EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

Blast Impact Analysis
Uppers Quarry
Part of Lots 119, 120, 136 and 137, Part of the road allowance between Lots 120 and 136 (Geographic Township of Stamford), City of Niagara Falls, Regional Municipality of Niagara

Submitted to:

Walker Aggregates
P.O. Box 100
Thorold, Ontario
Canada
L2V 3Y8

Prepared by

Explotech Engineering Ltd.
58 Antares Drive, Unit 5
Ottawa, Ontario
K2E 7W6

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EXECUTIVE SUMMARY

Explotech Engineering Ltd. was retained in November 2016 to provide a Blast Impact Analysis for the proposed Uppers Quarry located on Part of Lots 119, 120, 136 and 137. The Assessment also takes into account potential extraction of the portion of Upper's Lane and Part of the unopened road allowance between Lots 120 and 136 (geographic township of Stamford), where they exist between Thorold Townline Road and Beechwood Road, all in the City of Niagara Falls, Regional Municipality of Niagara.

Vibration levels assessed in this report are based on the Ministry of the Environment, Conservation and Parks (MECP) Model Municipal Noise Control By-law with regard to guidelines for blasting in Mines and Quarries. We have assessed the area surrounding the proposed licence area as it relates to potential damage from blasting operations and compliance with the aforementioned By-law document.

We have inspected the property and reviewed the available site plans. Explotech is of the opinion that the planned aggregate extraction on the proposed property can be carried out safely and within MECP guidelines as set out in NPC 119 of the By-Law.

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INTRODUCTION

Walker Aggregates (Walker) intends to apply for a Class A, Category 2 Licence for the property legally described as Part of Lots 119, 120, 136 and 137, former Township of Stamford, now in the City of Niagara Falls, in Niagara Region. Two municipal road allowances (Upper's Lane and an unopened road allowance between Part of Lots 120 and 136 in the former Township of Stamford) separate the proposed quarry site into three extraction areas:

i) North Extraction Area: extraction area north of Upper's Lane;
ii) Mid Extraction Area: extraction area south of Upper's Lane and north of the unopened road allowance between Township Lots 120 & 136 in the former Township of Stamford, now in the City of Niagara Falls ("unopened road allowance"); and
iii) South Extraction Area: extraction area south of the unopened road allowance. Part of the road allowance between Lots 120 and 136 (geographic township of Stamford), City of Niagara Falls, Regional Municipality of Niagara.

This Blast Impact Analysis assesses the ability of the proposed licence (whether the two road allowances are ultimately included in the extraction area or not) to operate within the prescribed blast guideline limits as required by the Ontario Ministry of the Environment, Conservation and Parks (MECP).

While not specifically required as part of the scope of the Blast Impact Analysis under the Aggregate Resources Act, this report also touches on the topics of the flyrock and residential water wells for general informational purposes only. Details related to residential water wells are addressed in the hydrogeological report while specific flyrock control is addressed at the operational level given significant influences related to blast design, geology and field accuracy. Additionally, potential impacts on the adjacent TC Energy pipeline, electrical transmission towers, and nearby waterbodies are discussed to confirm compliance with applicable external corporate policies and guidelines.

The proposed Uppers Quarry operation is bounded by farm land to the North and South, Beechwood Road to the East, a residential subdivision (Fernwood) to the Southeast and Thorold Townline Road to the West. A residential and employment subdivision (Rolling Meadows) has been approved west of Thorold Townline Road. The extraction areas will be accessed via Thorold Townline Road and Upper's Lane.

The proponent currently owns the lands housing the residences designated as 5872 Thorold Townline Road and 5497 Beechwood Road. The closest sensitive receptor not owned by the proponent is the residence designated as 5329 Beechwood Road.

This Blast Impact Analysis has been prepared based on the MECP Model Municipal Noise Control By-law with regard to Guidelines for Blasting in Mines and Quarries (NPC 119).

Given that mining operations have not been undertaken in the past on this property, site-specific blast monitoring data is not available. We have therefore applied data generated across a spectrum of quarries and construction projects which provides a conservative approximation of anticipated vibration levels from the operation. It has been our experience that this data represents a conservative starting point for blasting operations. It is a recommendation of this report that a vibration monitoring program be initiated on-site upon the commencement of blasting operations and maintained for the duration of all blasting activities to confirm compliance with MECP guideline limits for ground vibration and overpressure based on actual measurements taken during blast times.

EXISTING CONDITIONS

The licenced area for the proposed Uppers Quarry encompasses a total area of approximately 103.6HA. The total extraction area is approximately 89.1HA.

The site is separated into eight (8) extraction phases. The phases are designated as 1a, 1b, 2a, 2b, 3a, 3b, 4 and 5 with phased extraction progressing initially from the Northwest corner of Phase 1a along the West end of the property (Refer to Appendix A).

The topography of the proposed license area is generally lowest in the North portion of the site at an elevation in the order of 177masl rising towards the West and South with the highest elevations (185masl) lying in the middle of the West boundary of the site (Phase 1b). The design final quarry floor elevation is 141masl –148.7masl leading to the likely execution of 2 to 3 benches to achieve final grade.

The lands surrounding the proposed license area are largely characterized by agricultural areas with a limited number of residential structures within 500m. The closest receptors adjacent the extraction limits as defined by the MECP are as follows:

Table 1: Closest Sensitive and Non-Sensitive Receptors

Address	Sensitive Receptor or Non Sensitive Receptor	Distance to Receptor from Extraction Limits (m)	Direction from Extraction Limits
9337 Beaversdam Road	Sensitive	500	North
9417 Beaversdam Road	Sensitive	475	North
9582 Beaversdam Road	Sensitive	170	North
9582 Beaversdam Road	Non Sensitive	155	North
9722 Beaversdam Road	Sensitive	245	North
10138 Beaversdam Road	Sensitive	455	North
10148 Beaversdam Road	Sensitive	190	North
***5205 Beechwood Road	Sensitive	0	NA
5329 Beechwood Road	Sensitive	80	East
***5497 Beechwood Road	Sensitive	0	NA
5584 Beechwood Road	Sensitive	100	Southeast
5769 Beechwood Road	Sensitive	305	Southeast
5821 Beechwood Road	Sensitive	380	Southeast
9941 Lundy's Lane	Non Sensitive	405	South
9352 Madison Crescent	Sensitive	390	Southeast

9366 Madison Crescent	Sensitive	375	Southeast
9380 Madison Crescent	Sensitive	360	Southeast
9385 Madison Crescent	Sensitive	395	Southeast
9397 Madison Crescent	Sensitive	375	Southeast
9409 Madison Crescent	Sensitive	355	Southeast
9421 Madison Crescent	Sensitive	340	Southeast
9433 Madison Crescent	Sensitive	320	Southeast
9445 Madison Crescent	Sensitive	300	Southeast
5607 Osprey Avenue	Sensitive	280	Southeast
5610 Osprey Avenue	Sensitive	335	Southeast
5615 Osprey Avenue	Sensitive	290	Southeast
5622 Osprey Avenue	Sensitive	345	Southeast
5623 Osprey Avenue	Sensitive	300	Southeast
5631 Osprey Avenue	Sensitive	305	Southeast
5632 Osprey Avenue	Sensitive	350	Southeast
5639 Osprey Avenue	Sensitive	315	Southeast
5642 Osprey Avenue	Sensitive	360	Southeast
5647 Osprey Avenue	Sensitive	330	Southeast
5652 Osprey Avenue	Sensitive	370	Southeast
5655 Osprey Avenue	Sensitive	340	Southeast
5663 Osprey Avenue	Sensitive	345	Southeast
5668 Osprey Avenue	Sensitive	380	Southeast
5671 Osprey Avenue	Sensitive	355	Southeast
2711 Thorold Townline Road	Non Sensitive	85	West
4832 Thorold Townline Road	Non Sensitive	40	Northwest
5200 Thorold Townline Road	Sensitive	415	South
***5872 Thorold Townline Road	Sensitive	0	NA
6200 Thorold Townline Road	Sensitive	415	South
***9764 Upper's Lane	Sensitive	0	NA
***9903 Upper's Lane	Non Sensitive	0	NA
***10200 Upper's Lane	Sensitive	0	NA

***Properties located within the extraction area owned by the proponent

The properties on the proposed licenced land (5205 and 5497 Beechwood Road, 5872 Thorold Townline Road, 9764 Upper's Lane, 9903 Upper's Lane and 10200 Upper's Lane) are within the proposed extraction limits. Upon commencement of extraction, the use of these structures will be such that they do not qualify as sensitive receptors.

The utility buildings (4832 Thorold Townline Road) located directly adjacent the proposed license do not qualify as sensitive receptors as defined by the MECP (refer to Appendix E for Definitions) but will remain in place and operational for the foreseeable future. In order to safeguard the integrity of this structure, we recommend that vibrations at the utility buildings be maintained below 50mm/s in accordance with research performed by the United States Bureau of Mines (USBM RI8507). It is a recommendation of this report that this structure shall be monitored for ground vibration when vibration calculations suggest vibrations in excess of 35mm/s.

PROPOSED MINERAL EXTRACTION

An existing watercourse runs North-South through Phase 3a, Phase 4 and Phase 5 of the extraction limits. The proposed existing watercourse realignment will relocate the watercourse inside the excavation limits on the western limits of extraction inside Phase 1b and 2b.

The extraction operations will begin with a sinking cut at the Northwest portion of Phase 1a (Mid Extraction Area) and will retreat Easterly and Southerly through Phase 1a. Phase 1b is located on the Western edge of Phase 1a and borders the Western most boundary for the proposed licence. In the Mid Extraction Area, Phase 1a will be extracted to a final floor elevation of 141 – 145masl and given existing topography of 181 – 185masl, it is anticipated that Phase 1a extraction will take place in 2 – 3 benches. Phase 1b will be extracted to a depth of no greater than 155masl in order to facilitate the construction of the new realigned watercourse. The Phase 1a and Phase 1b areas are also located in the South Extraction area separated by a road allowance not owned by the proponent. As a result, an additional sinking cut in the Northwest corner of Phase 1a (South Extraction Area) will be required. Phase 1a (South Extraction Area) will retreat Easterly and Southerly through Phase 1a (South Extraction Area). Phase 1b (South Extraction Area) is located on the Western edge of Phase 1a and borders the Western most boundary for the proposed licence. In the South Extraction Area, Phase 1a will be extracted to a final floor elevation of 141 – 145masl and given existing topography of 182 – 185masl, it is anticipated that Phase 1a (South Extraction Area) extraction will take place in 2 – 3 benches. Phase 1b (South Extraction Area) will be extracted to a depth of no greater than 155masl in order to facilitate the construction of the new realigned watercourse.

Phase 2a (North Extraction Area) is located North of Phase 1a and will begin with a sinking cut at the Southwest corner of Phase 2a and will retreat Easterly and Northerly through Phase 2a. Phase 2b is located on the Western and Northern edge of Phase 2a and borders the Western most boundary for the proposed licence. Phase 2a will be extracted to a final floor elevation of 144 – 145masl and given existing topography of 180 – 182masl, it is anticipated that Phase 2a extraction will take place in 2 – 3 benches. Phase 2b will be extracted to a depth no greater than an elevation of 155masl in order to facilitate the construction of the new realigned watercourse whereas the watercourse alignment transition area found at the North end of Phase 2b will only be extracted to a depth of no greater than 174masl in order to facilitate the construction of the new realigned watercourse.

Phase 3a (North Extraction Area) is located to the East of Phase 2a and is currently traversed by the existing watercourse. The existing watercourse is to be

relocated to the West perimeter of the site after the successful completion of the Phase 1b and 2b extraction.

A sinking cut in the Southwest corner of Phase 3b will initiate extraction with a Northerly and Easterly retreat. Extraction for Phase 3a will leverage the face created by extraction in Phase 2a with a Easterly retreat. ***

Phase 3a/3b will be extracted to a final floor elevation of 146masl – 149masl and given existing topography of 177masl – 183masl, it is anticipated that Phase 3 extraction will take place in 2 – 3 benches.

Phase 4 is located in the middle of the proposed license area (Mid Extraction Area) and progresses from the Eastern Phase 1a limit (Mid Extraction Area) Easterly to the East proposed extraction limits. Extraction of Phase 4 will utilize the Eastern face of Phase 1a and will be extracted in 2 – 3 benches to a depth ranging from 141masl – 149masl given existing topography in Phase 4 of 177masl - 184masl.

Phase 5 is located in the South of the proposed license area (South Extraction Area) and progresses from the Eastern Phase 1a limit (South Extraction Area) Easterly to the South and East extraction limits. Extraction of Phase 5 will utilize the Eastern face of Phase 1a and will be extracted in 2 – 3 benches to a depth ranging from 141masl – 149masl given existing topography in Phase 5 of 178masl - 182masl.

All extraction phases bordering the perimeter limits of the quarry (namely phases 1b, 2b, and 3a) will have a catchment bench located at elevation 149masl – 155masl depending on the phase.

As quarry operations migrate across the property, the closest sensitive receptors to the required blasting operations will vary. The closest receptor to the proposed Upper's Quarry licence area over the life of the quarry is 5329 Beechwood Road at a distance of 80m from the extraction limit.

***Alternatively, if the existing watercourse is realigned prior to the extraction operations in Phase 3, extraction may begin in Phase 3a. Phase 3a will leverage the existing Phase 2a face and retreat Easterly. Phase 3b will then leverage the Phase 3a face and retreat Easterly. If this alternate extraction proceeds, the conclusions of this report are unchanged.

BLAST VIBRATION AND OVERPRESSURE LIMITS

The Ontario MECP guidelines for blasting in quarries are among the most stringent in North America.

Studies by the U.S. Bureau of Mines have shown that normal temperature and humidity changes can cause more damage to residences than blast vibrations and overpressure in the range permitted by the MECP. The guideline limits set by the MECP are as follows.

Vibration	12.5mm/sec	Peak Vector Sum (PVS)
Overpressure	128 dBL	Peak Sound Pressure Level (PSPL)

The above guidelines apply when blasts are being monitored. Cautionary levels are slightly lower and apply when blasts are not monitored on a routine basis. It is a recommendation of this report that all blasts at the operation be monitored to quantify and record ground vibration and overpressure levels employing a minimum of two (2) digital seismographs, one installed at the closest sensitive receptor in front of the blast, or closer, and a second installed at the closest sensitive receptor behind the blast, or closer.

BLAST MECHANICS AND DERIVATIVES

The detonation of explosives within a borehole results in the development of very high gas and shock pressures. This energy is transmitted to the surrounding rock mass, crushing the rock immediately surrounding the borehole (approximately 1 borehole radius) and permanently distorts the rock to several borehole diameters (5-25, depending on the rock type, prevalence of joint sets, etc.).

The intensity of this stress wave decays quickly so that there is no further permanent deformation of the rock mass. The remaining energy from the detonation travels through the unbroken material in the form of a pressure wave or shock front which, although it causes no plastic deformation of the rock mass, is transmitted in the form of vibrations.

Particle velocity is the descriptor of choice when dealing with vibrations because of its superior correlation with the appearance of cosmetic cracking. As such, for the purposes this report, ground vibration units have been listed in mm/s.

In addition to the ground vibrations, overpressure, or air vibrations are generated through the direct action of the explosive venting through cracks in the rock or through the indirect action of the rock movement. In either case, the result is a pressure wave which travels through the air, measured in decibels (or dB) for the purposes of this report.

VIBRATION AND OVERPRESSURE THEORY

Transmission and decay of vibrations and overpressure can be estimated by the development of attenuation relations. These relations utilize empirical data relating measured velocities at specific separation distances from the vibration source to predict particle velocities at variable distances from the source. While the resultant prediction equations are reliable, divergence of data occurs as a result of a wide variety of variables, most notably site-specific geological conditions and blast geometry and design for ground vibrations and local prevailing climatic conditions for overpressure.

In order to circumvent this scatter and improve confidence in forecast vibration levels, probabilistic and statistical modeling is employed to increase conservatism built into prediction models, usually by the application of 95% confidence lines to attenuation data.

The attenuation relations are not designed to conclusively predict vibration levels at a specific location as a result of a specific blast design, application of this probabilistic model creates confidence that for any given scaled distance, 95% of the resultant velocities will fall below the calculated 95% regression line.

While the data still provides insight into probable vibration intensities, attenuation relations for overpressure tends to be less reliable and precise than results for ground vibrations. This is due primarily to wider variations in variables outside of the influence of the blast design which impact propagation of the vibrations. Atmospheric factors such as temperature gradients and prevailing winds (refer to Appendix B) as well as local topography can all serve to significantly alter overpressure attenuation characteristics. Fortunately, as described above, the conservatism built into the equations and the on-site vibration and overpressure monitoring performed at the quarry will aid in quantifying the vibrations and overpressures specific to the area in order to further reduce the likelihood of damage to all structures adjacent the quarry limits.

Our experience and analysis demonstrates that blast overpressure is greatest when blasting towards receptors, and blast vibrations are greatest when retreating towards the receptors.

GROUND VIBRATION LEVELS AT THE NEAREST SENSITIVE RECEPTOR

The most commonly used formula for predicting Peak Particle Velocity (PPV) is known as the Bureau of Mines (BOM) prediction formula or Propagation Law. We have used this formula to predict the PPV's at the closest house for the initial operations.

$$PPV = k\left(\frac{d}{\sqrt{w}}\right)^{e}$$

Where, PPV = the predicted peak particle velocity (mm/s) this guy is a dummy

K, e = site factors

d = distance from receptor (m)

w = maximum explosive charge per delay (kg)

The value of K and e are variable and influenced by many factors (i.e. rock type, geology, thickness of overburden, etc.). As such, these site factors are developed empirically through the measurement of vibration characteristics at the specific operations of interested.

The portion of the BOM prediction formula contained within the parentheses is referred to as the *Scaled Distance* and represents another important PPV relation. It correlates the separation distance between a blast and receptor to the energy (usually expressed as explosive weight) released at any given instant in time. The two most popular approaches are square root scaling and cube root scaling:

$$\left(SDSR = \frac{R}{\sqrt{W}}\right) \qquad \left(SDCR = \frac{R}{\sqrt[3]{W}}\right)$$

Where, SDSR = Scaled distance square root method

SDCR = Scaled distance cube root method

R = Separation distance between receptor site and blast (m)

W = Maximum explosive load per delay period (kg)

Historically, square root scaling is employed in situations whereby the explosive load is distributed in a long column (i.e. blasthole) while cube root scaling is employed for point charges. In accordance with industry standard, square root scaling was adopted for ground vibration analysis for the purposes of this report.

For a distance of 710m (the standoff distance to the closest sensitive receptor for the initial Phase 1a blasting (Mid Extraction Area), namely 10148 Beaversdam Road) and a maximum explosive load per delay of 118kg (101mm diameter hole, 15m deep, 3m surface collar and 1 hole per delay), we can calculate the maximum PPV at the closest building using the following formulae:

Imperial Equations:

Oriard 50% Bound (2002)	$v = 160(\frac{D}{\sqrt{W}})^{-1.6}$
Oriard 90% Bound (2002)	$v = 242(\frac{D}{\sqrt{W}})^{-1.6}$
Quarry Production Blast (Bulletin 656 – 1971)	$v = 182(\frac{D}{\sqrt{W}})^{-1.82}$
Typical limestone Quarry (Pader report – 1995)	$v = 52.2(\frac{D}{\sqrt{W}})^{-1.38}$
Typical Coal Mine (RI8507 1980)	$v = 133(\frac{D}{\sqrt{W}})^{-1.5}$

Metric Equations:

General Blasting (Dupont)	$v = 1140(\frac{D}{\sqrt{W}})^{-1.6}$
Construction Blasting (Dowding 1998)	$v = 1326(\frac{D}{\sqrt{W}})^{-1.38}$
Agg. Quarry Blasting (Explotech 2005)	$v = 5175(\frac{D}{\sqrt{W}})^{-1.76}$
Agg. Quarry blasting (Explotech 2003)	$v = 7025(\frac{D}{\sqrt{W}})^{-1.85}$

The equations described above accommodate for a range of geological conditions. The proposed blast parameters were applied to the formulae to estimate a range of the potential vibrations to be imparted on the closest sensitive receptor behind the blast. As discussed in previous sections, the MECP guideline for blast-induced vibration is 12.5 mm/s (0.5 in/s). Appendix C demonstrates that the maximum (ie worst-case) calculated value for the vibration intensities imparted on the closest sensitive receptor based on all equations is 4.14mm/s for the initial blasting, well below the MECP guideline limit. All blasts will be monitored for overpressure and ground vibrations with blast designs adjusted in response to readings on site in order to confirm consistent compliance with established limits.

All vibration calculations and tables going forward will utilize the formula providing the worst case scenario for all geological conditions (Construction Blasting (Dowding 1998)).

An ***example*** of this calculation is as follows:

For a distance of 710m (the standoff distance to the closest sensitive receptor for the initial Phase 1a blasting, namely 10148 Beaversdam Road) and a maximum explosive load per delay of 118kg (101mm diameter hole, 15m deep, 3m surface collar and 1 hole per delay), we can calculate the maximum PPV at the closest sensitive receptor as follows:

$$ppv = 1326\left(\frac{710}{\sqrt{118}}\right)^{-1.38} = 4.14mm/s$$

As discussed in previous sections, the MECP guideline for blast-induced vibration is 12.5 mm/s (0.5 in/s). The calculated 95% predicted PPV (based on the proposed blasting data discussed above) would be 4.14mm/s, well below the MECP guideline limit. It is understood that as separation distance to the receptors decreases, adjustments to blast designs may be necessary to maintain compliance with the guideline limits.

