S.S. PAPADOPULOS & ASSOCIATES, INC.
ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

October 5, 2026

Mr. David Germain
Partner
David Germain Law Professional Corporation
Thomson Rogers LLP
390 Bay Street, Suite 3100
Toronto, ON M5H 1W2
dgermain@trlaw.com

Subject: Strada Aggregates Inc. Melancthon Pit/Quarry groundwater modelling review

Dear Mr. Germain:

On behalf of Melancthon Township, we have reviewed the Strada Pit/Quarry Level 1 and 2 Hydrogeological Assessment (Tatham Engineering and Earthfx Inc., 2025).

Summary

The Level ½ Assessment is a comprehensive document comprising five distinct reports.

- The Level 1 and 2 Hydrogeological Assessment Report (Tatham Engineering and Earthfx Inc., June 26, 2025)
- Appendix A [Field Program and Methodology], Appendix B [Field Program Data Assessment and Results] (Tatham Engineering and Earthfx Inc., October 23, 2024)
- Appendix C: Conceptual Model Report, Earthfx, October 2024
- Appendix D: Model Development Conceptual Model Report, Earthfx, October 2024
- Appendix E: Impact Assessment Report, Earthfx, January 2025.

In our opinion, the groundwater technical materials are fundamentally incomplete. The technical materials do not provide a sufficiently firm foundation for assessing the potential impacts of the proposed quarry. Our comments on the materials are provided in three main sections: data sources, groundwater model development and calibration, and impact assessment.

Following our initial review of the Level ½ Assessment, we also examined the Hydrogeology Arbitration Review (North Dufferin Agriculture and Community Task Force, 2025). As indicated in the final section of this letter, contrary to what is suggested in the document, in our opinion the "six key hydrogeology issues" are not entirely resolved.

Data sources

1. The map showing the locations in the Strada property groundwater monitoring network is out of date. The map does not illustrate that four of the well nests were destroyed between 2019 and 2021 and that PW1 and OW1 have not been monitored since May 2012 (yellow crosses in Figure 1). The map also does not highlight the fact that the monitoring records for several of the wells are brief, typically only one or two months (orange boxes)[1]. The hydrographs in Appendix B for these wells are not long enough to infer average conditions or the likely seasonal fluctuations.

Figure 1. Missing wells in the Strada property groundwater monitoring network
Source: Adapted from Appendix C, Figure 5.2.

[1] Wells OW24A/C, OW26A,OW27C, OW28A/C, OW29A/C, OW30C

2. As highlighted in Figure 2, since 2018 there has been only one station with precipitation data. The location of this station with respect to the footprint of the proposed quarry is not indicated. There is no indication that the data from this station are complete, and whether the data are representative of conditions around the quarry. There is no indication of the uncertainty in the analyses created by the reliance on the data from a single climate station.

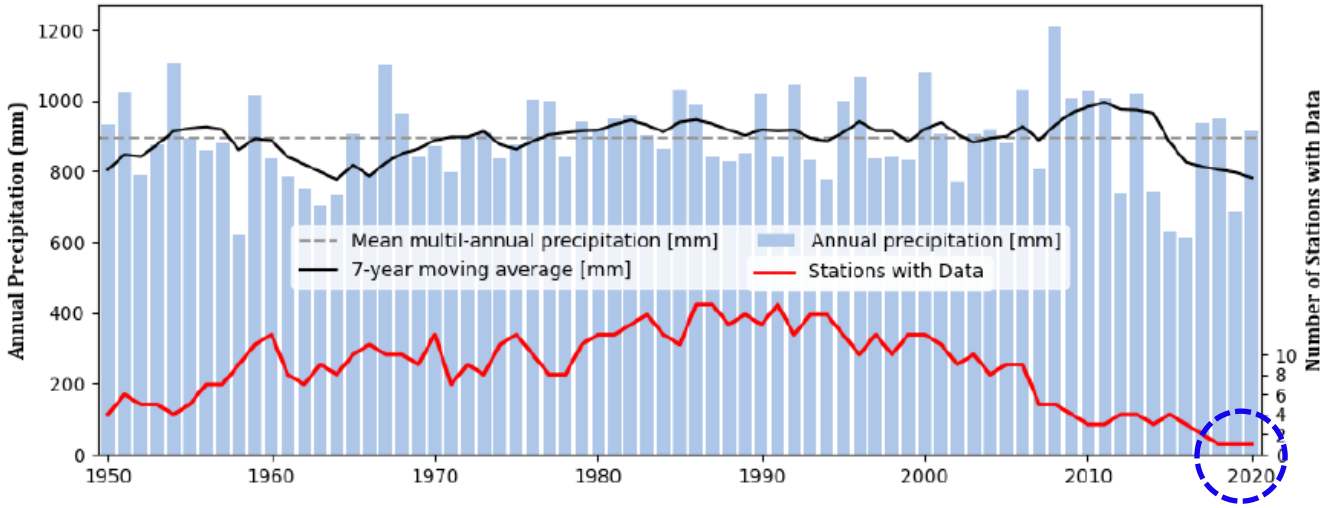


Figure 2. Stations with precipitation data
Source: Adapted from Appendix D, Figure 3.21

3. There is a substantial amount of data from the GENIVAR work on the previously proposed Melancthon Quarry that has not been considered in the assessment (GENIVAR, 2011). For example, Table 3.6 of the Model Development and Calibration Report lists data from four Genivar streamflow monitoring stations, but the subsequent model comparisons refer only to the four Environment Canada HYDAT gauging stations that are relatively distant from the proposed quarry.

4. The site monitoring network is limited to the area immediately surrounding the proposed quarry. This network is not sufficient to support the groundwater model. As shown in Figure 3, the area covered by the Strada monitoring network is a small portion of the model area. Data from the investigations for the Highland Melancthon Quarry are available from beyond the Strada network. Data from Highland Quarry should be considered in the analyses (GENIVAR, 2011). These data will at least fill in some of the gaps in the area north of the proposed quarry. [Clearer versions of the two figures are included in an appendix to this letter.]

