April 26, 2021

Bonnie Bryant
Hopewell Creek Ratepayers Association
Maryhill, Ontario

Sent via email: *bonniebryant@outlook.com*

Dear Ms. Bryant,

RE: Proposed gravel pit activities along Shantz Station Road and potential for environmental and economic disruption of water resources in study area

Environmental Liability Management Inc. (ELM) is pleased to provide the Hopewell Creek Ratepayers Association (HCRA) with a response letter following comments provided on our previous review of documents associated with the proposed construction of the Shantz Station Gravel Pit. The proposed Site of this activity is south of the village of Maryhill, Ontario, along Shantz Station Road. At this time, ELM has prepared a response, concerning the importance of groundwater and surface water volumes and quality in the study area.

A key aspect of our initial review included the recommendation to complete detailed baseline studies concerning the groundwater and surface waters in the area, as it is a resource used by plants, animals, and the residents of the area. The response included with this cover letter to recent comments further outlines the absolute requirement for the completion of baseline studies, with reference to previously submitted reviews of groundwater and surface water, in Frind and Frind (2020a,b). Please refer to the memorandum that follows this cover letter for the full technical ELM response.

We look forward to HCRA's response to this submission. If you have any questions or concerns, please contact Dean Fitzgerald via mobile phone at: 226-606-1072 or electronic mail at: Dean@elminc.ca.

Sincerely,

Environmental Liability Management Inc.
Dean Fitzgerald, M.Sc., Ph.D.
Senior Ecologist
Director, Environmental Services

MEMORANDUM

To:	Hopewell Creek Ratepayers Association
From:	Dean Fitzgerald & Jessica Zadori, ELM Inc.
Subject:	Proposed gravel pit activities along Shantz Station Road and potential for environmental and economic disruption of water resources in study area
Date:	April 26, 2021

Environmental Liability Management Inc. (ELM) was retained by the Hopewell Creek Ratepayers Association (HCRA) to assess the possible environmental liability that could arise from a proposed gravel pit along Shantz Station Road, near Maryhill (hereinafter the Site). This proposal is predicated on technical studies that suggest the gravel pit could be operated with minimal environmental disturbance. This suggestion the gravel pit operations will minimally disturb the environment has been questioned from several viewpoints. One view with concerns for water was included within the technical review submitted by Frind and Frind (2020a) with follow up details in Frind and Frind (2020b). The views on water included in Frind and Frind (2020a,b) articulate the varied reasons why significant risk exists for possible disturbance stemming from gravel pit construction and operation on future surface water quality and quantity as well as future groundwater quality and quantity. With this basis of articulated concerns for water quality and quantity, ELM (2021) identified that high water quality and an abundance of water represent keystone reasons for the presence of diverse flora and fauna in proximity to the Site. Since water is abundant, ELM (2021) identifies it sustains these plants and wildlife and a corollary is that if the water quality declines and water quantity decreases, it could have negative implications for the ecosystem as a whole. This view on water quality and quantity shaping the health of the plants and wildlife was then extended in ELM (2021) to the current human uses of water near the Site.

The findings reported in Frind and Frind (2020a) identify several times their concern for possible declines in water quality and reduced future water volumes stemming from the construction and operation of the proposed gravel pit. Given their background and credentials, these authors are highly qualified to extend these views. As a precis of these views about water quality and water quantity, we now refer the reader to explicit statements provided in Frind and Frind (2020a) of relevance to this rubric involving the assessment of risk from the proposed activity. That is, Frind and Frind (2020a) explicitly explain the risks from the proposed construction and extraction activities from different views, as follows:

Page 5 – vulnerability analysis and risk to groundwater quality and quantity included in technical studies supporting the proposal is deemed insufficient for the stated purpose for varied reasons;

Page 6 – background monitoring of groundwater reported in technical studies uses wells that extend to a maximum depth of 9.1 m and test pits to 6.1 m. This depth is deemed insufficient to fully quantify groundwater transport or groundwater infiltration dynamics in the area, as explicitly stated on Page 8.

