

Ontario Aggregate Industry and Ministry of Natural Resources Continue to Ignore or Trivialize the Notoriously Dangerous and Potentially Deadly Consequences of Flyrock from Blasting (Detonation of Explosives)

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ABSTRACT

Aggregate extraction is one of the most noxious, toxic and destructive uses of land, and one of the uncontrollable consequences of blasting rock is flyrock, which is a health and safety risk unknown to the general public. Flyrock is the dirty little secret of the Aggregate Industry and its Explosives Engineers. They have been remarkably successful in concealing the potentially deadly consequences of flyrock from the public while continuing to engage in reckless blasting practices based on theoretical guesswork (iterative trial and error process) and inadequate permanent onsite setbacks (excavation limits) and permanent offsite separation distances. An independent analysis of a running total of 240 (known) documented flyrock incidents as of August 2024 in various jurisdictions, in which 45 of the incidents resulted in the death of 49 individuals and injury to another 49 individuals, revealed an incident “kill” rate of 18.8% (45 ÷ 240). In Ontario, anyone can engage in blasting (detonation of explosives), as there are no statutory requirements (academic or practical) to demonstrate competency, as mandated by other jurisdictions. Government advisories about the dangers and health risks of detonating explosives incorrectly, in the wrong location or under inappropriate environmental conditions are frequently issued in several jurisdictions other than in Ontario, Canada, where oversight of the aggregate industry and its explosives engineers is ineffective or non-existent. When it comes to flyrock, the only aspects of a blast in doubt are how far flyrock debris will launch from the blast site, and whether it will damage equipment, vehicles or property, or injure, permanently disable or kill human or non-human life forms. Governments bear a fundamental duty to protect their citizens’ health, safety and welfare from all the adverse effects of aggregate extraction operations, not just flyrock.

Keywords: Flyrock, Misfires, Blasting, Aggregate Extraction, Explosives Engineers

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1. INTRODUCTION

The purpose of this paper is to raise awareness of the uncontrollable aspects of blasting rock in a proposed quarry operation, which are often by-passed or overlooked in a theoretical Blast Design Report, and deliberately mislabeled by explosives engineers as a Blast Impact Assessment; the lack of effective regulatory oversight of aggregate extraction in Ontario; and the need for appropriate onsite and offsite measures to protect human and non-human life from the potentially deadly consequences of flyrock, an inevitable by-product of blasting, and other adverse effects associated with aggregate extraction.

Accidents due to flyrock are rarely reported (Raina et al., 2014, citing Davies, 1995). Concealing the dangers of flyrock from the public serves the financial interests of the Aggregate Industry at the expense of the environment and its inhabitants, both human and non-human. According to the Ontario Aggregate Resources Act (Act), O. Reg. 244/97,¹ flyrock is not to be launched beyond the boundaries of a quarry site.

28. A licensee or permittee shall take all reasonable measures to prevent fly rock from leaving the site during blasting if a sensitive receptor is located within 500 metres of the boundary of the site.

There are no provisions in the Aggregate Resources Act (ARA) as to how flyrock debris is to be prevented from leaving the boundaries of a site, and as to what “reasonable measures” the onsite blaster-in-charge² is to take. Since the ARA does not define “flyrock”, it remains a mystery as to what constitutes “reasonable measures,” i.e., quantifiable measures to protect quarry personnel onsite and human and non-human life offsite from the potentially deadly consequences of flyrock debris. Based on ARA’s illusive premise, the blaster-in-charge is, in effect, given free rein to make up a definition of flyrock and arbitrarily engage in any manner of blasting anywhere onsite within a reckless and inadequate excavation limit (i.e., onsite setback) of only 30 metres under the ARA, which is grossly inadequate from a land use compatibility perspective, and puts the health, safety and welfare of the public at risk.

A phenomenon like flyrock, an intentional consequence of blasting (detonation of explosives) rock, can never be eliminated and its travel distance varies with each blast. No formula can account for human error, incompetence or environmental conditions above and below the ground encompassing the blast site. To suggest a controllable or knowable outcome from any blast is extremely misleading and defies common sense. A “controllable blast” can only control blast elements such as hole depth, spacing, burden,³ charge size (quantify of explosive in a blast hole), charge distribution, and delay sequence to excavate rock to a smooth surface with minimal over-break. The consequences of every blast are unique and unknowable because of the innumerable uncontrollable or unknown factors, which explains why the courts have declared the detonation of explosives an ultra-hazardous activity, regardless of whatever so-called “control” measures the blaster-in-charge has taken.

Flyrock, in the broadest sense, is any debris generated by a blast, regardless of where the debris lands, either onsite or offsite. Flyrock occurs wherever there is rock mining (Eze and Usani, 2014), and the authors cite 15 flyrock incidents: 3 that caused property damage; 3 that caused injury; and 12 that caused death. Because flyrock debris can reach speeds of up to 400 miles an hour (644 kilometres per hour), any amount of showering flyrock debris is capable of damaging property and injuring, permanently disabling or killing human and non-human life forms at a considerable distance from the blast site.

Research conducted by Tripathy and Gupta (2004) concluded that rock throw formulas applied in blast design produce vastly different outcomes, and that several factors cause flyrock to launch

¹ <https://www.ontario.ca/laws/regulation/970244>

² Unlike Ontario, where there are no licencing requirements to demonstrate proficiency and competency in blasting (detonation of explosives), in Newfoundland and Labrador, training to become a Level 1 Certified blaster requires 360 hours (120 classroom hours and 240 hours of supervised practical experience), and successful completion of Certification Exam Level 1. Required work experience “one thousand (1000) hours of practical experience as a Certified Blaster Level 1. Experience must be verified...; and two (2) blasts within 1000 metres of an occupied structure under the supervision of a certified Level II or higher blaster,” Apprenticeship and Trades Certification Division, <https://www.gov.nl.ca/atcd/cert-powengblaster/blaster/>.

³ The BURDEN is the distance from a single row to the face of the excavation, or between rows in the usual case where rows are fired in sequence.

farther than expected. Tripathy and Gupta (2004) quote a UK study (1980-1985) of 103 known flyrock incidents, where more than half of the flyrock incidents travelled from 350 metres to 900 metres.

In another quantitative study of flyrock incidents (Sevelka, 2023), the travel distances of 139 flyrock incidents were documented, 90 or 65% ($90 \div 139$) of which were launched farther than 300 metres from the blast site, reaching more than 1,300 metres from the blast site. In 49 or 35% ($49 \div 139$) of the flyrock incidents, flyrock debris was launched farther than 500 metres from the blast site. Tripathy and Gupta (2004) describe the inherent shortcomings associated with the various formulas relied upon to estimate flyrock throw distances:

“Flyrock is one of the most hazardous unwanted effects of rock blasting used in quarrying, mining and construction activities... [F]lyrock may be responsible for damage to property as well as fatal accidents and serious injuries at very long distances from the blasting site. More than 50% of the 103 accidents from different mining sites in United Kingdom during 1980-85 are reported to be due to flyrock up to distances ranging from 350 m to 900 m (Bandari, 1997)... Blast design errors like improper burden, use of shallow holes, faulty drilling, inappropriate delay period, wrong sequence of firing and unfavourable geological set up (e.g., presence of open joints, mudseams, voids and cavities are the principal cause of flyrock (Fletcher and D’Andrea, 1986; Schneider, 1996, 1997). Though, it is a difficult task to estimate the exact distance of flyrock from a blasting site, several studies (Lundborg et al., 1975; Roth, 1979; Gupta et al., 1988) have proposed empirical relations between the maximum distance of flyrock and the various blast design parameters like diameter of blast hole, powder factor and stemming⁴ to burden ratios. However, the results of these studies differ so widely that it becomes difficult to rely upon a particular relationship”

An October 2023 motion passed by the Town of Caledon, addressed to Ontario provincial agencies involved with issues associated with aggregate extraction operations sought the province’s support for separation distance requirements from sensitive land uses, a plea to which no response was received. The request reads as follows:

“That the Minister of Natural Resources and Forestry and Minister of the Environment, Conservation and Parks be requested to support approval by the Region of Peel policies in the new Caledon Official Plan that establish positive criteria for minimum influence areas and separation distances between the licensed pits and quarries, identified high potential mineral resource areas, designated and existing settlement areas, villages, hamlets, residential clusters and other sensitive land uses in order to achieve permanent land use compatibility within Caledon” (Roman, 2023).

Reform Gravel Mining Coalition with its coalition partners (environmental defence, The Council of Canadians, Water Watchers and Wilderness Committee) was established on January 31, 2022. The Coalition is demanding that the Ontario government impose a moratorium on all new approvals for gravel mining (aggregate extraction) in Ontario, and take actions (policy initiatives, including effective and timely oversight) necessary to protect lives, communities and the environment from the devastating impacts of aggregate extraction (mining).⁵ This initiative calling for a moratorium has been endorsed by a diverse range of community groups, and has garnered formal support from 20 municipalities, including the Town of Caledon.⁶

2. DEFINITIONS AND DESCRIPTIONS OF FLYROCK AND MISFIRE

The vast array of definitions of *Flyrock* in various jurisdictions significantly impacts understanding what qualifies as flyrock, and definitions that arbitrarily exclude onsite incidents of flyrock are one of the major sources of non-disclosure or concealment of flyrock incidents.

“Flyrock” means rock that is thrown through the air as a result of blasting.”⁷

⁴ “Stemming” means placing inert material in the portion between the top of the explosive column and the collar of a blast hole, intended to confine the explosive gases for an effective blast. OHS Regulation Part 21: Blasting Operations Definitions, WorkSafe, BC.

⁵ Reform Gravel Mining Coalition. <https://www.reformgravelmining.ca/who-we-are/>.

⁶ Reform Gravel Mining Coalition. DAMN! Campaign - Reform Gravel Mining Coalition.

⁷ Nova Scotia, Canada, website: <https://novascotia.ca/lae/healthandsafety/flyrock.asp>. In Ontario, *flyrock* is an undefined term in the Aggregate Resources Act O. Reg. 244/97, s. 0.13 (1) 28, requires that *reasonable* (undefined) steps to prevent *flyrock* only if there are *sensitive receptors* within 500 metres of the boundary of the site (s. 0.13 (1) 28).

“Flyrock can be gravel, rocks, tree trunks, construction materials, mud – even water.”⁸

“Flyrock is anything that is thrown by a blast and lands outside the blast area.”⁹

The Institute of Makers of Explosives (IME) has defined *flyrock* as the rock propelled beyond the blast area by the force of an explosion (IME, 1997).

“Flyrock can be defined as the throw of rock fragments from a surface or open pit blast that travel distances beyond the expected range or a pre-set safety zone, and which pose a serious threat of damage to property and infrastructure, and injury to people in and around the mine property” (Szendrei and Tose, 2023).

In a previous paper (Szendrei and Tose, 2023), it was pointed out that empirical approaches to the prediction of flyrock throw distances are necessarily limited for the reason that such models are unable to predict the two primary determinants of throw distance – flyrock mass and initial velocity.

