

MEMO

To:	Dirk Kassenaar
From:	Garry T. Hunter, M.A.Sc., P.Eng.
Date:	July 31, 2024
File:	21-407
Subject	Peer Review of Strada Draft Model Calibration Report (Earthfx May 2024)

Enclosed please find a page to page summary of my Peer Review of the Earthfx May 2024 Draft Model Calibration Report.

Many of the comments provided herein are a repeat of prior Model Review comments. Despite my requests of May 2024, the Applicant continues to withhold the site and regional water level data input required to audit this fundamental information. The model continues to be opaque.

The Applicant also has not responded to my request for routine Site and Participant Area calibration error statistics for the groundwater model. Therefore, I must conclude these statistics are not satisfactory.

pg 9, s1.2 para 2 The fundamental Tatham 2023 Appendices A and B Reports as documented on pg 9 (last para) and in the document Bibliography are now incomplete and more than one year out of date to support the Model Calibration Report. The myriad of supplemental communication updates have not been consolidated into these baseline monitoring history reports. This is a recipe for errors.

The Baseline Reports are the logical repository for the on-site and off-site bore logs, groundwater quantity and quality monitoring, pump tests, streamflow monitoring and other basic data relied on to support the proposed Strada Quarry application.

Inclusion of the above data in the Baseline Report avoids the need for repetition in the Modeling and other reports. The Applicant's overall approach to data management is inefficient, requiring searches through many documents.

pg 12 s2.2 para 2 20 years of manual and digital monitoring data has not been compiled and / or presented.

pg 12 to 21 Only 4 logs are presented, those drilled in late fall of 2023. For example, it is very unwieldy, impractical and inappropriate for readers to have look through multiple interim documents to find the borehole / monitor logs as identified on Fig 2.1. How does the reader know what is current and what is not? Earlier version reports should be replaced and eliminated from further consideration.

Where are the ludgeon values?

Table 2.1 and 2.2	This is only one Table. Only three core holes are identified when as many as 7 have been obtained. Has the Compliance Report legacy well data been converted to CGVD2013? The break up of this Table by Township Lots would assist well finding.
pg 26 s2.3 Fig 2.12	The results of the Private Well Monitoring Network WELLness checks need to be included in the Model Calibration Report. Apparently only 51 of 144 participant (only 1/3) have been provisionally linked to MECP well records by the applicant (Matrix Item 198). The applicant linkage is to the front of the Lot not to the actual well location.
pg 29 s2.4	Why discuss only the new 2023 cores. Why make the reader ‘go searching’.
pg 30 Fig 2.14	BH08-15 in Lot 15, Con 4 OS is mislocated. Where is the log? Other wells seem for the most part to be plotted at actual locations.
pg 31 to 34 Fig 2.15, 2.16, 2.17 and 2.18	All Figures should show Township Lot lines for reference. Elevations (CGVD 2013), show on both right and left vertical axes. Till is only Tavistock in Lot 11 and 12. Where is the well bore legend? Fig 2.15 4th Line Fig 2.16 Mid Concession 3 OS Fig 2.17 Mid Lot 12 . West-East Cross section not North-South. Mis labelling should be West (upper left) and East (upper right). Why does Guelph pinch-out and Eramosa thicken on the east (right) side of this important Figure? Where is the borehole control for this interpretation? Fig 2.18 Lot 13/14 Boundary
pg 48 Fig 4.4	Fig 4.4 Calibration catchments do not reflect the reality of surface / groundwater flows at the Strada site. The Strada site is almost completely in the Pine River watershed. Genivar _DP-SW10 catchment is incorrect and does not include a major Pine River tributary from the northern upland. Please extend Fig 2.11 northerly and easterly. Please provide details of Genivar Stream Gauge locations. Where are the Strada Stream discharge survey locations?
pg 50 s4.4.1 last para	I am not aware of storm sewers anywhere in the vicinity of the proposed Strada Quarry site.