Similarly, the above equation used to calculate PPV can be reformatted to find an approximation of the distance at which a vibration velocity of 12.5mm/s would occur if all blasting parameters are kept the same as used in the equation above:

$$12.5 = 1326\left(\frac{d}{\sqrt{118}}\right)^{-1.38} = 319.0m$$

The above result suggests that design modifications to the above preliminary design of an explosive load of 118kg/delay would be required once blasting operations encroach to within 319m of any sensitive receptor. Fortunately, vibration data will be continually collected and analyzed as the sensitive receptors are approached in order to confirm the requirement for any design modifications. An abundance of design modifications are available which would readily maintain vibration intensities below guideline limits. This is based on conservative assumptions which will be confirmed through monitoring.

Given the separation distances that will be involved at the proposed Uppers Quarry, Table 2 below provides initial guidance on maximum loads per delay based on various separation distances. The following maximum loads per delay were derived from the equation for ground vibrations listed above and are based on a maximum intensity of 12.5mm/s:

Separation distance between sensitive receptor and closest borehole (meters)	Maximum recommended explosive load per delay (Kilograms)
500	290
450	235
400	185
350	140
300	105
250	70
200	45
150	25
100	11

Table 2: Maximum Loads per Delay to Maintain 12.5mm/s at Various Separation Distances

It is noteworthy that the above values are typically conservative and are intended as a guideline only as the ground vibration attenuation equation is based on a calculated 95% regression line. Actual loads can be adjusted on the basis of the results of the monitoring program in place.

The closest separation distance between a sensitive receptor and the extraction limits of the license is 80m. While blasting at this separation distance is feasible from a technological perspective, given current blasting technology and techniques, market economics will dictate the feasibility of extracting rock at lesser separation distances. Monitoring and changes in blasting designs will be

required in order to confirm all blasts are within MECP guidelines when blasting comes closer to adjacent sensitive receptors.

Similarly to the paragraph above, the closest separation distance between a non-sensitive receptor (namely the utility buildings located at 4832 Thorold Townline Road) and the extraction limits of the license is 40m. Using the above equation and keeping the same blasting parameters with a suggested limit of 50mm/s, the calculation would suggest that once blasting encroaches to 116m removed from the utility buildings, modifications may be required.

OVERPRESSURE LEVELS AT THE NEAREST SENSITIVE RECEPTOR

It is unusual for overpressure to reach damaging levels and when it does, the evidence is typically immediate and obvious in the form of broken windows in the area. However, overpressure remains of interest due to its ability to travel further distances as well as cause audible sounds and excitation in windows and walls.

Air overpressure decays in a known manner in a uniform atmosphere, however, a uniform atmosphere is not a normal condition. As such, air overpressure attenuation is far more variable due to its intimate relationship with environmental influences. Air vibrations decay slower than ground vibrations with an average decay rate of 6dBL for every doubling of distance.

Air overpressure levels are analyzed using cube root scaling based on the following equation:

$$P = k\left(\frac{d}{\sqrt[3]{w}}\right)^{e}$$

Where, P = the peak overpressure level (psi – imperial, Pa, dB - metric)
K, e = site factors
d = distance from receptor (ft – imperial, m - metric)
w = maximum explosive charge per delay (lbs – imperial, kg - metric)

The value of K and e are variable and are influenced by many factors (i.e. rock type, geology, thickness of overburden, environmental conditions, etc.). As such, these site factors are developed empirically through the measurement of overpressure characteristics at the specific operations of interested.

As discussed in previous sections, the MECP guideline for blast-induced overpressure is 128dBL. For a distance of 710m (i.e. the standoff distance to the closest sensitive receptor in front of the blast for the initial Phase 1a blasting (Mid Extraction Area), namely 10148 Beaversdam Road) and a maximum explosive load of 118kg (101mm diameter hole, 15m deep, 3m surface collar and 1 hole per delay), we can calculate the overpressure at the nearest receptor in front of the blast using the following equations:

Imperial Equations:

USBM RI8485 (Behind Blast) $$P = 0.056(\frac{D}{\sqrt[3]{W}})^{-0.515}$$

USBM RI8485 (Front of Blast) $$P = 1.317(\frac{D}{\sqrt[3]{W}})^{-0.966}$$

USBM RI8485 (Full Confined) $$P = 0.061(\frac{D}{\sqrt[3]{W}})^{-0.96}$$

Construction Average (Oriard 2005) $$P = 1(\frac{D}{\sqrt[3]{W}})^{-1.1}$$

Metric Equations:

Ontario Quarry - dB (Explotech) $$P = 159(\frac{D}{\sqrt[3]{W}})^{-0.0456}$$

Limestone - dB (Explotech) $$P = 206(\frac{D}{\sqrt[3]{W}})^{-0.1}$$

Ontario Quarry - Pa (Explotech) $$P = 1222(\frac{D}{\sqrt[3]{W}})^{-0.669}$$

Appendix C demonstrates that the maximum calculated value for the overpressure intensities imparted on the closest sensitive receptor based on all equations is 126.8 dB(L) for the initial blasting, below the MECP guideline limit. For initial blasting, all blasts should be scheduled on days with favourable weather conditions to assist in mitigating overpressure levels.

The initial blasting area is also located in the most optimal location such that the direction of extraction will only increase the distance removed from where the front face is directed towards the sensitive receptor. Every subsequent blast in Phase 1a when retreating to the East and South from the initial Phase 1a sinking cut area will result in progressively lower overpressure results. All blasts will be monitored for overpressure and ground vibrations with blast designs adjusted in response to readings on site in order to maintain consistent compliance with established limits.

Based on the above calculation and the assumed blast parameters, and the conservatism built into the equations, overpressures from blasting operations can remain compliant with the MECP NPC 119 guideline limit of 128dBL. The design method of retreat has been planned so as to direct overpressures generated as much as practicable in the direction of vacant lands. All overpressure calculations and tables going forward will utilize the formula providing the worst case scenario for all geological conditions (Ontario Quarry – Pa (Explotech)).

We reiterate that air overpressure attenuation is far more variable due to its intimate relationship with environmental influences and as such, the equation employed is less reliable than that developed for ground vibration. Overpressure monitoring performed on site shall be used to guide blast design as it pertains to the control of blast overpressures. As demonstrated in Appendix B, prevailing winds during quarry operational periods are predominantly out of the Southwest.

The overpressure equation used to calculate PSPL can be reformatted to find an approximation of the distance at which an overpressure of 128 dB(L) would occur. If all blasting parameters are kept the same as above, a distance of 580m from the closest sensitive receptor in front of the blast would have a calculated overpressure of 128db(L). Once again, the on-site monitoring program will accurately delineate the overpressure intensities and provide guidance for the timing for any design changes.

Given the correlation between overpressure and environmental conditions as stated previously, care must be taken to avoid blasting on days when weather patterns are less favourable. Extraction directions have been selected so as to minimize overpressure impacts on adjacent receptors.

Table 3 below can be used as an initial guide showing maximum loads per delay based on various separation distances for receptors in front of the blast face. The following maximum loads per delay are derived from the air overpressure equation above and are based on a peak overpressure level of 128dB(L):

Separation distance between sensitive receptor and closest blasthole (meters)	Maximum recommended explosive load per delay (Kilograms)
1000	610
900	440
800	310
700	208
600	130
500	75

Table 3: Maximum Calculated Loads per Delay to Maintain 128dB(L) at Various Separation Distances for Receptors in Front of the Face

We note that the above values are conservative and are intended as a guideline only as the air overpressure attenuation is based on a calculated 95% regression line. Actual loads employed shall be based on the results of the monitoring program in place.

ADDITIONAL CONSIDERATIONS OUTSIDE OF THE BLAST IMPACT ANALYSIS SCOPE

The following headings are addressed for general information purposes and are not strictly required as part of the scope of the Blast Impact Analysis as required under the ARA to assess compliance with MECP NPC-119 guidelines. Considerations for the TC Energy Pipeline and Hydro One transmission towers can be expanded upon under separate cover with direct input from the owners as required. The hydrogeological study prepared by WSP as part of the licence application will address residential water wells in detail. Flyrock control is addressed at the operational level given significant influences related to blast design, geology and field accuracy which render concrete recommendations related to control inappropriate at the licencing phase. Considerations for aquatic species in the existing watercourse are further addressed in the Stantec report.

TC ENERGY HIGH PRESSURE NATURAL GAS PIPELINE

A TC Energy High Pressure Natural Gas Pipeline runs adjacent to the Northwest corner of the proposed quarry limits (refer to Appendix A). The MECP guideline for blast-induced vibration (12.5mm/s) does not apply to pipelines as they are not classified as sensitive receptors. Two (2) welded steel pipelines exist within the TC Energy right of way (ROW), one 20" and one 36" diameter pipeline. TC Energy Policy employs a 50mm/s vibration limit for welded steel pipelines. Based on the proposed Operations Plan for the Uppers Quarry, initial blasting operations are anticipated to be required approximately 345m from the subject pipeline, however, will reach as close as 7m throughout the course of extraction.

Applying the equation from Predicated Vibration Limits at the Nearest Sensitive Receptor, for a distance of 345m (the conservative standoff distance to the pipeline for the initial blasting (Mid Extraction Area)) and a maximum explosives load per delay of 118kg (101mm diameter hole, 15m deep, 3m surface collar and 1 hole per delay), we can calculate the maximum PPV at the pipeline as follows for the initial blast:

$$ppv = 1326\left(\frac{345}{\sqrt{118}}\right)^{-1.38} = 11.22 mm/s$$

The calculated 95% predicted PPV (based on the proposed blasting data discussed above) would be 11.22mm/s, well below the TC Energy limit of 50mm/s for a steel welded pipeline located adjacent to the proposed quarry.

While this initial value resides below the required threshold, it is anticipated that design modifications will be necessary to maintain compliance as the separation distance to the pipeline decreases and column loads increase. Fortunately, a variety of blast design alternatives are available to accomplish this including but not limited to reductions in blast hole diameter, change in explosives types, adjustment in bench heights and decking of holes.

We do note that the TC Energy Blasting Specification requires the presence of a vibration monitoring program when blasting operations are to be conducted within 100m of a pipeline. The proposed Operational Plan dictates that blasting is to encroach within 7m of the ROW and as such, it is a recommendation of this report that an independent third party firm be retained to conduct vibration monitoring on this pipeline when separation encroaches within 100m of the pipeline or when calculations suggest ground vibrations in excess of 35mm/s as measured at the pipeline are anticipated. The results of this monitoring program will determine what blast design alterations shall be necessary as the separation distance to the subject pipeline decreases. Walker will adhere to the guidelines set by TC Energy with respect to blasting in proximity of the gas lines.

FLYROCK

Flyrock is the term used to define rocks which are propelled from the blast area by the force of the explosion. This action is a predictable and necessary component of a blast and requires that every blast have an exclusion zone established within which no persons or property which may be harmed are permitted.

Government regulations strictly prohibit the ejection of flyrock off of a quarry property. The regulations regarding flyrock are enforced by the Ministries of Natural Resources, Environment and Labour. In the event of an incident where flyrock does leave a site, the punitive measures include suspension / revocation of licences and fines to both the blaster and quarry owner / operator. Fortunately, flyrock incidents are extremely rare due to the possible serious consequences of such an event. It is in the best interest of all, stakeholders and non-stakeholders, to ensure that dangerous flyrock does not occur. Through proper blast planning and design, it is possible to control and mitigate the possibility for flyrock.

THEORETICAL HORIZONTAL FLYROCK CALCULATIONS

Flyrock occurs when explosives in a hole are poorly confined by the stemming or rock mass and the high pressure gas breaks out of confinement and launches rock fragments into the air. The three primary sources of fly rock are as follows:

- **Face burst:** Lack of confinement by the rock mass in front of the blast hole results in fly rock in front of the face.
- **Cratering:** Insufficient stemming height or weakened collar rock results in a crater being formed around the hole collar with rock projected in any direction.
- **Stemming Ejection:** Poor stemming practice can result in a high angle throw of the stemming material and loose rocks in the blasthole wall and collar.

The horizontal distance flyrock can be thrown (L_H) from a blast hole is determined using the expression:

$$L_H = \frac{V_o^{\,2} Sin2\theta_0}{g} \qquad [1]$$

where: V_o = launch velocity (m/s)

θ_0 = launch angle (degrees)

g = gravitational constant (9.8 m/s^2)

The theoretical maximum horizontal distance fly rock will travel occurs when θ_0 = 45 degrees, thereby yielding the equation:

$$L_{H\max} = \frac{V_o^{\,2}}{g} \qquad [2]$$

The normal range of launch velocity for blasting is between 10m/s - 30m/s. To calculate the launch velocity of a blast the following formula is used:

$$V_o = k\left(\frac{\sqrt{m}}{B}\right)^{1.3} \qquad [3]$$

where: k = a constant

m = charge mass per meter (kg/m)

B = burden (m)

By combining equations 2 and 3 and taking into account the different sources of fly rock, the following equations can be used to calculate the maximum fly rock thrown from a blast:

Face burst: $$L_{H\max} = \frac{k^2}{g} * \left(\frac{\sqrt{m}}{B}\right)^{2.6}$$

Cratering: $$L_{H\max} = \frac{k^2}{g} * \left(\frac{\sqrt{m}}{SH}\right)^{2.6}$$

Stemming Ejection: $$L_{H\max} = \frac{k^2}{g} * \left(\frac{\sqrt{m}}{SH}\right)^{2.6} Sin2\theta$$

where: θ = drill hole angle
L_{hmax} = maximum flyrock throw (m)
m = charge mass per meter (kg/m)
B = burden (m)
SH = stemming height (m)
g = gravitational constant
k = a constant

The range for the constant k is 13.5 for soft rocks and 27 for hard rocks. Given the proposed licence area is predominantly limestone, we have applied a k value of 21. The explosive density is assigned to be 1.2 g/cc for emulsion products and the drill hole angles are assumed to be 90 degrees (i.e. vertical).

For calculation purposes, we have applied the initial blasting parameters which utilize 101mm (4") diameter holes on a 3.05m x 3.05m (10' x 10') pattern, with a lift height of 15m (49') and a collar length of 3.0m (10'). The following does not apply to the sinking cut which will require highly specialized designs and additional considerations for flyrock. Based on a free face blast, maximum anticipated horizontal flyrock projection distances are calculated as follows in Table 4:

Table 4 – Maximum Flyrock Horizontal

Collar **Lengths** (m)	**Maximum Throw Face Burst** (m)	**Maximum Throw Cratering and Stemming Ejection** (m)
1.5	48	302
2.0	48	143
2.5	48	80
3.0	48	50
3.5	48	33

Different collar lengths are displayed in the table above to account for over or under loaded holes. As demonstrated with these various collar lengths, any deviation, no matter how slight, can greatly affect these maximum values. The current proposed initial blasting parameters have the potential to send flyrock 50m assuming all holes achieve the designed collar lengths of 3.0m. Blast mats or sand can be placed on top of the initial blast to further reduce the distance for potential flyrock.

Through proper blast design and diligence in inspecting the geology before every blast, flyrock can readily be maintained within the quarry limits. It may be necessary to increase collars and adjust designs accordingly when blasting along the perimeter to accommodate the reduced deportation distance to receptors and to maintain flyrock within the property limits. The operational plan for the quarry has been designed to retreat towards the closest receptors thereby projecting flyrock and overpressures away from the receptors.

TRANSMISSION AND HYDRO TOWERS

Transmission towers (Namely the Hydro One Corridor) runs parallel to the Southern limits of the proposed quarry licence noted on the proposed Operational Plan (refer to Appendix A). The MECP guideline for blast-induced vibration (12.5mm/s) does not apply to transmission/hydro towers as they are not classified as sensitive receptors. In order to safeguard the integrity of these structures, Hydro One has set a vibration limit of 50mm/s at the foundations of the transmission towers.

As per direction from Hydro One, calculations will be based on the 50mm/s limit. The tower shall be monitored for ground vibration and overpressure when vibration calculations suggest vibrations in excess of 35mm/s at the tower base. Based on the proposed Operations Plan for the Uppers Quarry, initial blasting operations are anticipated to be approximately 530m from the closest tower, however, will reach as close as 30m throughout the course of extraction at the Southern limits of Phase 1b and Phase 5.

Applying the equation from Predicated Vibration Limits at the Nearest Sensitive Receptor, for a distance of 530m (the conservative standoff distance to the transmission tower for the initial blasting) and a maximum explosives load per delay of 118kg (101mm diameter hole, 15m deep, 3m surface collar and 1 hole per delay), we can calculate the maximum PPV at the transmission tower for the initial blast as follows:

$$ppv = 1326\left(\frac{530}{\sqrt{118}}\right)^{-1.38} = 6.2mm/s$$

The calculated 95% predicted PPV (based on the proposed blasting data discussed above) would be 6.2mm/s, well below the limit of 50mm/s. While this value resides below the 50mm/s threshold, it is anticipated that design modifications will be necessary to maintain compliance as the separation distance to some of the towers decreases and column loads increase. Fortunately, a variety of blast design alternatives are available to accomplish this including but not limited to reductions in blast hole diameter, change in explosives types, adjustment in bench heights and decking of holes.

RESIDENTIAL WATER WELLS

Possible impacts to the water quality and production capacity of groundwater supply wells is a common concern for residents near blasting operations. Complaints related to changes in water quality often include the appearance of turbidity, water discolouration and changes in water characteristics (including nitrate, e-coli, and coliform contamination). Complaints regarding water production most often involve loss of quantity production, air in water and damage to well screens and casings. A review of research and common causes of these problems indicates that most of these concerns are not related to blasting and can be shown to be the direct impact of environmental factors and poor well construction and maintenance.

There is significant research and scientific substantiation demonstrating that outside of the immediate radius of approximately 20-25 blasthole diameters from a loaded hole, there is no permanent ground displacement resulting from a blast. As such, barring blasting activity within several meters of an existing well, the probability of damage to residential wells is essentially non-existent.

Despite the scientific support for the above conclusion, numerous studies have been performed to verify the validity of this statement. These studies have investigated the effects of blasting on varied well configurations and in varied geological mediums to permit conclusions to be readily extrapolated to diverse blasting operations. The conclusion of these studies has confirmed that with the exception of possible temporary increases in turbidity, blasting operations did not result in any permanent impact on wells outside of the immediate blast zone of the blast until vibrations levels reached exceedingly high intensities. Applying universally accepted threshold levels for ground vibrations eliminates the possibility for any long term adverse effects on wells in the vicinity of blasting operations.

In a study by Froedge (1983), blast vibration levels of up to 32.3mm/s were recorded at the bottom of a shallow well located at a distance of 60 meters (200 feet) from an open pit blast. There was no report of visible damage to the well nor was there any change in the water pumping flow rate. This study concluded that the commonly accepted limit of 50mm/s PPV level is adequate to protect wells from any damage. We reiterate, the current guideline limit for vibrations from quarry and mining operations is 12.5mm/s.

Rose et al. (1991) studied the effect of blasting in close proximity to water wells near an open pit mine in Nevada, USA. Blasts of up to 70 kilograms of explosives per delay period were detonated at a distance of 75 meters (245 feet) from a deep water well. There was no reported visible damage to the well. Fluctuations in water level and flow rate were evident immediately after the blast. However, the well water level and flow rate quickly stabilized.

The U.S. Bureau of Mines conducted a study (Robertson et al., 1990) to determine the changes in well capacity and water quality. This involved pumping from wells before and after nearby blasting. One experiment with a well in sandstone showed no change in well capacity after blasts induced PPV's at the surface of 84mm/s and there was no change in water level after PPV's of 141mm/s, well above the current guideline limit of 12.5mm/s.

Matheson et al. (1997) brought together available information on the most common complaints, the possible causes of the complaints and the relation between blasting and the complaint causes. This study yet again reaffirmed the fact that the attribution of well problems to blast sources are unfounded.

The MECP vibration limit of 12.5mm/s effectively excludes any possibility of damage to residential water wells. Based on available research and our extensive experience in Ontario quarry blasting, blasting at the Upper's Quarry will induce no permanent adverse impacts on the residential water wells on properties surrounding the site.

EXPLOTECH

BLAST IMPACT ON ADJACENT WATERCOURSES

The detonation of explosives in or near water can produce compressive shock waves which initiate damage to the internal organs of fish in close proximity, ultimately resulting in the death of the organism. Additionally, ground vibrations imparted on active spawning beds have the ability to adversely impact the incubating eggs and spawning activity. In an effort to alleviate adverse impacts on fish populations as a result of blasting, the Department of Fisheries and Oceans (DFO) developed the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (1998). This publication establishes limits for water overpressure and ground vibrations which are intended to mitigate impacts on aquatic organisms while providing sufficient flexibility for blasting to proceed. Specifically, water overpressures are to be limited to 100kPa and, in the presence of active spawning beds, ground vibrations at the bed are to be limited to 13mm/s.

An existing watercourse currently runs in a North/South direction through the middle of Phase 3a and the Western sections of Phases 4 and 5. The operational plan has proposed for the realignment of the existing watercourse as part of the license but as per the phasing will remain in its current location during blasting in Phases 1a and 1b. The operational plan shows the existing watercourse alignment, prior to its realignment, at an approximate 26m setback distance from all surrounding phases. Based on these separation distances and our experience on similar operations, water overpressures generated by the blasting will reside below the DFO 100kPa guideline limit and will have no impact on the adult fish populations present.

As per a preliminary document completed by Stantec, one of the fish species identified (Pike) in the adjacent watercourse have two (2) distinct spawning areas but technically anywhere that vegetation is flooded could be potential spawning habitat. The closest area of potential spawning lies approximately 208m from the initial Phase 1a (Mid Extraction Area) Sinking Cut Area blasting operations. The spawning time for the identified fish species in the adjacent watercourses has been established from March – July. As such, active spawning beds present would be subject to the DFO guideline vibration limit of 13mm/s. During spawning season, vibration monitoring will be required at the shoreline adjacent the closest spawning area on the blast side of the water body in order to confirm compliance with DFO limits for ground vibration.