Page 6 – background monitoring of groundwater reported in technical studies extends for one calendar year and is proposed to be extended to two years. This background monitoring effort is identified as insufficient to establish a true baseline. On this theme of the inadequacy of baseline monitoring, Frind and Frind (2020a) state: "*…hardly sufficient to describe seasonal variations in the water cycle, much less year-to-year trends*."

Page 7 – use of spot measurements of groundwater levels during the monitoring period was deemed inappropriate compared with the amount of monitoring data that could have been obtained at low cost using digital monitors. The authors ascribe manual observations as "misleading" because they would likely miss rain events leading to large changes in groundwater volumes and subtle changes;

Page 7 – forecasts of future groundwater in light of possible consequences of climate change using records from 1981 to 2010 was also deemed incomplete due to the extreme and record-breaking weather observed during the last 10 years in particular. It was asked why the most recent 10 year period was excluded from the forecast predictions. These forecasts were then identified as representing uncertain estimates of future water table volumes in light of possible consequences of climate change;

Page 7 – the deep and shallow aquifer evident in proximity to the proposed gravel pit will respond differently to changes in surface land use. The response of the shallow aquifer will be fairly rapid compared with the deep aquifer. However, no measurements were made of the water table status of the deep aquifer and is therefore was not assessed for risk in the background studies;

Page 8 – recommend installation of bore holes to a depth of at least 50 m, to quantify fluctuations in the water table of the deep and shallow water aquifer simultaneously;

Page 8 – additional monitoring wells are required to quantify groundwater movement and fluctuations;

Page 8 – absence of groundwater monitoring at the wetland closest to the pit is a concern, as this wetland would likely respond first to any losses in groundwater seepage volumes;

Page 8 – background studies acknowledge the monitoring of Hopewell Creek was limited to one year and this was also confirmed as a weakness of the assessment of risk to surface waters. The assessment of risk to Hopewell Creek in background studies did not assess possible inter-annual changes in surface flows and this was also confirmed as another weakness of the assessment to surface waters.

Page 8 – explain why the assessment of interactions between shallow and deep groundwater and associated surface water flows was insufficient given the complex nature of the site;

Page 9 – background studies identify that the creation of a gravel pit will improve water quality and quantity seeping to Hopewell Creek by reducing evapotranspiration attributable to vegetation evident across the gravel pit area. This statement was identified as inappropriate given the lack of deep and shallow aquifer monitoring data. On this topic, Frind and Frind (2020a) state: "*The idea of Hopewell Creek's coldwater-stream status being improved as a result of the gravel pit eliminating vegetation-caused evapotranspiration is inappropriate, especially in view of the geologic complexity and hydrostratigraphic uncertainty of the site*."

Page 9 – note possible risk to groundwater volumes from even small spills at the new pit will be high due to the proposed thin sand-gravel layer between the extraction area and groundwater table;

Page 9 – state potential exists for turbidity to increase in water wells located in proximity to gravel pits. They then stated the only way to quantify such changes in these water wells requires "…*long-term water quality monitoring is needed in order to discern trends*."

Page 10 – identify concern for reduced water quantity in all shallow drinking water wells. They also state the current presence of bacteria and coliforms in these shallow wells could be made worse in the future due to a reduction of water volumes following gravel pit construction or operation;

Page 10 – estimates of existing groundwater elevations in the study area are likely overly conservative due to the presence of farm tile drains. These tile drains likely act to mis-represent how high the groundwater is elevated on the landscape and implies the groundwater is likely actually very close to surface, as represented by the use of shallow drinking water wells and numerous seeps to Hopewell Creek. By extension, this implies the maintenance of 1.5 m of distance in the gravel pit from the active groundwater zone may be overly conservative and not reflect actual groundwater elevations. Hence, if the groundwater is actually higher than reported in the supporting studies, high risk exists for reduction in groundwater volumes following the creation and operation of the pit;

Page 11 – explain concern the shallow drinking water wells will dry up in future, if the groundwater recharge is interrupted or slowed down due to gravel pit operations or climate change with drought;