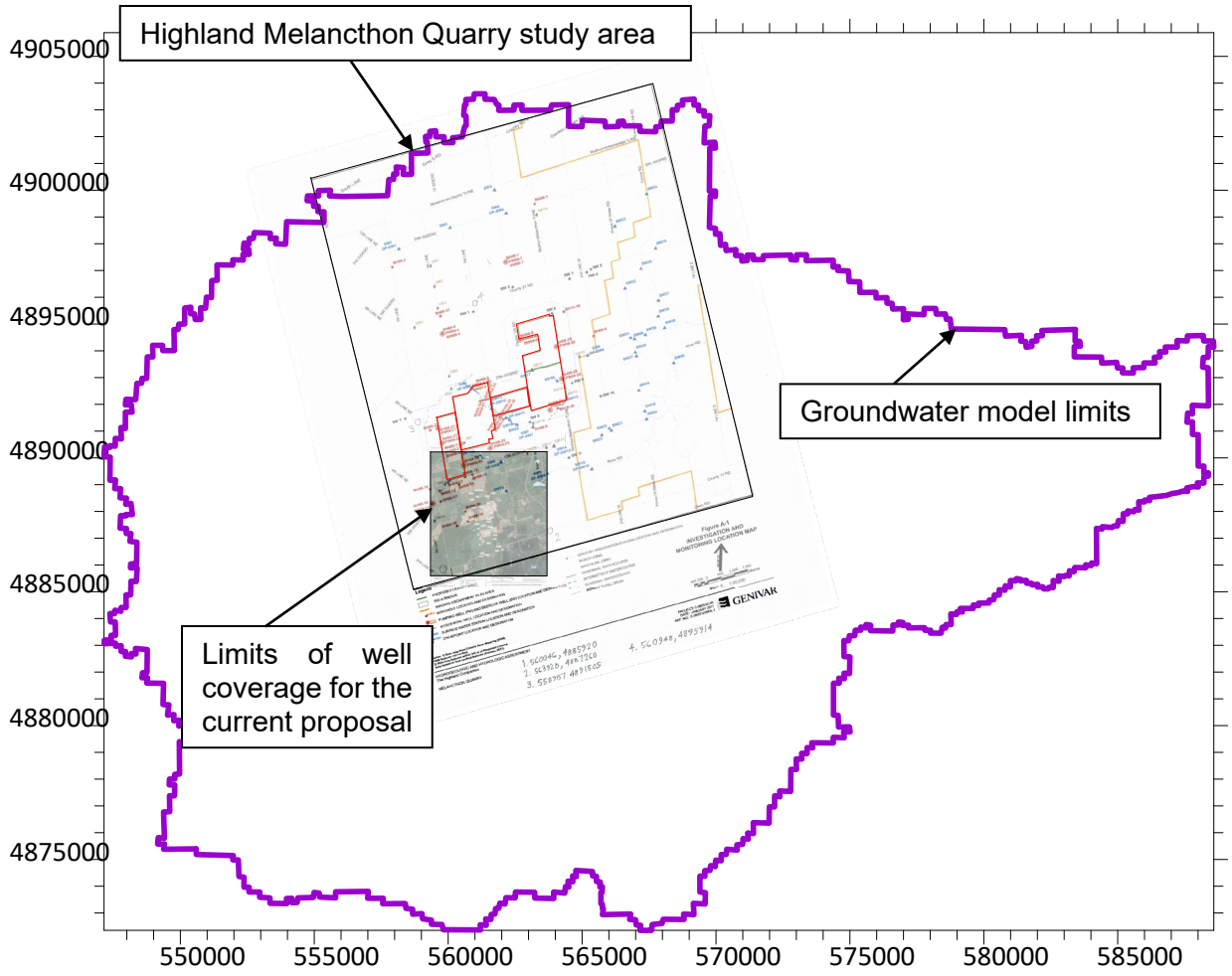


Figure 3. Available well coverage

5. In our opinion, the hydraulic testing that has been conducted for the submission is not adequate to characterize the properties of the rock at the proposed quarry. Limited data are available from two pumping tests conducted in 2004 (PW1) and 2007 MW2-07. The data from these brief tests in no way substitute for a controlled, long-term pumping test conducted with water levels measured at the site monitors. The results of packer tests (Lugeon tests) conducted at three boreholes are presented in Figure B.15. Lugeon testing was developed to assess the grouting requirements of dam foundations. The results obtained for the site provide only a rough sense of the rock properties. At a minimum, single-well response tests (slug tests) should have been conducted at all on-site monitors.

Groundwater model development and calibration

The reporting of the development and calibration of the site numerical model is incomplete. In our opinion it has not been demonstrated that the model can be applied to yield reliable predictions.

1. The Model Development and Calibration Report seems to be missing a substantial section documenting the calibration and results of the integrated model. Chapter 2 of Appendix D describes the integrated model, GSFLOW, in only a general sense. Sections 3 and 4 address in detail the "precursor" elements of the integrated model, the precipitation-runoff model PRMS and the MODFLOW groundwater flow model. There is no following section that ties the two submodels together in the GSFLOW analysis. This is important because on page D-61 it is indicated that "it is unlikely that a better match to summer low flows can be achieved without the use of a fully integrated surface water and groundwater model that properly represents the interaction with the groundwater system." Similarly, there is no assurance that the recharge distribution estimated with the PRMS analysis (Appendix D, Figure 3.49) is consistent with what would be obtained from the final calibration of the integrated GSFLOW analysis. Since no results are presented for an integrated model, by implication we read this to mean that the analyses are not founded on a proper representation of the interactions.

2. The PRMS model incorporates data from WY1990 to WY2020. However, the Model Development and Calibration Report is dated October 2024 and the impact assessment is dated January 2025. There is no indication as to why the data end where they do.

3. It is not clear whether the values listed on Tables 3.1 and 3.3 represent the final values for the PRMS model or the PRMS component of the integrated model. It is not indicated which of the values listed on the two tables were assigned fixed values or adjusted during model calibration. No sensitivity analyses are reported to identify which parameters make a difference and thereby guide the collection of additional data.

4. The groundwater recharge is the key output from the PRMS model, but the results shown in Appendix D Figure 3.50 do not appear to be internally consistent. The results suggest that there are some potions of the model area where the results are highly resolved, but large areas of low-resolution (solid green areas).

5. For the simulation of long-term average conditions, the matches of the groundwater model to the calibration targets are shown in Appendix D in the following figures:

   - Figure 4.9, 4.12, 4.15, 4.16, 4.31, 4.34
   - Figure 4.10, 4.13, 4.17, 4.32, 4.35
   - Figure 4.11, 4.14, 4.18, 4.33, 4.36

   For all of these figures, it appears that the targets are restricted to water levels estimated from the water well record database. Although there are higher reliability site-specific groundwater monitoring data, they either have not been considered in the calibration of the groundwater model, or no distinction has been made between high-reliability and low-reliability targets. The information from water well records are rough approximations of representative conditions. The wells are typically not surveyed, the units across which the wells are open are rarely identified by a professional geoscientist and the water levels represent spot measurements collected over a wide range of time and conditions. In our experience, the water levels from private water well records are typically reliable within ±10 m.

   In contrast to the water levels obtained from the water well records, current, high-quality data are available from19 on-site monitors[2]. The data from these wells should be the focus of the model calibration, to confirm that the groundwater model can be applied reliably. Up to the time of the preparation of the analyses, the records for wells OW27C, OW28A/C, OW29A/C and OW30C are too brief to support estimation of representative average water levels.

6. Appendices C and D include detailed treatment of selected stream flow data from four Environment Canada gauging stations. The results of baseflow analyses are presented in Appendix C (Figures 4.21 to 4.24). However, the estimated baseflows are not used to confirm that the groundwater model is capable of simulating realistic rates of groundwater discharge to streams.