Table 5 below is presented as initial guidance showing maximum permissible loads per delay based on various separation distances from spawning beds. The following maximum loads per delay are derived from the equation for ground vibrations listed earlier in this report and are based on a maximum vibration intensity of 13.0mm/s as experienced at the active spawning habitat:

Separation distance between possible spawning bed and closest borehole (meters)	Maximum recommended explosive load per delay (Kilograms)
500	305
450	245
400	195
350	150
300	110
250	75
200	49
150	27
100	12
75	6.5
50	3
30	1

Table 5: Maximum Loads per Delay to Maintain 13.0mm/s at Various Separation Distances

The generation of suspended solids within the watercourse as a result of the blasting activities will be negligible and grossly subordinate to suspended solids generated as a result of spring runoff and rain activity.

RECOMMENDATIONS

It is recommended that the following conditions be applied for all blasting operations at the proposed Upper's Quarry:

1. An attenuation study shall be undertaken by an independent blasting consultant during the first 12 months of operation in order to obtain sufficient quarry data to confirm the initial guideline parameters and assist in refining future blast designs.

2. All blasts shall be monitored for both ground vibration and overpressure at the closest privately owned sensitive receptors adjacent the site, or closer, with a minimum of two (2) instruments – one installed in front of the blast and one installed behind the blast.

3. Blasts shall be designed to maintain vibrations below 13mm/s at the location of the closest identified active spawning bed as per DFO guidelines. When blasting during active spawning season, a minimum of one supplemental vibration monitor shall be installed on the shoreline closest to the spawning bed to confirm the vibration levels.

4. The guideline limits for vibration and water overpressure shall adhere to standards as outlined in the Guidelines For the Use of Explosives In or Near Canadian Fisheries Waters (1998) or any such document, regulation or guideline which supersedes this standard.

5. All blasts shall be monitored for ground vibration at the adjacent TC Energy High Pressure Natural Gas Pipeline when blasting within 100m of the pipeline or when calculations suggest vibrations in excess of 35mm/s.

6. Blasts shall be designed to maintain vibrations at the transmission towers in the Hydro One Corridor below 50mm/s or any such document, regulation or corporate policy in effect at the time. When vibration calculations suggest vibrations at the towers may exceed 35mm/s, the towers shall be monitored for ground vibration.

7. Blasts shall be designed to maintain vibrations at the 4832 Thorold Townline Road utility buildings below 50mm/s. When vibration calculations suggest vibrations at the utility buildings may exceed 35mm/s, the buildings shall be monitored for ground vibration.

8. The guideline limits for ground vibration and air overpressure shall adhere to standards as outlined in the Model Municipal Noise Control By-law

publication NPC 119 (1978) or any such document, regulation or guideline which supersedes this standard.

9. Orientation of the aggregate extraction operation will be designed and maintained so that the direction of the overpressure propagation will be away from structures as much as possible.

10. Blast designs shall be continually reviewed with respect to fragmentation, ground vibration and overpressure. Blast designs shall be modified as required to maintain compliance with current applicable guidelines and regulations.

11. Detailed blast records shall be maintained in accordance with current industry best practices.

The blast parameters described within this report are supported by the modelling in the attached appendices. As the quarry progresses and as site-specific data is collected from the on-going operation, the blast parameters can be refined, as necessary, to maintain continual compliance with MECP Guidelines.

CONCLUSION

The blast parameters described within this report will provide a good basis for the initial blasting operations at this location. As site specific blast vibration and overpressure data becomes available, it will be possible to refine these parameters on an ongoing basis.

Blasting operations required for operations at the proposed Uppers Quarry site can be carried out safely and within governing guidelines set by the Ministry of the Environment, Conservations and Parks.

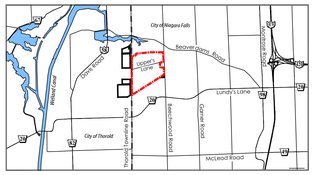
Modern blasting techniques will permit blasting to take place with explosives charges below allowable charge weights ensuring that blast vibrations and overpressure will remain minimal at the nearest receptors.

Appendix A

Key Map - (N.T.S.)

Subject Lands

Additional Lands Owned by Applicant



A. General

1. This Site Plan is prepared under the Aggregate Resources Act for a Class A Licence for a quarry below the ground water table.

2. Area to be licenced 103.6 ha. (±256.0 ac.)
   Area to be extracted 89.1 ha. (±220.2 ac.)

B. References

1. Contour information was obtained from a topographic survey prepared by TEC Engineering (formerly Renishaw (Canada) Limited) using October 2016 and February 2017 aerial photography and are displayed in one metre intervals. Elevations shown are in metres above sea level (masl).

2. Topographic information was obtained from numerous sources including Ontario GeoHub (Land Information Ontario), Google Earth Pro aerial photography captured on July 18, 2018 and field investigations for technical reports.

3. All topographic features and structures are shown to scale in Universal Transverse Mercator (UTM) with North American Datum 1983 (NAD83), Zone 17 (metre), Central Meridian 81 degrees west coordinate system.

4. Property boundaries were obtained from a Plan of Survey prepared by Matthews, Cameron, Heywood-Kerry T. Howe Surveying Ltd. dated April 5, 2012. Other property boundaries were established using Municipal Property Assessment Corporation (MPAC) parcel fabric data.

5. Zoning categories on or within 120 metres of the licence boundary are from the City of Niagara Falls Zoning By-law No. 79-200 (Schedules A3 and A4 - Consolidation April 2015).

6. Land use information on or within 120 metres of the licence boundary has been compiled from October 2016 ortho photography, site visits and water well survey data.

C. Groundwater

1. The maximum predicted water table is 184.9 masl and the contact aquifer potentiometric contours ranges between 176.0 and 184.9 masl (as per WSP's "Proposed Upper's Quarry - Maximum Predicted Water Table Report", dated October 2021.

D. Drainage

1. Existing surface water drainage on and within 120 metres of the licence boundaries are by overland flow in the direction shown by arrows on the plan view.

E. Site Access and Fencing

1. There are two (2) existing site accesses on Thorold Townline Road, six (6) existing site accesses on Upper's Lane, and three (3) existing site accesses on Beechwood Road.

2. Post and wire fencing (unless otherwise noted) exists in the locations shown on the plan view.

F. Aggregate Related Site Features

1. There are no existing aggregate operations or features within the licence boundaries such as stationary or portable equipment, stockpiles, recyclable materials, scrap, fuel storage, haul roads, berms or excavation faces.

G. Technical Reports - References

1. Upper's Quarry: Acoustic Assessment Report, RWDI, October 2021.

2. Agricultural Impact Assessment for Upper's Quarry, Colville Consulting Inc., October 2021.

3. Upper's Quarry: Air Quality Assessment, RWDI Air Inc., October 2021.

4. Archaeological Assessments:

   a. Stage 1 Archeological Resource Assessment of Walker Aggregates Proposed South Niagara Quarry, Part of Lots 102, 119, 120, 136 & 137, Archeological Services Inc., December 2008.

   b. Stage 1-2 Archeological Assessment of Part 9764 Uppers Lane, Part of Lots 119 & 120, Archeological Assessments Ltd., November 3, 2005.

   c. Stage 2-3 Archeological Assessment, Part of Lots 102, 119, 120, 136 & 137, Archeological Assessments Ltd., November 21, 2012.

   d. Stage 1-2 Archeological Assessments, Upper's Quarry Additional Lands, Part of Lots 119& 120, Archaeological Research Associates Ltd., April 20, 2020.

   e. Stage 3 Mitigation of Development Impacts, Final Excavation Report, Walker XI (AgGT-411), Upper's Quarry, Archaeological Research Associates Ltd., May 26, 2021.

   f. Stage 4 Mitigation of Development Impacts, Final Excavation Report, Walker XI (AgGT-178), Upper's Quarry, Archeological Research Associates Ltd., July 22, 2021.

5. Blast Impact Analysis, Upper's Quarry, Explotech, October 2021.

6. Cultural Heritage Impact Assessment Report, Proposed Upper's Quarry, MHBC, October 2021.

7. Economic Benefits Analysis, Prism, October 2021.

8. Level 2 Water Study Report, WSP, October 2021.

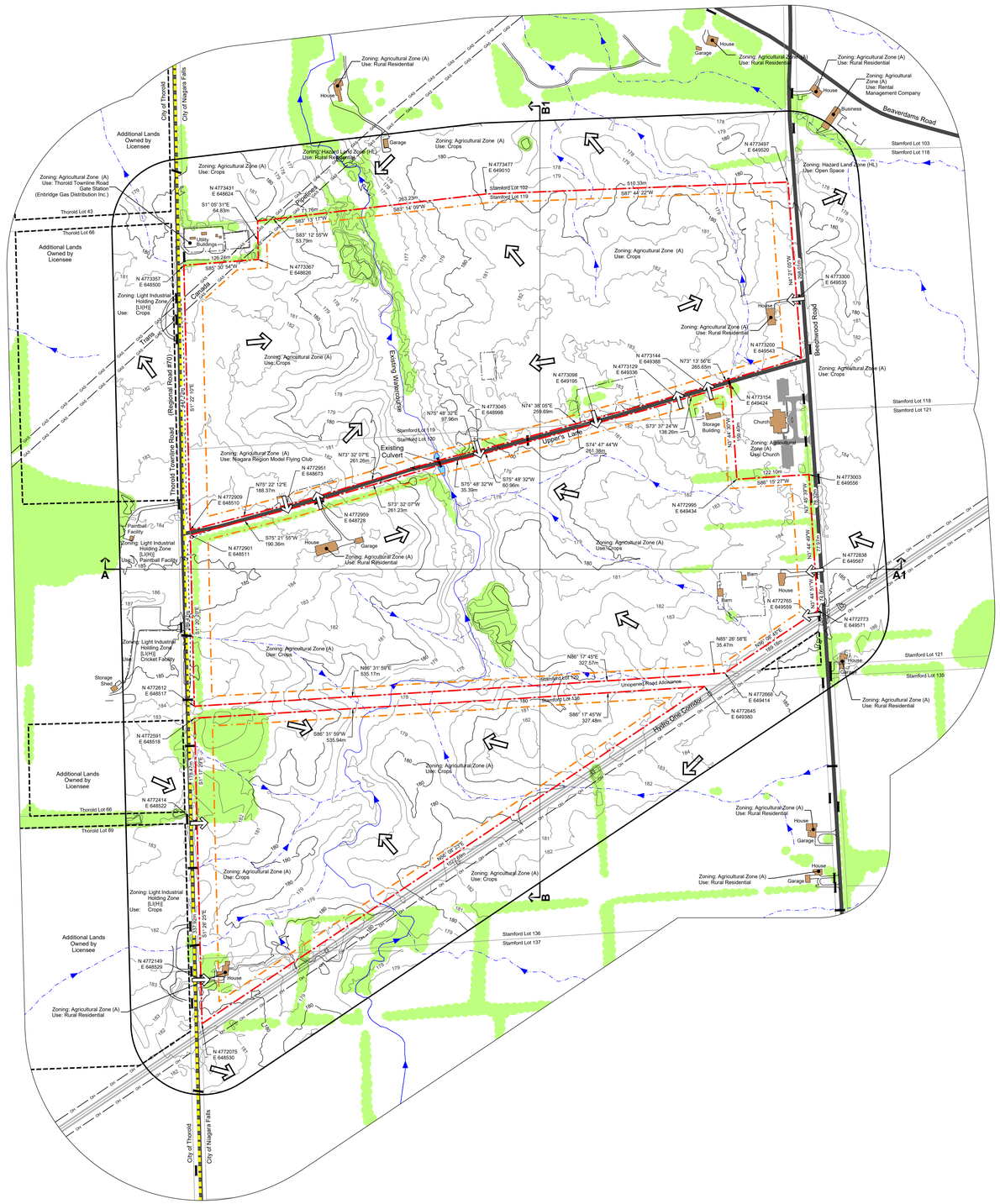
9. Maximum Predicted Water Table Report, WSP, October 2021.

10. Upper's Quarry, Niagara: Level 1 and Level 2 Natural Environment Technical Report and Environmental Impact Study, Stantec, October 2021.

11. Planning Justification Report and Summary Statement, MHBC, October 2021.

12. Traffic Impact Study, Upper's Quarry, TMIG, October 2021.

13. Visual Impact Assessment, Proposed Upper's Quarry, MHBC, October 2021.



Legal Description

Part of Lots 119, 120, 136 & 137
City of Niagara Falls (Geographic Township of Stamford)
Regional Municipality of Niagara

- Licence Boundary
- Limit of Extraction
- Additional Lands Owned by Licensee
- Municipal Boundary
- Contours with Elevation (Metres above sea level (MASL))
- Public Road
- Fence (1.2m post & wire farm fence unless otherwise noted)
- Watercourse (Direction of flow indicated by arrows)
- Surface Drainage Feature (Direction of flow indicated by arrows)
- Water Feature
- Wooded Area
- 120m Offset From Licence Boundary
- Parcel Fabric
- Trans Canada Pipeline Easement
- Hydro One Easement
- Existing Site Access
- Direction of Surface Drainage
- Existing Culvert
- Building/Structure
- Cross Sections (A1)

Site Plan Acronyms

1. ARA - Aggregate Resources Act
2. MNDMNRF - Ministry of Northern Development, Mines, Natural Resources and Forestry
3. MHSTCI - Ministry of Heritage, Sport, Tourism and Culture Industries
4. MECP - Ministry of the Environment, Conservation and Parks
5. MGCS - Ministry of Government and Consumer Services
6. DFO - Department of Fisheries and Oceans Canada
7. ECA - Environmental Compliance Approval
8. BMPP - Best Management Practices Plan
9. PTTW - Permit to Take Water
10. MASL - Metres above sea level
11. ROW - Right of way
12. HMA - Hot mix asphalt

Site Plan Amendments

No.	Date	Description	By

Site Plan Revisions (Pre-Licencing)

No.	Date	Description	By

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
113 COLLIER STREET, BARRIE, ON. L4M 1H2 | P: 705.728.0045 F: 705.728.2010 | WWW.MHBCPLAN.COM

MHBC Stamp
Debra Walker
Is authorized by the Ministry of Northern Development, Mines, Natural Resources and Forestry pursuant to Section 2 (1) of the Aggregate Resources Act to prepare and certify site plans.

MHBC Stamp
Christopher Poole
Is authorized by the Ministry of Northern Development, Mines, Natural Resources and Forestry pursuant to Section 2 (1) of the Aggregate Resources Act to prepare and certify site plans.

Applicant

Walker Aggregates Inc.
2800 Thorold Townline Road
P.O. Box 100
Thorold, Ontario
L2V 3Y8

Project

Upper's Quarry

MNDMNRF Licence Reference No.

Applicant's Signature

Plan Scale: 1:3000 (Arch E)
0 90 180 Meters

Date October 2021
Drawn By C.P.
Checked By D.W.
File No. 9811V

File Name
Existing Features

Drawing No.
1 of 6

File Path N:\Brian\9811V - Walker Uppers Quarry\Drawings\Site Plan\CAD\9811V - Site Plan - Proposed Scenario.dwg

A. General

1. Area to be licenced 103.6 ha. (±256.0 ac.)
   Area to be extracted 89.1 ha. (±220.2 ac.)
2. The maximum amount of aggregate to be removed from this site in any calendar year is 1,800,000 tonnes.
3. In the event that Walker obtains permission from the City of Niagara Falls to extract the road allowance(s), the licensee may apply to the MNDMNRF to amend the licence and site plan to expand the licence boundary to include the road allowance directly adjacent to the licence boundary (i.e. Upper's Lane and/or the road allowance between Lots 120 and 136). An expansion to the licence boundary for this purpose will not require a new licence under Section 7 of the Aggregate Resources Act (ARA).
4. All technical reports have taken into consideration the potential removal of the road allowance(s).
5. Table 1 on this drawing identifies the number of sensitive receptors within 500 metres of the licence boundary and the distance from the licence boundary to each receptor.

B. Hours of Operation

1. The proposed quarry will have the following hours of operation:

Activity	Monday to Friday	Saturday	Sunday
Drilling, extraction (at working face)	7:00 am to 7:00 pm	7:00 am to 7:00 pm	N/A
Blasting	8:00 am to 6:00 pm	N/A	N/A
Aggregate processing at mobile crusher plant	7:00 am to 7:00 pm	7:00 am to 7:00 pm	N/A
Asphalt plant operations	24 hours per day	24 hours per day	24 hours per day
Internal hauling of aggregate and/or recycled material: - From working face (shot rock) to mobile crusher plant - From mobile crusher plant/stockpiles to asphalt plant	7:00am to 7:00pm 24 hours per day	7:00am to 7:00pm 24 hours per day	N/A 24 hours per day
Aggregate and recycling shipping to and/or from the quarry (including hot mix asphalt shipping from quarry and receiving recycled asphalt to quarry)	24 hours per day	24 hours per day	24 hours per day
Maintenance	24 hours per day	24 hours per day	24 hours per day

A response to emergencies is not limited by the hours of operations shown on this plan.

C. Proposed Entrances/Exits and Fencing

1. For the Mid Extraction Area:
   a. All traffic for operations will enter and exit the Mid Extraction Area from Upper's Lane using a main entrance/exit in the location generally shown on the plan view.
   b. If an entrance/exit off of Upper's Lane is not permitted, traffic for operations will enter and exit the Mid Extraction area from Thorold Townline Road. If approved, the site plan will be updated to accurately depict the location of the entrance/exit off of Thorold Townline Road.
2. For the South Extraction Area:
   a. Material will be transported to the Mid Extraction Area for processing via a conveyor over the unopened road allowance between Lots 120 and 136. Limited traffic required for operations will enter and exit the South Extraction Area via a crossing over the unopened road allowance between Lots 120 and 136, subject to approval from the City, in the location generally shown on the plan view.
   b. If permission to cross the unopened road allowance is not granted, traffic for operations will enter and exit the South Extraction area from Thorold Townline Road. If approved, the site plan will be updated to accurately depict the location of the entrance/exit off of Thorold Townline Road.
3. For the North Extraction Area:
   a. All traffic for operations will enter and exit the North Extraction Area from Upper's Lane using a main entrance/exit in the locations generally shown on the plan view.
   b. If an entrance/exit off of Upper's Lane is not permitted, traffic for operations will enter and exit the North Extraction area from Thorold Townline Road. If approved, the site plan will be updated to accurately depict the location of the entrance/exit off of Thorold Townline Road.
4. Only one operational entrance/exit will be utilized at any one time.
5. Once established, each operational entrance/exit shall be gated. All gates shall be kept closed during hours of non-operation and shall be maintained throughout the life of the licence.
6. The licence boundaries shall be fenced in the locations shown on the plan view (prior to the commencement of operations) and shall be maintained for the life of the licence with upkeep during periodic inspections (see Section N Variations from Control and Operation Standards on this drawing).

D. Drainage and Siltation Control

1. Silt fencing/sediment control measures will be installed within the Watercourse Realignment Transition Area prior to extraction in each extraction area and along the easterly and northerly limits of Phase 1B after the watercourse realignment is completed.

E. Site Preparation

1. All existing structures within the licence boundary shall be demolished or removed prior to extraction in each extraction area.
2. Timber resources (if any) will be salvaged for use as saw logs, fence posts and fuel wood where appropriate. Stumps and brush cleared will be burned (with applicable permits), used for shoreline habitat enhancement or mulched for use in progressive rehabilitation.
3. Areas of the site will be stripped of topsoil/overburden in stages in accordance with the phases. Topsoil and overburden will be stripped and stored in berms and/or stockpiles wherever feasible.
4. Topsoil and overburden shall be placed in perimeter acoustic/visual berms, pond construction, watercourse realignment or used immediately for progressive rehabilitation in this licence or existing Licence Numbers 11175 and 4437 (see Section N Variations from Control and Operation Standards on this drawing).
5. Excess topsoil and overburden not required for immediate use in berms or rehabilitation may be temporarily stockpiled on the quarry floor. Topsoil and overburden stockpiles shall be located within the limit of extraction and remain a minimum of 30 metres from the licence boundary and 90 metres from a property with a residential use.
6. Temporary topsoil and overburden stockpiles which remain for more than one year shall have their slopes vegetated to control erosion. Seeding shall not be required if these stockpiles have vegetated naturally in the first year.

F. Setbacks, Berms and Screening

1. Setbacks are as shown on the plan view. Excavation will occur within the extraction setback area along the west and northwest area of the licensed boundary to accommodate grading required for the realignment of the existing watercourse. Furthermore, areas within the setbacks will be accessed as necessary to perform general site servicing, maintenance (berming, fencing etc.) and progressive rehabilitation. See Section N Variations from Control and Operation Standards on drawing 2 of 6.
2. Locations and heights for all acoustic/visual berms are provided on the plan view. All proposed berms shall be constructed in accordance with the "Typical Acoustic Berm Detail" (on this drawing), "Typical Visual Berm Detail" (on drawing 4 of 6) and, more specifically, berms adjacent to Beechwood Road will be constructed in accordance with "Typical Berm - Adjacent to Beechwood Berm Detail" (on this drawing). Where the proposed berm transects the existing watercourse along the north perimeter, a culvert shall be installed in accordance with DFO requirements. Culverts will also be installed under berms, where necessary, to maintain existing drainage to and from off-site and to the existing watercourse. All proposed berms and will be vegetated and maintained to control erosion. Temporary erosion control will be implemented as required.
3. Perimeter acoustic berms may be removed for final rehabilitation in the final Phase when they are no longer required for noise attenuation.
4. Any natural treed buffer areas in the setbacks will be maintained where feasible subject to berm requirements.

G. Site Dewatering

1. Surface water will be discharged from the sump areas to the existing watercourse until the watercourse is realigned to the location of Phases 1B and 2B. Once the watercourse realignment has been completed, surface water will be discharged from the sumps to the realigned watercourse in Phase 1B.
2. Sump: During quarry development, a portable submersible pumps will be installed in each Initial Sinking Cut Area for the purpose of dewatering to maintain a dry working area and/or aggregate washing. Water will be pumped from the sumps to a pond where it is either used for aggregate washing or discharged to the existing watercourse. The sumps shall be relocated (as required) within each extraction area during the operational life of the quarry.

