38.1
Annual	864.6	479.6	-119	497.8	6.2

Table 4.8- 3: East Lake Ontario subwatershed under future land use scenario

Month	Water Budget Components (mm)				
	P	ET	G_{net}	Q	△S
January	61.1	1.0	-6	32.6	33.5
February	49.0	1.6	0	28.9	18.5
March	64.7	7.6	-11	74.5	-6.4
April	74.5	32.8	-18	83.5	-23.8
May	73.8	73.1	-5	43.9	-38.2
June	70.1	91.9	0	24.6	-46.4
July	62.3	105.3	-7	25.4	-61.4
August	85.0	75.5	-5	22.5	-8.0
September	86.0	49.3	-10	27.9	18.8
October	78.1	28.9	-25	46.4	27.8
November	89.5	10.0	-20	48.3	51.2
December	70.5	2.3	-12	39.9	40.3
Annual	864.6	479.3	-119	498.4	5.9

Table 4.8- 4: East Lake Ontario subwatershed exiting water demand estimation

Subwatershed Area 42.71 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	17,592	762	628	604	532	2,040	2,122	2,085	2,186	1,936	2,013	1,994	691
Groundwater	8,046	762	628	604	532	657	784	702	803	598	630	656	691
Surface Water	9,547	0	0	0	0	1,383	1,338	1,383	1,383	1,338	1,383	1,338	0
Non-Residential (G)	21,797	1,816	1,816	1,816	1,816	1,816	1,816	1,816	1,816	1,816	1,816	1,816	1,816
Non-Agriculture (S)	46,115	750	750	750	750	750	750	19,309	19,309	750	750	750	750
Total	85,504	3,328	3,194	3,170	3,098	4,606	4,688	23,210	23,311	4,503	4,579	4,560	3,257
Groundwater	29,843	2,578	2,445	2,421	2,348	2,473	2,600	2,518	2,619	2,415	2,446	2,472	2,507
Surface Water	55,662	750	750	750	750	2133	2,088	20,692	20,692	2,088	2,133	2,088	750

Unit: mm

PTTW	0.41	0.02	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.02
Groundwater	0.19	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02
Surface Water	0.22	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00
Non-Residential (G)	0.51	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Non-Agriculture (S)	1.08	0.02	0.02	0.02	0.02	0.02	0.02	0.45	0.45	0.02	0.02	0.02	0.02
Total	2.00	0.08	0.07	0.07	0.07	0.11	0.11	0.54	0.55	0.11	0.11	0.11	0.08
Groundwater	0.70	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Surface Water	1.30	0.02	0.02	0.02	0.02	0.05	0.05	0.48	0.48	0.05	0.05	0.05	0.02

Table 4.8- 5: East Lake Ontario subwatershed future water demand estimation

Subwatershed Area 42.71 km^2 *Unit: m^3*

	Annual	January	February	March	April	May	June	July	August	September	October	November	December
PTTW	21,615	1,142	942	906	797	2,368	2,514	2,436	2,587	2,235	2,328	2,322	1,036
Groundwater	12,068	1,142	942	906	797	985	1,176	1,053	1,204	897	945	983	1,036
Surface Water	9,547	0	0	0	0	1,383	1,338	1,383	1,383	1,338	1,383	1,338	0
Non-Residential (G)	32,868	2,739	2,739	2,739	2,739	2,739	2,739	2,739	2,739	2,739	2,739	2,739	2,739
Non-Agriculture (S)	46,115	750	750	750	750	750	750	19,309	19,309	750	750	750	750
Total	100,598	4,631	4,431	4,395	4,286	5,857	6,003	24,484	24,635	5,724	5,817	5,810	4,525
Groundwater	44,936	3,881	3,681	3,645	3,536	3,724	3,915	3,792	3,943	3,636	3,684	3,722	3,775
Surface Water	55,662	750	750	750	750	2,133	2,088	20,692	20,692	2,088	2,133	2,088	750

Unit: mm

PTTW	0.51	0.03	0.02	0.02	0.02	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.02
Groundwater	0.28	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.02
Surface Water	0.22	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00
Non-Residential (G)	0.77	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Non-Agriculture (S)	1.08	0.02	0.02	0.02	0.02	0.02	0.02	0.45	0.45	0.02	0.02	0.02	0.02
Total	2.36	0.11	0.10	0.10	0.10	0.14	0.14	0.57	0.58	0.13	0.14	0.14	0.11
Groundwater	1.05	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Surface Water	1.30	0.02	0.02	0.02	0.02	0.05	0.05	0.48	0.48	0.05	0.05	0.05	0.02

