R.J. Burnside & Associates Limited 292 Speedvale Avenue West Unit 20 Guelph ON N1H 1C4 CANADA
telephone (519) 823-4995 **fax** (519) 836-5477 **web** www.rjburnside.com

BURNSIDE
[THE DIFFERENCE IS OUR PEOPLE]

April 24, 2015

Via: Email

Mr. Stan Denhoed, M.Sc., P.Eng.
Harden Environmental Services Ltd.
4622 Nassagawaya-Puslinch Townline Road
RR 1
Moffat Ontario N0P 1J0

Dear Mr. Denhoed:

Re: Harden Letter of December 9, 2014
And Septic Well Contingency Plan dated January 8, 2015
Project No.: 300032475.0000

Thank you for your letter of December 5, 2014 which provides responses to the R.J. Burnside & Associates Limited (Burnside) letter of October 6, 2014. In addition to addressing the comments in the Burnside letter, proposed contingency plans for a number of wells in the vicinity of the proposed Hidden Quarry are presented in Table 1 of your Memorandum of January 8, 2015. Comments on the Memorandum are provided under separate cover.

Burnside offers the following comments in response to your December 9, 2014 letter. Our response uses the same section numbering system as the October 6, 2014 Burnside letter.

1.0 Karst

Comments only, no response from Harden required.

2.1 Groundwater Elevation Multi-Level M15

Harden collected water level data from M15 on six occasions between May 2014 and October 2014. The hydraulic gradient between the shallowest well (M15-IV) and the deeper wells changes from downwards gradients in the spring to upwards gradients in the fall. The water levels in M15-III and M15-IV (both in bedrock above the proposed quarry floor) were identical in May 2014, but differ during the remainder of the year by up to 0.5 m indicating that there is separation between the fractures and that the well seals are effective.

Although water levels in all four screened intervals show a similar pattern, the greatest decline occurs in M15-IV (the shallowest well) and as a result, the gradient in the monitored portion of the Gasport Formation changes from downwards in the spring to upwards after August 9, 2014. The water levels all follow a single trend (except M15-IV on October 8, 2014) indicating that the various zones in the bedrock are influenced by regional events.

Burnside Response

The additional data collected by harden has improved the understanding of the bedrock system at M15. As would be expected, the shallow bedrock behaves somewhat differently than the deeper intervals. Water level differences between M15-III and M15-IV vary from 0.2 to 0.5 m suggesting that creating a hydraulic connection between these intervals will result in significant water level changes.

2.2 Hydraulic Testing in Multi-Level M15

Revised testing by Harden using a Waterra pump to remove water from each well separately did not produce any measurable drawdown in the other wells at M15. This confirms the integrity of the well seal.

Harden revised the groundwater model in order to address the presence of a zone of higher hydraulic conductivity beneath the quarry (as measured in M15-I and M15-II). Four layers were used in the model to represent a portion of the dolostone aquifer. In the first scenario the data obtained from the testing at M15 was used to assign hydraulic conductivity values to the four layers used by the revised groundwater model.

For Scenario 1, the revised model predicts a reduced water level decline at domestic well W3 than predicted by the original model.

Scenario 2 used a significantly higher hydraulic conductivity for layer 3, the same hydraulic conductivity for layer 4 as Scenario 1 and a slightly lower value for layer 1 and layer 2. Again the revised model predicts less drawdown at the nearest domestic well than predicted by the original model and also predicts less drawdown than estimated in Scenario 1.

Harden concludes that “the presence of a zone with greater permeability results in less impact to local wells than the scenario without a zone of greater permeability within the Gasport Aquifer”. Therefore the prediction of water level change on nearby wells is conservatively high in the Harden 2012 report submitted with the “quarry application.”

Harden investigated the integrity of the bentonite seals by manually pumping each screened interval for 10 minutes using a Waterra internal pump. No water level response was observed other than in the interval being pumped.

Burnside Response

The use of site specific data collected from M15 confirms that the prediction of water level changes predicted by the original Harden groundwater model as result of the proposed quarry are reasonable and conservative. The water level declines predicted by the model will need to be utilized along with data collected during detailed domestic well surveys to refine the well specific contingency plans that have been developed using historical domestic well data collected by Harden as part of their work at the proposed Hidden Quarry. Testing completed by Harden confirmed the integrity of the bentonite seals.