H. Extraction Details

1. The extraction sequence is outlined on drawing 3 of 6.
2. The proposed maximum depth of extraction is indicated by the spot elevations shown on the plan view. Extraction shall proceed to a maximum depth of approximately 42 m below ground surface (ranging in elevation from 141 masl in the southwest to 149 masl in the northeast portions of the site), corresponding to the geologic base of the Gasport dolostone of the Lockport Group.
3. For Phases 1B and 2B, the maximum depth of extraction is approximately 30 metres (down to an elevation of 155 masl) and may be extracted in 1-2 lifts.
4. For the "Watercourse Realignment Transition Area", the maximum depth of extraction is approximately 1 metre (down to an elevation of 174 masl) and any extraction in the "Watercourse Realignment Transition Area" shall be completed as part of site preparation (construction of compensatory ponds). No drilling or blasting shall be permitted in the "Watercourse Realignment Transition Area".
5. Internal haul road locations shall vary as extraction progresses and will be located on the quarry floor with the exception of at grade crossings.
6. Blasted aggregate will be transported back to the mobile crusher plant and processing area on the quarry floor for processing and shipping.
7. An office/scale house and weigh scale will be established on site. A maintenance shop and shed(s) may be constructed on site. Portable office/storage trailers and structures associated with fuel storage may be brought onto the site for temporary periods for uses associated with quarry activity. All structures shall remain 30 metres from the licence boundary / Trans Canada Pipelines easement or 90 metres from the licence boundary if the boundary abuts land that is used for residential purposes or is restricted to residential use by the Zoning By-law at the time the licence is issued.
8. Aggregate stockpiles (including recyclable material) shall be located within the limits of extraction and remain a minimum of 30 metres from the licence boundaries (except where the licence boundaries abut Upper's Lane and the unopened road allowance - See Section N Variations from Control and Operation Standards on this drawing) and 90 metres from a property with a residential use.

I. Equipment and Processing

1. A portable processing plant (including primary, secondary and tertiary crushing and screening units) will be permitted within the North and Mid Extraction Areas inclusive.
2. Processing shall be located within the limit of extraction and remain a minimum of 30 metres from the licence boundary and 90 metres from a property with a residential use.
3. During the sinking cuts and early phases of operation, the primary crusher will be integrated into a single processing plant located near the working face. In later phases, the primary crusher will split from the single integrated plant and start to follow the working face. The processing plant, which contains the secondary and tertiary crushers, will remain close to the quarry entrance. The processing plant will be located at varying elevations, beginning at the top of rock during the sinking cut portion of operations, and moving to the first bench and then the final quarry floor as space becomes available.
4. Once processing has progressed to Phase 2A, a hot mix asphalt (HMA) batch plant facility shall be established on the quarry floor (in the location shown on the plan view) in Phase 1A. The HMA batch plant shall remain in the location shown on the plan view for the life of the quarry.
5. In Phase 4, the portable processing plant shall require additional shielding in accordance with note A.5 on drawing 4 of 6.
6. A wash plant and temporary wash ponds may be established and located to move together with the portable processing plant, subject to permit approval from MECP.
7. Equipment to be used onsite may include, but shall not be limited to:
   a. Working Face - 1 silenced rock drill; 1 loader;
   b. Processing - 1 portable processing plant including crushers, screeners, and stackers; 2 loaders (at stockpiles);
   c. Asphalt - 1 asphalt plant; 2 loaders, 1 compressor vent, 1 dust controller blower (motor and stack); elevator motor, conveyor motor, oven motor, pug mill (door and motor);
   d. Conveyor(s);
   e. Generator(s) (diesel-fueled); and
   f. Rock trucks, haul trucks, shipment trucks and fuel trucks.
8. All processing equipment is subject to applicable permitting under MECP Environmental Compliance Approvals and Ontario Water Resources Act where water use requires water taking and/or discharge. If required, a Certificate of Approval will be obtained for processing equipment to be used on site.
9. Equipment used for construction of the perimeter berms/barriers, overburden stripping, rehabilitation, the new watercourse corridor, as well as other quarry related construction projects will be utilized on site.

J. Frequency / Timing of Blasts

1. Prior to blasting being permitted within the 100 m setback of the TransCanada Pipeline, identified as 'TransCanada Blasting Buffer Area' on this Plan, the licensee shall address the requirements of notes D.5 on drawing 4 of 6.
2. All blast monitoring reports shall be retained by the licensee for a period of seven years after each blast and made available upon request for audit purposes. See Section D on drawing 4 of 6 for detailed blasting requirements.

K. Fuel Storage

1. Fuel storage tanks will be located in close proximity to the main processing plant (or in an alternative location subject to approval by the MNDMNRF). Fuel storage tanks shall be installed and maintained in accordance with Technical Standards and Safety Act, 2000, Liquid Fuels Handling Code, 2000 and Liquid Fuels Regulation Reg. 217/01.
2. All fuel tanks shall be doubled sided or placed in containment facilities large enough to hold the tanks maximum volume.
3. Fuel trucks shall be used to transfer fuel to on-site equipment in accordance with the Liquid Fuels Handling Code, 2000.
4. A Spills Contingency Plan shall be prepared and implemented prior to site preparation. The Spills Contingency Plan shall be available on site and all employees and contractors shall be informed and required to comply with this plan.

L. Spills Plan

1. In case of an accidental spill of petroleum products, the following contingency plan will be activated:
   a. The Ministry of Environment, Conservation and Parks (MECP) (see address and phone number below) and surrounding landowners will be notified.
   b. For a leakage or spill, immediate action will be taken to stop it. At the same, measures will be taken to prevent spreading. These measures may include building or berm or construction of a ditch, for instance.
   c. The quarry operator shall commence recovery procedures by collecting the spilled substance into containers.
   d. The soil in the area affected by the spill or leak shall be removed and disposed of at a location prescribed by the MECP.

   Ministry of Environment, Conservation and Parks
   Niagara District Office
   Garden City Tower 9th Floor Suite 15
   301 St. Paul Street
   St. Catharines, Ontario
   L2R 7R4

   Spills Action Centre: 1-800-268-6060

M. Scrap and Recycling

1. Scrap may be stored on-site and shall be removed on an on-going basis.
2. Scrap shall only include material generated directly as a result of the aggregate operation such as refuse, debris, scrap metal, lumber, discarded machinery, equipment and motor vehicles.
3. All fluids shall be drained from any discarded equipment, machinery or motor vehicle prior to storage and disposed of in accordance with the Environmental Protection Act.
4. Scrap shall not be stored within 30 metres of any body of water or the licence boundary and shall be kept in close proximity to the main processing plant.
5. Recycling of asphalt, concrete, porcelain and glass shall be permitted on-site.
6. Recyclable asphalt materials shall not be stockpiled within:
   6.1. 30 metres of any waterbody or man-made pond; or
   6.2. 2 metres of the ground water table.
7. Recyclable material shall be kept in close proximity to the main processing plant.
8. Rebar or other structural metal shall be separated from recyclable aggregate material during processing and placed in a designated scrap pile on-site which shall be removed on an o-going basis.
9. Recycled aggregate shall be removed on an on-going basis.
10. Recycling activities shall not interfere with the operational phases of the site or with rehabilitation.
11. Once the site is depleted, no further importation of recyclable material shall be permitted.
12. Once final rehabilitation has been completed and approved in accordance with the site plan, all recycling operations shall cease.
13. The site shall be kept in an orderly condition.

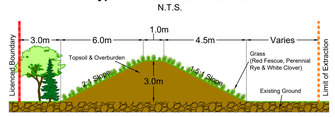
N. Variations from Control and Operation Standards

Variations from Control and Operation Standards

No.	Variation	Standard (O.13)
1	Extraction shall occur within 30 metres but no closer than 15 metres from the Upper's Lane road allowance and the unopened road allowance between Lots 120 and 136. In addition, as part of construction of any access shown on the Site Plan and the existing watercourse realignment, extraction may occur: - Within the 15 metre setback from the Upper's Lane road allowance and the unopened road allowance between Lots 120 and 136 for access purposes, - Within the 15 metre setback from the north and south boundaries of the site for riparian corridor construction and - Within the 30 metre setback from Thorold Townline Road for riparian corridor construction.	(1) 9 and 10
2	Overburden may be removed from the extraction setback area to permit: - Extraction within 30 metres but no closer than 15 metres from Upper's Lane road allowance and the unopened road allowance between Lots 120 and 136 Overburden and aggregate may be removed from the excavation setback areas to permit the construction of any access or to implement the existing watercourse realignment as follows: - Within the 15 metre setback from the Upper's Lane road allowance and the unopened road allowance between Lots 120 and 136 for access purposes, - Within the 15 metre setback from the north and south boundaries of the site for riparian corridor construction and - Within the 30 metre setback from Thorold Townline Road for riparian corridor construction.	(1) 11
3	Topsoil and overburden may be moved between this Licence and Licence Numbers 11175 & 4437 to provide for effective rehabilitation of these licences.	(1) 18
4	A portion of the quarry face shall remain vertical. See Rehabilitation Plan, drawing 5 of 6.	(1) 19
5	The licence boundary for the North Extraction Area shall not be fenced on or west of the Trans Canada Pipeline easement. Fencing shall be erected on the eastern extent of the easement.	(3)(a)

Typical Acoustic Berm Detail

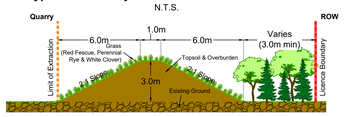
N.T.S.



Note: The existing vegetation shall be maintained within the three metre setback from the licence boundary (where applicable) if feasible.

Typical Berm - Adjacent to Beechwood Road Detail

N.T.S.



Note: Construct berm in close proximity to limit of extraction to provide additional vegetative screening along Beechwood Road.

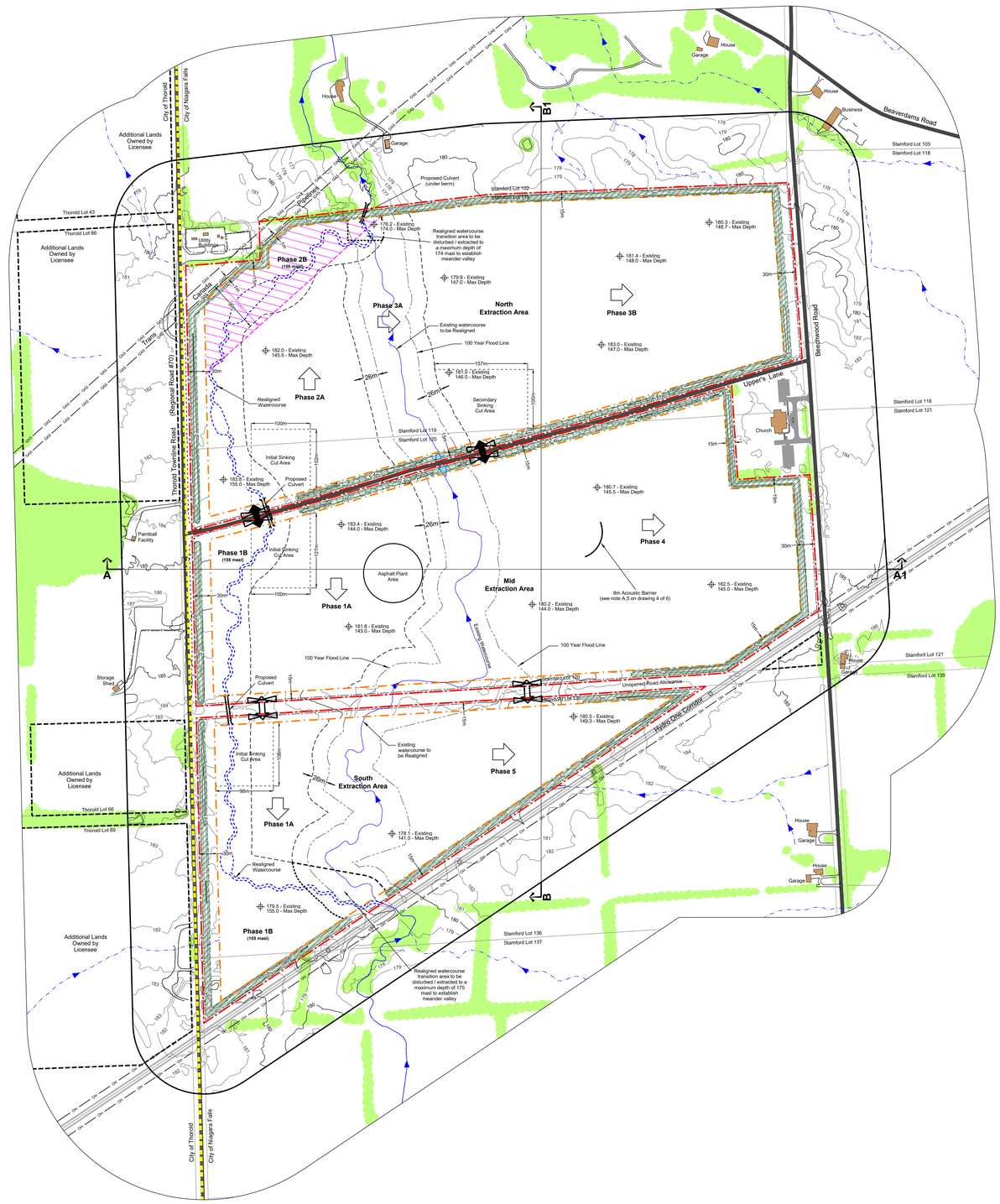


Table 1: Receptors Within 500m of Licence Boundary

Receptor	Address	Distance	Receptor	Address	Distance	Receptor	Address	Distance	Receptor	Address	Distance	Receptor	Address	Distance	Receptor	Address	Distance
101	10148 Beavers Road	184 m	121	5695 Osprey Avenue	374 m	141	9349 Madison Crescent	415 m	161	9245 Shoveller Drive	489 m	181	9414 Shoveller Drive	416 m	201	9461 Eagle Ridge Drive	427 m
102	10138 Beavers Road	442 m	122	5687 Osprey Avenue	362 m	142	9337 Madison Crescent	423 m	162	9245 Shoveller Drive	495 m	182	9404 Shoveller Drive	423 m	202	9500 Eagle Ridge Drive	474 m
103	9722 Beavers Road	234 m	123	5679 Osprey Avenue	350 m	143	9325 Madison Crescent	434 m	163	9312 Madison Crescent	417 m	183	9394 Shoveller Drive	428 m	203	9494 Eagle Ridge Drive	477 m
104	9582 Beavers Road	151 m	124	5671 Osprey Avenue	339 m	144	9315 Madison Crescent	445 m	164	9324 Madison Crescent	404 m	184	9374 Shoveller Drive	443 m	204	9490 Eagle Ridge Drive	478 m
105	9417 Beavers Road	447 m	125	5663 Osprey Avenue	333 m	145	9245 Shoveller Drive	469 m	165	9336 Madison Crescent	390 m	185	9364 Shoveller Drive	450 m	205	9484 Eagle Ridge Drive	480 m
106	9337 Beavers Road	475 m	126	5655 Osprey Avenue	321 m	146	9245 Shoveller Drive	461 m	166	9352 Madison Crescent	370 m	186	9354 Shoveller Drive	460 m	206	9440 Eagle Ridge Drive	484 m
107	5584 Beavers Road	81 m	127	5647 Osprey Avenue	311 m	147	9245 Shoveller Drive	453 m	167	9366 Madison Crescent	354 m	187	9344 Shoveller Drive	467 m	207	9440 Eagle Ridge Drive	495 m
108	5769 Beavers Road	287 m	128	5639 Osprey Avenue	299 m	148	9245 Shoveller Drive	447 m	168	9380 Madison Crescent	338 m	188	9334 Shoveller Drive	478 m	208	5772 Osprey Avenue	499 m
109	5821 Beavers Road	360 m	129	5631 Osprey Avenue	290 m	149	9245 Shoveller Drive	440 m	169	5610 Osprey Avenue	311 m	189	9324 Shoveller Drive	488 m	209	9440 Eagle Ridge Drive	494 m
110	5783 Osprey Avenue	490 m	130	5623 Osprey Avenue	284 m	150	9245 Shoveller Drive	410 m	170	5622 Osprey Avenue	323 m	190	9314 Shoveller Drive	494 m			
111	5775 Osprey Avenue	480 m	131	5615 Osprey Avenue	271 m	151	9245 Shoveller Drive	425 m	171	5632 Osprey Avenue	331 m	191	9355 Eagle Ridge Drive	494 m			
112	5767 Osprey Avenue	470 m	132	5607 Osprey Avenue	259 m	152	9245 Shoveller Drive	435 m	172	5642 Osprey Avenue	341 m	192	9365 Eagle Ridge Drive	481 m			
113	5759 Osprey Avenue	459 m	133	9445 Madison Crescent	280 m	153	9245 Shoveller Drive	443 m	173	5652 Osprey Avenue	350 m	193	9375 Eagle Ridge Drive	469 m			
114	5751 Osprey Avenue	448 m	134	9433 Madison Crescent	299 m	154	9245 Shoveller Drive	457 m	174	5668 Osprey Avenue	362 m	194	9385 Eagle Ridge Drive	471 m			
115	5743 Osprey Avenue	438 m	135	9421 Madison Crescent	316 m	155	9245 Shoveller Drive	467 m	175	9405 Shoveller Drive	374 m	195	9395 Eagle Ridge Drive	464 m			
116	5735 Osprey Avenue	424 m	136	9409 Madison Crescent	334 m	156	9245 Shoveller Drive	476 m	176	9395 Shoveller Drive	383 m	196	9045 Eagle Ridge Drive	457 m			
117	5727 Osprey Avenue	415 m	137	9397 Madison Crescent	351 m	157	9245 Shoveller Drive	485 m	177	9385 Shoveller Drive	392 m	197	9415 Eagle Ridge Drive	448 m			
118	5719 Osprey Avenue	404 m	138	9385 Madison Crescent	371 m	158	9245 Shoveller Drive	498 m	178	9446 Shoveller Drive	400 m	198	9425 Eagle Ridge Drive	445 m			
119	5711 Osprey Avenue	393 m	139	9373 Madison Crescent	391 m	159	9245 Shoveller Drive	474 m	179	9434 Shoveller Drive	405 m	199	9435 Eagle Ridge Drive	443 m			
120	5703 Osprey Avenue	383 m	140	9361 Madison Crescent	407 m	160	9245 Shoveller Drive	482 m	180	9424 Shoveller Drive	412 m	200	9445 Eagle Ridge Drive	436 m			

Legal Description

Part of Lots 119, 120, 136 & 137
City of Niagara Falls (Geographic Township of Stamford)
Regional Municipality of Niagara

Legend

- Licence Boundary
- Limit of Extraction
- Additional Lands Owned by Licensee
- Municipal Boundary
- Contours with Elevation (Metres above sea level (MASL))
- Public Road
- Fence (1.2m post & wire farm fence unless otherwise noted)
- Watercourse (Direction of flow indicated by arrows)
- Surface Drainage Feature (Direction of flow indicated by arrows)
- Watercourse - Realigned (Stantec, 2020)
- Water Feature
- Wooded Area
- 120m Offset From Licence Boundary
- Trans Canada Blasting Buffer Area - See Note D.5 on drawing 4 of 6
- Parcel Fabric
- Trans Canada Pipeline Easement
- Hydro One Easement
- Entrance / Exit
- Limited Service Access (For Phases 1A, 1B and 5 in South Extraction Area)
- Gate
- Culvert
- General Direction of Excavation & Boundary
- Berm (Top - Noise Attenuation Berm; Bottom - Visual Berm)
- Building/Structure
- Spot Elevation (Metres above sea level (MASL)) (Top - Existing; Bottom - Maximum Depth of Extraction)
- Cross Sections (A1)

Site Plan Acronyms

1. ARA - Aggregate Resources Act
2. MNDMNRF - Ministry of Northern Development, Mines, Natural Resources and Forestry
3. MHSTCI - Ministry of Heritage, Sport, Tourism and Culture Industries
4. MECP - Ministry of the Environment, Conservation and Parks
5. MGCS - Ministry of Government and Consumer Services
6. DFO - Department of Fisheries and Oceans Canada
7. ECA - Environmental Compliance Approval
8. BMPP - Best Management Practices Plan
9. PTTW - Permit to Take Water
10. MASL - Metres above sea level
11. ROW - Right of way
12. HMA - Hot mix asphalt

Site Plan Amendments

No.	Date	Description	By

Site Plan Revisions (Pre-Licencing)

No.	Date	Description	By

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
113 COLLIER STREET, BARRIE, ON. L4M 1H2 | P: 705.728.0045 F: 705.728.2010 | WWW.MHBCPLAN.COM

MHBC Stamp
Debra Walker
Is authorized by the Ministry of Northern Development, Mines, Natural Resources and Forestry pursuant to Section 2 (1) of the Aggregate Resources Act to prepare and certify site plans.

MHBC Stamp
Christopher Poole
Is authorized by the Ministry of Northern Development, Mines, Natural Resources and Forestry pursuant to Section 2 (1) of the Aggregate Resources Act to prepare and certify site plans.

Applicant

Walker Aggregates Inc.
2800 Thorold Townline Road
P.O. Box 100
Thorold, Ontario
L2V 3Y8

Project

Upper's Quarry

MNDMNRF Licence Reference No.

Applicant's Signature

Plan Scale: 1:3000 (Arch E)
0 90 180 Meters

Date October 2021
Drawn By C.P.
Checked By D.W.
File No. 9811V

File Name

Operational Plan

Drawing No.