7. Four stream gauging stations associated with the Highland Companies Melancthon Quarry are listed on Appendix C Table 4.3. The corresponding streamflow records are shown for only two of the four stations (DP-SW7 and DP-SW10). No subsequent use of these important data is made to confirm the reliability of the groundwater model.

[2] Of the 43 monitoring locations, one well has been dry, 10 wells have been destroyed and the data from OW3C and OW21C are questionable.

8. The numerical groundwater flow model is not consistent with the understanding of the physical system. As shown in Figure B.1, the bedrock units are truncated at the Niagara Escarpment (Figure 4). In contrast, as shown in Figure 5, the layers of the groundwater model are draped over the escarpment. It is indicated that the groundwater flow simulator MODFLOW requires continuity of aquifer layers. To meet the "layer continuity requirements", a minimum layer thickness of 0.5 m was applied where physical layers pinch out. Layer continuity is required only within the model interior. The correct representation of the truncation of units requires termination of the layers with drain boundary conditions at the escarpment. As shown in Figure 5, the misrepresentation of the subsurface structure creates hydraulic connections that does not actually exist, with the calculation of water levels where formations no longer exist, and incorrect simulations of the groundwater discharge off the escarpment.

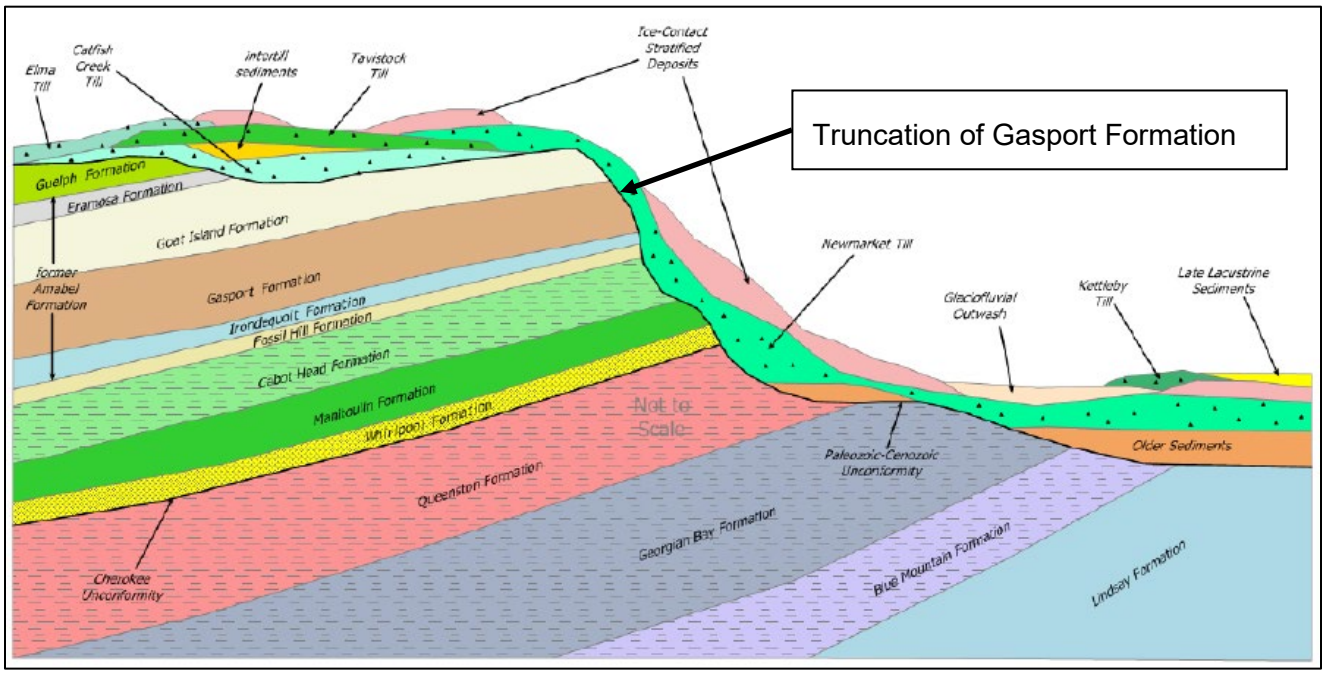


Figure 4. Interpreted stratigraphy at the Niagara Escarpment
Source: Adapted from Appendix B, Figure B.1, Appendix C, Figures 2.8