2.3 Combined Impact of Future Rockwood Well Number 4 and Hidden Quarry

Burnside indicated that wells on the proposed quarry site would be monitored during testing of Rockwood Well Number 4 to assess the degree of connection (if any) between the new well and the bedrock aquifer in the area of the proposed quarry.

Burnside Response

Rockwood Well 4 has been constructed and a pumping test was recently completed with monitoring of select wells at Hidden Quarry undertaken before, during and after the test. The data collected from the test reviewed by Burnside and indicates that there was no measurable response to pumping in the bedrock aquifer in wells monitored at the site of the proposed quarry.

2.4 Water Quality Testing in Multi-Level M15

This is also discussed in Section 4.1.3 of the Harden letter. Water quality samples were collected from M15 on November 11, 2014 approximately 10 days after being chlorinated. No E.coli was detected in any of the M15 screens, however total coliform was present in the sample from M15-IV. Nitrate ranged from 1.99 mg/L in M15-II to 2.33 mg/L in M15-III. This is consistent with previous testing where highest nitrate concentration was present in the sample from M15-III. The results for the two sampling events are shown in Table 1.

Table 1: Sampling Results

Well	Nitrate Concentration (mg/L)	
	May 5, 2014	**November 11, 2014**
M15-I	1.61	2.01
M15-II	2.19	1.99
M15-III	3.17	2.33
M15-IV	1.96	2.25

Burnside Response

The two sets of samples indicate that there is nitrate present at low concentrations throughout the entire bedrock sequence at the location of M15. This suggests that a vertical connection already exists in the bedrock and that the vertical connections created by bedrock extraction will not result in a significant change to the water quality.

3.1 Guelph Limestone Quarry Water Quality Sampling

a) Harden indicates that the background nitrate value of 0.5 mg/L in the Guelph Limestone Quarry pond represents an average concentration of water from the overburden, the unconfined Guelph Formation, stormwater runoff, groundwater from the underlying Gasport Aquifer along with dry deposition from nearby highways, residential areas and industrial areas.

b) Harden indicates that although the mass of nitrogen in a blast at Hidden Quarry will be greater than a typical blast at the Guelph Limestone Quarry, the volume of water at Hidden Quarry is much greater and will provide significantly more dilution. In addition, sampling

from the Dufferin Milton Quarry, the James Dick Cambridge Quarry and the Guelph Limestone Quarry has demonstrated that nitrogen compounds in quarry pond water are not an environmental or health concern.

Burnside Response

The data presented by Harden confirms that the nitrogen compounds entering the quarry pond and the groundwater will not result in any significant increase in nitrate concentrations.

3.2 Nitrogen Compounds in Groundwater and Surface Water

Harden references Table 7 (Harden, June 10, 2014) which indicates that the nitrate concentration in the quarry pond will be 3.67 mg/L. Harden also indicates in the June 10, 2014 letter that nitrogen concentrations down gradient of the quarry property will continue to be less than entering the quarry property.

Burnside Response

Harden has demonstrated through the use of mass balance calculations and examples from other quarries that the proposed Hidden Quarry will not result in an increase in nitrate concentrations down gradient of the quarry.

3.3 Revised Nitrate Prediction

Harden indicates that the mass of nitrogen introduced by the explosives (Table 3 of their January 14, 2014 letter) is conservative. This is based on recent testing at the Guelph Limestone Quarry which indicates that the predicted nitrogen input to water from explosives far exceeded the concentrations measured in surface water samples from the quarry.

Burnside Response

The data presented for Harden is based on samples taken from the Guelph Limestone Quarry which is completed in the same bedrock formation. The data indicates that the input of nitrogen compounds from explosives is minimal. However, Burnside's main concern related to nitrate was that the removal of the bedrock would result in a vertical connection of the fractures from the bedrock surface to the base of the quarry at 327 masl. It was envisioned that the shallow fracture system would have been the most impacted by anthropogenic activities and would have the highest concentration of nitrate as a result of upgradient agricultural/farming activities. The two rounds of sampling at M15 have demonstrated that low concentrations of nitrates are distributed fairly evenly throughout the bedrock, suggesting that there is already a connection between the horizontal fracture systems. The water quality data and calculations presented by Harden demonstrate that the quarry will not result in an increase in nitrate concentrations in the downgradient groundwater.