2 of 6

File Path N:\Brian\9811V - Walker Uppers Quarry\Drawings\Site Plan\CAD\9811V - Site Plan - Proposed Scenario.dwg

A. General

1. This plan depicts a schematic operations sequence for the property based on the best information available at the time of preparation.
2. Phases do not represent any specific or equal time period.
3. The direction of extraction will generally be in accordance with the General Direction of Excavation (shown on the plan view). Notwithstanding the operational and rehabilitation notes, demand for certain products, blending of materials or Water Study Contingency measures may require minor deviations in the extraction and rehabilitation sequence.
4. Progressive and final rehabilitation will be completed in direct correlation to the development of the quarry as the extraction limits are reached and enough area is available to ensure that rehabilitation activities will not interfere with the production, stockpiling and processing of aggregate materials.

B. Initial Site Preparation

1. Generally, site preparation in Phases 1 and 2 to include but not limited to:
   a. Constructing the main entrance and cross over(s) in accordance with entrance permit approvals
   b. Establishing fencing around licenced boundary (see Section N Variations from Control and Operation Standards on drawing 2 of 6)
   c. Removal of trees and existing buildings (in accordance with all site plan requirements and applicable regulations)
   d. Proceed with stripping of overburden/topsoil from Phase 1 and, if necessary, Phase 2
   e. Construction of berms/acoustic barriers within the perimeter setback of the licence boundary (as shown on the plan view).
2. Install water management and erosion and sediment control measures (silt fencing) in accordance with note D.1 on this drawing and note E.1.c on drawing 4 of 6.
3. Commence portable crushing/screening plant set up. The plant shall operate in accordance with Section A on drawing 4 of 6 for all Phases.

C. Phase 1 (1A and 1B)

1. Commence extraction in the 'Initial Sinking Cut Area' identified in the Mid Extraction Area (see plan view for location).
2. Phase 1A shall be extracted in up to three (3) lifts to a depth ranging between 140 masl and 145 masl.
3. Phase 1B shall be extracted in one (1) to two (2) lifts to a depth of 155 masl.
4. A portable pump shall be utilized as necessary in the Mid Extraction Area and the South Extraction Area to discharge water to a man-made pond for aggregate washing or to a sediment forebay before being discharged to the existing watercourse. During heavy rainfall events (25 mm or more), the pump will be deactivated as necessary to prevent flooding along the watercourse downstream of the site. The discharge pond and forebay locations will move with the quarry face until the final quarry depth is reached in each extraction area. At this point, a permanent sump shall be established in each extraction area.
5. During Phase 1, a new watercourse channel shall be constructed along the east side of Thorold Townline Road (within Phase 1B) for the eventual realignment of the existing watercourse. As resource extraction is completed in Phase 1B, this area will be filled with clay overburden material from on-site to an elevation ranging between 173 to 178 masl. The new watercourse and riparian wetland channel shall be constructed, designed and vegetated in accordance with this Rehabilitation Plan (drawing 5 of 6).
6. As extraction reaches the final quarry floor, and there is sufficient separation from the quarry floor working areas in Phase 1A, a 2:1 sideslope along the easterly and northerly limit of Phase 1B shall be backfilled with either: (i) overburden stockpiled on-site; (ii) overburden in Phase 2; or (iii) material imported from Licence Numbers 11175 4437.
7. Commence site preparation of Phase 2.

D. Phase 2 (2A & 2B)

1. Commence extraction in the 'Initial Sinking Cut Area' identified in the North Extraction Area (see plan view for location).
2. Phase 2A shall be extracted in up to three (3) lifts to a depth ranging between 141 masl to 145 masl.
3. Phase 2B shall be extracted in one (1) to two (2) lifts to a depth of 155 masl.
4. A portable pump shall be utilized as necessary to discharge water to a man-made pond for aggregate washing or to a sediment forebay before being discharged to the existing watercourse. During heavy rainfall events (25 mm or more), the pump will be deactivated as necessary to prevent flooding along the watercourse downstream of the site. The discharge, pond and forebay locations will move with the quarry face until the final quarry depth is reached. At this point, a permanent sump will be established.
5. Similar to Phase 1, the new watercourse channel shall be constructed within Phase 2 running along the east side of Thorold Townline Road (Phase 2B) for the eventual realignment of the existing watercourse. As resource extraction is completed in Phase 2B, this area will be filled with clay overburden material from on-site to an elevation ranging between 173 to 178 masl. The new watercourse and riparian wetland channel will be constructed, designed and vegetated in accordance DFO authorization and Rehabilitation Plan (drawing 5 of 6).
6. As extraction reaches the final quarry floor, and there is sufficient separation from the quarry floor working areas in Phase 2A, a 2:1 sideslope along the easterly and northerly limit of Phase 2B shall be backfilled with either: (i) overburden stockpiled on-site; (ii) overburden in Phase 3B; or (iii) material imported from Licence Numbers 11175 and 4437.
7. Commence site preparation of Phase 3.

E. Phase 3 (3A & 3B)

1. Proceed with stripping of overburden/topsoil.
2. Prior to undertaking any works within Phase 3A that may result in any serious harm to fish, according to 35(1) of the Fisheries Act, the Licensee shall obtain a Fisheries Act Authorization from the Department of Fisheries and Oceans (DFO) and shall fulfill any other conditions required by the DFO as stated on its authorization. Once the watercourse has been realigned to the satisfaction of DFO, stripping of overburden and topsoil can proceed in Phase 3A.
3. In the event that watercourse relocation has not been approved or completed, extraction in Phase 3B may proceed before extraction in Phase 3A.
4. In the event that Phase 3B is extracted before Phase 3A, a portable pump shall be utilized as necessary to discharge water to a man-made pond for aggregate washing or to a sediment forebay before being discharged to the existing watercourse. During heavy rainfall events (25 mm or more), the pump will be deactivated as necessary to prevent flooding along the watercourse downstream of the site. The discharge, pond and forebay locations will move with the quarry face until the final quarry depth is reached. At this point, a permanent sump will be established.
5. Phase 3A and 3B shall be extracted in up to three (3) lifts to a depth ranging between 145 masl to 149 masl. Extraction will proceed in an easterly direction, moving gradually from north to south.
6. Once the existing watercourse has been realigned, extraction in Phase 3A may proceed.
7. Continue progressive rehabilitation of the quarry perimeter where limits of extraction have been reached and there is sufficient separation from the quarry floor working areas.
8. Commence site preparation of Phase 4.

F. Phase 4

1. Proceed with stripping of overburden/topsoil.
2. Commence Phase 4 extraction in an easterly direction, moving gradually from north to south.
3. Phase 4 shall be extracted in up to three (3) lifts to a depth ranging between 142 masl in and 147 masl.
4. Continue progressive rehabilitation of the quarry perimeter where limits of extraction have been reached and there is sufficient separation from the quarry floor working areas.

G. Phase 5

1. Proceed with stripping of overburden/topsoil.
2. Commence Phase 5 extraction in an easterly direction, moving gradually from north to south.
3. Phase 5 shall be extracted in up to three (3) lifts to a depth ranging between 140 masl and 143 masl.
4. Continue progressive rehabilitation of the quarry perimeter where limits of extraction have been reached and there is sufficient separation from the quarry floor working areas.

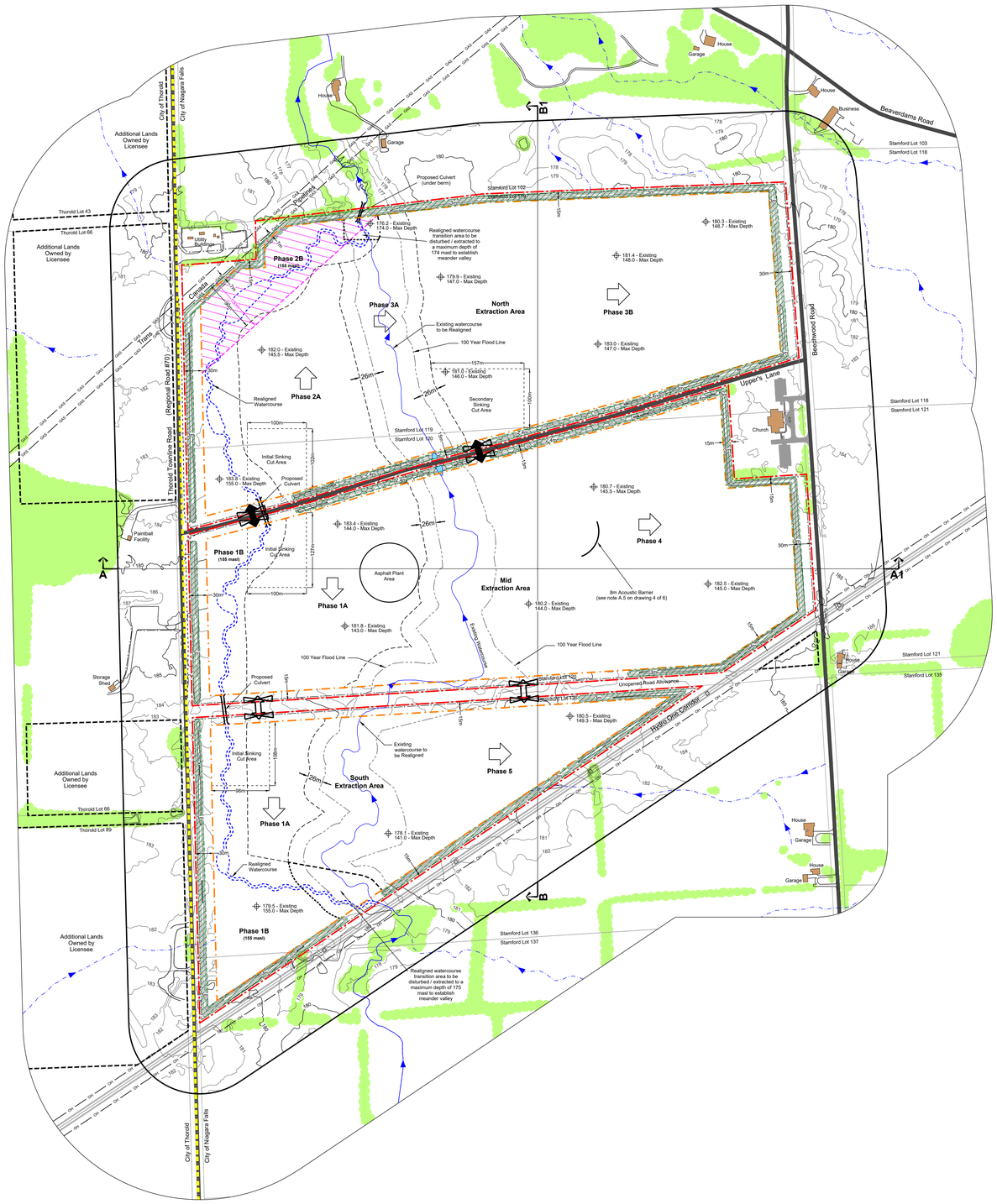
H. Final Phase

1. Complete extraction of any remaining resource in the extraction limit near the entrance in Phase 1A and 1B (e.g. ramp).
2. As part of the final operations of the site, remove office/scale house and scales and any other equipment and scrap from the site.
3. Continue with final rehabilitation of the site. Complete quarry face backfilling on the remaining quarry faces as identified on drawing 5 of 6.

Extraction Sequence Schematic

Scale 1:7500

0 200 400 Meters



Legend

- Licence Boundary
- Limit of Extraction
- Additional Lands Owned by Licensee
- Municipal Boundary
- Contours with Elevation — Metres above sea level (MASL)
- Public Road
- Fence — 1.2m post & wire farm fence unless otherwise noted
- Watercourse — Direction of flow indicated by arrows
- Surface Drainage Feature — Direction of flow indicated by arrows
- Watercourse - Realigned (Stantec, 2020)
- Water Feature
- Wooded Area
- 120m Offset From Licence Boundary
- Trans Canada Blasting Buffer Area - See Note D.5 on drawing 4 of 6
- Parcel Fabric
- Trans Canada Pipeline Easement
- Hydro One Easement
- Entrance / Exit
- Limited Service Access — For Phases 1A, 1B and 5 in South Extraction Area
- Gate
- Culvert
- General Direction of Excavation & Boundary
- Berm — Top - Noise Attenuation Berm; Bottom - Visual Berm
- Building/Structure
- Spot Elevation — Metres above sea level (MASL); Top - Existing; Bottom - Maximum Depth of Extraction
- Cross Sections

Legal Description

Part of Lots 119, 120, 136 & 137
City of Niagara Falls (Geographic Township of Stamford)
Regional Municipality of Niagara

Site Plan Acronyms

1. ARA - Aggregate Resources Act
2. MNDMNRF - Ministry of Northern Development, Mines, Natural Resources and Forestry
3. MHSTCI - Ministry of Heritage, Sport, Tourism and Culture Industries
4. MECP - Ministry of the Environment, Conservation and Parks
5. MGCS - Ministry of Government and Consumer Services
6. DFO - Department of Fisheries and Oceans Canada
7. ECA - Environmental Compliance Approval
8. BMPP - Best Management Practices Plan
9. PTTW - Permit to Take Water
10. MASL - Metres above sea level
11. ROW - Right of way
12. HMA - Hot mix asphalt

Site Plan Amendments

No.	Date	Description	By

Site Plan Revisions (Pre-Licencing)

No.	Date	Description	By

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
113 COLLIER STREET, BARRIE, ON. L4M 1H2 | P: 705.728.0045 F: 705.728.2010 | WWW.MHBCPLAN.COM

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N W E S

Applicant

walker aggregates

Walker Aggregates Inc.
2800 Thorold Townline Road
P.O. Box 100
Thorold, Ontario
L2V 3Y8

Project

Upper's Quarry

MNDMNRF Licence Reference No.	**Applicant's Signature**
Plan Scale: 1:3000 (Arch E) 0 90 180 Meters	**Date** October 2021
	Drawn By C.P.
	Checked By D.W.
	File No. 9811V
File Name	**Extraction Sequence**
Drawing No.	**3 of 6**
File Path	N:\Brian\9811V - Walker Uppers Quarry\Drawings\Site Plan\CAD\9811V - Site Plan - Proposed Scenario.dwg

A. Acoustic Assessment

1. Minimum 3 metre tall acoustic berms shall be constructed in the locations shown on the plan view.
2. The acoustic berms shall be constructed during site preparation and prior to extraction.
3. The primary crusher shall stay within 30 metres of the working face to maximize shielding effect of the quarry terrain.
4. Material extracted from the South Extraction Area shall be processed in the Mid Extraction Area.
5. While processing in Phase 4, the licensee shall maintain an 8 metre tall barrier at a radius of 40 metres to the southeast of the processing plant's secondary crushers (see plan view for location). The barrier can be material stockpiles, noise walls, or a combination of both. The barrier shall extend long enough to shield receptors R4 and R5 (see plan view) from the secondary crushers.
6. All construction equipment shall meet the sound emission standards defined in MECP Publication NPC-115.
7. The following best practice measures shall be undertaken to minimize the potential for construction noise impacts:
   a. Construction will be limited to time periods allowed by the City's applicable by-laws. If construction activities are required outside of these hours, the licensee will seek permits / exemptions directly from the City in advance.
   b. All internal combustion engines will be fitted with appropriate muffler systems.
   c. The licensee's operating procedures will contain a provision that any initial complaint will trigger verification that the general noise control measures agreed to on this Plan are in effect.
   d. In the presence of persistent noise complaints, all construction equipment will be verified to comply with MECP's NPC-115 guidelines.
   e. In the event of verified noise complaints, alternative noise control measures may be required where reasonably available. In selecting appropriate noise control and mitigation measures, consideration will be given to the technical, administrative and economic feasibility of the various alternatives.

B. Air Quality

1. The licensee shall apply water or another provincially approved dust suppressant to internal haul roads and processing areas, as necessary to mitigate dust.
2. Processing equipment shall be equipped with dust suppressing or collection devices, where the equipment creates dust and is operating within 300 metres of an air quality sensitive receptor (as set out in the Air Quality Impact Assessment).
3. The licensee shall obtain an environmental compliance approval under the Environmental Protection Act where required to carry out operations at the quarry.
4. The site will operate in accordance with the Best Management Practices Plan (BMPP) for Fugitive Dust Emissions. The BMPP may be amended from time to time, considering actual impacts and operational considerations. The recommendations in the BMPP are based on the maximum daily production rates. At lower production rates, the control measures specified in the BMPP can be reduced accordingly, provided dust remains mitigated on site.
5. The following mitigation measures shall be incorporated into the BMPP:
   a. Blasting operations occurring within 300 metres of a residential receptor shall have a smaller blast area, not exceeding 200 m² in area.
   b. Aggregate extraction, processing and shipping does not exceed 9,000 tonnes per day.

C. Archaeology

1. Areas identified as "Archaeological Site - Protected Areas Requiring Further Archaeological Assessment" on this drawing reflect areas that require further archaeological assessment and are protected by a 20 to 30 metre protective buffer. A 50 metre monitoring buffer is also identified on this drawing.
2. No ground alterations including overburden stripping and excavation, or development of any kind shall occur within areas identified as "Archaeological Site - Protected Areas Requiring Further Archaeological Assessment" and their respective protective buffers until:
   a. the required investigations are completed in accordance with the Stage 1 and 2 Archaeological Assessment prepared by Archaeological Research Associates Ltd. (April 2020),
   b. any recommendations that the respective site(s) has no further cultural heritage value or interest are made as a result of completing further investigations, and,
   c. the associated reports are entered into the Ontario Public Register of Archaeological Reports.
3. A temporary barrier shall be established around the perimeter of each 'Archaeological Site - Protected Areas Requiring Further Archeological Assessment" identified on this drawing as part of site preparation and in advance of extraction.
4. All soil disturbing activities within the 50 metres monitoring buffers shall be monitored by a licensed archaeologist to ensure the effectiveness of the avoidance strategy. The archaeologist shall ensure that the temporary barrier is in the appropriate location and shall be empowered to stop construction if there is a concern for impacts to an archaeological site. 'No go' instructions shall be issued to all work crews for the protected areas, and the locations of the protected areas shall be shown on all appropriate contract drawings. The protected areas shall be inspected by a licensed archaeologist once the strategy is no longer required, and the effectiveness of the strategy shall be reported to the MHSTCI.
5. Immediately upon issuance of the Licence, and once the construction schedule has been finalized, a licensed archaeologist will be retained by the licensee so that monitoring can occur where required. The remaining archaeological fieldwork will be completed upon issuance of the licence by the MNDMNRF.
6. Should deeply buried archaeology remains be found during the course of site preparation and/or extraction related activities, the MHSTCI shall be notified.
7. In the event that human remains are encountered during construction or extraction activities, the licensee shall immediately contact both the MHSTCI and Registrar or Deputy Registrar of the Cemeteries Regulation Unit of the Ministry of Government and Consumer Services (MGCS).

D. Blasting

1. An attenuation study shall be undertaken by an independent blasting consultant during the first 12 months of operation in order to obtain sufficient quarry data to confirm the initial guideline parameters and assist in refining future blast designs.
2. All blasts shall be monitored for both ground vibration and overpressure at the closest privately owned sensitive receptors adjacent the site, or closer, with a minimum of two (2) instruments - one installed in front of the blast and one installed behind the blast.
3. Blasts shall be designed to maintain vibrations below 13mm/s at the location of the closest identified active spawning bed as per DFO guidelines. When blasting during active spawning season, a minimum of one supplemental vibration monitor shall be installed on the shoreline closest to the spawning bed to confirm the vibration levels.
4. The guideline limits for vibration and water overpressure shall adhere to standards as outlined in the Guidelines For the Use of Explosives In or Near Canadian Fisheries Waters (1998) or any such document, regulation or guideline which supersedes this standard.
5. All blasts shall be monitored for ground vibration at the adjacent Trans Canada Energy High Pressure Natural Gas Pipeline when blasting within 100m of the pipeline or when calculations suggest vibrations in excess of 35mm/s.
6. Blasts shall be designed to maintain vibrations at the transmission towers in the Hydro One Corridor below 50mm/s or any such document, regulation or corporate policy in effect at the time. When vibration calculations suggest vibrations at the towers may exceed 35mm/s, the towers shall be monitored for ground vibration.
7. Blasts shall be designed to maintain vibrations at the 4832 Thorold Townline Road utility buildings below 50mm/s. When vibration calculations suggest vibrations at the utility buildings may exceed 35mm/s, the buildings shall be monitored for ground vibration.
8. The guideline limits for ground vibration and air overpressure shall adhere to standards as outlined in the Model Municipal Noise Control By-law publication NPC 119 (1978) or any such document, regulation or guideline which supersedes this standard.
9. Orientation of the aggregate extraction operation shall be designed and maintained so that the direction of the overpressure propagation will be away from structures as much as possible.
10. Blast designs shall be continually reviewed with respect to fragmentation, ground vibration and overpressure. Blast designs shall be modified as required to maintain compliance with current applicable guidelines and regulations.
11. Detailed blast records shall be maintained in accordance with current industry best practices.