“Flyrock is a phenomenon that consists of the projection of rock fragments beyond the quarry’s permitted work area, which represents a big danger for the population that inhabits close to the limit of said work area (Xavier, 2020).”

“Flyrock means any uncontrolled material generated by the effect of a blast that was hazardous to persons, or to property not owned by the operator.”¹⁰

“Flyrock consists of rock blown from the shot area by the explosive force. This rock can be lethal because of its weight and velocity of travel. Flyrock is also caused by a blowout. When a blast hole is drilled deep enough into the rock, the explosive force blows the rock out into the drift or work area.”¹¹

“Almost every blast has some material movement which might be called flyrock. Flyrock is a major cause of injury and death in mining.”¹²

“Any blasting event in surface mines produces a sudden ejection of rock pieces, called flyrock, which may result in human injuries, fatalities and property damage (Jamei et al., 2021).”

“Flyrock from surface blasting operations has caused serious injury and death to employees and other persons (Bajpayee et al., 2007).”

“Flyrock can travel in any direction or multiple directions from a blast” (Tim Rath, Manager of Technical Services at Green Mountain Explosives).¹³

“...[T]he effects of flyrock do not decrease with distance: a 200-gram projectile can be fatal at 20 metres, as it can at 1,000 metres”¹⁴.

“If you are a mile [1,609 metres] away or even only 500 yards [457 metres] away, you may be able to see flyrock coming but it is too fast to avoid. And if one piece of rock flies, there will likely be others with it.”¹⁵

“It is well known that rock and/or debris can be thrown over a kilometre [$>1,000$ metres] from the blast site, and in a recent case rocks travelled approx. 1.3 km [1,300 metres],”¹⁶

“Flyrock has been known to land a half mile [805 metres] farther than [the] planned [blast area, as arbitrarily defined by the blaster-in-charge]. In Kentucky, flyrock killed a blaster by flying high enough to clear a 200-foot [61-metre] bench and hit him standing 550 feet [168 metres] away.”¹⁷

“...Wind can assist in the producing of flyrock. When the wind direction is in accord with the designed throwing distance, the flyrock can travel distance two times [more] than normal [p. 1185]” (Zhou, 2009).

“The multiple studies reviewed and analyzed concluded that ‘there are major research gaps into the phenomena of flyrock and that this concept is not well understood (Raina et al., 2015).”

⁸ Workers’ Hazard Alert issued by the National Institute for Occupational Safety and Health (NIOSH), 2019.

⁹ Workers’ Hazard Alert issued by the National Institute for Occupational Safety and Health (NIOSH), 2019.

¹⁰ Virginia Department of Mines, Minerals and Energy

¹¹ Explosives Handbook for Accident Prevention, March 2001, <https://www.dir.ca.gov/dosh/documents/mining-and-tunneling/exam-study-materials-blaster-part-4.explosives-handbook.pdf>

¹² Explosives Handbook for Accident Prevention, March 2001, <https://www.dir.ca.gov/dosh/documents/mining-and-tunneling/exam-study-materials-blaster-part-4.explosives-handbook.pdf>

¹³ Testimony of Tim Rath. Blasting and Flyrock Cross Exam of Rath 12/15/2008, http://www.killthealbionquarry.org/flyrock_danger.pdf.

¹⁴ SAFEX Newsletter No. 61 June 2017, 2017-2-Newsletter-61.pdf (efee.eu).

¹⁵ Toolbox Safety Talks: Blast Safety, Lesson A, NIOSH.

¹⁶ “Flyrock incidents,” Explosives information bulletin no.69 | 27 February 2009 | Version 1, <https://www.rshq.qld.gov.au/safety-notices/explosives/flyrock-incidents2>.

¹⁷ Toolbox Safety Talks: Blast Safety, Lesson A, NIOSH

According to Keith Taylor, General Manager, Austin Powder Company Ltd., “90% of flyrock incidents are ‘unexplainable.’”¹⁸

“There isn’t a company that could stand up here and say they don’t have flyrock,” said Shawn McGoldrick, of McGoldrick Brothers Blasting Services (Hartwell, 2006).¹⁹

“Flyrock can never be completely eliminated.” (Scottish Government – Surface mineral workings: control of blasting, February 1, 2000)²⁰

“Flyrock” is defined as “blasted material cast into the air, or traveling along the ground, that is cast from the blasting site more than half the distance to the nearest dwelling, public building, school, church; commercial, community or institutional building; or any occupied structure; or that is cast beyond the permit boundary.”²¹

Flyrock events historically have not been limited to blasting operations within the distances which require the submission and approval of an “anticipated blast design (SMP-61) prior to blasting. Rather, flyrock events have occurred and impacted dwellings, vehicles, persons, animal life, and other physical structures thousands of feet from the blast site resulting in death and the destruction of property (Reclamation Advisory Memorandum #140 – issued July 18, 2008).

Flyrock debris, an inevitable and uncontrollable by-product of blasting rock, can never be eliminated, regardless of the amount of explosive power employed:²²

- Flyrocks are one of the most uncontrollable events we have in rock blasting, and can be generated with a small amount of energy.
- We can estimate the normal launch behavior of blasted material, but not Flyrocks.
- Launch control techniques help to minimize the occurrence of Flyrocks, but even so we can have punctual events, which can occur even in controlled blasts.
- Flyrocks are not directly related to the amount of blast charge, but to the escape of energy (gases), so even blasts with low power factor can cause Flyrocks.
- Usually Flyrocks are caused by specific situations, which can be pre-existing, and not identified, or can also be caused during any of the stages of blasting preparation, such as sizing the drill pattern, drilling, loading, choice of delays and others.
- There are no magic ways to control Flyrocks, and the best way is prevention, ensuring an effective assessment to identify critical situations, good operational practices, quality controls at all stages (from design to blast performance), and good clearance zone practices.

An increase in the number of blast holes (detonations) increases the amount of flyrock debris generated, as each detonation produces flyrock debris,²³ and the probability of misfires increases. According to David Camara Jr. and his son, David Camara III, owners of the Blissville Quarry and Mill in Castleton, Vermont “the power of a blast and whether it produces flyrock or not, has less to do with the amount of explosive being used and depends more on the delays between charges and space between drill holes.” (Whitcomb Jr., 2022).

“An expert blaster....[testified] that blasting is not an exact science, and he appeared unwilling to blame the blaster. Had it not been for the flyrock incident, he testified that he would have considered the blast a success [para. 23]. [The expert] did acknowledge that there was zero tolerance for flyrock in urban settings [para. 24] [but said] he might have made the same decisions as the blaster [para. 25]”²⁴ “No one can do a perfect blast every time. That’s why blasting companies carry insurance.” (Davidson, 2010)

¹⁸ MOE 2009 investigation Case File Number: 2283-83MN69 of two flyrock incidents at Pakenham Quarry, and investigating explosives engineer recommended 500-metre onsite setback for all future blasts (Detonation of explosives).

¹⁹ Hartwell, M. (2006). “Busque quarry stonewalled at town meeting,” *Lakes Region Weekly*, November 16, 2006, Updated March 10, 2016. <https://www.pressherald.com/2006/11/16/busque-quarry-stonewalled-at-town-meeting/>.

²⁰ Part of planning advice notes (PANs), <https://www.gov.scot/publications/blasting-surface-mineral/>.

²¹ Kentucky Energy and Environment Cabinet Department for Natural Resources, July 18, 2008, <https://eec.ky.gov/Natural-Resources/Mining/Mine-Permits/RAMS/RAM140.pdf>

²² Flyrock (part 01 of 03), Blasting Trainings, August 12, 2022, LinkedIn. <https://www.linkedin.com/pulse/flyrock-part-01-03-blasting-trainings/>. Retrieved on May 18, 2024. As the Blasting Training course was being presented, at 9:15 am on June 8, 2022, the blasting instructor received a message of a June 17, 2022 report in Portuguese “of an incident where a Flyrock hit a car and killed a [35-year-old] man.”

²³ Every blast hole is a separate detonation, which means that during every blast event there would be 62 chances for flyrock from face burst, cratering, or stemming ejection (Testimony of Art Hendrickson 12/15/2008).

²⁴ *Director of Occupational Health and Safety v. Government of Yukon, William R. Cratty and P.S. Sidhu Trucking Ltd.*, 2012 YKSC 47 (CanLII), <<http://canlii.ca/t/fs6vt>>, retrieved on 2019-09-28.

“Following an analysis of reported explosives incidents, the most common type of explosives incident reported is consistently misfires (68.3% between July 2021-July 2022...)”²⁵ (As reported in January 2008, Explosives Inspectorate, Queensland Government, “a mine has been neglecting to advise the Inspectorate of misfires in a timely fashion. Eventually, reports of 69 misfires were received in one batch.”)²⁶

2.1 Definition of Misfire

An explosive charge in a drill hole that has partly or completely failed to explode as planned. Causes include unskilled charging; defective explosive, detonator, or fuse; broken electric circuit or--most dangerous--cutting off of part or all of the charge through lateral rock movement as other holes in the vicinity are fired. Stringent safety precautions cover procedure in minimizing these risks and in dealing with known or suspected misfires. A smoldering fuse may delay explosion, causing a hangfire, so return to workings after a suspected failure is necessary. Another main cause of accident is drilling into or dangerously near a socket--an apparently empty drill hole.²⁷

“Misfire from the surface and underground mining blast operation has caused serious injury and death of mine workers and other persons. Damage due to misfire and lack of proper handling accounted for over two-thirds of all blasting-related accidents in the mine and likewise in explosive magazine and manufacturing companies. Consequently, blasting misfire cause several adverse economic, environmental, and health (Triple-Helix) effects such as; ground vibrations, air blast, flyrock, generation of fines, fumes and mud, crush injuries, asthma or COPD exacerbations.” (Taiwo et al., 2022) (In Ontario, the Aggregate Resources Act does not reference “misfires,” and aggregate extraction operations are not required to report a “misfire.”)

“A misfire is the complete or partial failure of any blasting material to explode as planned. Due to the fact that a misfire is a charge that does not detonate, it is obvious that the occurrence itself does not directly injure or kill. It is in the aftermath of a misfire that a serious hazard exists to the blaster and those around him as they try to resolve the problem. Often a misfire results in unexploded charges being mixed with the blasted rock; in such a situation, any one excavating this material could cause the charges to fire due to impact or friction.”²⁸

On 04/09/98, a misfire of one [blast] hole containing 880 pounds [399 kilograms] of explosive with an unfired booster and cap occurred. The licensed blaster in charge and the general contractors Safety Department were aware of the condition. Between these dates, the loaded hole was left unattended... Production in the pit area continued as usual for five days and nights. On 04/16/98, while shooting... [the] misfire, flyrock was cast 2,700' [823 metres] and landed in the vicinity of employees. One large rock was cast over the head of an inspector and struck an excavator 1,700' [518 metres] from the blast site. Employees were exposed to serious injury.