**pg 51 Fig 4.5 and
pg 53 Fig 4.7**

Catchments (WSC) in the vicinity of the proposed Strada Quarry are not correct. Very little of the Quarry site is in the Boyne watershed. Why keep showing this inaccurate WSC watershed boundary?

**pg 54 s4.4.2
para 4 and 5**

These paragraphs are poorly written and confused. The Honeywood potato soils to the north are developed in Loess (windblown silt) and overlie mainly internally drained compact sandy stony tills over dolostones. (Catfish Creek or Newmarket?). Despite some poorly researched OGS mapping, the Honeywood Soils are not underlain by finer textured Tavistock Tills. These finer textured Tavistock Tills likely underly Strada Pit W½ Lot 11 and the wetlands to the south, east and west.

Geotechnical descriptions of the Strada site glacial tills are required.

**pg 55 Fig 4.8,
pg 56 Table 4.1 and
pg 57 Fig 4.9**

This map may provide a good approximation of Tavistock versus Catfish Creek Tills distribution except ice contact stratified drift may be over represented. The Catfish Creek Till may actually be stony sandy silt Newmarket Till - Simcoe basin origin (see Table 4.1) with one meter depth of loess cover (silt loam soils with high capillarity and moisture holding capacity) on Fig 4.9. These tills have subdued fluted (drumlinoid) features towards Honeywood.

These Tills have different hydraulic characteristics despite claims to the contrary by Earthfx.

pg 59 Fig 4.10

Fig 4.10 does not include the local wetlands (where is the NRSI ELC Mapping?).

pg 60 Fig 4.11

Again WSC catchment boundaries are incorrect in the vicinity of the Strada Pit.

**pg 61 s4.4.3,
pg 63 Fig 4.13,
pg 64 Fig 4.14 and
pg 65 Table 4.3**

Where or what are the 'bare' agricultural fields in the Strada vicinity? Pasture / forage fields are different than bare fields?

**pg 70 to 73
Fig 4.17 to Fig 4.20**

All Figures contain incorrect WSC catchment boundaries in the vicinity of the Strada Pits.

pg 83 s4.6.3 7 pg 84

The specific discharges for the Pine and Boyne catchments may be underestimated because of significant groundwater underflows and substantive seasonal irrigation water takings in the downstream gauge site areas in the Everett and Earl Rowe area. The Boyne River catchment includes Sewage Treatment Plant flows originating, in part, from the Grand River watershed.

pg 84 Table 4.6

A number of catchment areas are suspect in Table 4.6 (see also pg 48 Fig 4.4) . Furthermore underflow is a significant issue and sewage treatment plant flows on the Boyne River and Dundalk lagoon discharges on the Grand River may be significant issues. The Melancthon Mega-quarry monitoring sites are incomplete