E. Natural Heritage

1. General
   a. Existing vegetation within the setbacks shall be maintained except where berms, haul roads and conveyors are required.
   b. New vegetation shall be maintained in accordance with note G.5 on this drawing.
   c. Silt fencing shall be installed at the easterly limit of Phases 1A and 2A where field drainage enters the existing watercourse. Silt fencing will serve to demarcate the limit of protected area until the watercourse is diverted.
   d. Stockpiling of all excavated material shall be in accordance with note H.7 on drawing 2 of 6.
   e. Topsoil and overburden stockpiles shall be maintained in accordance with the Best Management Practices for the Protection, Creation and Maintenance of Bank Swallow Habitat in Ontario (MNRF 2017). Stripped overburden and topsoil for rehabilitation shall be utilized in accordance with notes E.4, E.5 and E.6 on drawing 2 of 6.
   f. Dust control will be implemented in accordance with Section B on this drawing.
   g. Fuel storage shall be in accordance with the notes under Section K on drawing 2 of 6.
2. Natural Channel Design
   a. The existing watercourse will remain open (not culverted) where it enters the south limit of the South Extraction Area.
   b. Where the watercourse exits the North Extraction Area, a culvert will be installed to maintain the watercourse while allowing an acoustic berm to be constructed. As part of final rehabilitation, the berm and culvert shall be removed to allow for the watercourse to be open.
   c. As part of site preparation, a compensation pond will be constructed in the Watercourse Realignment Transition Area within Phase 2B, in accordance with the Natural Channel Design Report (Stantec 2021). The compensation pond will be excavated to a maximum depth of 174 masl in this area and in accordance with DFO authorization. No drilling or blasting shall occur in this Transition Area.
   d. As extraction is completed in Phases 1B and 2B, these areas will be filled with clay overburden material to an elevation ranging between 173 to 178 masl. In accordance with the Natural Channel Design Report (Stantec 2021), a new watercourse channel will be constructed, vegetated and designed in these areas and will include the following design elements:
      d.1. Floodplain wetlands
      d.2. Fish habitat ponds, including new pike spawning habitat as well as foraging, spawning and rearing habitat for other fish species
      d.3. Creek sections
      d.4. Wood debris toe protection and wood reinforced banks
      d.5. Log sills
      d.6. Augmented riffle.
   e. Culverts will be installed under Upper's Lane and the unopened road allowance.
   f. 2:1 side slopes shall be established on the east side of the new watercourse channel down to the quarry floor.
   g. Once the realigned watercourse channel has been constructed in Phases 1B and 2B and adequate vegetation has been established (as confirmed by an ecologist), water from the existing watercourse will be diverted to the realigned watercourse in consultation with regulatory authorities.
3. Woodland and Terrestrial Habitat Enhancement
   a. The 2.0 ha woodland situated on the east side of Thorold Townline Road shall be removed during the advancement of operations in Phase 1A/1B. Tree clearing in the woodlot shall be undertaken outside of the breeding bird period and the active bat season from March 23 and August 26.
   b. The lands identified off-site as "Woodland Compensation Area" on this drawing, an area of 4.7 ha, shall be planted in accordance with the Rehabilitation Plan (drawing 5 of 6).
   c. The lands identified on-site as Deciduous Woodland, Treed Deciduous Swamp and Swamp Thicket / Marsh Meadow on drawing 5 of 6, an area of 4.0 ha, shall be planted in accordance with the Rehabilitation Plan.
   d. Planting for the off-site woodland compensation will commence in the appropriate planting season following licence approval.
4. Significant Wildlife Habitat and Wildlife
   a. Vegetation clearing where milkweed plants are present will proceed when monarch larvae are absent (September 30 to April 1).
   b. The setbacks along Thorold Townline Road and Beechwood Road shall be planted with a mix of deciduous and coniferous trees and shrubs with a range of sizes. Native plant materials that are complementary to the regional and local landscape shall be used (see Rehabilitation Plan, drawing 5 of 6).
5. Woodland and Wildlife Habitat Compensation Plan
   a. A woodland and wildlife habitat compensation plan shall be prepared in consultation with regulatory authorities to: (i) allow practices and management to respond to changing forest dynamics in the Woodland Compensation Areas such as pest infestations, climatic conditions (e.g. species selection) and restoration ecology; and (ii) achieve a net gain in the ecological functions of the local and regional landscape through:
      a.1. Increasing the total area of woodland cover in the regional landscape;
      a.2. Improving associated landscape functions such as vegetative linkages and interior forest areas
      a.3. Improving forest ecological characteristics such as species diversity, age class distribution and structural diversity, while retaining native genetics through seed collection and replanting. For example, prior to the removal of the existing 2 ha woodland:
         a.3.1. Tree seeds and nuts will be gathered from the woodland for direct planting in the Woodland Compensation Area to promote the continuity of genetic stock and a similar community composition to the removed vegetation community (FOD9)
         a.3.2. Leaf litter and sods containing native understory vegetation will be transplanted to promote rapid establishment of a healthy forest soil microbiome
         a.3.3. Transplanting of native saplings and small shrubs from the woodland to the compensation planting area, where feasible.
      a.4. Incorporating specific wildlife habitat features for bats, deer and other wildlife, such as bat roosting structures (bat boxes or condos), coniferous tree clusters for cover, browse-tolerant shrubs and mast producing trees;
      a.5. Incorporating specific planting in setbacks and the watercourse realignment channel. For example, plantings that provide habitat for monarch including common milkweed (Asclepias syriaca), swamp milkweed (Asclepias incarnata) and nectar producing plants.
6. Fish and Fish Habitat
   a. Implement notes D.3 and D.4 on this drawing.
   b. Water shall be discharged from the sump area to the existing watercourse until water flow is diverted to the watercourse realignment channel. Once the watercourse realignment has been completed, water shall be discharged from the sump locations to the realigned watercourse. Pumping and discharge shall occur as required to support fish habitat.
   c. Water collected from the sump area shall be directed to a holding pond for storage to allow for settling of suspended solids and dissipation of other constituents such as hydrogen sulfide an alkalinity. Following this pond treatment, water will be discharged to the existing watercourse until water flow is diverted to the watercourse realignment channel. Once the watercourse realignment has been completed, water shall be discharged from the holding pond to the realigned watercourse. Pumping and discharge shall occur as required to support fish habitat.
7. Wetlands
   a. Wetlands along the existing watercourse will be maintained until the watercourse has been diverted to the watercourse realignment channel.
   b. Once the watercourse has been diverted, the created wetlands in the watercourse realignment channel shall be maintained.
8. Monitoring Program
   a. A monitoring plan shall be prepared in consultation with regulatory authorities to assess the performance of the watercourse realignment channel and to confirm that impacts to off-site wetlands are not occurring as a result of dewatering.
   b. A monitoring program of compensation planting shall be prepared in consultation with regulatory authorities to confirm stable conditions have been established.
   c. A trigger mechanism and contingency plan, as detailed in WSP's Water Study Report, shall be implemented upon licence approval to proactively ensure natural heritage features and their functions are maintained (i.e. fish habitat, wetland features downstream and at 5584 Beechwood Road, and woodlands) during operational and rehabilitation phases.

F. Traffic

1. Prior to commencement of extraction operations, the required entrance improvements, road improvements and road widenings (to Thorold Townline Road) shall be completed to the satisfaction of the applicable road authorities and in general accordance with the figures titled "Uppers Lane Conceptual Intersection Design" and "Uppers Lane Vehicle Movement Diagram" provided on this drawing.

G. Visual

1. Where possible and to the extent to which it is present, existing vegetation located along the site perimeter within the setback area shall be retained.
2. 3.0 metre high acoustic berms and 2.4 metre high visual berms shall be established in the locations shown on the plan view. Berms shall be constructed in a smooth, rolling manner with varying highpoints (where space permits while respecting minimum height requirements), and variations along the berm length to create a more natural appearance. Berms shall be seeded with a naturalizing mix of wildflowers and grasses to stabilize slopes and minimize mowing and maintenance.
3. Within the "Extended Planting Areas" (as shown on this drawing), trees shall be planted at a spacing of 5 to 10 metres on centre, depending on species. Where possible, plantings shall be randomly spaced and staggered up on the berm up to one third of its maximum height to appear more natural. Plantings shall also extend a minimum of 3 metres out from the berm towards the road where available space permits. All vegetation shall be selected for wind and salt tolerance and hardiness. Native species that complement the existing surroundings shall be utilized.

   Where "Large Planting Stock" is indicated (see plan view and "Typical Visual Berm Detail" on this drawing), this area shall be planted with deciduous trees of minimum 40 millimetres caliper, coniferous trees of minimum 1.0 metre in height, and shrub species of minimum 40 centimetres height.

   Where "Small Planting Stock" is indicated (see plan view and "Typical Visual Berm Detail" on this drawing), this area shall be planted with deciduous tree whips of minimum 1.2 metres in height, coniferous trees of minimum 0.6 metre in height, and shrub species of minimum 20 centimetres height (or bare root stock when in season).

   Planting shall occur for 40 metre stretches on either side of Upper's Lane and the unopened road allowance facing Thorold Town Line Road. The large planting stock shall be planted 3 metres beyond the berm and small planting stock shall extend from the toe of the berm to 2 metres up the berm.

   Plant species for berms may include, but shall not be limited to the following:

   Trees

White Pine	Common Hackberry	Chokecherry
White Spruce	Paper Birch	Pin Oak
Sugar / Silver Maple	Trembling Aspen	Basswood
White Pine	White Spruce	White Cedar

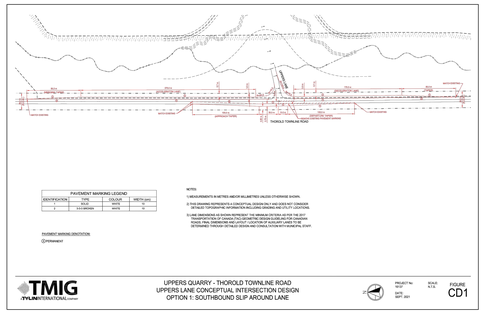
   Shrubs

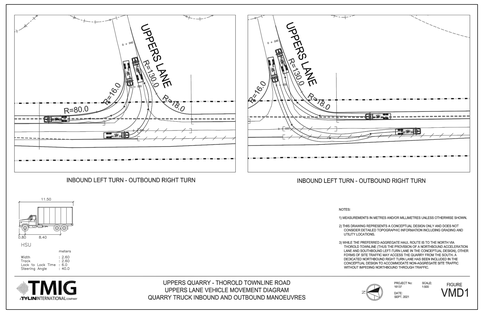
Staghorn Sumac	Nannyberry	Common Ninebark
American Elder	Dogwood	Highbush Cranberry

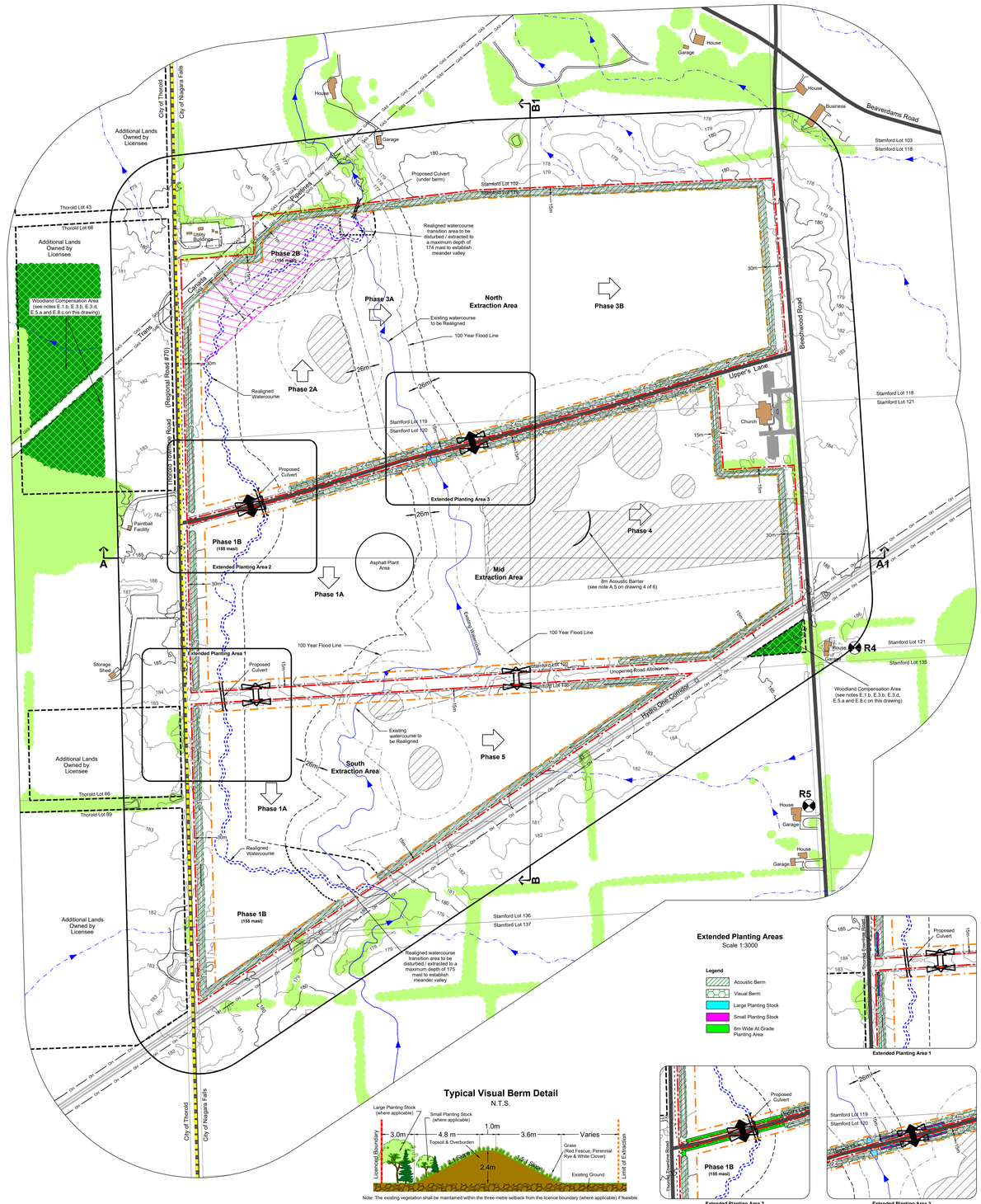
4. To ensure survival and positive growth rate, the vegetative screening shall be maintained as an effective visual screen over time. Allowance of natural succession is encouraged.
5. During the first year, planted trees shall be watered and monitored until established. After the first year and up to five years, trees shall be inspected biannually (end of Year 1, beginning of Year 3 and end of Year 4). Trees which are in poor condition at the time shall be fertilized, watered and monitored to improve their health and vigor.
6. A mortality rate of up to 15% of all trees planted over the course of the five year maintenance period is expected. Trees that die exceeding this percentage shall be replaced yearly, preferably in the spring or late summer.

H. Water Study

1. A long-term monitoring program will be implemented during the quarry operational and rehabilitation phases, until stable conditions are observed after quarry decommissioning.
2. In the event a well interference claim is received, the licensee shall implement the following mitigation plan to proect the local groundwater users.
   a. Prior to extraction, landowners shall be provided with a copy of the water well interference plan as well as the contact information for the licensee and MECP (Wells Help Desk 1-888-396-9355 or email wellshelpdesk@ontario.ca).
   b. If a water well interference claim is received by the licensee the following actions shall be taken:
      b.1. The licensee shall immediately notify MNDMNRF and MECP of the complaint.
      b.2. The licensee shall contact a well contractor in the event of a well malfunction and residents will be provided a temporary water supply within 24 hours, if the issue cannot be easily determined and rectified.
   c. The well contractor shall contact the resident with the supply issue to rectify the problem as expeditently as possible, provided landowner authorization of the work.
   d. If the issue raised by the landowner is related to loss of water supply, the licensee shall have a qualified hydrogeologist / well contractor determine the likely causes of the loss of water supply, which can result from a number of factors, including pump failure (owner's expense), extended overuse of the well (owner's expense), lack of well maintenance / well cleaning (owner's expense) or lowering of the water level in the well from the quarry development (licensee expense). This assessment process shall be carried out at the expense of the licensee and the results provided to the homeowner.
   e. If it has been determined that the quarry caused the water supply interference (i.e., lowering of the water level), the licensee shall continue to supply water at their expense until the problem is rectified. The following mitigation measures shall be considered, and the appropriate measure(s) implemented at the expense of the licensee:
      e.1. Adjust pump pressure;
      e.2. Lowering of the pump to take advantage of existing water storage within the well;
      e.3. Deepening of the well to increase the available drawdown, if the well deepening changes the water quality a water treatment shall be provided;
      e.4. Widening of the well to increase the available storage of water;
      e.5. Relocation of the well to another area on the property; or
      e.6. Drilling multiple wells.
   f. If the issue raised by the landowner is related to water quality, the licensee shall have a qualified hydrogeologist / well contractor determine the likely causes of the change in water quality, and review monitoring results at the quarry and background monitoring results from the baseline well survey to determine if there is any potential correlation with the quarry. If it has been determined that the quarry caused a water quality issue, the licensee shall continue to supply water at their expense until the problem is rectified. The licensee shall be responsible for restoring the water supply by replacing the well or providing a water treatment system. The licensee is responsible for the expense to restore the water quality.
3. A spill action plan shall be carried out in accordance with the notes in Section N Spills Plan on drawing 2 of 3.
4. A trigger mechanism and contingency plan as set out in WSP's Level 2 Water Study Report shall be implemented.







Typical Visual Berm Detail
N.T.S.

Note: The existing vegetation shall be maintained within the three metre setback from the licence boundary (where applicable) if feasible.

Extended Planting Areas
Scale 1:3000

Legend
- Acoustic Berm
- Visual Berm
- Large Planting Stock
- Small Planting Stock
- 6m Wide At Grade Planting Area

Legal Description

Part of Lots 119, 120, 136 & 137
City of Niagara Falls (Geographic Township of Stamford)
Regional Municipality of Niagara

Legend

- Licence Boundary
- Limit of Extraction
- Additional Lands Owned by Licensee
- Municipal Boundary
- Contours with Elevation (Metres above sea level (MASL))
- Public Road
- Fence (1.2m post & wire farm fence unless otherwise noted)
- Watercourse (Direction of flow indicated by arrows)
- Surface Drainage Feature (Direction of flow indicated by arrows)
- Watercourse - Realigned (Stantec, 2020)
- Water Feature
- Wooded Area
- Woodland Compensation Area (Off-site)
- Archaeological Site (Protected Areas Requiring Further Assessment (Includes 20-30m Buffer))
- Archaeological Offset (50m Monitoring Buffer)
- 120m Offset From Licence Boundary
- Trans Canada Blasting Buffer Area - See Note D.5 on this drawing
- Parcel Fabric
- Trans Canada Pipeline Easement
- Hydro One Easement
- Entrance / Exit
- Limited Service Access (For Phases 1A, 1B and 5 in South Extraction Area)
- Gate
- Culvert
- General Direction of Excavation & Boundary
- Berm (Top - Noise Attenuation Berm; Bottom - Visual Berm)
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10. MASL - Metres above sea level
11. ROW - Right of way
12. HMA - Hot mix asphalt

Site Plan Amendments

No.	Date	Description	By

Site Plan Revisions (Pre-Licencing)

No.	Date	Description	By

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
113 COLLIER STREET, BARRIE, ON. L4M 1H2 | P: 705.728.0045 F: 705.728.2010 | WWW.MHBCPLAN.COM

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Is authorized by the Ministry of Northern Development, Mines, Natural Resources and Forestry pursuant to Section 2 (1) of the Aggregate Resources Act to prepare and certify site plans.

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Applicant

walker aggregates

Walker Aggregates Inc.
2800 Thorold Townline Road
P.O. Box 100
Thorold, Ontario
L2V 3Y8

Project

Upper's Quarry

MNDMNRF Licence Reference No.

Applicant's Signature

Plan Scale: 1:3000 (Arch E)
0 90 180 Meters

Date: October 2021
Drawn By: C.P.
Checked By: D.W.
File No.: 9811V

File Name

Report Recommendations

Drawing No.

4 of 6

File Path N:\Brian\9811V - Walker Uppers Quarry\Drawings\Site Plan\CAD\9811V - Site Plan - Proposed Scenario.dwg

PROGRESSIVE REHABILITATION

A. General

1. Area calculations:

a.	Licenced area	**103.6 ha**
b.	To be extracted	**89.1 ha**
c.	Final rehabilitation within licence (total)	**103.6 ha**
c.a.	Lake	68.8 ha
c.b.	Shoreline wetland	1.3 ha
c.c.	Wetland/pond/stream	2.9 ha
c.d.	Terrestrial	22.7 ha
c.e.	Deciduous Woodland	1.2 ha
c.f.	Treed Deciduous Swamp	2.0 ha
c.g.	Swamp Thicket & Marsh Meadow	0.8 ha
c.h.	Undisturbed	3.9 ha
d.	To be rehabilitated outside of licence:	**4.7 ha**
d.a.	Woodland Compensation Area	4.7 ha

2. The maximum predicted water table is 184.9 masl and the contact aquifer potentiometric contours ranges between 176.0 and 184.9 masl (as per WSP's "Proposed Upper's Quarry - Maximum Predicted Water Table Report", dated October 2021.

B. Phasing

1. As excavation reaches the limit of extraction or maximum depth, progressive rehabilitation shall commence.
2. Progressive rehabilitation shall follow the general direction and sequence of extraction identified on the plan view and described in the notes on drawing 3 of 6. Minor deviations in operational/rehabilitation sequence will be permitted in order to adjust for any variable resource and market conditions.
3. Prior to extraction commencing in Phases 3A and 3B, side sloping adjacent to Phases 1B and 2B shall be completed to allow for the existing watercourse realignment to be finalized.
4. Dewatering of the quarry will ultimately discharge to the watercourse (pre and post realignment). The quarry will continue dewatering operations to maintain a dry quarry floor. When the rock is fully extracted, it is proposed that dewatering operations will cease and the quarry will be permitted to fill naturally with surplus precipitation, surface water and any contribution from groundwater seepage to form a lake. As shown on the plan view, shallow shoreline wetland areas shall be created to provide aquatic habitat.
5. Watercourse Realignment Channel Area - As portions of the watercourse realignment channel are constructed, the channel shall be planted according to the requirements of each respective planting zone; (i) riparian planting zone; (ii) upland planting zone; (iii) shoreline planting zone and (iv) life staking planting zone. Details relating to construction, planting and monitoring requirements for the watercourse realignment corridor are contained within the "Natural Channel Design Report" prepared by Stantec Consulting Ltd. (dated October 2021).
6. Reforestation Areas - There are two main reforestation areas:
   - 6.1. The Woodland Compensation Area (Off-site) to be no less than 4.3 ha in area. Plantings in this area are set out in Table 1 on this drawing. Planting for this Area (Off-site) will commence in the appropriate planting season following licence approval.
   - 6.2. The on-site Woodland Compensation Area includes the areas identified as the Deciduous Woodland, Treed Deciduous Swamp and Swamp Thicket/Marsh Meadow, to be no less than 4.0 ha in total area. Plantings in these areas are set out in Tables 1 to 3 on this drawing respectively. In the Deciduous Woodlands (on-site), additional conifer species will be added to the species mix to provide additional screening.
7. A woodland and wildlife habitat compensation plan shall be prepared in consultation with regulatory authorities in accordance with Note E.5.a on drawing 4 of 6.