Page 11 – presence of gravel pit within 2 km could confound measurements and analysis of water quality and water quantity disturbance from the proposed new pit. This confounding influence of the nearby pit implies it is going to be very difficult to establish baseline water quantity near the Site;

Page 11 – concern that washing trucks and other use of water at the pit could result in demand for high volumes of water on a daily basis, placing further stress on local groundwater volumes;

Page 11 – use of water to suppress dust at the gravel pit likely will result in demand for high volumes of water on a daily basis, placing further stress on local groundwater volumes;

Page 12 – To reinforce the need quantify groundwater quality and quantity, Frind and Frind (2020) state: "*The effect of uncertainty on water management at the site should be investigated.*"

Page 12 – A small stream near the proposed pit and mapped previously by GRCA was not assessed in the background studies. Since this small stream would likely suffer reduced water seepage with gravel pit activities, a paucity of information on the feature was identified as a significant gap in the risk analysis. Frind and Frind (2020a) reinforce this point with providing a solution for the proponents: "…*would need to visit the site several times during wet periods in the spring*."

Page 13 – Due to the noted deficiencies in the assessment of risk of groundwater seepage to Hopewell Creek, this aspect of the background study requires the collection of a complete monitoring database followed by re-assessment. If the risk of lost groundwater seepage to the creek is not assessed, the flows could be reduced, the temperature status of cold water could be lost, with any of these considerations leading to the harm of the existing fauna;

Page 14 – deficiencies were reported in the water balance calculations provided in background studies for Hopewell Creek and one wetland features.

Page 14 – noted absences in monitoring data led to the determination the flow of groundwater cannot be confirmed and this results in implications for seepage to the adjacent un-assessed wetland;

Page 14 – noted absences in monitoring data led to the determination the groundwater volumes cannot be reliably predicted and could increase with climate change, leading to flooding of land not prone to flooding currently.

The Frind and Frind (2020a) review ends with 18 recommendations for follow-up activities. These authors recommend no less than 10 separate activities intended to improve the understanding of the groundwater quality and quantity associated with the proposed activity. To illustrate the nature of this activity intended to improve the understanding of this matter, five recommendations are copied here:

Such activities include these recommendations (direct copy from page 17 of Frind and Frind (2020a)):

"3. Groundwater monitoring should be continued for a period of five years before extraction begins, as well as during the entire extraction period, and additionally for a decade post-closure. Monitoring wells should be equipped with dataloggers."

"5. Consideration should be given to increasing the number of monitoring wells to account for hydrogeologic heterogeneity/uncertainty."

"10. Potential impacts on private and municipal wells, both in terms of water quantity and water quality, should be investigated."

Such activities include these recommendations (direct copy from page 18 of Frind and Frind (2020a)):

"14. The potential impact of the pit on Hopewell Creek should be recognized as a complex issue that requires re-assessment."

"16. Potential changes in the groundwater flow regime as a result of pit operations and their effect on users should be investigated."

Then in response to criticisms of the noted review, Frind and Frind (2020b, page 1- 2) state:

"*Current regulations assume that aggregate extraction above the water table will not affect the groundwater, as long as the pit bottom remains at least 1.5 m above the water table. The water table is established on the basis of past records. But these records say nothing about how the water table will react to an exceptional wet period where the water table rises higher than the highest on record. In such an event, the pit may be flooded, contaminant sources (such as machinery fluids) in the pit may connect to the groundwater, affecting nearby wells. The choice will then be to either dewater the pit, leading to major drawdowns, or to abandon it. In any case, impacts to private wells will occur. This is a key concern that has not been addressed by MTE, nor by the peer reviewers*."

This aforementioned information within Frind and Frind (2020a,b) was assessed by Staff from ELM when they prepared their review of the proposed activity. Hence, the ELM (2021) assessment identified four basic findings from the review of background studies by Frind and Frind (2020a,b), including:

1. Groundwater quality and quantity background studies were incomplete and require more monitoring observations to quantify baseline conditions including flow direction, chemistry, and volumes not to mention the relationship between the shallow and deep aquifers;
2. Studies of groundwater quality and quantity seepage to Hopewell Creek, wetlands, and an un-studied creek are regarded as incomplete and require additional monitoring data to quantify baseline conditions including chemistry, flow direction, and volumes;
3. Degradation of existing groundwater quality and quantity by the proposed activity cannot be quantified without reliable baseline information; and
4. Degradation of existing groundwater quality and quantity will harm plants, wildlife, and current users of clean and abundant groundwater.