4.1 Current State of Local Water Supplies and Vulnerability of the Aquifer

At a meeting held on October 21, 2014, it was agreed that Harden would collect water quality samples from 15 select private wells, nine on-site monitoring wells and five surface water locations. Approximately 70% of the residents did not want to have their water quality results

made public; therefore a three digit random number is used to identify all individual wells. Where available, information on the pump depth, static water level and available drawdown is included in Table 3 (Private Well Survey) along with general observations about the condition of the well head.

4.1.1 Private Well Sampling

A variety of water quality issues were identified in nearby domestic wells including significant coliform bacteria concentrations in four wells, chloride and sodium above the ODWQS in two wells; nitrate ranging from not detected to 6.74 mg/L; iron above the ODWQS in three wells, hardness above the ODWQS (all wells), and total dissolved solids (TDS) above the ODWQS in six wells. Four of the 14 residents have either a UV light or chlorination system installed.

Burnside Response

The collection of water quality samples from nearby domestic wells provides baseline data that can be used to evaluate water quality impacts (if any) from the quarry (if approved). As would be expected, hardness was above the ODWQS in all samples. The information presented by Harden indicates that the quarry will not result in an increase in nitrate concentration in groundwater. However, it could be perceived by residents that the quarry could be the source of increasing nitrate concentrations in their well. As a result it will be important that the probable sources of the elevated nitrate be established prior to the onset of any quarrying activities as a condition of development.

4.1.2 Surface Water Quality

Surface water samples were collected from RS1 (Tributary A), SW4 (Tributary B), SW7 (Tributary B), SW11 (Tributary C) and Brydson Spring. The highest concentrations of coliform bacteria were found in Tributary B (SW4 and SW7). E.coli was present in all the surface water. Nitrate was not detected at SW11, and ranged in concentration from 0.80 mg/L at SW7 to 6.02 mg/L at RS1. The elevated sodium and chloride in the Brydson Spring, are attributed to road salt impacts by Harden.

Burnside Response

It is apparent that surface water has been impacted by coliform and E.coli bacteria which are likely being introduced by agricultural activities and local wildlife. The decline in coliform from 50,000 cfu/100 ml at SW7 to 500 cfu/100 ml at the Brydson Spring sample location suggests that either there is a limited connection between Tributary B and the Spring or there is a significant degree of attenuation occurring. The elevated sodium and chloride seen in the Brydson Spring sample may be due to road salt impacts.

4.1.3. On-Site Monitoring Wells Groundwater Quality

The on-site wells were chlorinated approximately 10 days prior to sample collection. Three well volumes were purged prior to sample collection and free-chlorine was not present in any of the wells when sampled. Harden provides the following comments on the data:

1. *M15-IV is the only monitoring well with coliform bacteria. The sample contained a bacterial concentration of 14 cfu/100 ml.*
2. *Water obtained from M1D had a manganese concentration of 0.058 mg/L. This exceeds the Aesthetic Objective of 0.05 mg/L.*
3. *All wells exceeded the Aesthetic Objectives for Hardness and M1D exceeded the Aesthetic Ojbective for Total Dissolved Solids due to the presence of sodium and chloride from road salting activities.*
4. *Nitrate concentrations in the groundwater range from not detected (ND) to 3.99 mg/L. Nitrate occurred in all wells except M1D.*
5. *The chemistry of each interval in monitoring well M15 is distinct. This corroborates the findings of the hydraulic testing that there is not leakage between test sections.*

Burnside Response

The data collected by Harden provides a good indication of groundwater quality in the area of the proposed quarry, both upgradient and downgradient of the two extraction areas.

4.2 Recent Research and Susceptibility of Local Wells to Contamination

Harden indicates that two baseline samples of water quality will be obtained post approval of the quarry during a period of relatively high water table and relatively low water table. Samples will be analyzed for general chemistry, anions, metals, nutrients, coliform bacteria and E.coli.

Burnside Response

Wells that have elevated levels of parameters such as bacteria and nitrate will require further investigation to establish the source as a condition of development. This will assist in the resolution of any future water quality interference claims. We would also recommend that an upgradient well with known nitrate impacts be used as a background well to monitor nitrate impacts from agricultural activities.

4.3 Water Fowl Use of Hidden Quarry Pond

Appendix D of the June 10, 2014 Harden letter addresses the potential for water fowl to use the quarry pond. Harden indicates that the proposed quarry will not be favourable for heavy water fowl use.