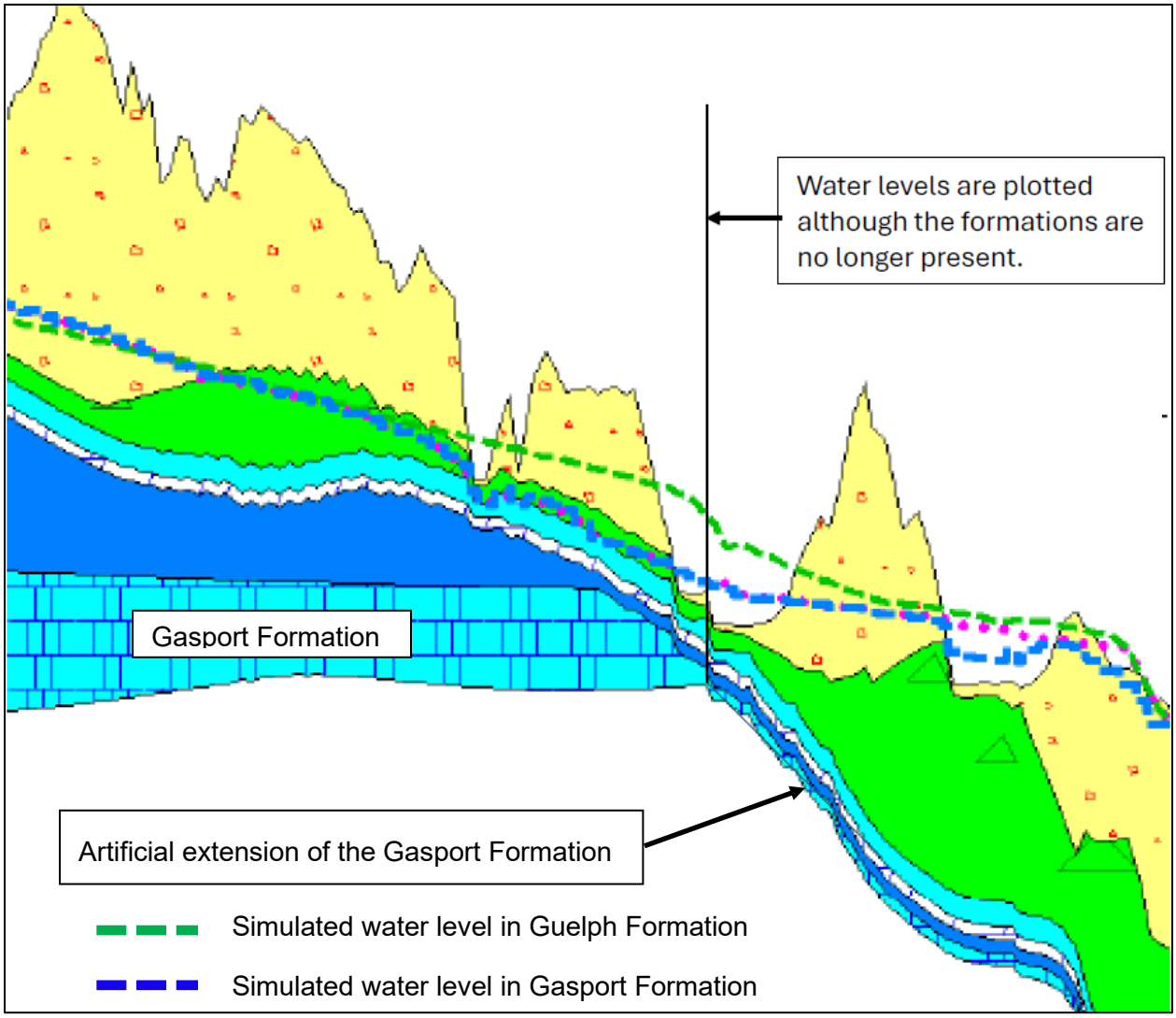


Figure 5. Model cross-section at the Niagara Escarpment
Source: Adapted from Appendix E, Figure 2.7

Impact assessment

The following modelling results are presented for the Level ½ impact assessment:

- Predicted declines in average groundwater levels in model layer 1 (water table), layer 4 (Guelph Formation) and layer 6 (Gasport Formation);
- Predicted changes in groundwater levels at hypothetical locations GWP1 - GWP6;
- Predicted changes in streamflows, with plots for hypothetical stations STR7, STR8, STR9; and
- Potential changes in wetland water budgets.

The impact assessment is fundamentally incomplete. The impact assessment does not consider potential impacts to private groundwater supplies, the removal of the protective strata above the regional aquifer, potential impacts to the Shelburne municipal production wells, and nearby surfaces water features.

Potential impacts to private wells

A map showing private wells in the vicinity of the proposed quarry is presented in Appendix A, Figure A.6. The yellow circles shown here in Figure 6 denote wells labelled as "Wells in Target Participation Area." The map suggests that there are several private wells that are closer to the proposed quarry. The impact assessment does not address potential impacts to these wells.

The orange circles in Figure 6 denote wells labelled as "Strada DW Series Private Monitoring Wells." Referring to Table A.1, there are five private wells in the long-term monitoring program, DW1 through DW5. Although the hydrographs for the wells are shown in Figures B.46 through B.50, the wells are apparently not included in the targets for the calibration of groundwater model. Simulated water levels at these wells during quarry development are not presented.

The consideration of potential impacts to private wells in the Level ½ report is incomplete. The report does not include a well interference protocol. The report does not include any site-specific data that confirm potential impacts can be alleviated by deepening existing wells. In this setting it is typical that the hydraulic conductivity of the bedrock and the quality of groundwater declines with depth. It is not a foregone conclusion that deepening wells will remedy impacts to all private wells.

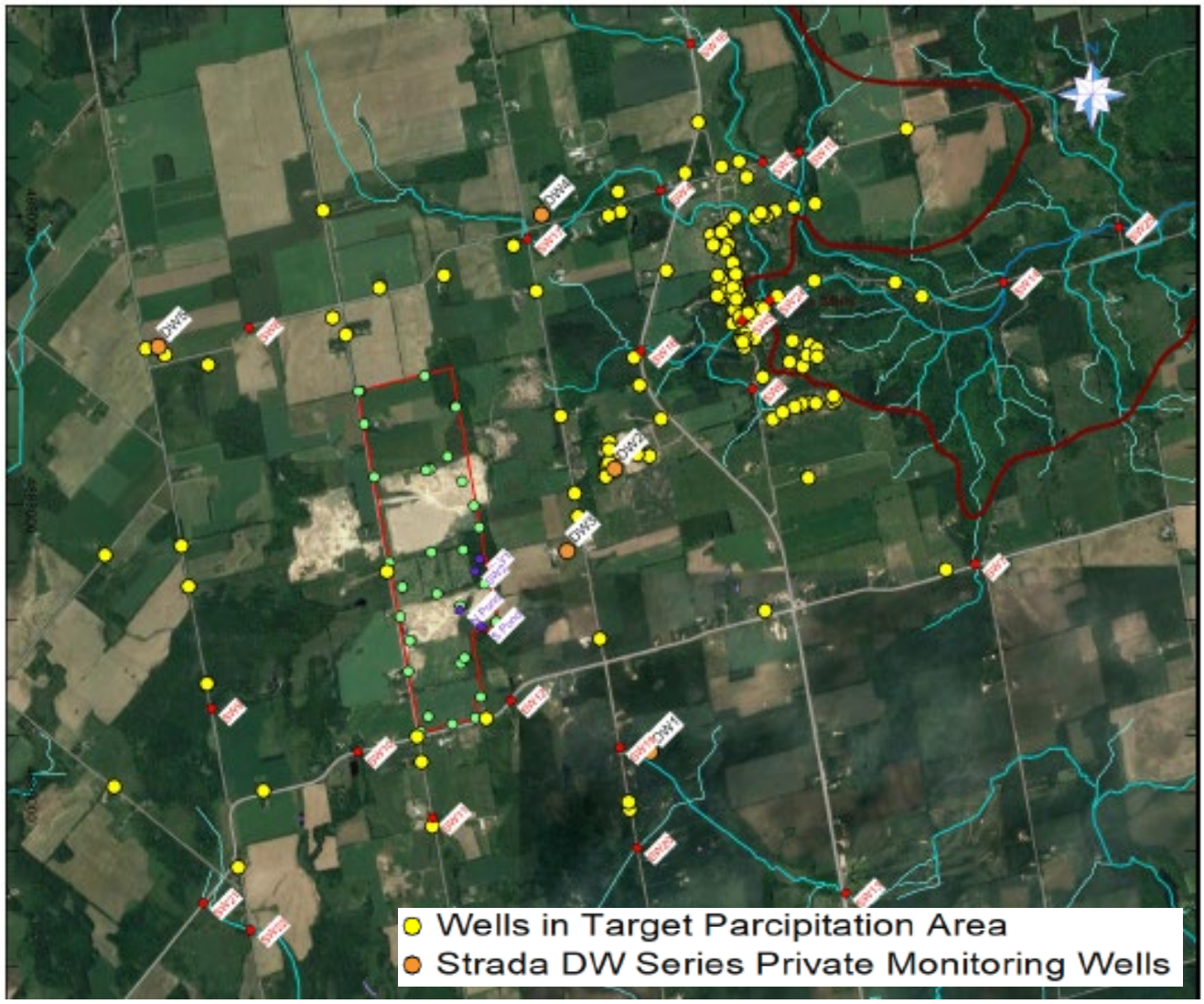


Figure 6. Locations of private wells near the proposed quarry
Source: Adapted from Figure A.6

Removal of the protective strata above the regional aquifer

The planned phases of the proposed quarry are illustrated in Tatham and Earthfx (2025) Figures 3, 5, 7 and Appendix E Figures 3.5, 3.22 and 3.39. As shown in Figure 7, the final phase of the proposed development involves the complete removal of any protective strata above the regional aquifer, the Gasport Formation. There is no discussion in the impact assessment of the potentially important consequences of this with respect to regional water quality. In effect, there will be a direct pathway to the Gasport Formation for any sources of contamination within the capture area of the quarry.