C. Slopes and Grading

1. Progressive rehabilitation will utilize a variety of rehabilitation techniques including:
   - a. backfilling extraction faces and quarry floors; or
   - b. Leaving extraction faces vertical
2. Excess soil, as defined by Ontario Regulation 406/19 under the Environmental Protection Act, may be imported for the following rehabilitation purposes:
   - 2.1. To establish the final elevations, slopes and grades depicted on the plan view
3. Excess soil imported for the rehabilitation purposes described above shall meet the soil quality, tracking and testing standards required by Ontario Regulation 406/19 or the applicable MECP standards at the time.
4. The final rehabilitated landforms established using the rehabilitation techniques will consist of a lake, shoreline wetlands, riparian corridor, woodlands, gradually sloping grades, 2:1 and 3:1 side slopes, and vertical faces as shown on the plan view.

D. Seeding and Planting

1. Side slopes steeper than 3:1 shall be seeded with the Ministry of Transportation's (MTO) Ontario Roadside Seed Mix (Creeping Red Fescue, Kentucky Bluegrass, Perennial Ryegrass and White Clover) or equivalent.
2. The deciduous woodlands, treed deciduous swamp, swamp thicket/marsh meadow, shoreline wetland, and realigned watercourse channel (riparian corridor) shall be planted with species identified in Tables 1-5 on this drawing respectively.

E. Drainage

1. Final surface drainage will follow the rehabilitated contours and directional arrows shown on the plan view.
2. Once the quarry is depleted, pumping will cease and portions of the site below the ground water table will fill with water.
3. The quarry dewatering discharge will be directed to the watercourse (pre and post alignment) and ultimately flow to Beaverdams Creek to support fish habitat and downstream wetlands.
4. The licensee shall operate in accordance with the conditions of the MECP, PTTW and ECA for the ongoing dewatering of the site.

F. Trigger Mechanism and Contingency Plan

1. During progressive rehabilitation, until surrendering the licence, the licensee is required to operate in accordance with the Trigger Mechanism and Contingency Plan, included in the Upper's Quarry Level 2 Water Study Report prepared by WSP, dated October 2021, as may be amended from time to time with approval from MNDMNRF.

FINAL REHABILITATION

A. General

1. All equipment shall be removed from the licenced area.
2. A field/property access entrance shall remain to access the watercourse (as realigned).
3. The long term average surface water and lake level elevation is estimated to be approximately 175.15 masl.
4. At final rehabilitation, outflow from the realigned watercourse and the quarry lake will continue to discharge from the licence area at the present location where the existing watercourse channel crosses the northern licence boundary.

Table 1: Deciduous Woodland Planting List

%	Botanical Name	Common Name
TREES		
5	*Acer saccharum*	Sugar Maple
25	*Carya ovata*	Shagbark Hickory
15	*Fagus grandifolia*	American Beech
15	*Ostrya virginiana*	Ironwood
20	*Prunus serotina*	Black Cherry
5	*Quercus rubra*	Red Oak
15	*Tilia Americana*	Basswood
SHRUBS		
15	*Amelanchier arborea*	Juneberry
20	*Carpinus caroliniana*	Blue-beech
15	*Hamamelis virginiana*	Witch Hazel
15	*Prunus virginiana*	Chokecherry
20	*Rhus typhina*	Staghorn Sumac
20	*Cornus racemosa*	Grey Dogwood
15	*Rubus odoratus*	Purple-flowering Raspberry
GROUND COVER		
20	*Schizachyrium scoparium*	*Little Bluestem*
15	*Elymus histrix*	*Bottlebrush grass*
15	*Rudbeckia hirta*	*Black Eyed Susan*
15	*Carex granularis*	*Meadow Sedge*
8	*Solidago canadensis*	*Canada Goldenrod*
8	*Oenothera biennis*	*Evening Primrose*
5	*Asclepias syriaca*	*Common Milkweed*
5	*Clematis virginiana*	*Virgin's Bower*
5	*Monarda fistulosa*	*Wild Benjamin*
1	*Anemone canadensis*	*Canada Anemone*
1	*Euthamia graminifolia*	*Grass Leaved Goldenrod*
1	*Symphyotrichum cordifolium*	*Heart-leaved Aster*
1	*Aster novae-angliae*	*New England Aster*

Table 2: Treed Deciduous Swamp Planting List

%	Botanical Name	Common Name
TREES		
20	*Acer x freemani*	Freeman's Maple
20	*Juglans nigra*	Black Walnut
20	*Populus deltoides*	Eastern Cottonwood
20	*Quercus macrocarpa*	Bur Oak
20	*Thuja occidentalis*	Eastern White Cedar
SHRUBS		
14	*Cornus amomum*	Silky Dogwood
12	*Cornus foemina*	Gray Dogwood
12	*Ilex verticillata*	Winterberry
12	*Rosa palustris*	Swamp Rose
12	*Salix bebbiana*	Bebb's Willow
14	*Spirea alba*	Meadowsweet
12	*Viburnum lentago*	Nannyberry
12	*Viburnum trilobum*	American Cranberry-bush

Table 3: Swamp Thicket / Marsh Meadow Planting List

%	Botanical Name	Common Name
SHRUBS		
14	*Cornus amomum*	Silky Dogwood
12	*Cornus foemina*	Gray Dogwood
12	*Ilex verticillata*	Winterberry
12	*Rosa palustris*	Swamp Rose
12	*Salix bebbiana*	Bebb's Willow
14	*Spirea alba*	Meadowsweet
12	*Viburnum lentago*	Nannyberry
12	*Viburnum trilobum*	American Cranberry-bush
LIVE STAKES		
34	*Cornus sericea*	Red Osier Dogwood
33	*Salix discolor*	Pussy Willow
33	*Salix eriocephala*	Heartleaf Willow
MARSH SEED MIX		
20	*Poa palustris*	Fowl Bluegrass
15	*Carex vulpinoidea*	Fox Sedge
10	*Verbena hastata*	Blue Vervain
10	*Carex granularis*	Meadow Sedge
10	*Euthamia graminifolia*	Grass Leaved Goldenrod
10	*Asclepias incarnata*	Swamp Milkweed
5	*Scirpus atrovirens*	Dark Green Bulrush
5	*Juncus effusus*	Soft Rush
2	*Eupatorium perfoliatus*	Boneset
2	*Carex stipata*	Stalk Grain Sedge
2	*Glyceria grandis*	Tall Manna Grass
2	*Scirpus cyperinus*	Woolgrass
2	*Eupatorium maculatum*	Spotted Joe Pye Weed
2	*Carex bebbii*	Bebb's Sedge
1	*Lobelia siphilitica*	Blue Lobelia
1	*Symphyotrichum puniceum*	Purple Stemmed Aster
1	*Mimulus ringens*	Square Stemmed Monkey Flower

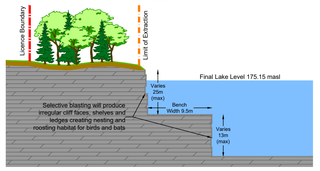
Table 4: Shoreline Wetland

%	Botanical Name	Common Name
PLUGS		
10	*Alisma plantago-aquatica*	Water-plantain
15	*Asclepias incarnata*	Swamp Milkweed
10	*Calla palustris*	Wild Calla
10	*Carex stricta*	Tussock Sedge
10	*Carex vulpinoidea*	Fox Sedge
5	*Chelone glabra*	Turtlehead
5	*Iris versacolor*	Blue Flag Iris
10	*Lemna minor*	Little Duckweed
10	*Polygonum amphibium*	Water Smartweed
10	*Sagittaria latifolia*	Broad-leaved Arrowhead
5	*Scirpus cyperinus*	Wool-grass

Table 5: Riparian Planting List

%	Common Name	Latin Name
SHRUBS		
14	*Cornus amomum*	Silky Dogwood
12	*Cornus foemina*	Gray Dogwood
12	*Ilex verticillata*	Winterberry
12	*Rosa palustris*	Swamp Rose
12	*Salix bebbiana*	Bebb's Willow
14	*Spirea alba*	Meadowsweet
12	*Viburnum lentago*	Nannyberry
12	*Viburnum trilobum*	American Cranberry-bush
LIKES STAKES (Along Creek)		
34	*Cornus sericea*	Red Osier Dogwood
33	*Salix discolor*	Pussy Willow
33	*Salix eriocephala*	Heartleaf Willow
RIPARIAN SEED MIX		
20	*Poa palustris*	Fowl Bluegrass
20	*Carex granularis*	Meadow Sedge
10	*Asclepias syriaca*	Common Milkweed
10	*Verbena hastata*	Blue Vervain
10	*Andropogon gerardii*	Big Bluestem
10	*Juncus tenuis*	Path Rush
5	*Rudbeckia hirta*	Black Eyed Susan
4	*Solidago canadensis*	Canada Goldenrod
4	*Clematis virginiana*	Virgin's Bower
4	*Monarda fistulosa*	Wild Benjamin
1	*Anemone canadensis*	Canada Anemone
1	*Symphyotrichum novae-angliae*	New England Aster
1	*Symphyotrichum puniceum*	Purple Stemmed Aster

Stepped Cliff Face Detail
N.T.S.



Typical Backfilled Side Slope Detail - Quarry
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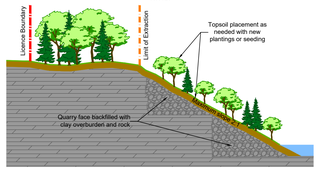

Typical Shoreline Wetland Detail
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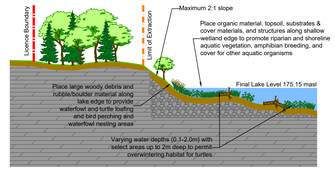
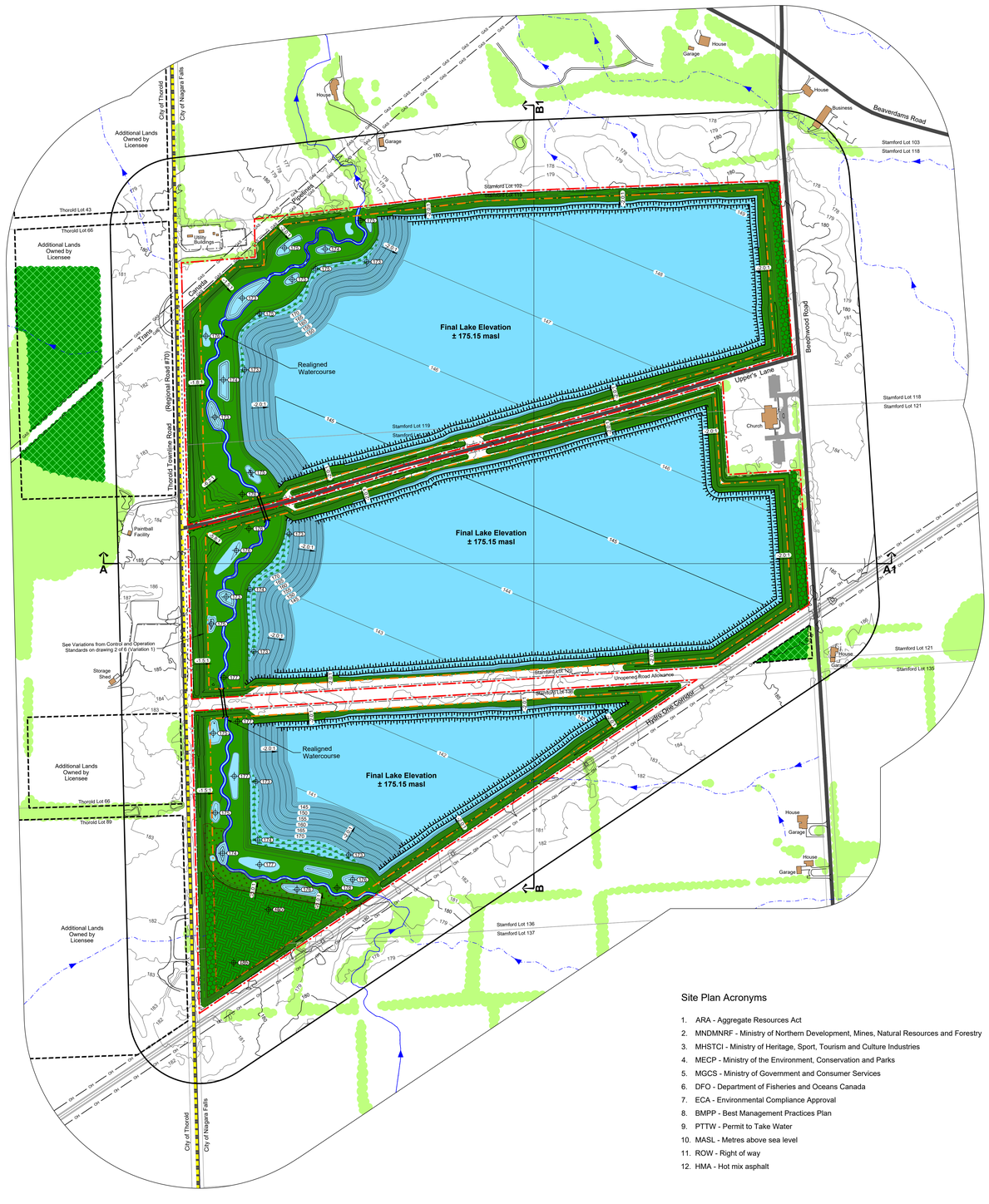




Site Plan Acronyms

1. ARA - Aggregate Resources Act
2. MNDMNRF - Ministry of Northern Development, Mines, Natural Resources and Forestry
3. MHSTCI - Ministry of Heritage, Sport, Tourism and Culture Industries
4. MECP - Ministry of the Environment, Conservation and Parks
5. MGCS - Ministry of Government and Consumer Services
6. DFO - Department of Fisheries and Oceans Canada
7. ECA - Environmental Compliance Approval
8. BMPP - Best Management Practices Plan
9. PTTW - Permit to Take Water
10. MASL - Metres above sea level
11. ROW - Right of way
12. HMA - Hot mix asphalt

Legal Description

Part of Lots 119, 120, 136 & 137
City of Niagara Falls (Geographic Township of Stamford)
Regional Municipality of Niagara

Legend

- Licence Boundary
- Limit of Extraction
- Additional Lands Owned by Licensee
- Municipal Boundary
- Watercourse — Direction of flow indicated by arrows
- Surface Drainage Feature — Direction of flow indicated by arrows
- Watercourse - Realigned (Stantec, 2020)
- Waterbody
- Shoreline Wetland
- Terrestrial Habitat
- Deciduous Woodland
- Treed Deciduous Swamp
- Swamp Thicket and Marsh Meadow
- Woodland Compensation Area (Off-site)
- Wooded Area
- 120m Offset From Licence Boundary
- Parcel Fabric
- Contours with Elevation — Metres above sea level (MASL)
- Public Road
- Trans Canada Pipeline Easement
- Hydro One Easement
- Extraction Face (Below water)
- Entrance / Exit
- Gate
- Culvert
- Fence — 1.2m post & wire farm fence unless otherwise noted
- Building/Structure
- Proposed Floor Elevation — Metres above sea level (MASL)
- Proposed Final Grade
- Cross Sections

Legend - Cross Sections

- Licence Boundary
- Limit of Extraction
- Existing Grade - Undisturbed
- Existing Grade - Removed / Altered
- Maximum Predicted Water Table (See note A.2 on this drawing)
- Quarry Floor / Face
- Backfilled
- Lake or Pond
- Hydro Corridor

Site Plan Amendments

No.	Date	Description	By

Site Plan Revisions (Pre-Licencing)

No.	Date	Description	By

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
113 COLLIER STREET, BARRIE, ON. L4M 1H2 | P: 705.728.0045 F: 705.728.2010 | WWW.MHBCPLAN.COM

MHBC Stamp
Debra Walker
Is authorized by the Ministry of Northern Development, Mines, Natural Resources and Forestry pursuant to Section 2 (1) of the Aggregate Resources Act to prepare and certify site plans.

MHBC Stamp
Christopher Poole
Is authorized by the Ministry of Northern Development, Mines, Natural Resources and Forestry pursuant to Section 2 (1) of the Aggregate Resources Act to prepare and certify site plans.

Applicant

walker aggregates
Walker Aggregates Inc.
2800 Thorold Townline Road
P.O. Box 100
Thorold, Ontario
L2V 3Y8

Project

Upper's Quarry

MNDMNRF Licence Reference No.	**Applicant's Signature**
Plan Scale: 1:3000 (Arch E)	**Date** October 2021
0 90 180 Meters	**Drawn By** C.P.
	Checked By D.W.
	File No. 9811V

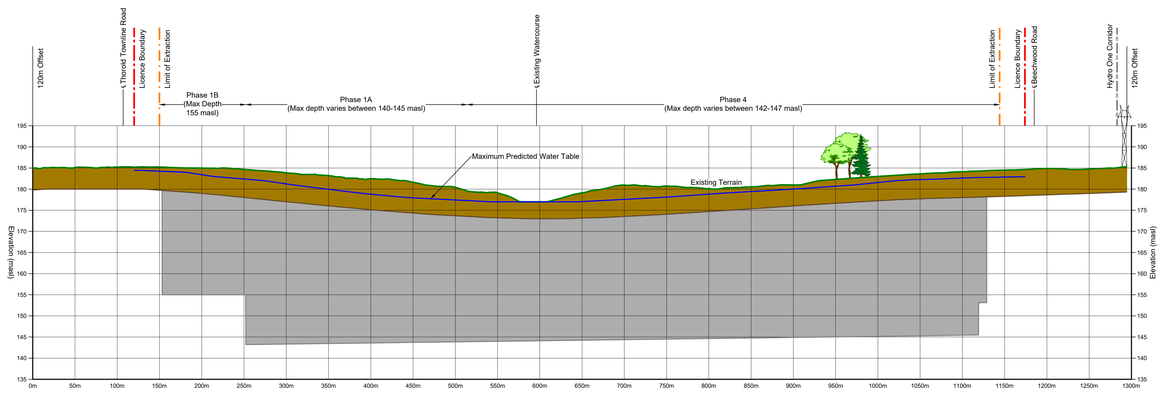
File Name

Rehabilitation Plan

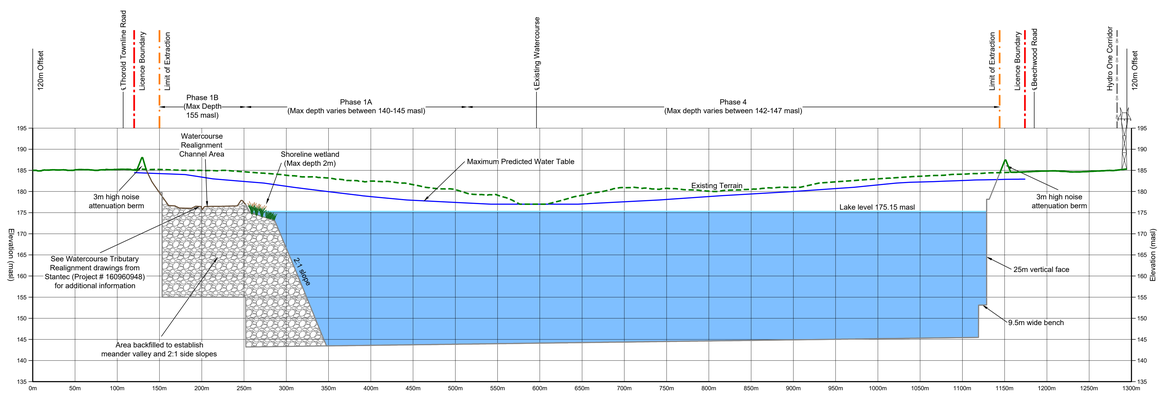
Drawing No.