With these four tenets under consideration, the ELM (2021) review assessed the potential disturbance to plant communities attributable to the degraded groundwater quality and reduced groundwater volumes identified in Frind and Frind (2020a). If groundwater degradation and/or water volume reduction is evident, either factor could harm existing herbaceous and woody plant species. Such changes in groundwater quality and quantity also holds potential to result in significant disturbance to adjacent wetlands and the unstudied creek also identified by Frind and Frind (2020a). If the baseline monitoring data for groundwater quality and quantity is poor, it will not allow for any future assessment of degraded groundwater quality or reduced groundwater volumes. This need for detailed baseline studies of groundwater quality and quantity represents a key theme of the Frind and Frind (2020a) review and the same thinking is applied within the ELM (2021) review. For these reasons, ELM (2021) identifies that an interpretation of possible liability from degraded groundwater quality and reduced groundwater volumes is fully justified, again based on findings within Frind and Frind (2020a,b).

It is only feasible to interpret degradations of groundwater quality and reductions of groundwater volumes through the detailed collection of groundwater monitoring data. Without details on groundwater quality and quantity, it is impossible to detect changes over time nor is it feasible to quantify changes over time. Such detection of changes in environmental endpoints requires detailed baseline studies, and represent a key facet in all Before-After-Control-Impact (BACI) assessments for proposed activities (Underwood, 1994; Benedetti-Cecchi, 2001). If a poor baseline exists for groundwater quality and quantity, then it will be nearly impossible to detect changes attributable to an episodic event like a spill of hazardous chemicals or from persistent activities such as gravel pit extraction over time.

On a similar theme, the ELM (2021) review also inferred that if groundwater degradation and/or water volume reduction is evident, either factor could harm existing wildlife like amphibians, turtles, or other species that depend on an abundance of clean water. Similarly, if wildlife species depend on wetland plants, then it is probable that disturbance to groundwater could harm wetland plants, leading to indirect secondary consequences on wildlife.

On this theme, the ELM (2021) review also inferred that if groundwater degradation is evident and/or water volume reduction is evident, either factor could harm existing aquatic plants, fish communities, turtles, and freshwater mussels in Hopewell Creek. The background documents and Frind and Frind (2020a) identified the baseline studies for the creek flows are inadequate to detect change over time. Again, the need for comprehensive baseline studies are warranted, as a means to protect existing fish communities, wildlife, and freshwater mussels in Hopewell Creek. Additional background information for this creek exists in environmental studies prepared for the environmental assessment of the expansion of Highway 7 and could provide further information to quantify the water quality trends and water volumes.

To reinforce the importance of water volumes to wildlife, fish, plants, and human users, we have estimated the cost of possible lost water volumes from the proposed activity. These estimates are predicated on the possible loss of 1%, 2%, 5%, or current uses of existing abundant groundwater; such losses of groundwater volumes could be directly and/or indirectly result from construction and/or operations at the proposed Shantz Pit. Given the cost of impact on water quality is hard to define, we have estimated the potential cost of a loss of water volume available for use in the following general framework. Further, we value lost water volumes currently and for the future predicated on the value of a litre of water as being worth from 0.5 to 5 cents; such values contrast with the current retail value of water being greater than 25 cents per litre. These estimates of cost or the value of lost water quantity therefore are very conservative and reflect past valuations of water within Region of Waterloo and other jurisdictions. Hence, this conservatism identifies these estimates of potential economic loss are likely lower than what would be realized with the loss of water volumes, a resource currently identified as abundant, clean, and free in the study area.