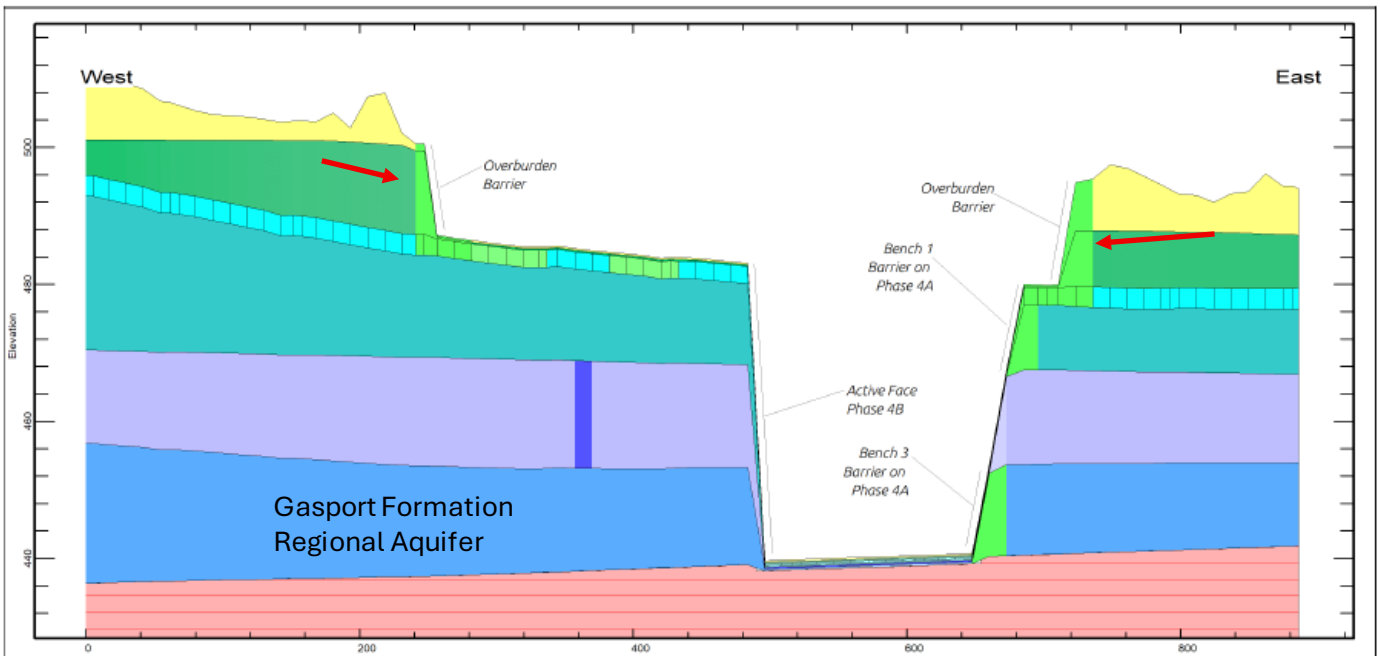


Figure 7. Cross-section through Phase 4 of the proposed quarry
Source: Adapted from Appendix E, Figure 3.39

Potential impacts to the Shelburne municipal production wells

The Shelburne municipal wells are located relatively close to the proposed quarry (Shelburne PW1, PW3, PW5, PW6, PW7 and PW8). The site is located close enough to the municipal wells that the initial model parameter values listed on Appendix D Table 4.3 were taken from the Shelburne wellfield model (Earthfx, 2022).

As shown in Figure 8, the proposed quarry is located about 5,000 m from the nearest Shelburne municipal production wells.

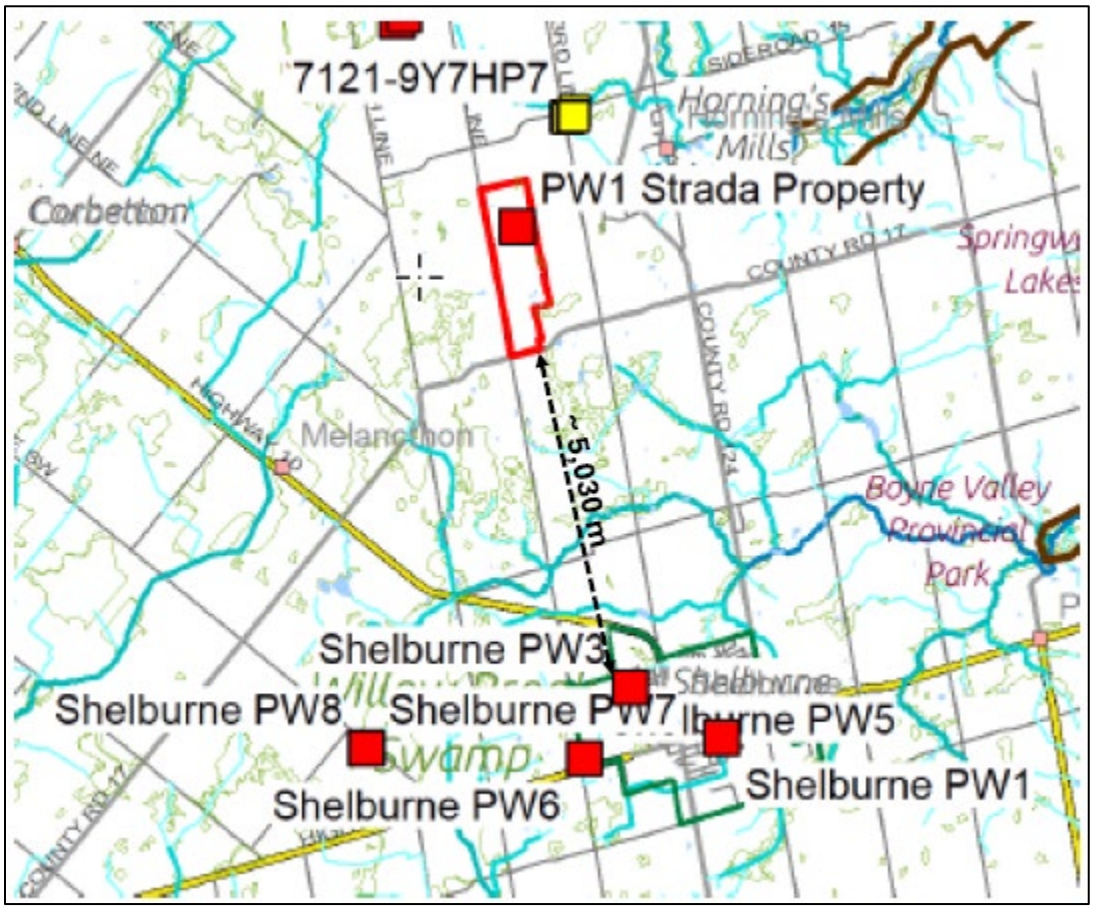


Figure 8. Distance between the Strada site and the Shelburne municipal production wells
Source: Adapted from Appendix D, Figure 4.7 [page D-105]