During the drilling stage, boreholes most likely won't follow the planned straight trajectory, as deviations to the trajectory are quite common. These increase with the depth of the boreholes and are caused by innumerable factors. Also to be taken into consideration is the fact that benches²⁹ rarely display a uniform behaviour as is thought of in theory, which makes it difficult to measure the actual burden between the boreholes and the free face. All of these concerns compromise the correct distribution of explosive within the intended blasting area and can lead to flyrock, noise, seismic waves, formation of fines or boulders with dimensions bigger than the ones that the crusher can act on, causing a decrease in safety and increasing the cost of extraction. The flyrock 'factor' must always be taken into consideration since it can cause serious damage to not only personnel but to other people in adjacent communities, the company's facilities, and nearby structures (Xavier, 2020).

²⁵ Best Practice Guideline, Prevention of Explosive Misfires in Blasting Applications, Resources Safety & Health Queensland, December 2022, Explosives Act 1999 (1), Coal Mining Safety and Health Act 1999 (2), Mining and Quarrying Safety and Health Act 1999 (3), Best Practice Guidelines - Prevention of Explosive Misfires | Resources Safety & Health Queensland ([rshq.qld.gov.au](https://www.rshq.qld.gov.au)).

²⁶ Significant explosives accidents and incidents report 2007 ([rshq.qld.gov.au](https://www.rshq.qld.gov.au)).

²⁷ <https://www.mindat.org/glossary/misfire>

²⁸ Explosives Handbook for Accident Prevention, March 2001, <https://www.dir.ca.gov/dosh/documents/mining-and-tunneling/exam-study-materials-blaster-part-4.explosives-handbook.pdf>

²⁹ “Bench” is a horizontal ledge from which holes are drilled downward into the material to be blasted. *Geotechnical Engineering Manual*, New York, August 2015.

3. FLYROCK INCIDENTS UNDERREPORTED OR UNNOTICED

In many jurisdictions, including Ontario, Canada, flyrock debris that does not leave the boundaries of a pit or quarry remains unreported and undocumented, which adds to the illusion perpetuated by the aggregate industry and their explosives engineers that flyrock is a “controllable” event. Suspicions and root causes behind *flyrock* and the under-reporting of *flyrock* incidents in Ontario were discussed by participants during an interactive forum at the 2011 annual general meeting of the Western Canada Chapter of the International Society of Explosives Engineers in Vernon, BC (Loeb, 2012):

“Flyrock incidents in Ontario are probably just not being recorded. The fine is for flyrock leaving a property onto another property. Often that is not seen and the evidence would be swept off the street. I would strongly suspect that several flyrock incidents in Ontario are not recorded....” (A. Grogan, pers. comm., 16 October 2011).

According to Loeb (2012), blasters, consultants and inspectors complain that *flyrock* is treated with indifference and not taken seriously by blasting companies:

“It is the general consensus among blasters, consultants and inspectors alike, that blasting companies are not taking the necessary precautions to prevent flyrock, and are pushing the blasters to conduct their work too cheaply. This in turn causes larger holes, wider spacing on blast hole patterns, and less regard for safety from flyrock. Due to the manner in which the regulations are written, the blaster is essentially a scapegoat, and the company simply hires a new blaster and continues business as usual [p. 48]”.

Non-Disclosure Agreements (NDAs) are another form of concealment within the aggregate extraction industry. In an online Facebook exchange a former employee of Orica, one of the world’s largest suppliers and blasters of explosives of the aggregate industry, related a flyrock incident around 2009 in Ontario, the details of which the employee was precluded from disclosing for 25 years under a NDA. The flyrock incident as described on Facebook on October 9 and November 3, 2024, reads as follows:

“I was invited to a large quarry by the manufacturer of blasting equipment. I was shocked when the employees in the way of the blocks of rock had very little time to close the window guards and hop in a truck and by the time they got to a safe spot the explosion next to my feet threw rock up everywhere. Luckily the whole area to be blasted failed to completely fire. I took what I could to find out why it failed to completely fire but I would rather not be there ever again. Pieces of rock were flying everywhere[,] and these were not tiny pieces. Before they fire[,] all the equipment is supposed to self-test including all the detonators and all had secondary explosives to self-test including all the detonators and all had secondary explosives two to a [blast] hole.”

“The vehicles were parked almost a kilometre (1,000 metres) away and the flyrock took chunks out of the windshields and left dents in the metal. When we got back the company laughed about it. As observers we could have been killed.”

4. WHAT IS FLYROCK AND WHAT POLICIES ARE IN PLACE TO PROTECT THE PUBLIC FROM FLYROCK?

As noted below, flyrock is an inevitable by-product of blasting rock and is considered the ultimate *adverse effect* because of its potential to injure, permanently disable or kill human and non-human life forms. Flyrock debris can be launched and scattered over long distances, regardless of the amount of explosives used, and at great speed, and can also damage the environment and third-party public and private property. Despite the undesirable impacts caused by blasting rock, in Ontario there are no policies or protocols under the ARA to prevent flyrock, and provincial government oversight of the aggregate extraction industry is ineffective and undermined by self-reporting. The ARA has no definition of flyrock, and both explosives engineers and land use planners simply advocate on behalf of the aggregate industry without regard to an overriding duty to protect the health, safety and welfare of the public. Land use planners often conflate provincial operational requirements under the ARA with municipal requirements that relate to issues of land use compatibility (e.g. *use* and *enjoyment* of property, and *health, safety* and *welfare*) and preservation of property values. The term *adverse effect*,

similarly defined in both the Ontario Environmental Protection Act and the 2024 Provincial Policy Statement, also routinely goes undefined, and, yet, both the Blast Impact Assessment (BIA) and Planning Justification Report (PJR) conclude with a bald assertion that “there are no adverse effects.” An undefined problem has no solution, and is a classic example of by-passing.

- Flyrock, as the name suggests, refers to chunks of rock or debris ranging in size, weight and quantity launched into the air or along the ground due to blasting (detonation of explosives) at operating quarries. Persson et al. (1994) referenced flyrock weighing approximately three tons (6,000 pounds) thrown 980 feet (299 metres).
- Flyrock is a hazardous phenomenon, and Ontario’s Ministry of Natural Resources (MNR) has failed to provide effective oversight of blasting quarry operations, relying instead on (unenforced) self-reporting requirements³⁰ and indirect complaints from the public. As documented in the December 2023 report of Ontario’s Auditor General,³¹ MNR has failed to protect the environment and communities from the adverse effects of aggregate extraction. The quote that follows is from the Auditor General’s report:
“Limited inspection and enforcement, and the lack of experienced inspectors, means that the Province is not doing enough to maintain a balance between the need for aggregates for Ontario’s growing population, and the need to minimize the impacts of aggregate operations on the environment and communities,” said Stavropoulos [Acting Auditor General].
- Flyrock, if it doesn’t get launched beyond the boundaries of the quarry site, the incident goes unreported despite how far the flyrock travels onsite. For example, if the point of a blast (detonation of explosives) is setback 500 metres from a site boundary, and flyrock is launched 499 metres, the flyrock incident goes unreported. Similarly, if the flyrock is launched offsite, it also remains unreported if the incident goes unnoticed (e.g., lands in a farmer’s field, a park, a tree stand/forest).
- A regulator (i.e., MNR) that permits a quarry to blast rock within 30 metres of a quarry site boundary is irresponsible and reckless,³² as virtually all flyrock debris will travel much farther distances, most of which routinely exceeds 300 metres and sometimes more than 1,000 metres.
- Surprisingly, despite flyrock’s frequency and danger, MNR has never conducted an evidence-based quantitative study on flyrock incidents,³³ and prefers to remain blissfully ignorant and continue to put the health and safety of human and non-human life forms at risk of flyrock. Statistics as to the number of injuries and deaths between 1978 and 1998 caused by blasting rock in the United States are provided below:
...[A] study revealed that a [reported] total of 45 fatal and 367 non-fatal accidents in [US] coal, metal and non-metal surface mines had occurred between 1978 and 1998 where the primary causes were the lack of [onsite] blast area security, flyrock, premature blast, and misfires. The lack of [onsite] blast area security and flyrock accounted for 281 (68.2%). The study shows that accidents due to lack of blast area security are caused by failure to use appropriate blasting shelter, failure to evacuate humans from the blast area, and inadequate guarding of the access roads leading to the blast area (Kecojevic and Radomski, 2005).
- Ontario’s Aggregate Resources Act (ARA)³⁴ has no definition of “blast area”³⁵ and it is not a licence requirement of a theoretical “Blast Design Report,”³⁶ which the Aggregate Industry’s

³⁰ “The Ministry did not enforce penalties for aggregate extraction operators who failed to submit a self-compliance report on time or at all,” Management of Aggregate Resources, 2023 Value-for-Money Audit, Management of Aggregate Resources - Audit at a Glance (auditor.on.ca).

³¹ Management of Aggregate Resources, Management of Aggregate Resources (auditor.on.ca)

³² Black’s Law Dictionary, Centennial Edition (1881-1991) defines “reckless” as “disregard of, or indifference to consequences, under circumstances involving danger to life or safety to others, although no harm was intended.” (p. 1270).

³³ Correspondence from Tony Sevelka (caledon.ca).

³⁴ Aggregate Resources Act, R.S.O. 1990, c.A.8, <https://www.ontario.ca/laws/statute/90a08>,

³⁵ The Australian Explosives Industry and Safety Group’s Code of Practice, Edition 1, Nov 2015, define “Blast Area” as the area where blastholes are to be charged and fired, and within which access will be restricted to authorised persons, authorised vehicles, or personnel/vehicles under the supervision of authorised persons. The blast area may also include clearance distances outside the immediate charging area. For example, drilling, excavation and other operations may be restricted, adjacent to, above or in front of the immediate charging area, Code-of-Practice-On-Bench-Practices-for-open-cut-Mines-and-Quarries-November-2015-.pdf (aeisg.org.au). “Blast area” is also defined as the area in which there is any potential for flying material, air overpressure, or blasting gases to cause injury to persons, Codified Ordinances of the Village of Valley View, Ohio, November 7, 2023, https://codelibrary.amlegal.com/codes/valleyview/latest/valleyview_oh/0-0-0-23803

Explosives Engineers deliberately mislabel and mischaracterize as a “Blast Impact Assessment.”