	for the Pine River headwaters in the vicinity of the proposed Strada quarry site (see also pg 85 last para)
pg 84 Fig 4.30	Fig 4.9 (pg 57) Soil Texture is likely a better comparative hydraulic surrogate than surficial geology.
pg 87 and 88 Fig 4.31 to 4.34	These Figures for the Boyne and Grand River are influenced by groundwater takings for Shelburne from the Grand River watershed (addition of flows to the Boyne) and at Dundalk (increase in surface flow to the local Grand River). The long recession curve referenced in Fig 4.33 (pg 89 second last para) may be due to seasonal sewage lagoon dumping at Dundalk.
pg 95 s 4.6.4 Table 4.8	No definition of NSE, Spearman's rank correlation coefficient and other statistical parameters employed is provided. Conspicuously no 'goodness of fit' error statistics are provided for the Melancthon Mega Quarry (Genivar) Monitoring Stations in Table 4.6 (pg 84).
pg 101 s 4.6.6	No definitions are provided for Hortonian, Dunnian and Cascading Runoff, Curve Numbers and other technical jargon. In second last paragraph, the headwater regions of the Pine River, for the most part are not characterized by fine textured soils.
pg 102 Fig 4.42	This Figure appears to be a reasonable representation of annual observed precipitation.
pg 106 Fig 4.46	Figure 4.46 shows the lack of runoff (high recharge) on the Honeywood upland as well as in the vicinity of the Strada Pits.
	Note: All figures in this Report have Honeywood Village incorrectly located.
pg 108 to 111 Fig 4.47 to 4.50	Again WSC catchment boundaries used in the Strada pits area are incorrect. Fig 4.49 The Net groundwater recharge is substantially underestimated in the Niagara Escarpment Strada Pit northeasterly to the Honeywood area. Recharge is not the same south of the Strada Pits and in the Melancthon New Survey 'rubber boot' country. The Applicant needs to revisit its mapping logic.
pg 115 s4.7	The last sentence of para 3 is a non sentence. The last para, when will this occur? Is this Calibration Report Sec 5?
pg 119 Fig 5.1	Water takings for Dundalk, other farm irrigation takings in Lot 27 to 32 OS Melancthon and for the lower reaches of the Pine River near Everett and for the Boyne River near Earl Rowe P.P. within the model domain need to be included.

	What is the recharge to deeper aquifers and the underflow in the lower reaches of the Pine and Boyne Rivers at the Gauge sites?
pg 120 Fig 5.2	Where do we find the logs and monitoring data for the Strada Groundwater Monitoring Network? Where are the Strada Core Locations described in the legend?
	Why is the wrong Boyne / Pine catchment boundary still being used and not included in the legend?
pg 121 Table 5.1	Tavistock Till is fine textured. Coarser textured stony sandy tills are also common above the Niagara Escarpment (see Fig 4.8 pg 55). No authority is given for Tavistock Till occurring below the Escarpment.
pg 126 s5.6 Fig 5.6	This karst representation may be locally updated considering new hydraulic information available from the updated Strada groundwater monitoring network.
	Fig 5.6 clearly demonstrates that the Genivar Melancthon Mega-quarry flow monitoring station at the Mill Pond does not include the northern Pine River tributary and catchments crossing 15th Sideroad east of Main Street. The Mill Pond catchment (drainage area) in Table 4.6 pg 84 is in substantially overestimated (error).
pg 127 to 130 s5.8 and 5.9 Table 5.2, Fig 5.7	The simulated water takings on an annual basis for seasonal agricultural takings appear overestimated in Table 5.2. However there are many takings in the model area not included in Table 5.2 and Fig 5.7 most notably near the Boyne and Pine River gauging stations.
pg 131 s5.10 Table 5.3 Fig 5.8 and Fig 5.9	Again, the loess covered stony sandy tills of the North Dufferin highland potato farms are omitted from Table 5.3. Tavistock Till is absent over significant areas.
	Figures for all layers as for Layer 3 (Fig 5.8) should be provided.
	The weathered (or Karst) should be extended to include the narrower hydraulic flow convergence zone through the Strada Melancthon Pit (Lot 13) to Duivenvoorden Lot 14). It may also extend northerly to 15th Sideroad at CR 124 where stream losses are apparent upgradient of Mill Street.
	Figure 5.9 also demonstrates that the Genivar Mill pond stream gauge does not include the north tributaries from Lot 16 upstream of Sideroad 15 and east of 124 despite Earthfx including these catchments in unit flows.
pg 134, s5.1.1 Table 5.4	Agree with second last parathe MECP well record data has a high intrinsic errorand this impedes the ability to produce lower RMSE values. This high intrinsic error may be reduced by incorporation of the WELLness survey more precise geographic locations results within the 'The Participation Area'

surrounding the proposed Strada Quarry site. This survey will also produce contemporary water levels to address the last para.

The high RMSE's are typical of use of unedited raw water well records. A 5 m RMSE is excessive for assessment of drawdown impacts on water wells, springs and groundwater discharges (stream base flows).