Referring to Appendix D Figure 4.15, the regional interpretation suggests that the groundwater level at the Shelburne wells is about 480 masl (this is consistent with the results shown in Figures 4.32 and 4.33). It is likely that this level corresponds to non-pumping conditions. As shown in Appendix C Figure 5.10, during the 2021 pumping test conducted at the PW7 and PW8, the water level in the Gasport Formation declined to about 456 masl. It is likely that the wellfield levels are lower when the wellfield is operated at its full capacity.

Although cross-sections through quarry are not presented for final rehabilitated conditions, it is indicated in Appendix E, Section 3.8.2, that the overall change in water levels around the quarry lake with respect to baseline conditions will be less than 1 m. Based on the results shown in Appendix E Figure 2.3, the average pre-quarry water level in the pit is estimated to be about 492 m, substantially higher than the water level at the Shelburne municipal wellfield. The difference in groundwater levels between the rehabilitated quarry and the Shelburne wells implies that upon final rehabilitation, a relatively strong horizontal hydraulic gradient will be established from the final quarry lake to the municipal wells. The impact assessment does not consider any potential changes in groundwater flow directions between the quarry and the municipal wellfield. This element of the assessment is particularly important, as an important increase in municipal pumping is projected for Shelburne pumping, with the maximum daily municipal demand projected to increase from 5,671 m^3/day to 8,513 m^3/day between 2021 and 2041 (S. Burnett & Associates, 2025). In contrast, the total Shelburne municipal pumping specified in the groundwater model is near

As shown in the mapping of the Ontario Source Protection Information Atlas[3] (Figure 9), the wellhead protection areas that have been delineated for the Shelburne municipal wells are relatively close to the proposed quarry (see also S. Burnett & Associates, 2025). It is important to note that in fractured-rock settings, local groundwater velocities may be much larger than the velocities obtained from groundwater models that idealize the subsurface as an equivalent porous medium (see for example Worthington et al., 2012, Worthington, 2022).

Potential impacts to the nearby surface water features

As shown in Appendix E, there are streams and wetlands close to the proposed quarry. However, neither the water levels nor the flow rates in these features have been used as calibration targets for the groundwater model. Therefore, it is not possible to assess whether the predicted impacts are realistic.

---

3 https://www.lioapplications.lrc.gov.on.ca/SourceWaterProtection/index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-CA

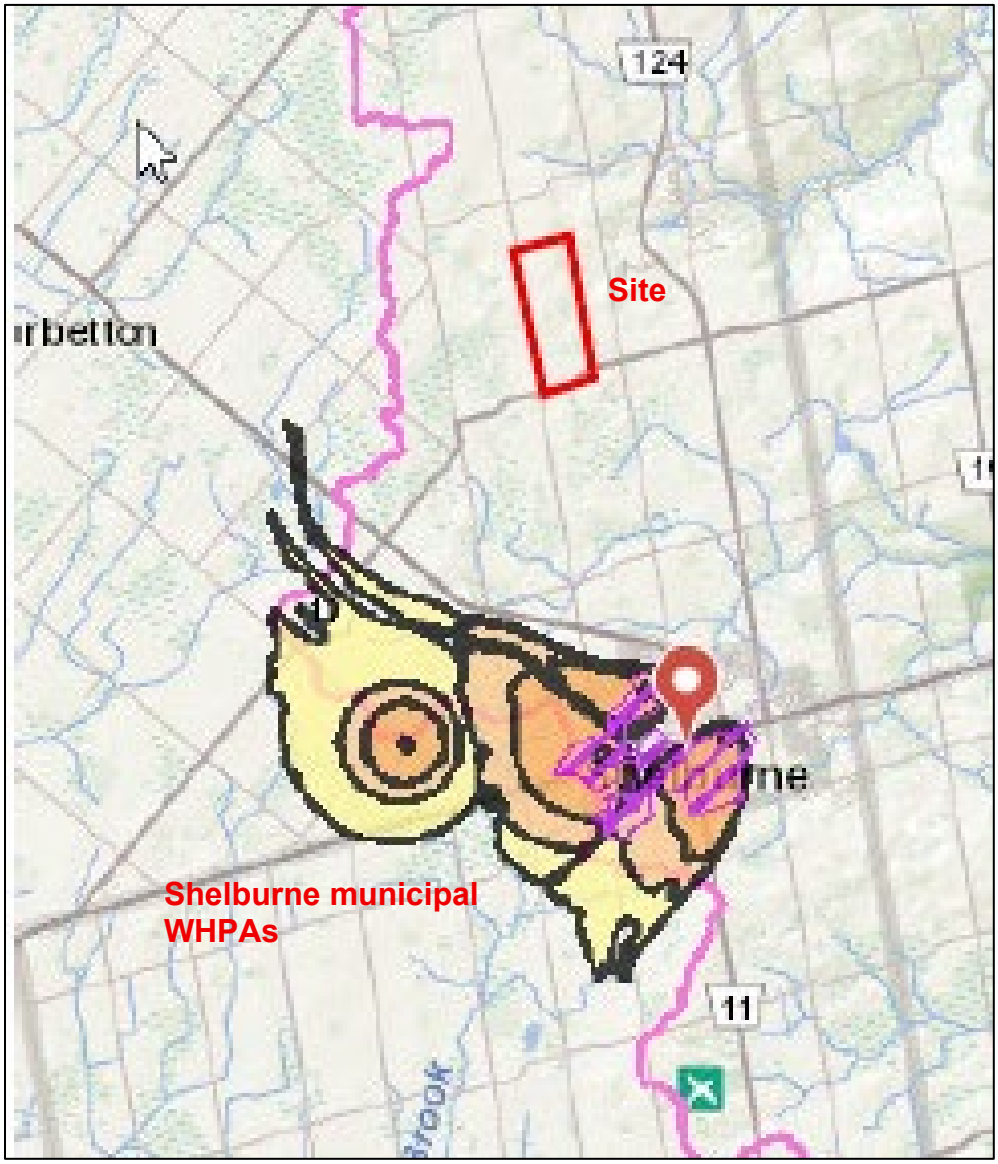


Figure 9. Shelburne municipal wellhead protection areas

Comments on the NDACT Hydrogeology Arbitration Review (June 24, 2025)

As noted above, following our initial review of the Level ½ Assessment, we reviewed several additional documents produced by other reviewers.