- Blast Impact Assessments also fail to define or disclose that “flyrock” is an unavoidable by-product of blasting rock, and that “flyrock” is a contaminant under Ontario’s Environmental Protection Act (EPA). The EPA defines “contaminant” as follows:

“contaminant” means any solid, liquid, gas, odour, heat, sound, vibration, radiation or combination of any of them resulting directly or indirectly from human activities that causes or may cause an adverse effect (EPA, R.S.O., 1990, c. E. 19, April 1, 2024)³⁷

- Blast Impact Assessments also fail to disclose that “flyrock” is the ultimate *adverse effect*, and has the potential to destroy personal or real property, and to injure, permanently disable or kill humans and non-human life forms onsite and offsite.
- In preparing a Blast Impact Assessment, most of Ontario’s Explosives Engineers ignore entirely the issue of flyrock, advocating on behalf of their client and arguing that there is no statutory requirement under the ARA, while engaging in wilful blindness or recklessness, and abdicating their overriding professional duty to protect the health and safety of the public from the potentially deadly consequences of flyrock. The Professional Engineers’ Code of Ethics, and the legal definitions of Wilful Blindness and Recklessness are shown as follows:

Code of Ethics

Through the Code of Ethics, professional engineers have a clearly defined duty to society, which is to regard the duty to public welfare as paramount, above their duties to clients or employers. (Professional Engineers Ontario, Code of Ethics)³⁸

Wilful Blindness

*As Heffernan writes in her book *Wilful Blindness: Why we Ignore the Obvious at Our Peril*, the “focus on making money can circumscribe what we see and do.” When compensation systems are based solely on outcomes, little regard may be given to how those outcomes are achieved. Under pressure to reach specified goals or benchmarks, executives and managers may either explicitly or implicitly communicate to employees: “I don’t care how it gets done, as long as it gets done” (McMillan, 2013).*

Distinction between Wilful Blindness and Recklessness

Wilful blindness is distinct from recklessness because, while recklessness involves knowledge of a danger or risk and persistence in a course of conduct which creates a risk that the prohibited result will occur, wilful blindness arises where a person who has become aware of the need for some inquiry declines to make the enquiry because he does not wish to know the truth. He would prefer to remain ignorant. The culpability in recklessness is justified by consciousness of the risk and by proceeding in the face of it, while in wilful blindness it is justified by the accused’s fault in deliberately failing to inquire when he knows there is reason for inquiry [para. 114]. (Panini v. Canada, 2006 FCA 224 (CanLII)³⁹

- Municipalities and planning staff, administrative tribunals and civil courts are routinely misled as to the dangers of blasting (detonation of explosives) by the aggregate industry’s Explosives Engineers often providing speculative opinions⁴⁰ “with no reasonable foundation” or assertions without proof (*ipse dixit*), conduct for which punishment is virtually nonexistent in Ontario.
- Relying on outdated published blasting studies, discredited blasting studies, or misrepresenting blasting studies, ignoring relevant blasting studies or not relying on any blasting studies is a common practice of Explosives Engineers in preparing a theoretical Blast Impact Assessment on behalf of the aggregate extraction industry in Ontario.
- Blasting Impact Assessments often include exculpatory clauses denying all liability to any person or legal entity other than the authorized client, which means that no party other than

³⁶ Aggregate Resources of Ontario: Technical Reports and Information Standards, August 2020, <https://files.ontario.ca/mnrf-aggregate-resources-of-ontario-technical-reports-and-information-standards-2020-en-2021-03-18.pdf>.

³⁷ <https://www.ontario.ca/laws/statute/90e19#BK24>.

³⁸ Code of Ethics | Professional Engineers Ontario (peo.on.ca).

³⁹ *Panini v. Canada*, 2006 FCA 224 (CanLII), <<https://canlii.ca/t/1nnhg>>, retrieved on 2024-08-24.

⁴⁰ “Speculation is a legal basis for objecting to witness testimony on grounds similar to *argumentative* objection – because the evidence is not considered reliable or factual...It’s akin to guessing – and it’s not permitted,” *Legal Seagull*, 5 Common Objections in Court You Should Master – Legal Seagull (thelegalseagull.com)<retrieved Sept 25, 2024>

the authorized client can succeed in a claim of negligence against a wayward Explosives Engineer whose work product has the potential to compromise public health and safety.

5. DIRECT AND INDIRECT IMPACTS FROM BLASTING ROCK HELD TO STRICT LIABILITY WHILE HEALTH AND SAFETY OF PUBLIC TAKES PRECEDENCE

As ruled by the Illinois Appellate Court in *Opal v. Material Service Corp.*, (1956),⁴¹ there should be no distinction between blasting that causes *flyrock debris* to directly injure persons or damage property, and blasting that causes damage or injury indirectly through concussion or vibration. Impacts, whether direct or indirect, resulting from the same blast are held to the legal standard of strict liability. As described below, while the quarry operator was legally entitled to operate a quarry, because the quarry operated in a manner that compromised the health, safety and welfare of occupants in the neighbouring community, the court ruled that the well-being of the community takes priority over the quarry owner's desire to maximize profits at the expense of innocent third-party property owners.

“It is true that some courts have distinguished between liability for a common-law trespass, occasioned by blasting, which projects rocks or debris upon the property or the person of the plaintiff, and liability for so-called consequential damages arising from concussion, and have denied liability for the latter where the blasting itself was conducted at a lawful time and place and with due care.” The characterization of the Illinois Supreme Court in the *Fitz Simons* case that such a distinction can be made only by the merest subtlety of reasoning echoes in Justice Hand's continuing comment: “Yet in every practical sense there can be no difference between a blasting which projects rocks in such a way as to injure persons or property and a blasting which, by creating a sudden vacuum, shatters buildings or knocks down people. In each case, a force is applied by means of an element likely to do serious damage if it explodes. The distinction is based on historical differences between the actions of trespass and case and, in our opinion, is without logical basis.”

As Justice Holmes has said in *The Common Law*, p. 154: ‘The possibility of a great danger has the same effect as the probability of a less one, and the law throws the risk of the venture on the person who introduces the peril into the community.’ ... If damage is inflicted, there ordinarily is liability, in the absence of excuse. When, as here, the defendant, though without fault, has engaged in the perilous activity of storing large quantities of a dangerous explosive for use in his business, we think there is no justification for relieving it of liability, and that the owner of the business, rather than a third person who has no relation to the explosion, other than that of injury, should bear the loss. The blasting cases seem to afford ample analogies and to justify this conclusion.

...[P]laintiffs charged that their homes were shaken, jarred and damaged, and their lives made highly uncomfortable by vibrations caused by the blastings of rock at the quarry; that the blastings cast stones [flyrock debris] upon the lands of some of them, endangering the safety of the persons thereon; and that their peace and comfort were disturbed and their health affected by the noises occasioned by the blastings, etc.

In reviewing the decisions, the court called attention to *Blackford v. Heman Construction Co.*, 132 Mo. App. 157, 112 S.W. 287⁴², which was said to be a case directly in point. The Missouri court enjoined the operation of defendant's quarry, which had resulted in the casting of stones [flyrock debris] on complainants' property and the jarring and vibrating of buildings. In speaking of the relative rights of the complainants and the defendant quarry, the Missouri court said: “Although defendants have, beyond a doubt, the right to quarry stone on their property, the plaintiff enjoys the right to the undisturbed possession of his home. If these rights conflict, the right to operate the quarry must yield to the latter, which, in the eye of the law, is the more important of the two ...”

Planners, who are members of the Ontario Professional Planners Institute (OPPI), have been equally remiss in their overriding obligation to protect the health and safety of the public, and routinely

⁴¹ *Opal v. Material Service Corp.*, 9 Ill. App. 2d 433 (1956) 133 N.E.2d 733, <https://casetext.com/case/opal-v-material-service-corp>.

⁴² <https://case-law.vlex.com/vid/blackford-v-heman-construction-929698759>

ignore or are unaware of the OPPI's Flyrock advisory issued June 2021 (Dorfman and McGibbon, 2021):

On January 1, 2022, Rule 22 of subsection 0.13 in Ontario Regulation 244/97 of the Aggregate Resources Act, comes into effect. It stipulates that the licensee of an aggregate quarry shall ensure that the quarry is in compliance with the Rule as follows:

a licensee shall take all reasonable measures to prevent fly rock from leaving the site during blasting if a sensitive receptor is located within 500 metres of the boundary of the site.

Fly Rock discharge from quarry blasting is a contaminant as determined by the Supreme Court of Canada. It is likely to cause an adverse effect under the Environmental Protection Act.

Members of OPPI are advised to also consider the directions provided under Policy 1.2.6 under Provincial Policy Statement 2020 [now section 3.5, Provincial Policy Statement 2024⁴³] to establish the appropriate municipal planning policies as a preventative measure to achieve land use compatibility between quarries that undertake blasting and sensitive land uses.

6. REDUCING VIBRATION LEVELS TO PREVENT DAMAGE AND HARM

There is growing public awareness of the need to substantially reduce Peak Particle Velocity (PPV)⁴⁴ levels occasioned by blasting rock to avoid property damage, annoyance, emotional distress, psychological harm⁴⁵ or injury, permanent disability or death, all of which are magnified or exacerbated by repeated long-term blasting especially in proximity to existing and future settlement areas and areas of significant human and non-human activity. As noted below, Ramasinghe et al. (2012) describe the variability of vibrations due to a variety of known and unknown factors:

There has been a trend for regulatory authorities, especially those concerned with the environment, to impose low limits on blast vibration levels in response to community pressure, based on human perception and response to vibration. The effects of vibration can vary according to a number of factors including the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (e.g. dimensions, materials, type and quality of construction, and footing conditions). The intensity, duration, frequency and number of occurrences of a vibration contribute to both the annoyance levels caused and the strains induced in structures (Ramasinghe et al., 2012).

The Howard County Board of Appeals in the *Chase Land, LLC*. (2024) case⁴⁶ rejected the plaintiff's argument that property damage from repeated blasting at the 350-acre quarry (on a 546.207-acre parcel) over an extended period is "scientifically impossible." Most of the Petitioner's expert testimony was found not to be credible, either being false, misleading or inapplicable, as noted below:

Petitioner claims that it is scientifically impossible for Chase Land to have caused the damages alleged by homeowners. This is plainly false, as that fact has not been proven either by the scientific community or in this case. Petitioner has not produced one study scientifically examining the long-term and cumulative effects of over 20 years of blasting on two story residential structures. Petitioner's own expert, Mr. Rudenko, was not aware of any studies that have taken place over a 20-year period to determine cumulative blasting effects....In support of Petitioner's theory that it is not in violation of Condition 13,

⁴³ Provincial Policy Statement 2024, Provincial Planning Statement, 2024 (ontario.ca).