**pg 135 to 141 s5.1.2
Fig 5.10, 5.11, 5.12
and 5.13**

The proponent needs to provide similar error statistics as in Table 5.4 for each of the proposed Strada Quarry site and The Participation Area. Based on Fig 5.10 and 5.11 the MAE's and RMSE's are unlikely to be an improvement (not acceptable).

Explain legend code 'BAS L4' and 'BAS L6'.

The shallow system at 30 m depth has not been rationalized. The Goat Island Aquitard must be recognized in the proposed Quarry and WELLness Participant areas.

The 3 m contour intervals selected for Fig 5.10 and Fig 5.11 reflect basic water level monitoring data issues required to support higher resolution contouring.

The 20 m contour interval selected for Fig 5.12 and 5.13 is basically meaningless for quarry impact assessment.

Where is the Fig 5.13 corollary local simulated head Figure for Layer 6 (Gasport)?

These Figures are no substitute for direct analysis of site data.

Strada has not responded to our request, for audit purposes, to provide the water level data used to prepare Fig 5.10, 5.11, 5.12 and 5.13

**pg 141 to 143
Fig 5.14 and 5.15**

There are 3 to 12 m difference in surfaces on Fig 5.15 for the site. What is this telling us. This is not satisfactory.

**pg 144 to 148 s5.1.3
Fig 5.16 to 5.19**

The RMS Errors are approaching or exceeding 5 m for Layer 1, Layer 4 and Layer 6 (see also Table 5.4 pg 135). Where is Layer 3 the important weathered bedrock in this series?

These 5 m RMSE results are of limited use for local proposed quarry site assessment despite the discussion in the last para of pg 144.

The WELLness survey and a supplementary groundwater discharge survey results must be incorporated into the model calibration to produce meaningful and useful results.

pg 149 to 153 s5.1.4
Fig 5.20 to 5.23

The Applicant does not provide a Table of site residuals, residuals below are a best estimate from the graphics.

Fig 5.20 (pg 150) shows residuals up to -10 to + 1 m for the shallow overburden (Layer 1) near and on the Strada site.

Fig 5.21 (pg 151) show a range of residuals approaching -10 to + 10 m for the weathered overburden (Layer 3) on and near and on the Strada site.

Fig 5.22 (pg 152) show a residual range of about -2 to + 10 m for the Guelph (Eramosa?) Layer 4 (see Table 5.1 pg 121).

Fig 5.23 (pg 153) show a residual range of about -2 to + 2 m for the Gasport Formation. Only five water level data points are shown on site and one offsite. Where are the receiving Gasport monitors? The offsite well near 4th Line and County Road 17 is mislocated and should be on site.

Notwithstanding the discussion on pg 149, these wide range of on site residuals may reflect the poor quality of the on site water level monitoring data base, uncorrected errors and the inadequate statistical stratification of the Strada monitor well population by Model Layer and Hydraulics.

The wide range of residuals in water well areas remote from the Strada site reflects mainly the poor location and incorrectly assigned ground elevations in the MECP water well database. The availability of the WELLness Survey should improve the water well database.

Conclusion:

It is acknowledged that the Niagara Escarpment regional area is complex to model, however, the immediate proposed quarry site is far less complex.

The current Model Calibration is not suitable for impact assessment purposes until the Strada site water level monitor vertical and horizontal location deficiencies are addressed, the Wellness Participation Area results are incorporated into an edited MECP database, the local groundwater discharge survey is incorporated, groundwater takings and underflow near the Pine and Boyne gauging stations are addressed and corrections to the Genivar Mill Pond gauge catchment are undertaken.

The Applicant's lack of response to my model input data audit requests prevents a more complete review of this Calibration Report.

This Peer Review statistical stratification of onsite monitor wells historical data into Epikarst / Weathered Upper Bedrock and Gasport equivalent well populations if incorporated into the Earthfx Groundwater Model would likely provide improved Site Error Statistics.