5 of 6

File Path N:\9\barr\9811V - Walker Uppers Quarry\Drawings\Site Plan\CAD\9811V - Site Plan - Proposed Scenario.dwg



Section A-A' - Existing
Horizontal - 1:2500
Vertical - 1:500



Section A-A' - Rehabilitation
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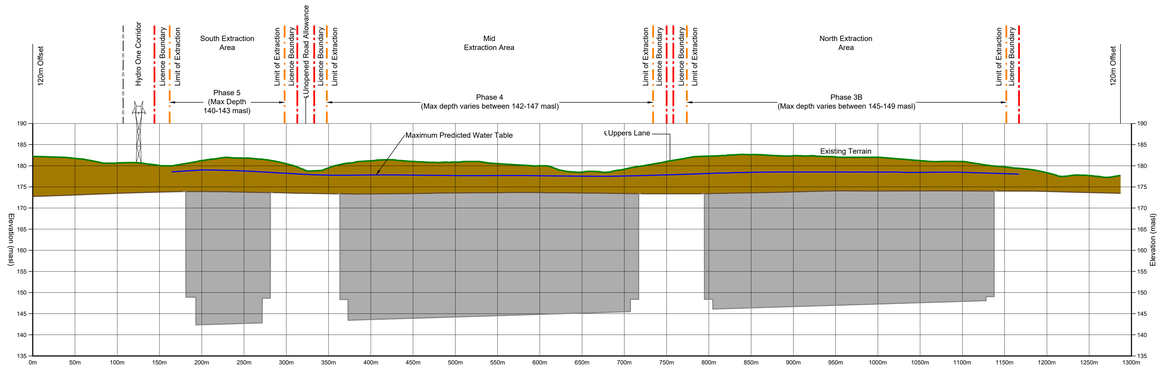
Vertical - 1:500



Section B-B' - Existing
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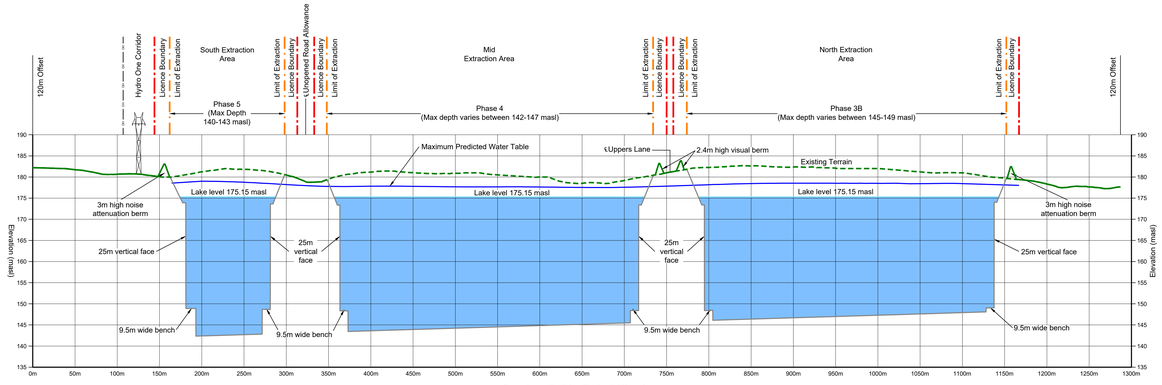
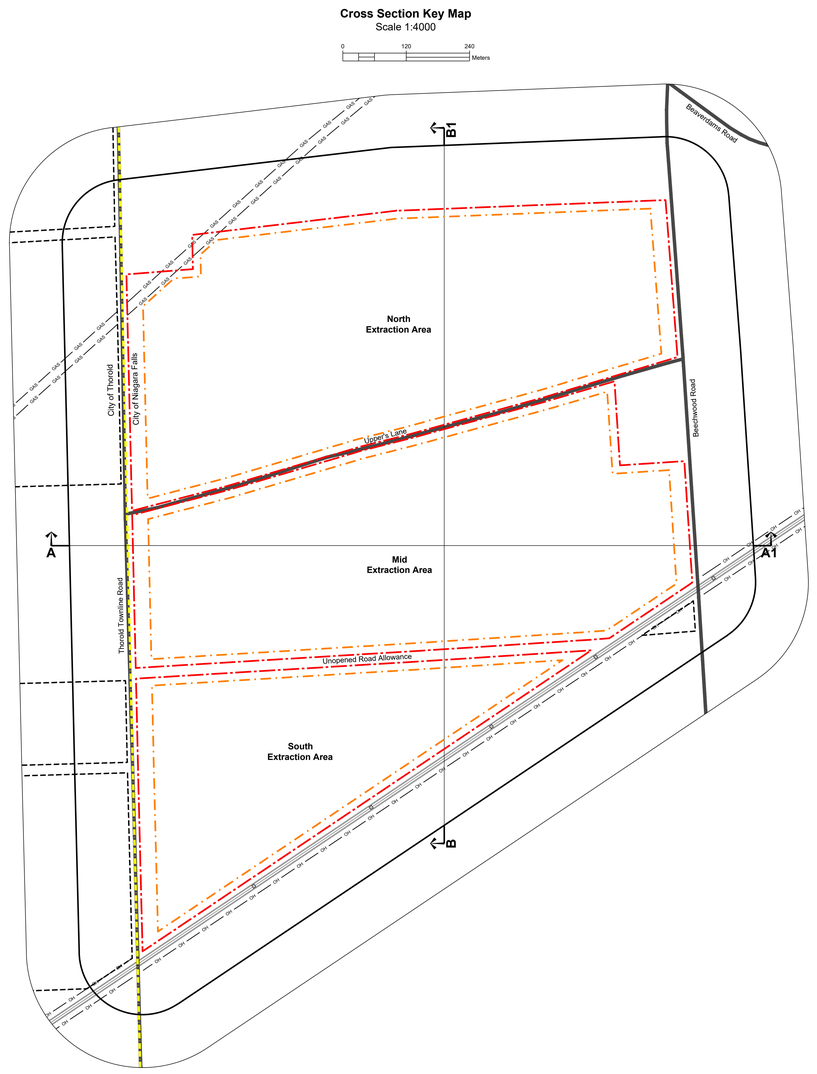
Vertical - 1:500



Section B-B' - Rehabilitation
Horizontal - 1:2500
Vertical - 1:500

Cross Section Key Map
Scale 1:4000



Legal Description

Part of Lots 119, 120, 136 & 137
City of Niagara Falls (Geographic Township of Stamford)
Regional Municipality of Niagara

Legend

- Licence Boundary
- Limit of Extraction
- Additional Lands Owned by Licensee
- Municipal Boundary
- 120m Offset From Licence Boundary
- Public Road
- Trans Canada Pipeline Easement
- Hydro One Easement
- Cross Sections (A1)

Legend - Cross Sections

- Licence Boundary
- Limit of Extraction
- Existing Grade - Undisturbed
- Existing Grade - Removed / Altered
- Berm
- Maximum Predicted Water Table (See note A.2 on drawing 5 of 6)
- Quarry Floor / Face
- Topsoil and/or Overburden
- Aggregate Available for Extraction
- Backfilled
- Lake or Pond
- Hydro Corridor

Site Plan Amendments

No.	Date	Description	By

Site Plan Revisions (Pre-Licencing)

No.	Date	Description	By

PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
MHBC
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Applicant

walker aggregates

Walker Aggregates Inc.
2800 Thorold Townline Road
P.O. Box 100
Thorold, Ontario
L2V 3Y8

Project

Upper's Quarry

MNDMNRF Licence Reference No.

Applicant's Signature

Plan Scale: (Arch E)
Horizontal 1:2500
Vertical 1:500

Date October 2021
Drawn By C.P.
Checked By D.W.
File No. 9811V

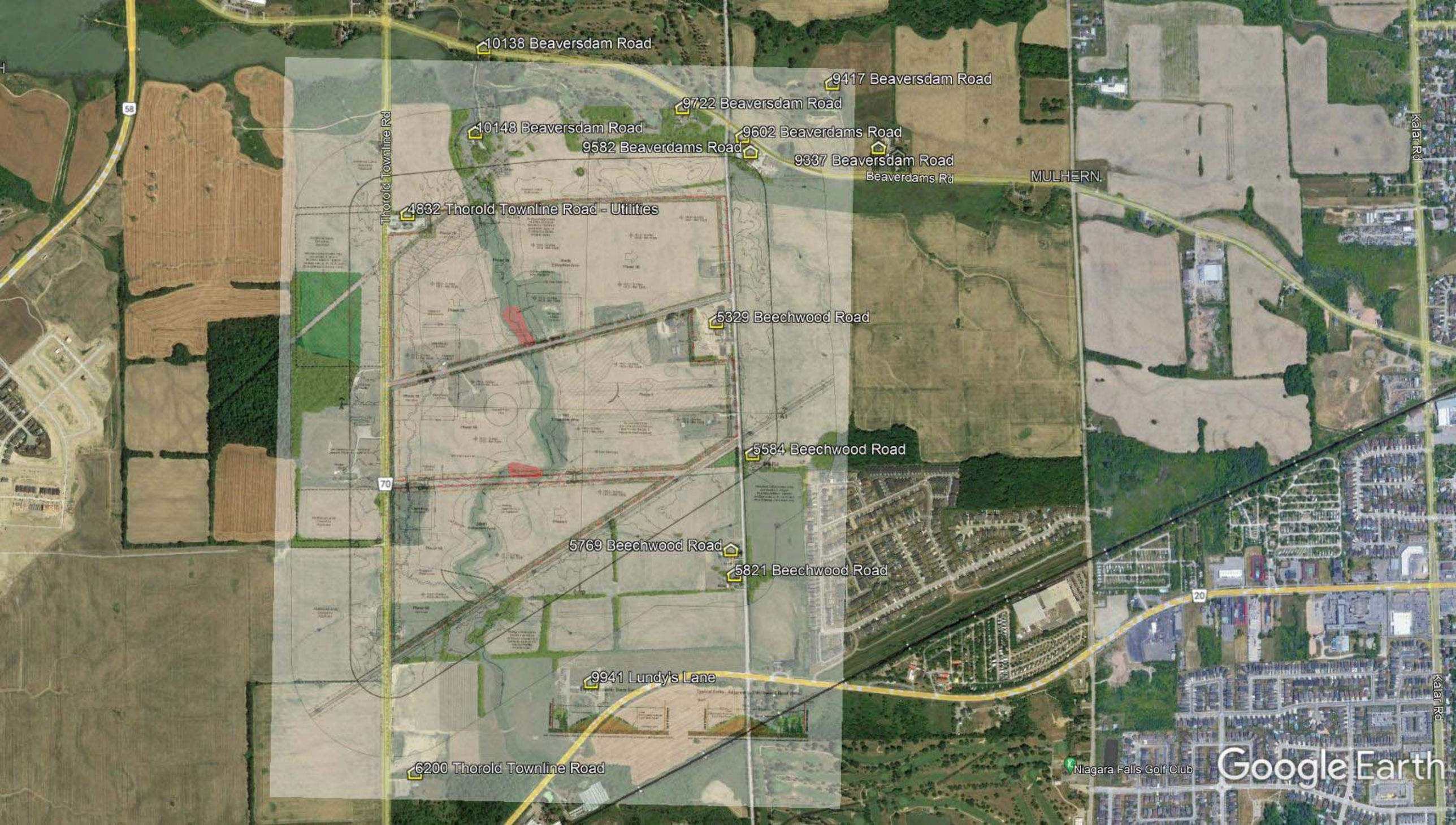
File Name

Cross Sections

Drawing No.

6 of 6

File Path N:\Brian\9811V - Walker Uppers Quarry\Drawings\Site Plan\CAD\9811V - Site Plan - Proposed Scenario.dwg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9417 Beaversdam Road
9722 Beaversdam Road
10148 Beaversdam Road
9602 Beaverdams Road
9582 Beaverdams Road
9337 Beaversdam Road
Beaverdams Rd
MULHERN.
Thorold Townline Rd
4832 Thorold Townline Road - Utilities
Kalar Rd
5329 Beechwood Road
5584 Beechwood Road
5769 Beechwood Road
5821 Beechwood Road
9941 Lundy's Lane
6200 Thorold Townline Road
Niagara Falls Golf Club
Google Earth
58
70
20

Beechwood Golf & Social House
Beaverdams Rd
10138 Beaversdam Road
Beaverdams Rd
Beaverdams Rd
Thorold Townline Rd
Beechwood Rd
9417 Beaversdam Road
9722 Beaversdam Road
10148 Beaversdam Road
9602 Beaverdams Road
9337 Beaversdam Road
9582 Beaverdams Road
Beaverdams Rd
9301 Beaversdam Road
Beaverdams Rd
Additional Lands Owned by Applicant
Proposed Culvert (Inlet of Depth)
4832 Thorold Townline Road - Utilities
Phase 2B
Phase 3A
North Extraction Area
Phase 3B
Phase 2A
Realigned Watercourse
100 Year Flood Line
Secondary Settling
Upper's Ln
Beechwood Road
Regional Road #10
Google Earth

R4

Stamford Ln

dland Compensation Area
see Section P. Report
ommendations - Natural
ge Notes 2, 16, 18, 21 and
drawings 2 of 4 and 3 of 4)

9433 Madison Crescent
9445 Madison Crescent
9409 Madison Crescent
9385 Madison Crescent
9421 Madison Crescent
9397 Madison Crescent
Madison Cres
Madison Cres
5607 Osprey Avenue
5610 Osprey Avenue
9366 Madison Crescent
5615 Osprey Avenue
9352 Madison Crescent
9380 Madison Crescent
5623 Osprey Avenue
5622 Osprey Avenue
Fernwood Early Learning Academy
5631 Osprey Avenue
Osprey Avenue
5632 Osprey Avenue
5639 Osprey Avenue
5642 Osprey Avenue
5647 Osprey Avenue
5652 Osprey Avenue
5655 Osprey Avenue
5663 Osprey Avenue
5668 Osprey Avenue
Shoveler Dr
Shoveler Dr
5671 Osprey Avenue
Google Earth

Appendix B

EXPLOTECH

Uppers Quarry

PREVAILING METEOROLOGICAL CONDITIONS

Medians provided by Environment Canada
Canadian Climate Normals 1981-2010
St Catherines – Municipal Airport

Date	Wind Direction	Max Hourly Wind Velocity Km/h	Temperature (Deg Celsius)
January	SW	89	-3.8
February	E	63	-2.9
March	SW	74	1.1
April	SW	74	7.4
May	SW	65	13.7
June	SW	65	19.0
July	SW	63	21.9
August	W	59	20.8
September	W	53	16.6
October	SW	63	10.4
November	SW	70	4.6
December	SW	70	-0.9

Appendix C

Ground Vibrations

Imperial Equations

Equation 1	Equation 2	Equation 3	Equation 4	Equation 5
Oriard 50% Bound (2002)	Oriard 90% Bound (2002)	Typical Production Blast (Bulletin 656 – 1971)	Typical limestone Quarry (Pader report – 1995)	Typical Coal Mine (RI8507 1980)
$v = 160\,(\frac{D}{\sqrt{W}})^{-1.6}$	$v = 242(\frac{D}{\sqrt{W}})^{-1.6}$	$v = 182\,(\frac{D}{\sqrt{W}})^{-1.82}$	$v = 52.2(\frac{D}{\sqrt{W}})^{-1.38}$	$v = 133(\frac{D}{\sqrt{W}})^{-1.5}$

Metric Equations

Equation 1	Equation 2	Equation 3	Equation 4
DuPont General (1968)	Construction Blasting (Dowding 1998)	Agg. Quarry Blasting (Explotech 2005)	Agg. Quarry blasting (Explotech 2003)
$v = 1140\,(\frac{D}{\sqrt{W}})^{-1.6}$	$v = 1326(\frac{D}{\sqrt{W}})^{-1.38}$	$v = 5175(\frac{D}{\sqrt{W}})^{-1.76}$	$v = 7025(\frac{D}{\sqrt{W}})^{-1.85}$

D (m)	W (Kg)	PPV1 (mm/s)	PPV2 (mm/s)	PPV3 (mm/s)	PPV4 (mm/s)	PPV5 (mm/s)	PPV1 (mm/s)	PPV2 (mm/s)	PPV3 (mm/s)	PPV4 (mm/s)
710	118	**1.4**	**2.2**	**0.5**	**1.4**	**1.9**	**1.4**	**4.1**	**3.3**	**3.1**

Air Overpressure

Imperial Equations

Equation 1	Equation 2	Equation 3	Equation 4
USBM RI8485 (Behind Blast)	USBM RI8485 (Front of Blast)	USBM RI8485 (Full Confined)	Construction Average
$P = 0.056\,(\frac{D}{\sqrt[3]{W}})^{-0.515}$	$P = 1.317\,(\frac{D}{\sqrt[3]{W}})^{-0.966}$	$P = 0.061(\frac{D}{\sqrt[3]{W}})^{-0.96}$	$P = 1(\frac{D}{\sqrt[3]{W}})^{-1.1}$

Metric Equations

Equation 1	Equation 2	Equation 3
Ontario Quarry (Explotech 2013)	Limestone (Explotech 2011)	Ontario Quarry (Explotech 2012)
$P = 159(\frac{D}{\sqrt[3]{W}})^{-0.0456}$	$P = 206\,(\frac{D}{\sqrt[3]{W}})^{-0.1}$	$P = 1222\,(\frac{D}{\sqrt[3]{W}})^{-0.669}$

D (m)	W (Kg)	OP1 (dB)	OP2 (dB)	OP3 (dB)	OP4 (dB)	OP1 (dB)	OP2 (dB)	OP3 (dB)
710	118	**119.3**	**123.6**	**97.3**	**114.4**	**126.7**	**125.3**	**126.8**

Appendix D

EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

Robert J. Cyr, P. Eng.

Principal, Explotech Engineering Ltd.

EDUCATION

Bachelor of Applied Science,
Civil Engineering, Queen's University

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers of Ontario (APEO)
Association of Professional Engineers and Geoscientists of BC (APEG)
Association of Professional Engineers, Geologists and Geophysicists of Alberta
Association of Professional Engineers and Geoscientists of New Brunswick
Association of Professional Engineers of Nova Scotia
Association of Professional Engineers and Geoscientists Manitoba
Professional Engineers and Geoscientists Newfoundland and Labrador
International Society of Explosives Engineers (ISEE)
Aggregate Producers Association of Ontario (APAO)
Surface Blaster Ontario Licence 450109

SUMMARY OF EXPERIENCE

Over thirty years experience in many facets of the construction and mining industry has provided the expertise and experience required to efficiently and accurately address a comprehensive range of engineering and construction conditions. Sound technical training is reinforced by formidable practical experience providing the tools necessary for accurate, comprehensive analysis and application of feasible solutions. Recent focus on vibration analysis, blast monitoring, blast design, damage complaint investigation for explosives consumers and specialized consulting to various consulting engineering firms.

PROFESSIONAL RECORD

2001 – Present	-Principal, Explotech Engineering Ltd.
1996 – 2001	-Leo Alarie & Sons Limited - Project Engineer/Manager
1993 – 1996	-Rideau Oxford Developments Inc. – Project Manager
1982 – 1993:	-Alphe Cyr Ltd. – Project Coordinator/Manager

EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

Mitch Malcomson, P.Eng.

Explotech Engineering Ltd.

EDUCATION

Bachelor of Engineering,
Civil Engineering with Concentration in Business Management,
Carleton University

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers of Ontario (APEO)
International Society of Explosives Engineers (ISEE)

SUMMARY OF EXPERIENCE

A Civil Engineer and Project Organizer for Explotech Engineering Ltd. Mitch holds a Bachelor of Engineering degree from Carleton University in Civil Engineering with a Concentration in Business Management. Mitch has strong analytical, technical, business and leadership skills. Recent projects have focused on vibration analysis and the drilling and blasting portions of mining, quarrying and construction projects across Canada.

PROFESSIONAL RECORD

2008 – Present - Engineer / Project Manager, Explotech Engineering Ltd.

EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

Andrew Campbell, P.Eng.

Explotech Engineering Ltd.

EDUCATION

Bachelor of Engineering,
Mechanical Engineering, Carleton University

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers of Ontario (APEO)
International Society of Explosive Engineers (ISEE)

SUMMARY OF EXPERIENCE

An engineer working for Explotech Engineering Ltd., Andrew holds a Bachelor of Engineering degree in Mechanical Engineering and has strong analytical, technical, and interpersonal skills. A proven leader in collaborative environments, Andrew is comfortable managing projects, specifying details, and communicating internally and externally. Recent focus on blast designs, blast impact analyses, vibration analysis, damage complaint investigation, blast monitoring, and job estimations.

PROFESSIONAL RECORD

2018 – Present	- Engineer, Explotech Engineering Ltd.
2013 – 2018	- Technician, Explotech Engineering Ltd.
2012 – 2012	- Ride Technician, Canada's Wonderland

EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

Mark Morelli, B.Eng.

Explotech Engineering Ltd.

EDUCATION

Bachelor of Engineering,
Civil Engineering, Carleton University

PROFESSIONAL AFFILIATIONS

International Society of Explosives Engineers (ISEE)

SUMMARY OF EXPERIENCE

A technician working for Explotech Engineering Ltd., Mark holds a Bachelor of Engineering degree in Civil Engineering and has strong technical, leadership, interpersonal, communication, and presentation skills. Recent focus on blast monitoring, data management, scheduling, job estimations, vibration analysis, damage complaint investigation and attenuation anlysis.

PROFESSIONAL RECORD

2006 – Present - Technician, Explotech Engineering Ltd.

2003 – 2004 - Labourer, Hydracorp Canada Ltd.

2002 – 2003 - Labourer, Quad Construction

Appendix E

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Blasting Terminology

ANFO:	Ammonium Nitrate and Fuel Oil – explosive product
ANFO WR:	Water resistant ANFO
Blast Pattern:	Array of blast holes
Body hole:	Those blast holes behind the first row of holes (Face Holes)
Burden:	Distance between the blast hole and a free face
Column:	That portion of the blast hole above the required grade
Column Load:	The portion of the explosive loaded above grade
Collar:	That portion of the blast hole above the explosive column, filled with inert material, preferably clean crushed stone
Face Hole:	The blast holes nearest the free face
Overpressure:	A compressional wave in air caused by the direct action of the unconfined explosive or the direct action of confining material subjected to explosive loading.
Peak Particle Velocity:	The rate of change of amplitude, usually measured in mm/s or in/s. This is the velocity or excitation of the particles in the ground resulting from vibratory motion.
Scaled distance:	An equation relating separation distance between a blast and receptor to the energy (usually expressed as explosive weight) released at any given instant in time.
Sensitive Receptor:	Sensitive land use may include recreational uses which are deemed by the municipality or provincial agency to be sensitive; and/or any building or associated amenity area (i.e. may be indoor or outdoor space) which is not directly associated with the industrial use, where humans or the natural environment may be adversely affected by emissions generated by the operation of a nearby industrial facility. For example, the building or amenity area may be associated with residences, senior citizen homes, schools,

	day care facilities, hospitals, churches and other similar institutional uses, or campgrounds.
Spacing:	Distance between blast holes
Stemming:	Inert material, preferably clean crushed stone applied into the blast hole from the surface of the rock to the surface of the explosive in the blast hole.
Sub-grade:	That portion of the blast hole drilled band loaded below the required grade
Toe Load:	The portion of explosive loaded below grade

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