⁴⁴ "Peak particle velocity (ppv) is the maximum of three single-component blast induced ground motions measured in vertical, longitudinal, and transverse directions. "Vertical" means motion up and down; "Transverse" means motion at right angles to the line joining shot point and point of observation; "Longitudinal" or "radial" means motion along a line joining the shot point and point of observation; and "Velocity" means the rate at which the ground or earth particle vibrates measured in inches per second (or millimetres per second) https://codelibrary.amlegal.com/codes/valleyview/latest/valleyview_oh/0-0-0-29196

⁴⁵ In *Saadati v. Moorhead*, 2017 SCC 28, [2017] 1 S.C.R. 543, the Supreme Court of Canada ruled that "while relevant expert testimony will often be helpful in determining whether the claimant has proven a mental injury, it is not required as a matter of law....Where a psychiatric diagnosis is unavailable, it remains open to a trier of fact to find on other evidence adduced by the claimant that he or she has proven on a balance of probabilities the occurrence of mental injury." *Saadati v. Moorhead*, 2017 SCC 28 (CanLII), [2017] 1 SCR 543, <<https://canlii.ca/t/h42pw>>, retrieved on 2024-09-05

⁴⁶ *Chase Land, LLC, v. Hearing Examiner*, Howard County Board of Appeals, BA Case No. 95-58E, May 13, 2024, BA 95-58E | Howard County (howardcountymd.gov)

Petitioner's witnesses cite a 1984 U.S. Bureau of Mines study that attempts to model what nearby homes might look like after 20+ years of blasting at a coal mine. The study was conducted for only 2 years and not the 20 years the Oppositions homes have been the recipient of the blasts and vibrations. Mark S. Stagg, et al., *Effects of Repeated Blasting on a Wood Frame House*, Rep. of Invest. 8896 at 2 (1984).

Petitioner's witness cites Galileo's formula for the acceleration to bolster their argument that their extremely old data is scientifically sound. By Petitioner's logic, smoking does not cause lung cancer because there was no scientific proof of that in the early 1600s. Old science is not always good science.

Importantly, the Bureau of Mines study does not account for the psychological impacts of blasting for any duration. Nor does it address how the blasting impacts vulnerable populations, such as those with PTSD like Ms. Smith-Barrett.... Psychological impacts are one of the cumulative impacts that blasting causes. Petitioner has offered absolutely no evidence that addresses this fact.

Seismographs alone do not indicate causes of past damage. Mr. Patrick Hastings, the President of Seismic Surveys and a certified geologist, testified that these seismograph readings are only to determine if blast vibrations are within State levels. The seismograph readings are not used to estimate damage attributable to the blast, or to measure the cumulative impact of past blasting. [Over a five-year period (Feb 5, 2019 – Feb 4, 2024), there were a total of 298 blasts at the quarry, which generated approximately 80 resident complaints (Kazanjan, 2024), and the maximum PPV reading at the permanent Pleasant Chase seismograph was 0.258 inches per second (6.44 mm/sec), p. 19.]

Petitioner claims that because the homeowners are not geologists or are not familiar with the science of blasting or vibrations, they are not qualified to testify to their lived experiences. This is a fundamental misunderstanding of eye-witness testimony and, again, Petitioner's burden in this case. The record is replete with testimony from residents that they feel the blasts almost every week and that blast intensity has become greater over time. Residents also testified that they have seen things fall off their walls and their homes shake during a blast. There is no doubt they feel the blasts and they have seen the damage to their properties increase over time.

The ANZEC guidelines 1990 state that experience has shown that for almost all sites in Australia, a PPV (Peak Particle Velocity) of 1 mm/sec is generally achieved. As it may not be practical to achieve a PPV of 1 mm/sec for all sites, ANZEC recommends a maximum of 2 mm/sec be considered as the long-term regulatory goal for the control of ground vibration from blasting. Seismographs used to measure ground vibrations must be installed along the perimeter of a quarry site, as to place seismographs (or any other testing equipment) offsite on public or private third-party property without permission constitutes unlawful trespass and interference with the use and enjoyment of third-party property.⁴⁷

7. UNAVOIDABLE IMPACTS OF ROCK BLASTING

In addition to flyrock, there are several other undesirable and unavoidable impacts associated with blasting rock, identified and described as follows by Madanayaka (2013) and Naveen et al. (2016):

Ground vibration, air blast and fly-rock are unavoidable environmental impacts of rock blasting (Madanayaka, 2013). Blasting produces dust, toxic fumes, noise, fly rocks and ground vibration (Naveen et al., 2016). (See and hear 23 startling and frightening rock blasting explosions in 2.5 minutes and watch for the flyrock debris, posted September 13, 2021 on this internet link: Bing Videos⁴⁸)

A structure readily catches the blast induced ground vibration when the frequency of ground vibration falls close to the natural frequency of the structure (Dowding, 1985;

⁴⁷ "The ANZEC guidelines 1990 state that experience has shown that for almost all sites a ppv [Peak Particle Velocity] of 1mm/sec is generally achieved. It is recognized that it is not practicable to achieve a ppv of this level at all sites and hence a recommended maximum of 2mm/sec (ppv) be considered as the long-term regulatory goal for the control of ground vibration." ANZECC reports | neps

⁴⁸ <https://shorturl.at/0OjJT>

Siskind et al, 1980). At resonant frequency, the structure absorbs most of the energy of ground vibration and oscillates with a larger amplitude for a longer period. Because of this amplification, structural damage may occur even at a relatively low peak particle velocity [PPV]. Amplification factor is defined as the ratio of structural vibration to that of the ground vibration. It has been found to vary between 3.2 and 5.2 (Siskind et al, 1980), and between 1.00 and 2.82 (Adhikari et al, 1989). Residential structures typically resonate at frequencies in the range of 3 Hz to 8 Hz indicating a problem (Naveen et al., 2016).

8. PLANNING POLICIES TO PREVENT INCOMPATIBLE USES OF LAND AND TO PRESERVE PROPERTY VALUES

Planning authorities must give full weight to the environmental effects of blasting at surface mine operations and the potential disturbance, damage and harm to local communities. A proposal to extract aggregate that would interfere or likely interfere with the legal rights of others or cause or potentially cause demonstrable and material harm, permission should not be granted. However, the planning system can control blasting times, set allowable levels of ground vibration, control overpressure, ensure monitoring of vibration levels and control dust and noise. The authorized use of planning controls by municipalities under the Ontario Municipal Act, 2001, in particular the use of conditions/restrictions, is an important means of ensuring that the effects of blasting at surface mine sites (e.g., quarries) do not pose a threat to the health and safety of communities.

Municipalities have overriding statutory and common law obligations to protect the *health, safety* and *welfare* of the communities under their jurisdiction, including the residents' rights to the uninterrupted *use* and *enjoyment* of their properties⁴⁹ and to the preservation of their property values (Sevelka, 2022).

The ultimate goal of good planning is to create complete, healthy, liveable and sustainable communities for current and future generations, and prevent anticipated land use conflicts now and in the future that have the potential to destabilize or stigmatize a community or to lower the quality of life of a community (Sevelka, 2023).

According to *Canadian Law of Planning and Zoning* (Butler & Rogers, 1988), zoning regulations, as with restrictive covenants, are to preserve property values (Sevelka, 2022) by maintaining separation of incompatible land uses and preventing encroachment of incompatible land uses and their operational impacts into existing or planned communities:

The principal purpose of zoning regulations, as with restrictive covenants, is to preserve property values by prohibiting uses which are believed to be deleterious to neighbourhoods mainly residential in character. People living in an area of single-family dwellings want the same type of homes in the district, that is, a use that is compatible. They want to preserve the amenities of their locality. Thus, from the standpoint of ratepayers it is the status quo that is sought to be maintained and built-up residential areas, which are figuratively rimmed with "keep out" signs. Industry, an unwelcomed intruder in a residential community, also favours a zoning wall that bars residential and other incompatible encroachments. The notional route is segregation of people and the uses they make of their land. Density and formula development standards control the costs of the dwelling placed on the land and a latter determines the economic (and usually the social) position of those who live in them. Ghettos are created for the rich as well as the poor by walls of exclusionary restrictions. Land values are thus preserved by keeping out undesirable uses and consequently undesirable people. The preservation of property investment is the prime motive underlying many bylaws although they do not always clearly articulate this policy [para. 113].⁵⁰ [underscoring added]

⁴⁹ "Loss of enjoyment of normal of use of property," is item (g) of the list of "adverse effects" under both the *Ontario* Environmental Protection Act (Section 15) and the 2024 *Ontario* Provincial Policy Statement (p. 38)

⁵⁰ *Service Corporation International (Canada) Inc. v. Burnaby (City of)*, 1999 CanLII 7012 (BC SC), <<https://canlii.ca/t/1d45r>>, retrieved on 2024-09-01 <https://canlii.ca/t/1d45r>. I. M. Rogers in *Canadian Law of Planning and Zoning* (Toronto: Carswell, 1973).

In *Bowen et al. v. Bedford et al.*, (1992),⁵¹ the New Brunswick Assessment and Planning Appeal Board (NBAPAB), in response to an application for a quarry and its potential impact on the community, quoting from Rogers' text, *Canadian Law of Planning and Zoning*, (1988), stated that

... the regulation by districts of the building development and uses of property, and its essence is a territorial division according to the character of lands and structures and their peculiar suitability for particular uses, and the uniformity of use within the division.

Zoning is a deprivation for the public good of certain uses by owners of property to which the property might otherwise be put. Underlying planning statutes is the principle that the interest of landowners in securing the maximum value of their land must be controlled by the community. Zoning is a deprivation for the public good of certain uses by owners of property to which the property might otherwise be put. Underlying planning statutes is the principle that the interest of landowners in securing the maximum value of their land must be controlled by the community.

The theory of zoning is that each district is an appropriate area for the location of certain uses which the plan designates, and the existence or entrance of other uses will tend to impair the development and stability of the area for the appropriate uses. The objective of zoning must be considered from the standpoint of the public welfare and of all the property within any particular use district.

According to Rossouw and Chmielewski (2018) in a post on the Ontario Professional Planners Institute's website, the land use plans that municipal planners create and implement have a significant impact on property values and a municipality's tax base, which is funded primarily from property taxes. As noted below, property values are an important consideration in formulating effective land use planning policies that maximize municipal revenues.

As planners it is important...[to] understand how the plans we create and implement have a real impact on both property owners and municipalities who rely on accurate property assessments to generate tax revenues. By virtue of their nature, planning policies, which regulate or restrict land uses, have the potential to drastically influence the values of properties.

The concepts of *use* and *enjoyment* are integral to property rights, which have a significant impact on property values. Property rights include the right to use, enjoy and dispose of property. The right to use and enjoy property includes the right to exclude others and the right against trespass. Well-defined and protected property rights contribute to higher property values. This is because potential buyers are assured that they can fully enjoy and utilize the property without undue interference, making the property more desirable.⁵²

Campbell (2014), citing Hite (2006), who examined property value impacts of aggregate extraction operations, concluded that because property value losses increase for properties located closer to existing aggregate extraction operations, new aggregate extraction operations should be located at separation distances great enough to prevent land use incompatibility and to prevent those economic losses from being inflicted on innocent third-party property owners by the direct and indirect adverse impacts (externalities) from aggregate extraction operations.

An evaluation of Three Oaks Quarry application, a proposed 50-acre quarry on a 320-acre property in Yadkin County, North Carolina, by Schnabel Engineering in July 2022,⁵³ recommended that residents take advantage of Three Oaks "written property value guarantee to Neighbors [within 2,500 feet (762 metres) of the property boundary⁵⁴] that request it" (Quarry Operations Plan, 4/29/2022), with the following recommendations: (quarry application denied August 30, 2022, by Board of Commissioners as "not in character with surrounding land uses")

⁵¹ *Bowen et al. v. Bedford et al.*, 1992 NBAPAB 20 (CanLII), <<https://canlii.ca/t/26cpw>>

⁵² USLegal, Landowner's Right to Use and Enjoyment of Property – Adjoining Landowners (uslegal.com).