The North Dufferin Agriculture and Community Task Force (NDACT) summarized the results of a peer review to resolve six key hydrogeology issues identified in Mr. Garry Hunter's extensive review of the proposed quarry. In our opinion, not all of the issues raised by Mr. Hunter have been resolved. In several instances, key issues are deferred to the submission of additional materials.

The "collective" response to Hunter comment 2.3 provides a good illustration of the limitations of this approach. It is important to bear in mind that thresholds referred to in this response do not yet exist.

> *If water levels change more than the established thresholds developed for the Phases One through Four and Rehabilitation conditions, considering the predicted groundwater levels and established baseline conditions, a detailed investigation will be undertaken in regards to the potential impacts to the local groundwater system. This investigation will include a review of current quarry activities, a review of on-site and off-site groundwater levels, and a review of climate data. Should quarry activities be found to be responsible for the change the licensee will discuss options with the MNR and consider the following:*
> - *Suspension of below water table activities;*
> - *Moving mining to a different phase; and*
> - *Conducting a detailed investigation including installing more observation wells.*

The response to Hunter comment 2.5 is further illustration that the resolutions of Mr. Hunter's concerns are based on parameters that have not yet been established. With respect to the infiltration infrastructure, it is indicated in the Harden review that:

> *The model shows that the system will work, and performance criteria will confirm this during operations.*

The performance criteria do not yet exist, and there are no data from the site that confirm the performance criteria will be achieved for the bedrock. The confirmation that the infiltration system will work must be based on data, rather than results of a model that has not yet been demonstrated to be capable of yielding reliable predictions.

Closing

We appreciate the opportunity to be of service. If you have any questions on this review please contact the undersigned at either (519) 579-2100 or cneville@sspa.com.

Sincerely,

S.S. PAPADOPULOS & ASSOCIATES, INC.

Christopher J. Neville, M.Sc., P.Eng.
Chief Hydrogeologist

Professional Engineers Ontario #100013705 (valid through December 31, 2026)
S.S. Papadopulos PEO Certification of Authorization # 100077381 (valid through June 30, 2027)

p:\1991_melancthon\reporting\01\20261005\ssp1991_01_letter_text_cjn20261005.docx

References

Earthfx Incorporated, 2022: Updated Wellhead Protection Area Delineation, Vulnerability Scoring, and Threats Assessment for the Town of Shelburne, Ontario, prepared for: S. Burnett and Associates, June 2022.

Earthfx Incorporated, 2024: Strada Aggregates Proposed Strada Pit/Quarry, Appendix C: Conceptual Model Report, October 2024.

Earthfx, Incorporated, 2024: Strada Aggregates Proposed Strada Pit/Quarry, Appendix D: Model Development and Calibration Report, October 2024.

Earthfx, Incorporated, 2025: Strada Aggregates Proposed Strada Pit/Quarry, Appendix E: Impact Assessment, January 2025.

GENIVAR Inc., 2011: The Highland Companies Proposed Melanchthon Quarry Hydrogeologic and Hydrologic Assessment, Geographic Township of Melancthon, County of Dufferin, 4 volumes, January 2011.

S. Burnett & Associates Limited, 2025: Town of Shelburne: Increased Capacity of the Town of Shelburne's Water Supply – Schedule 'B' Municipal Class Environmental Assessment, May 2025.

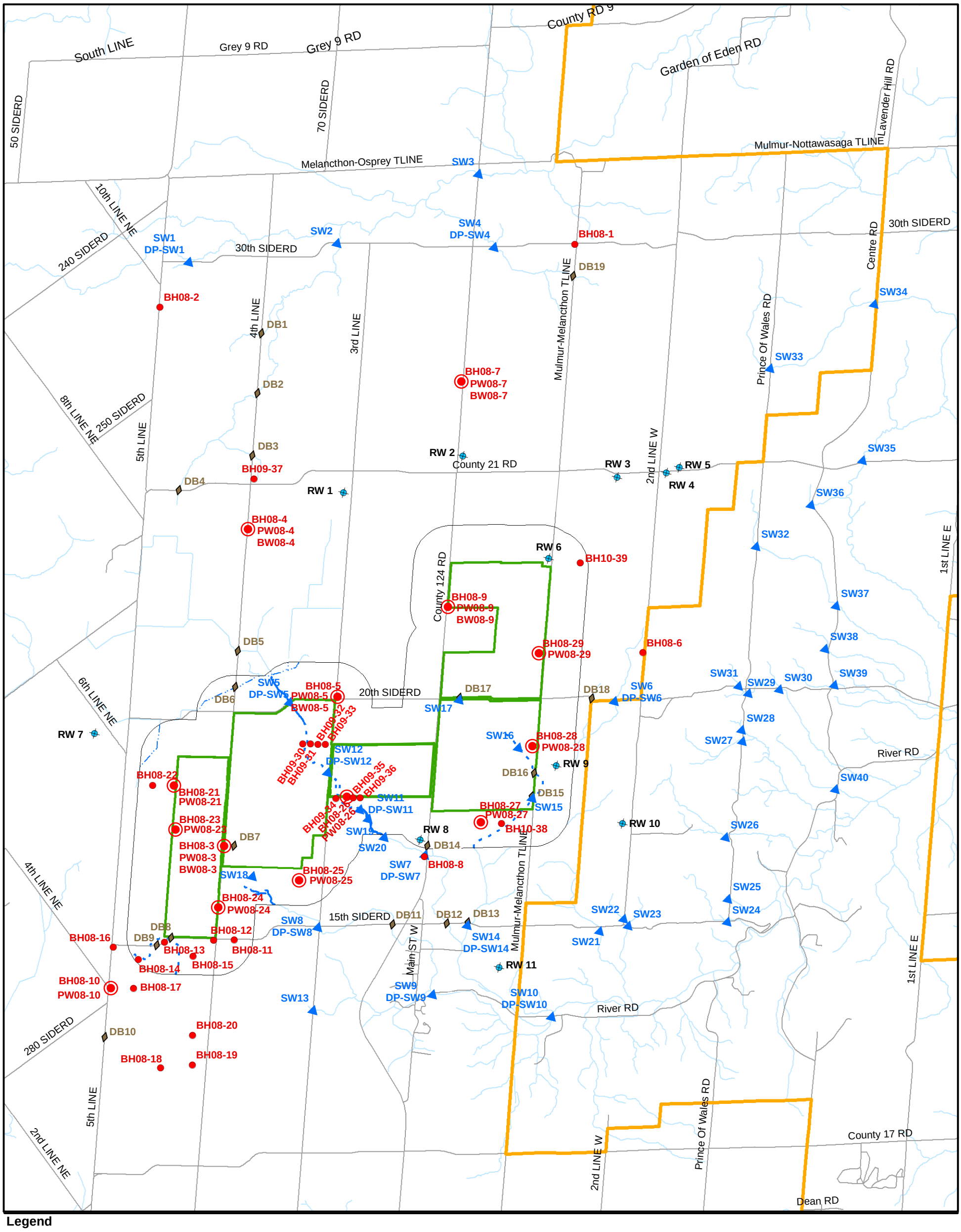
Tatham Engineering and Earthfx Incorporated, 2025: Strada Pit/Quarry, Level 1 and 2 Hydrogeological Assessment Report, June 26, 2025.