Table 4.8- 6: East Lake Ontario subwatershed surface water stress calculation (existing scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply - Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.48	28.85	0.27	16.41	0.20	12.43	750	0.018	0.14	Low	High
February	0.41	24.85	0.27	16.41	0.14	8.44	750	0.018	0.21	Low	High
March	1.19	72.38	0.48	29.40	0.71	42.98	750	0.018	0.04	Low	High
April	1.41	85.39	0.56	33.74	0.85	51.65	750	0.018	0.03	Low	High
May	0.77	46.86	0.30	18.50	0.47	28.37	2133	0.050	0.18	Low	High
June	0.42	25.46	0.27	16.41	0.15	9.05	2088	0.049	0.54	Low	High
July	0.42	25.41	0.27	16.41	0.15	9.00	20692	0.484	5.38	Low	High
August	0.37	22.58	0.27	16.41	0.10	6.17	20692	0.484	7.85	Low	High
September	0.44	26.59	0.27	16.41	0.17	10.17	2088	0.049	0.48	Low	High
October	0.70	42.19	0.28	17.24	0.41	24.94	2133	0.050	0.20	Low	High
November	0.68	41.03	0.30	18.22	0.38	22.80	2088	0.049	0.21	Low	High
December	0.63	38.21	0.28	16.89	0.35	21.33	750	0.018	0.08	Low	High

Table 4.8- 7: East Lake Ontario subwatershed surface water stress calculation (future scenario)

Month	Water Supply (Q_{p50})		Water Reserve (Tessman)		Water Supply- Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.48	28.86	0.27	16.43	0.20	12.42	750	0.018	0.14	Low	High
February	0.45	27.32	0.27	16.43	0.18	10.89	750	0.018	0.16	Low	High
March	1.20	72.78	0.49	29.84	0.71	42.94	750	0.018	0.04	Low	High
April	1.40	84.70	0.55	33.44	0.84	51.26	750	0.018	0.03	Low	High
May	0.73	44.27	0.29	17.61	0.44	26.66	2133	0.050	0.19	Low	High
June	0.40	24.37	0.27	16.43	0.13	7.94	2088	0.049	0.62	Low	High
July	0.42	25.33	0.27	16.43	0.15	8.90	20692	0.484	5.44	Low	High
August	0.38	23.07	0.27	16.43	0.11	6.64	20692	0.484	7.30	Low	High
September	0.44	26.66	0.27	16.43	0.17	10.23	2088	0.049	0.48	Low	High
October	0.75	45.53	0.31	18.61	0.44	26.92	2133	0.050	0.19	Low	High
November	0.72	43.66	0.32	19.37	0.40	24.29	2088	0.049	0.20	Low	High
December	0.59	35.90	0.27	16.43	0.32	19.47	750	0.018	0.09	Low	High

Table 4.8- 8: East Lake Ontario subwatershed groundwater stress calculation (existing scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply- Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.67	40.56	0.067	4.06	0.60	36.50	2578	0.060	0.17	Low	High
February	0.67	40.56	0.067	4.06	0.60	36.50	2445	0.057	0.16	Low	High
March	0.67	40.56	0.067	4.06	0.60	36.50	2421	0.057	0.16	Low	High
April	0.67	40.56	0.067	4.06	0.60	36.50	2348	0.055	0.15	Low	High
May	0.67	40.56	0.067	4.06	0.60	36.50	2473	0.058	0.16	Low	High
June	0.67	40.56	0.067	4.06	0.60	36.50	2600	0.061	0.17	Low	High
July	0.67	40.56	0.067	4.06	0.60	36.50	2518	0.059	0.16	Low	High
August	0.67	40.56	0.067	4.06	0.60	36.50	2619	0.061	0.17	Low	High
September	0.67	40.56	0.067	4.06	0.60	36.50	2415	0.057	0.15	Low	High
October	0.67	40.56	0.067	4.06	0.60	36.50	2446	0.057	0.16	Low	High
November	0.67	40.56	0.067	4.06	0.60	36.50	2472	0.058	0.16	Low	High
December	0.67	40.56	0.067	4.06	0.60	36.50	2507	0.059	0.16	Low	High
Annual	8.02	486.68	0.802	48.67	7.22	438.01	29843	0.699	0.16	Low	High

Table 4.8- 9: East Lake Ontario subwatershed groundwater stress calculation (future scenario)

Month	Water Supply (Q_r+Q_{in})		Water Reserve (10% supply)		Water Supply- Water Reserve		Water Demand (Q demand)			Stress Level	Uncertainty
	m^3/s	mm/month	m^3/s	mm/month	m^3/s	mm/month	m^3	mm/month	% Water Demand		
January	0.64	39.14	0.064	3.91	0.58	35.23	3881	0.091	0.26	Low	High
February	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.086	0.24	Low	High
March	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.085	0.24	Low	High
April	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.083	0.24	Low	High
May	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.087	0.25	Low	High
June	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.092	0.26	Low	High
July	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.089	0.25	Low	High
August	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.092	0.26	Low	High
September	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.085	0.24	Low	High
October	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.086	0.24	Low	High
November	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.087	0.25	Low	High
December	0.64	39.14	0.064	3.91	0.58	35.23	0.64	0.088	0.25	Low	High
Annual	7.74	469.68	0.77	46.97	6.97	422.71	44936	1.052	0.25	Low	High