⁵³ Schnabel Engineering, "222100219.000 Yadkin County – Three Oaks Quarry Evaluation Support Yadkin County, North Carolina, *Schnabel Engineering*, July 1, 2022, Microsoft Word - 2022-07-01 Three Oaks Quarry Evaluation Support_FINAL.docx (yadkincountync.gov). The quarry application was unanimously declined by the Yadkin County Board of Commissions on August 31, 2022, because "[t]he mine would be incompatible with the character, scope and intensity of the neighborhood. It is at cross-purposes with farmland preservation goals," Community members turn out in force to oppose proposed Yadkin granite mine • NC Newsline.

⁵⁴ Petition for Zoning Map Amendment, The Colinas Group, Inc., March 4, 2022, <https://www.yadkincountync.gov/DocumentCenter/View/5382/Three-Oaks-Quarry-Rezoning-Package-342022>.

We suggest property values be evaluated prior to development of the quarry for baseline comparison and we suggest the County take measures to encourage property owners to take advantage of the guarantee. Appraisals should be performed by an independent third-party.

According to Schnabel Engineering, the Blasting Evaluation (February 28, 2022) prepared in connection with the Three Oaks Quarry application

“does not mention the potential for flyrock...”;

“[a]ll blasts will produce localized flyrock...”; and

“[g]round vibrations are influenced by many subsurface features that are not accounted for in the initial assessment and cannot be accounted for in these calculations.”⁵⁵

(July 1, 2022, Review by Schnabel Engineering South, P.C.)

9. MUNICIPAL AUTHORITY TO IMPOSE SEPARATION DISTANCES BETWEEN INCOMPATIBLE LAND USES AS A HEALTH, SAFETY AND WELFARE MEASURE

In *Tinsley Properties v. Grundy County* (2023),⁵⁶ the Tennessee Court of Appeals upheld the lower court’s ruling, which granted summary judgment⁵⁷ in favour of Grundy County. Resolution No. 19-5-20c, enacted by Grundy County on May 20, 2019, prohibits *quarries, rock crushers, and gravel pits* within 5,000 feet (1,524 metres) of sensitive land uses and protects the inhabitants from uses of property detrimental or likely to be detrimental to their *health, safety and welfare*. Roughly 354 parcels are within 5,000 feet (1,524 metres) of the quarry, 300 of which are zoned residential, with the remainder either agricultural, forest or farm, and 146 properties have at least one residence, some with multiple homes or apartments/condos, all of which would have been exposed to the cumulative impacts of the blasting quarry for the entire life of the quarry operation.^{58 59} Owners of unimproved lots would have been deprived of the opportunity to develop their properties to the fullest extent permitted under the law because some permitted uses would be precluded or considered inappropriate near the blasting quarry operation. As noted below, the quarry operation was deemed illegal by the Tennessee Court of Appeals pursuant to Grundy County Resolution No. 19-5-20c.

This case concerns the validity of a county resolution prohibiting quarries and rock crushers "within five thousand (5,000) feet [1,524 metres] of a residence, school, licensed daycare facility, park, recreation center, church, retail, commercial, professional or industrial establishment." [Measurements shall be taken from the nearest recorded property line of the quarry business to the nearest property line or boundary of the foregoing.]

After learning about the new quarry, Grundy County Mayor Michael Brady conducted an informal investigation and determined that neither Tinsley Sand nor Tinsley Properties had obtained a county-issued permit as required by Grundy County Resolution No. 19-5-20c. He also determined that the quarry violated the Resolution's location requirement, which mandated at least 5,000 feet [1,524 metres] between a quarry's property line and that of any "residence, school, licensed daycare facility, park, recreation center, church, retail, commercial, professional or industrial establishment."

“The General Assembly has not limited local government’s authority to control the private use of property to the enactment of zoning ordinances.” KLN Associates, 797 S.W.2d at 902⁶⁰. Relevant here is the legislature that has also authorized counties to "[d]efine, prohibit, abate, suppress, prevent and regulate all. . . uses of property . . . detrimental, or liable to be detrimental, to the health, morals, comfort, safety, convenience

⁵⁵ “These site-specific factors are difficult to determine without localized testing, which would involve a series of test blasts.”

⁵⁶ *Tinsley Properties, LLC v. Grundy County*, No. M2022-01562-COA-R3-CV, Tenn: Court of Appeals, 2023, <https://www.tncourts.gov/courts/court-appeals/opinions/2024/02/08/tinsley-properties-llc-et-al-v-grundy-county-tennessee>

⁵⁷ A summary judgment, also referred to as judgment as a matter of law or summary disposition entered by a court for one party and against another party summarily, i.e., without a full trial when there is no genuine dispute of fact or law. https://en.wikipedia.org/wiki/Summary_judgment

⁵⁸ Stop the Cluse Hill Sand Plant website: STOP the Clouse Hill Sand Plant - FAQ

⁵⁹ Taylor, Michael Ray. “Road to Ruin: The Fight Over a New Quarry in Grundy County,” *Nashville Scene*, July 7, 2022, https://www.nashvillescene.com/news/coverstory/road-to-ruin-the-fight-over-a-new-quarry-in-grundy-county/article_331752c0-f974-11ec-8c12-5771a0ab676c.html.

⁶⁰ <https://casetext.com/case/kln-assoc-v-metro-development-housing>

or welfare of the inhabitants of the municipality." Tenn. Code Ann. § 6-2-201(22) (emphasis added). Thus, both the County Zoning Act and the County Powers Statute authorize counties to regulate land use.

As reported by the Supreme Court of Los Angeles in *Consolidated Rock Products Co. v. City of Los Angeles*, (1962),⁶¹ "[t]he primary purpose of comprehensive zoning is to protect others, and the general public, from uses of property which will, if permitted, prove injurious to them." Aggregate extraction is one of the most noxious,⁶² toxic and destructive⁶³ uses of land with a large environmental footprint and its operations are detrimental to the health, safety and welfare of the public. The location, scale, intensity and duration of a blasting quarry operation, and the character and nature of the surrounding landscape, are prime determinants in assessing the magnitude of *adverse effects* (e.g., health, safety and welfare) attributed to the onsite and offsite operations of a blasting quarry.

In denying Weir's Construction's application for a proposed 3.0-hectare (7.41-acre) gravel pit/quarry, Council reviewed the gravel pit/quarry application citing Section 51 of the Town of South River Development Regulations, and the concerns of the area residents. On appeal, the Eastern Newfoundland Regional Appeal Board, (Dec 13, 2019), upheld the decision of Council, which denied the application on several grounds, including the fact that the proposed gravel pit/quarry is an "offensive and dangerous use."⁶⁴

51. Offensive and Dangerous Uses

No building or land shall be used for any purpose which may be dangerous by causing or promoting fires or other hazards or which may emit noxious, offensive or dangerous fumes, smoke, gases, radiation, smells; ash, dust or grit, excessive noise or vibration, or create any nuisance that has an unpleasant effect on the senses unless its use is authorized by Council and any other authority having jurisdiction.

In reaching this decision, council considered the zoning regulations, the results of the environmental assessment, and concerns raised by area residents including safety, noise, pollution, environmental concerns, health concerns, effect on property value, etc. The proposed activities would be a nuisance to surrounding residents.

On May 18, 2021, Council for The Town of Conception Bay South, NL, (population 27,168) voted unanimously to deny Application No. COM-21-044 for a 19-hectare (47-acre) quarry and asphalt plant at Middle Ridge based on the recommendation of Planning and Development Committee chairman Rex Hiller, citing several reasons. The proposed quarry was intended "to be a long-term operation (10+ years)":

"...Council is of the opinion that the proposed quarry at Middle Ridge would result in nuisances in the form of smells, emissions, vibrations, noise, dust, increased commercial and industrial traffic that will adversely affect the amenity of existing residential development within 1000 m and the general vicinity of the proposed quarry..."⁶⁵

"The trigger here for council is that 1,000 metre [Separation] distance,"⁶⁶ Hiller said. "If we've got residents within that 1,000 metres who would be subject to those nuisances in the motion, then it's on us to refuse the application."...Inside the 1,000-metre radius outlined in the proposal are about 195 residences. "This is not the place, at this point in time, that anybody needs to be putting a quarry," Hiller said....There were 260-odd submissions, and I don't think one of them was in favour.... (Lewis, 2021).

⁶¹ *Consolidated Rock Products Co. v. City of Los Angeles*, 57 Cal.2d 515 (1962), <https://scocal.stanford.edu/opinion/consolidated-rock-products-co-v-city-los-angeles-27127>.

⁶² In the Town of Caledon Zoning By-law 2006-50, as amended, *Noxious Use means a use which, from its nature or operation, creates a nuisance or is liable to become a nuisance or offensive by the creation of noise or vibration, or by reason of the emission of gas, fumes, dust or objectionable odour, or by reason of the matter, waste or other material generated by the use, and shall include any uses which may be declared to be a noxious or offensive trade or business under the Public Health and Promotion Act, as amended (Section 3-27, Definitions, revised June 13, 2023).*

⁶³ "Once aggregate extraction occurs on agricultural land, it can never be as reproductive as it was before. If extraction occurs below the water table resulting in a pond or small lake (which it often does), the land can never be rehabilitated back to an agricultural condition," *Ontario Farmland Trust*, July 2, 2020, <https://ontariofarmlandtrust.ca/2020/07/02/the-impacts-of-aggregate-mining-on-farmland/>.

⁶⁴ *Wier's Construction v. Town of South River*, Eastern Newfoundland Regional Appeal Board, Urban and Rural Planning Act, 2000, December 13, 2019, for-decisions-2019-12-13-weirs-construction-south-river.pdf (gov.nl.ca).

⁶⁵ Resolution #21-181, May 18, 2021. <https://www.conceptionbaysouth.ca/council/meetings-minutes/>

⁶⁶ Conception Bay South Development Regulations, Section 10.27.5 Mineral Workings, (minimum) Separation Distance "Existing or Proposed Residential Development, Bedrock Quarries 1,000 metres". <https://shorturl.at/5FZ6d>

10. MUNICIPALITIES CAN IMPOSE ONSITE SETBACKS GREATER THAN THOSE MANDATED BY THE ONTARIO AGGREGATE RESOURCES ACT (ARA)

It is within the jurisdiction of a municipality to pass by-laws that enhance minimum setbacks (beyond those mandated provincially) for health and safety reasons and to prevent adversely affecting the value of neighbouring properties. This jurisdiction extends beyond the setback requirements for pits and quarries under the Aggregate Resources Act (ARA), as ruled by the Ontario Court of Appeal in *Township of Uxbridge v. Timber Brothers Sand & Gravel Ltd.*, (1975).⁶⁷ The following quotes are from the Ontario Court of Appeal's ruling in this case.