Tatham Engineering and Earthfx Incorporated, 2025: Strada Aggregates Proposal, Strada Pit/Quarry, Appendix A: Field Program Methodology, Appendix B: Field Program Data Assessment and Results, October 22, 2024.

Worthington, S.R.H., 2022: Estimating effective porosity in bedrock aquifers, *Groundwater*, vol. 60, no. 2, pp. 169-179.

Worthington, S.R.H., C.C. Smart, and W. Ruland, 2012: Effective porosity of carbonate aquifer with bacterial contamination, Walkerton, Ontario, Canada, *Journal of Hydrology*, vol., 464-465, pp. 517-527.

Appendix



Legend

- PROPOSED LICENCE AREA
- 500 m RADIUS
- NIAGARA ESCARPMENT PLAN AREA
- BH08-2 — BOREHOLE LOCATION AND DESIGNATION
- PW08-4 / BW08-4 — PUMPING WELL (PW) AND BEDROCK WELL (BW) LOCATION AND DESIGNATION
- RW7 — RESIDENTIAL WELL LOCATION AND DESIGNATION
- SW2 — SURFACE WATER STATION LOCATION AND DESIGNATION
- DP-SW7 — DRIVEPOINT LOCATION AND DESIGNATION
- DB3 — DRIVE-BY OBSERVATION STATION LOCATION AND DESIGNATION
- ROADS (OBM)
- WATERLINE (OBM)
- PERENNIAL WATERCOURSE
- INTERMITTENT WATERCOURSE
- SEASONAL WATERCOURSE
- AGRICULTURAL DRAIN

Notes: 1) Base map from Ontario Base Mapping (2008). OBM features not verified.
2) Waterline features within 500 m of Proposed Licence Area based on field-verified features (Stantec, 2011).

Figure A-1
INVESTIGATION AND MONITORING LOCATION MAP

NORTH

500 250 0 500 1,000 1,500
Metres

SCALE: 1:50,000

HYDROGEOLOGIC AND HYDROLOGIC ASSESSMENT
The Highland Companies

MELANCTHON QUARRY

PROJECT: 0-082032.05
DATE: JANUARY 2011
REF. NO.: 0-08203205FA-1

GENIVAR

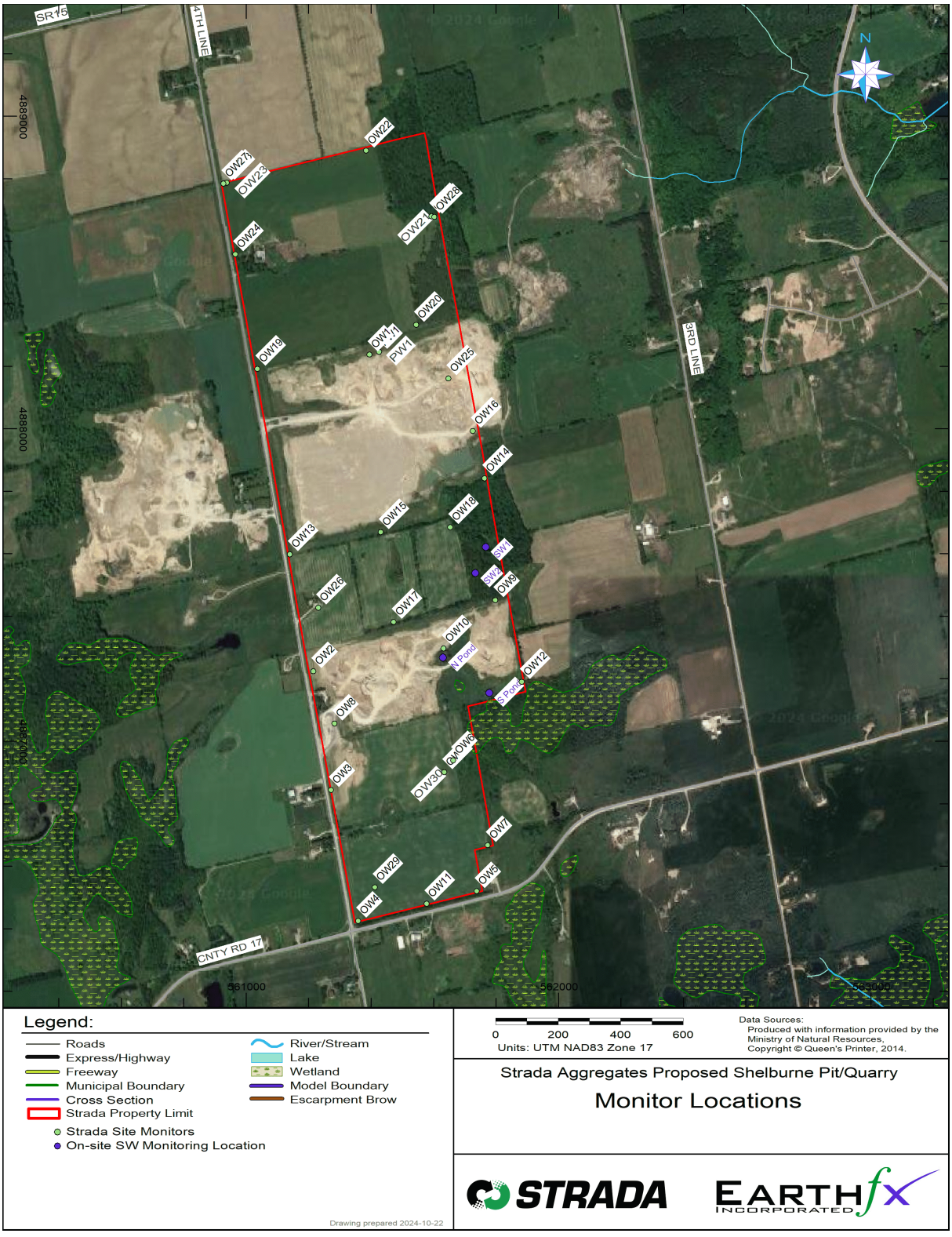


Figure A.5: Groundwater and surface water monitoring locations at the Strada site.