Estimates of cost have been broken down into multiple use categories, including general use at varying volumes, residential use, commercial use, agricultural use, and recreational use. In order to complete an estimate of cost of water lost, it is assumed that an average individual uses around 251 litres of water daily (Government of Canada, 2017). Assuming that there is an average of four persons per household, each household within 2 km of the Site would require around 1004 L daily of water to be delivered. It is assumed that commercial, agricultural and recreational well use requires a much higher daily water requirement than a single-family household, this was assumed to be vary between 225,000 L or 15 truckloads of water for commercial purposes, to 50,000 L of water for agricultural purposes, and 1,000,000 L of water for recreational purposes such as irrigation at the local golf course. These estimates also reflect past conversations with Maryhill residents operating commercial, agricultural, and recreational business in proximity to the Site.

Table 1: Summary of predicted cost per day of water volumes potentially lost due to the construction of the Shantz Station Pit.

Water Use	Volume Lost (L)	Estimated value of water with forecast loss in dollars ($) per day based on different estimates of the value of one litre of water			
		0.005	0.01	0.02	0.05
General	10,000	0.50	1	2	5
General	100,000	5	10	20	50
General	200,000	10	20	40	100
General	500,000	25	50	100	250
General	1,000,000	50	100	200	500
General	1,500,000	75	150	300	750
Residential	1,004	0.05	0.10	0.20	0.50
Commercial	225,000	11.25	22.5	45	112.5
Agricultural	50,000	2.5	5	10	25
Recreational	1,000,000	50	100	200	500

A review of the cost estimates for lost water volumes range from $0.05/day for the smallest value to amounts greater than $100/day; estimates of annual cost can be determined by multiplying daily cost estimates by 365. Hence, such costs of potential lost water volumes range from small to large. By extension, the estimation of loss requires an understanding of existing water volumes used during existing day-to-day activities. Since detailed baseline water volume estimates for daily activity are not available, it is not feasible to clarify or even confirm or deny the validity of these cost estimates. Due to an inability to provide clarification or confirmation of these cost estimates, it again identifies the need for the completion of baseline studies of water volumes and quality prior to any disturbance from the proposed activity. These costs of estimates for the value of potential losses of water volumes are independent of other potential costs to complete baseline studies of water volumes and quality, as included in ELM (2021). Specifically, ELM (2021) estimated a cost in excess of $9,000,000 to establish baseline measurements for the existing 195 water wells within 2 km of the proposed activity. As a complement for this memorandum, these estimated costs of baseline studies of water volumes included in ELM (2021) are included herein as Appendix A.

For these reasons, it is essential to contemplate the water quality and water volume issues that may arise from the proposed activity, due to the close proximity of the groundwater table to surficial soils, as explained in explicit detail within Frind and Frind (2020a,b); this pattern is reinforced by the extensive standing water, seeps, and large areas of wetlands in the study area. These concerns for future changes in water quality and water volumes were explained in explicit detail within Frind and Frind (2020a) and reinforced with additional comments in Frind and Frind (2020b) in context of the local ecology. Such ecological concerns represent risk to wildlife, fish, and plants that require the same water as the humans in the area. For these reasons, it is not appropriate to exclude human users of clean, abundant groundwater in proximity to the proposed activity. Nor is it appropriate to exclude the non-human users of clean, abundant groundwater in proximity to the proposed activity.

This response is framed within the Statement of Limitations included in Appendix B.

"*When the well's dry, we know the worth of water*." Benjamin Franklin

References

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Frind, E., and M. Frind. 2020b. Letter to Mr. George Lourenco, P.Eng., Resources Manager, Capital Paving Inc., P.O. Box 815 Guelph, ON N1H 6L8,. Dated November 26, 2020.