Burnside Response

The addition of giardia and cryptosporidium to the monitoring program will be useful in assessing the impacts of water fowl and other animals that may use the ponds and is recommended. Ideally the ponds will be completed in a manner to discourage their long term use by water fowl.

4.4 Water Quality Early Warning and Mitigation

Harden has agreed to complete a detailed well survey and install M16 and M17 upon approval of the quarry. The installation of M16 and M17 will provide additional information on the bedrock sequence. In particular M16 will provide information on the east side of the site where there is limited data.

Burnside Response

Since bedrock fractures are heterogeneous, it will be important that the degree of connectivity between fracture systems identified in M16/M17 and M15 be established. Similarly the water quality variation with depth must also be assessed. At a minimum the following will need to be completed at M16/17 (and at M18/19) as a condition of development:

- Detailed core logging which includes fracture identification;
- A pumping test on the open hole wells to assess connectivity with other wells on site;
- A downhole video and flow profile to identify productive fracture systems;
- Completion of a multi-level well at M16 with M17 to remain as an open hole;
- Water quality sampling from each well to allow for assessment of water quality variations with depth; and
- Hydraulic conductivity testing.

The results of the drilling should be documented in a technical memorandum.

5.0 Local Well Survey

Harden has agreed to update the local well survey for wells downgradient of the quarry. Retrofits at the well head(s) will be undertaken.

Burnside Response

The well survey should include wells upgradient of the quarry as they have the greatest potential to be negatively impacted by water level changes as a result of the proposed quarry.

6.0 Quarry Depth Limitation

No comment necessary

7.0 Brydson Spring and Blue Springs Creek

Harden has agreed to include Brydson Spring in the background study and will include flow measurements and water quality testing. Two flow measurements were obtained on October 16, 2014. Flow in Tributary B was not occurring beneath Highway 7 at the time of these measurements.

A review of water quality results from Tributary B (SW4 and SW7) and Brydson Spring indicates that there are some differences.

Burnside Response

The water quality sample from the Brydson Spring had much higher sodium and chloride than samples from SW4 and SW7 and nitrate (2.39 mg/L) was elevated in comparison to results from SW4 (1.05 mg/L) and SW7 (0.80 mg/L). Total coliform was much lower at Brydson Spring (500 cfu/100 ml) compared to SW4 (20,000 cfu/100 ml) and SW7 (50,000 cfu/100 ml). Parameter such as hardness are similar in both the surface water and bedrock samples which makes it difficult to confirm the contribution of bedrock/surface water to spring flow.

It is known that there are times when there is flow at SW4 when at the same time there is no flow at Tributary B at the point where it crosses the southern property boundary. Flow measurements on October 16, 2014 indicate an average flow in the Brydson Spring of 22.4 L/s while flow in Tributary B was not occurring beneath Highway 7. It is not known what the flow was at SW4 at the time so the contribution from Tributary B to the spring is not known. Although quarry operations are not predicted to impact flow in Tributary B, the contribution of Tributary B to flows at Brydson Spring has not been quantified. Flow in the Brydson Spring should be compared to flows in Tributary B near SW3, SW4 and SW5 under a variety of conditions. Flow measurements should begin as soon as possible to ensure that sufficient baseline data is collected under a variety of conditions. This will allow the contribution of Tributary B to Brydson Spring to be quantified. The relationship of the flow in Tributary B and the flow in Brydson Spring can then be monitored to confirm that the quarry operations are not impacting the spring. The proposed monitoring program should be revised to include flow monitoring at SW3, SW4, SW5 and Brydson Spring...

8.0 Rock Extraction Water Level Change Monitoring

JDCL has agreed to install M17 and a trigger level will be established prior to commencement of quarrying activities. Trigger levels have been established for M1D, M2, M13D, M14D, M15 and M16.

Burnside Response

Once M17 is installed, several rounds of water levels will need to be collected from all the on-site wells and the upgradient domestic wells so that the relationship between water levels can be established and reviewed. The trigger levels will need to consider how the water levels relate to those in nearby domestic wells so that the allowable water level change on site does not result in unacceptable changes in domestic wells. Harden did not respond to the Burnside recommendation to deepen M3. M3 should be deepened as a condition of development with water level data collected far enough in advance of quarrying to develop a defensible baseline that can be used to assess quarry impacts.

8.1 Historic Low Water Level

Harden has agreed to complete a well survey and a well construction drawing for each well. A safety factor type rating and contingency plans will be developed for each well.