The provincial legislation [ARA] does no more than set minimum set-back requirements or standards and in no way attempts to restrict the right of a municipality to enhance these standards. This the municipality may do provided it acts within its delegated legislative powers and does not enact provisions in by-laws which are inconsistent with statutory provisions.

The fact that the township requires a pit operator to enter into an agreement when the latter seeks an extension of his operations, which in turn would require an amendment to By-law 1517, is regulatory and not discriminatory. It has for its purpose a controlled development scheme which would occasion minimum inconvenience to other ratepayers and at the same time provide maximum restorative and rehabilitative procedures which would not adversely effect [sic] values of neighbouring properties.

Some sections of the Town of Uxbridge By-laws 1517 and 1590 were invalidated as aggregate licencing provisions, but the court ruled that the valid sections of the by-laws, i.e., s. 21(7) of By-law 1517 and s. 21 of By-law 1590, the Municipal Council would have passed with the invalid provisions deleted, leaving intact the enhanced setback requirements.

11. MUNICIPALITIES HAVE BROAD AUTHORITY ON MATTERS OF HEALTH, SAFETY AND WELFARE AND PROTECTION OF PERSONS AND PROPERTY

In *114957 Canada Ltée (Spraytech, Société d'arrosage) v. Hudson (Town)* (2001),⁶⁸ the Supreme Court of Canada addressed a challenge to restrictions imposed by the Town of Hudson, Quebec, on the "use of combustible, explosive, corrosive, toxic, radioactive or other materials that are harmful to public health and safety." The Town of Hudson passed By-law 270 prohibiting the use of pesticides within the "territory of the municipality or within 1 kilometre thereof," subject to exemptions. "The by-law targets problems of use of land and property, and addresses neighborhood concerns that have always been within the realm of local government activity." Accordingly, the Supreme Court of Canada ruled that the by-law was thus properly authorized, and respected international law's "precautionary principle,"⁶⁹ as a preventive action. The following quotes are from the ruling of the Supreme Court of Canada acknowledging the municipality's authority to pass and enforce By-law 270:

The appellants are landscaping and lawn care companies operating mostly in the greater Montreal area, with both commercial and residential clients. They make regular use of pesticides approved by the federal Pest Control Products Act in the course of their business activities and hold the requisite licences under Quebec's Pesticides Act⁷⁰. In 1991 the respondent Town, located west of Montreal, adopted By-law 270, which restricted the use of pesticides within its perimeter to specified locations and for enumerated activities. The definition of pesticides in By-law 270 replicates that in the Pesticides Act⁷¹. Under s.

⁶⁷ *Township of Uxbridge v. Timber Brothers Sand & Gravel Ltd.*, 1975 CanLII 507 (ON CA), <<https://canlii.ca/t/g1cpz>>, retrieved on 2021-04-30. Leave to appeal to the Supreme Court of Canada denied.

⁶⁸ *114957 Canada Ltée (Spraytech, Société d'arrosage) v. Hudson (Town)*, 2001 SCC 40 (CanLII), [2001] 2 SCR 241, <<https://canlii.ca/t/51zx>>, retrieved on 2024-09-01

⁶⁹ [para. 31] Canada "advocated inclusion of the precautionary principle" during the Bergen Conference negotiations (D. VanderZwaag, CEPA Issue Elaboration Paper No. 18, *CEPA and the Precautionary Principle/Approach* (1995), at p. 8). The principle is codified in several items of domestic legislation: see for example the *Oceans Act*, S.C. 1996, c. 31, Preamble (para. 6); *Canadian Environmental Protection Act, 1999*, S.C. 1999, c. 33, s. 2(1)(a); *Endangered Species Act*, S.N.S. 1998, c. 11, ss. 2(1)(h) and 11(1).

⁷⁰ <https://www.canlii.org/en/qc/laws/stat/cqlr-c-p-9.3/latest/cqlr-c-p-9.3.html>

⁷¹ <https://www.canlii.org/en/qc/laws/stat/cqlr-c-p-9.3/latest/cqlr-c-p-9.3.html>

410(1) of the Quebec Cities and Towns Act⁷² (“C.T.A.”), the council may make by-laws to “secure peace, order, good government, health and general welfare in the territory of the municipality”, while under s. 412(32)⁷³ C.T.A. it may make by-laws to “regulate or prohibit the ... use of ... combustible, explosive, corrosive, toxic, radioactive or other materials that are harmful to public health or safety, in the territory of the municipality or within 1 km therefrom”. In 1992 the appellants were charged with having used pesticides in violation of By-law 270. They brought a motion for declaratory judgment asking the Superior Court to declare By-law 270 to be inoperative and ultra vires the Town’s authority. The Superior Court denied the motion, and the Court of Appeal affirmed that decision.

The Supreme Court of Canada, citing I. M. Rogers that “the legislature cannot possibly foresee all the powers that are necessary to the statutory equipment of its creatures [municipalities],” and concluded that “[u]ndoubtedly, the inclusion of ‘general welfare’ provisions was intended to circumvent the effect of the doctrine of *ultra vires* which puts the municipalities in the position of having to point to an express grant of authority to justify each corporate act (*The Law of Canadian Municipal Corporations* (2nd ed. (loose-leaf)), Cum. Supp. to vol. 1, at p. 367).”:

Section 410 C.T.A. [*Cities and Towns Act*, R.S.Q., c. C-19] is an example of such a general welfare provision and supplements the specific grants of power in s. 412. More open-ended or “omnibus” provisions such as s. 410 allow municipalities to respond expeditiously to new challenges facing local communities, without requiring amendment of the provincial enabling legislation. There are analogous provisions in other provinces’ and territories’ municipal enabling legislation: see ...*Municipal Act*⁷⁴, S.M. 1996⁷⁵, c. 58, C.C.S.M. c. M225, ss. 232⁷⁶ and 233⁷⁷; ...[para. 19]

In overturning the lower court’s decision in *Peacock v. Norfolk (County)* (2004),⁷⁸ which concluded that Norfolk County By-law No. 64-Z-2003 requiring a setback greater than mandated provincially under the Nutrient Management Act was inoperative, the Ontario Court of Appeal (2006),⁷⁹ found:

There was no conflict between the [Municipal] By-law and the Regulation [Nutrient Management Act]. The setbacks provided for in the Regulation were only minimum setbacks. There was nothing to prevent the respondent [The Corporation of Norfolk County] from enacting a by-law that provided for more stringent or enhanced requirements in terms of distance separation, based on local exigencies. [underscoring added]

Under the Ontario *Municipal Act*, 2001,⁸⁰ municipalities have broad powers to pass bylaws (subject to certain limits) on matters such as health, safety and well-being of the municipality, and to protect persons and property. This includes the authority to license, regulate and govern businesses operating within the municipality. *Flyrock*, along with the other adverse effects such as *vibration, noise, toxic fumes* and *fugitive dust*,⁸¹ *odours, etc.*, associated with aggregate extraction operations are matters of health, safety and welfare, especially to those communities in proximity, as aggregate extraction operations in Ontario can remain operational indefinitely. As acknowledged below, municipalities are

⁷² <https://www.canlii.org/en/qc/laws/stat/cqlr-c-c-19/latest/cqlr-c-c-19.html>

⁷³ https://www.canlii.org/en/qc/laws/stat/cqlr-c-c-19/latest/cqlr-c-c-19.html#sec412subsec32_smooth

⁷⁴ <https://www.canlii.org/en/mb/laws/stat/ccsm-c-m225/latest/ccsm-c-m225.html>

⁷⁵ <https://www.canlii.org/en/mb/laws/astat/sm-1996-c-58/latest/sm-1996-c-58.html>

⁷⁶ https://www.canlii.org/en/mb/laws/stat/ccsm-c-m225/latest/ccsm-c-m225.html#sec232_smooth

⁷⁷ https://www.canlii.org/en/mb/laws/stat/ccsm-c-m225/latest/ccsm-c-m225.html#sec233_smooth

⁷⁸ *Peacock v. Norfolk (County)*, 2004 CanLII 32268 (ON SC), <<https://canlii.ca/t/1hz7t>>, retrieved on 2024-09-22.

⁷⁹ *Peacock v. Norfolk (County)*, 2006 CanLII 21752 (ON CA), <<https://canlii.ca/t/1nq2k>>, retrieved on 2024-09-22

⁸⁰ Municipalities have authority – and human rights obligations, <https://www.ohrc.on.ca/en/zone-housing-human-rights-and-municipal-planning/municipalities-have-authority-%E2%80%93-and-human-rights-obligations>

⁸¹ “Unlike traditional air pollution sources such as coal fire power plants, there is no effective control device for mining operation since there is no central stack for flue gas exiting. The mining operation is more so an “area source” than a “point source.” Air pollution devices are much less effective in these situations. Therefore, it puts the burden of protecting health and well-being on those who receive the pollution, especially those who live nearby (<1 mile) [<1,609 metres]. It is also difficult and costly to monitor and estimate the emission and exposure on daily basis in 40 years of operating span.” Jun Wang, Associate Professor of Environmental and Industrial Hygiene Department of Environmental and Public Health Sciences College of Medicine, University of Cincinnati, extract from September 6, 2023 report prepared in response to an application for a limestone quarry and processing plant in the City of Piqua, Ohio.

empowered by the province to pass by-laws to fit local needs and circumstances, and that result in complete, healthy and sustainable communities.

The [Ontario] Planning Act provides a framework for municipalities to make land use decisions to fit local needs and circumstances. In making these decisions, municipalities must make sure they do not violate the Human Rights Code.

The built environment – buildings, transport networks, green spaces, public realms, natural systems and all the other spaces that make up a community – plays a critical role in shaping the physical, psychological and social health of individuals and their communities. Healthy communities need a mixture of rental and ownership opportunities, as well as market, non-market and social housing.⁸²

Municipalities are also empowered to enact by-laws as proactive measures to prevent potential harm before it occurs, as ruled by the Ontario Court of Appeal, which upheld a by-law passed by Township of Seguin, *Seguin (Township) v. Hamer*, 2014, ONCA,⁸³ preventing the feeding of bears, citing as authority comments by Twaddle J.A. of the Manitoba Court of Appeal in *Mr. Pawn Ltd. v. Winnipeg (City)*, 2002 MBCA 2⁸⁴, 170 Man. R. (2d) 1, at para. 11⁸⁵:

City Council is a legislative body, not a court. It must, of course, act within the authority conferred on it and, in doing so, enact its by-laws in good faith and not for an improper purpose. There is, however, no requirement that Council have evidence of anything before enacting a by-law. In particular, there is no requirement that Council have evidence of potential harm before enacting a by-law designed to prevent such harm. Council can enact laws within its authority on whatever information it chooses, be that information placed before it by evidence or representation or even information within councillors' own knowledge.