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APPENDIX A

Summary of estimates of cost to quantify baseline human water use in the study area, from ELM (2021)

Information from ELM (2021, page 21) regarding registered water wells in Study Area

According to data obtained from the Ontario Well Records database, obtained during March 2020, it is estimated that approximately 75 groundwater wells exist within 1 km of the Site and approximately 195 groundwater wells exist within 2 km of the Site (Appendix A) (MECP, 2020). On top of the identified 195 wells within 2 km of the Pit, it is also likely that a number of unregistered wells also exist in nearby areas. As discussed above, baseline studies should be completed for each of these wells. It is estimated that studies of this scope, completed by a qualified company would likely total upwards of $50,000 for each well. Thus providing an estimated study cost of approximately $3,750,000 for consideration of wells within a 1 km radius, or $9,750,000 for a study with consideration of wells within a 2 km radius. This represents a conservative value in excess of 13 Million dollars to establish baseline prior to the initiation of the proposed activities. This approach is presented herein, to illustrate the magnitude of the effort required to establish baseline analyses for an important resource such as water used for residential and commercial purposes. This requirement to assess all wells within a 2 km radius is also consistent with the understanding of groundwater connectivity associated with the gravel deposit, as described in detail by Frind and Frind (2020). A summary of these cost estimates for residential and commercial wells are within Table 1.

Table 1: Summary of the approximate cost associated with the completion of baseline studies for groundwater wells within a one kilometer radius and a two kilometer radius of the Site.

Surrounding Radius	No. of Wells	Approximate Cost for Study per Well	Total Cost (No. wells x approximate cost)
1 km	75	$50,000	$3,750,000
2 km	195	$50,000	$9,750, 000

Contingency Funds

Once appropriate baselines studies have been completed, it would be prudent to develop a contingency fund for use in the case that groundwater is effected by the construction or continuing operations of the Pit. The purpose of this fund would be to ensure that no residents or businesses operating within proximity to the Site, are left without access or functional use of their private or municipal groundwater wells. The development of a contingency fund would involve assigning a dollar value to each of the wells within a two kilometer radius of the Site. This dollar value should be based on the cost to source and deliver potable water to residents and/or businesses in the case that groundwater is impacted as a result of operations at the Shantz Station Pit. Impacted groundwater could include cases in which wells run dry, become contaminated, or simply differ from the baseline condition documented within the proposed baseline studies. It is expected that this would involve retention of a qualified individual/company, in consultation with the impacted residents in order to discern an appropriate cost estimate for each well. From these estimates, a total dollar amount suitable to be put aside in a contingency fund could be developed.

APPENDIX B

Statement of Limitations

Statement of Limitations

For this study, the information, conclusions and recommendations given herein are specifically for HRCA only and for the scope of work described herein for the work completed along Shantz Station Road in Maryhill, Ontario. The scope of work involves environmental screening for constraints based on a desk top review and focused field study. Hence, the findings from study may not be sufficient for other uses. ELM Inc. does not accept responsibility for this or other uses by third parties.

The data, conclusions and recommendations included within this report, and the quality thereof, are based on the scope authorized by the Client. Note however, that no scope of work, no matter how exhaustive, can identify all environmental constraints, environmental contaminants or all conditions above and below ground that may exist. For example, environmental observations may differ across survey dates. Hence, conditions may differ from those encountered in the investigation. Similarly, flood zone features may vary dramatically from year to year even when the site in question is not mapped as flood plain by government agencies. This report therefore cannot warrant that all conditions on or off the site are presented by those identified at specific locations on the focal inspection date. Also, Species At Risk migrate and could possibly enter the Site boundaries at any time, and could have been missed by this review and field survey. Any recommendations and conclusions provided that are based on conditions or assumptions reported herein will inherently include any uncertainty associated with those conditions or assumptions. In fact, many aspects involving professional judgment such as habitat available for Species At Risk, potential for Species At Risk to migrate to the site in question and follow up study recommendations inherently contain a degree of uncertainty that cannot be eliminated. This uncertainty should be managed by periodic review and refinement as additional information becomes available. The same challenges apply to wetland boundaries that change from one year to the next.

Note also that standards, guidelines and practice related to environmental investigations may change with time. Those which are applied at the time of this investigation may be obsolete or unacceptable at a later date. The scope of work and findings reported may not be sufficient to determine all of the factors that may affect construction or other on-site activities. Contractors bidding on future aspects of this undertaking should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the conditions may affect their work. Similarly, ELM Inc. cannot warranty the accuracy of information supplied by the Client regarding the legal boundaries of the Site.