Burnside Response

A significant amount of information has been gathered for the domestic wells in the area. The information has been summarized in Table 1 which is included as an attachment to the Harden January 8, 2015 Memorandum. Seventy percent of residents asked that details about their wells remain private and as a result, the location of the wells in the table is not shown. There are a number of wells with limited available drawdown above the pump intake or with completion depths above 327 masl which makes them more vulnerable to water level declines. These wells will require additional investigation and the development/implementation of a rigorous contingency plan as a condition of development.

8.2 Monitoring Plan Revisions

a) Harden has agreed to install M17 between the sinking cut and the nearest domestic wells, M17 will remain as a full depth open hole and a trigger level will be established. M18 and M19 are to be installed along the southern property boundary.

Burnside Response

Burnside had recommended deepening M3 to 227 masl to provide information on the entire bedrock sequence. Harden does not respond to this recommendation. The well as constructed does not conform to O. Reg. 903 and should be deepened in order to provide more reliable water level data.

b) Harden has agreed to water level monitoring of private wells as part of the baseline monitoring program, but suggests that the dedicated on-site monitoring provide a superior opportunity to determine water level changes between the quarry and the domestic wells. Harden has agreed to retrofit the nearest wells in order to limit the possibility of surface contamination.

Burnside Response

Burnside recommends that the long term monitoring program include both on-site well and nearby domestic wells. Domestic wells should be equipped with direct read loggers installed in conduit to minimize disturbance to the well during data collection. Sufficient baseline water level data should be collected to allow for water levels in on-site monitors to be correlated to domestic well water levels. The data can then be used to develop trigger levels in on-site wells that will be used to initiate appropriate actions in domestic wells.

c) Harden disagrees that a rigorous domestic well monitoring program is necessary, but provides a list of residents who will be contacted for the opportunity to have water level monitoring conducted as part of approval.

Burnside Response

Burnside recommends that any resident who wishes to have water levels monitored be included in the program. To date there has been no indication of the volumes or source of wash water that will be required for material processing. If a groundwater source is required the predictions of drawdown may change, particularly if the source is located along the southern portion of the site. As a result, we continue to require a rigorous domestic well monitoring program.

2.3 Trigger levels for Sinking Cut

Harden recommends that the agreed to monitoring network be used to establish the level of disturbance to the water levels between the sinking cut and the domestic wells. A “ball and tether” system will be installed in the pond to inform on-site workers if the water level falls below the established datum. Harden indicates that the Township will be informed on a “regular basis” of water levels with comparison to the agreed upon trigger levels.

Burnside Response

The “ball and tether” system needs to be augmented by an automated water level data collection device. Requiring on-site workers to visually confirm that the ball is above the trigger level is not a rigorous method of ensuring compliance with a trigger level. The requirement to inform the Township of water levels on a regular basis is too vague. Data from the automatic water level recording device should be provided to the Township on a bi-weekly basis until the data indicates that water levels are remaining consistently above the trigger level.

3.0 Contingency Measures

Harden has made the changes to the wording recommended by Burnside.

Burnside Response

No comment required.

3.2 Water Quality

Harden has agreed to complete two sampling events which will become the baseline against which future water quality can be compared.

Burnside Response

No comment.

5.0 Annual Reporting and Interpretation

No Comment needed.

9.0 Additional Work

Harden has agreed with the Burnside recommendation with exception of the recommendation to evaluate wells M16, M17, M18 and M19 in the same manner as M15. Harden indicates that completion in the same manner as M15 is not warranted.

Burnside Response

Burnside agrees with Harden that the new wells do not need to be completed in the same manner as M15. However as indicated in the December 6, 2014 letter, the new wells should be

evaluated in the same manner as M15. To clarify, Burnside recommends that downhole video flow profiling be completed on M16, M17, M18 and M19 as there is limited information in the vicinity of these new wells. In addition, a short term test should be completed on the open hole to obtain a bulk hydraulic conductivity value. We agree that the wells should be completed as "open holes" to be consistent with domestic well construction.

Yours truly,

R.J. Burnside & Associates Limited

Mr. David Hopkins, P.Geo.
Senior Hydrogeologist
DH:sd

Enclosure(s)

cc: Ms. Kim Wingrove, Guelph Eramosa Township (Via: Email)
Ms. L. Howson, MCIP, RPP, MSH (Via: Email)

150209_Denhoed Letter
24/04/2015 1:54 PM