As noted in *Weir's Construction v. Town South River*, (March 19, 2024),⁸⁶ in response to an appeal of the Town's March 1, 2023, decision to deny an application for a 3.0-hectare (7.41-acre) gravel pit operation (148-152 Hodgewater Line),⁸⁷ the Adjudicator cited the Supreme Court of Canada in *Baker v. Canada (Minister of Citizenship)*, [1999] 2 SCR 817, at Para 53, as the standard for reviewing discretionary decisions of an administrative body (municipality):

"In my opinion, these doctrines incorporate two central ideas – that discretionary decisions, like all administrative decisions, must be made within the bounds of the jurisdiction conferred by the statute, but that considerable deference will be given to decision-makers by courts in reviewing the exercise of that discretion and determining the scope of the decision-maker's jurisdiction. These doctrines recognize that it is the intention of a legislature, when using statutory language that confers broad choices on administrative agencies, that courts should not lightly interfere with such decisions, and should give considerable respect to decision-makers when reviewing the manner in which discretion was exercised."

Accordingly,

"The Authority [municipality] can decide an application with whatever information is allowed by their bylaws and can use that information however they wish so long as the outcome of the application is a reasonable decision. If the Authority [municipality] felt in their discretion that another gravel pit, particularly one that is applying to open after the town bylaws were put in place unlike the neighbouring gravel pit which was grandfathered into the area, the Adjudicator is unable to step in an[d] exercise their own discretion. It is entirely within the discretion of the Authority [municipality] to decide that, based on prior public consultations and hearings, that they can deny a discretionary application to develop the property. While each application must be determined on a case-

⁸² Ontario Human Rights Commission, <https://www.ohrc.on.ca/en/zone-housing-human-rights-and-municipal-planning/good-planning-leads-healthy-inclusive-communities>.

⁸³ *Seguin (Township) v. Hamer*, 2014 ONCA 108 (CanLII), <<https://canlii.ca/t/g3156>>, retrieved on 2024-10-03. Leave to appeal to the Supreme Court of Canada denied, *Dennis Neil Hamer v. Corporation of the Township of Seguin*, 2014 CanLII 35896 (SCC), <<https://canlii.ca/t/g7x1t>>, retrieved on 2024-10-03

⁸⁴ <https://www.canlii.org/en/mb/mcga/doc/2002/2002mbca2/2002mbca2.html>

⁸⁵ <https://www.canlii.org/en/mb/mcga/doc/2002/2002mbca2/2002mbca2.html#par11>

⁸⁶ Scanned Document

⁸⁷ Decision of Town of South River, NL, reversed on other grounds involving missed procedural steps, but the municipality "still holds the power to deny the application."

by-case basis, this doesn't exclude information obtained previously regarding the same or similar applications from being considered when the authority [municipality] makes a decision. As such, the Adjudicator finds that in making their decision, the Authority [municipality] acted within the scope of their discretion."

12. PUBLIC SAFETY IS PARAMOUNT AND TAKES PRIORITY OVER PROFITS

According to *Eloranta*,⁸⁸ (former) vice-president for technical matters for the International Society of Explosives Engineers (ISEE), there is no practical economic way of preventing flyrock impacts from quarry blasting:

"Really, flyrock is intolerable." Any amount of flyrock is unacceptable. You lose control of the process at that point," said Eloranta. "Speaking generally, Eloranta said flyrock doesn't automatically suggest an excessive amount of explosives had been used. "Explosives doesn't equal flyrock," he said."

A fault in the rock, if unknown to the explosives engineer, can provide a path for that explosive energy that can mess up an otherwise well-designed blast, he said. "The same amount of energy in there can just launch those materials."

Caution can be costly. It's not accurate to suggest that the presence of faults and seams in a section of rock is unknowable, though. Enough geologic testing could identify those problem areas. But there's an economic issue with that solution. "The cost of the testing would exceed the value of that product," Eloranta said...

[A]nyone involved in blasting is obligated to place safety above all other considerations, according to Eloranta. Even if blasts that launch life-threatening rocks into populated areas are rare, even if no one is injured, accepting that as inevitable is unethical.

"To say 'It might happen again, there's nothing we can do about that,' well, nobody buys that," he said.

The options, really, are only two in Eloranta's mind: Don't blast in a location that threatens public safety or adopt the safety measures required, regardless of the price, that meet the challenges Mother Nature has put in place.⁸⁹

Barnabas David, a union member of quarry marketers in Abuja, Nigeria, said "most quarry companies are more concerned about profit than mitigating the impact of their activities on the people." The impacts on the residents of the community from blasting at a nearby quarry are detailed as follows:

During a visit to Ibrahim's house in March [2024], he walked through the cracked parts of the building branded with cemented patches to save it from caving in. He said the company would rarely engage in its blasting operations without the fly-rocks hurtling their roofing sheets or structures.

"Whenever...[Perfect Stone Quarries Limited] want to blast, even if it happens under the rain, we are all expected to leave our houses because of flyrock or casualty induced by the heavy vibration. During the week they blasted again. The wall here (pointing to the right wall) cracked badly and it may soon fall. The ceilings fell on me too. We later realized that a man was injured while the window glasses in his house were all shattered. God is our only saviour in this community," Rita said.

The reporters took the coordinates of Ibrahim and Rita's neighbourhood and plotted them back to the blasting site. Using Google Earth...it was discovered that the distance was just a meager 0.47 km [470 metres]....However, the National Environmental (quarrying and blasting operations) Regulations, 2013, states that "a person shall not locate a quarry or engage in blasting within three kilometres (3,000 metres) of any existing residential, commercial or industrial area" (Uthman and Samuel, 2024).

⁸⁸ *Eloranta* has 29 years of blasting experience, has degrees in mining and geology, has a master's degree in mining, has authored more than 20 papers on mining and blasting, and revised the ISEE Handbook chapter on open pit and quarry operations. In 2004, he was awarded the President's Award by the society for meritorious service to the explosives industry. In 2005, he was elected to the board of directors for the ISEE. *Eloranta & Associates Inc.* website: About Us – *Eloranta & Associates* (elorantaassoc.com). He is also a past President of ISEE.

⁸⁹ Expert: Flyrock from any blast "unacceptable", *The Free Press*, Oct 21, 2017, Expert: Flyrock from any blast "unacceptable" | *Local News* | mankatofreepress.com.

13. SUPREME COURT OF CANADA EXPOSES THE POTENTIALLY DEADLY CONSEQUENCES OF (UNREPORTED) FLYROCK INCIDENTS IN ONTARIO

The 2013 Supreme Court of Canada ruling in *Castonguay Blasting Ltd. v. Ontario (Environment)*, for the first time brought public awareness to the issue of *flyrock* in Ontario and its potentially deadly consequences. Up to this point, *flyrock* had remained a closely guarded secret of the Aggregate Industry, and with the tacit approval of MNRF *flyrock* remained concealed from the public until January 1, 2022, when the Aggregate Resources Act referenced *flyrock* but only as a meaningless undefined term. The quotes that follow are from the Supreme Court of Canada ruling in the 2013 *Castonguay* case, which determined that *flyrock* qualifies as a contaminant under the Environmental Protection Act (EPA), and is likely to cause an “adverse effect” both environmental and from a land use perspective.

[T]he discharge of fly-rock caused an “adverse effect” under paras. (b) and (g) of the definition, [s. 1(1) of the Ontario EPA] namely, it caused injury or damage to property and loss of enjoyment of the normal use of the property. Because the reporting requirement is also engaged when the discharge is “likely to cause an adverse effect,” para. (e) is also applicable since the potential existed for “impairment of the safety of any person.” The adverse effects were not trivial. The force of the blast, and the rocks [*flyrock* debris] it produced, were so powerful they caused extensive and significant damage, penetrating the roof of a residence and landing in the kitchen. A vehicle was also seriously damaged. The fly-rock could easily have injured or killed someone (*Castonguay*, 2013, Supreme Court of Canada).⁹⁰

...[T]he EPA is, in my view, also concerned with uses of the environment that cause harm to people, animals and property - for example, as a conduit for contaminants that cause damage or harm to people, animals or property. Blasting is a perfect example. In many cases, blasting will not harm the environment; para. (a) of the definition of “adverse effect” will not be triggered. However, where blasting causes the discharge of a contaminant, such as fly-rock, into the natural environment, blasting may harm people, animals or property. That is what happened in this case. A blasting activity gone wrong (as the appellant concedes) may not have caused more than trivial or minimal harm to the air, land or water. However, the fly-rock generated by the blasting did cause significant harm to property, a different adverse effect under the Act. Importantly, the direct conduit resulting in this harm was the appellant's use of the environment (the air) to disperse a contaminant (fly-rock). (*Ontario (Environment) v. Castonguay Blasting Ltd.*, 2012)⁹¹

14. CAUTIONARY HEALTH AND SAFETY ADVISORIES ISSUED IN OTHER JURISDICTIONS

According to a 2003 paper prepared on behalf of the International Society of Explosives Engineers (ISEE) (Verakis and Lobb, 2003), *flyrock* accounted for 21.5% of all blasting injuries in surface mining in the United States from 1994 to 2001. According to records of Mine Safety and Health Administration (MSHA),⁹²

“1 out of 10 blasting accidents since 1978 happened because of *flyrock* that landed outside the blast area. Accidents happened not just to blasters but also to people guarding the blast area, contractors sitting in their trucks, miners waiting to go back to work, neighbors working in their own yards, and even to people driving on the highway.”

The United States National Institute for Occupational Safety and Health (NIOSH) in a December 2005 press release introduced a training Toolbox on blasting, which includes historical statistics documenting the number of people killed and injured by *flyrock* from 1994 to 2001, as described below:⁹³

⁹⁰ *Castonguay Blasting Ltd. v. Ontario (Environment)*, 2013 SCC 52 (CanLII), [2013] 3 SCR 323, <<https://canlii.ca/t/g1038>>, retrieved on 2023-06-02.

⁹¹ *Ontario (Environment) v. Castonguay Blasting Ltd.*, 2012 ONCA 165 (CanLII), <<https://canlii.ca/t/fq1t7>>, retrieved on 2024-09-01.

⁹² “Toolbox Safety Talks: Blast Safety, <http://www.cfins.com/wp-content/uploads/2019/01/blasting-safety-toolbox-complete.pdf>.

⁹³ Mining Product: Training on *Flyrock* Awareness, December 2005, <https://www.cdc.gov/niosh/mining/works/cover-sheet1824.html>.

Flyrock has killed and injured people. Flying material, both within the blast area and outside it, is responsible for over half of all blasting-related injuries and fatalities. Records from the Mine Safety and Health Administration for 1994-2001 show that in surface mining, 32 people were killed or badly hurt because the blast area was not cleared. Another 17 people were injured or killed by rocks that were thrown outside of the blast area. This total (49 people) is greater than the combined total of the other blast accident causes in mining (premature blast, transporting explosives, fumes, and misfires). Flyrock is a potential hazard anytime and anywhere there is blasting.

According to the Centre for Disease Control and Prevention (CDC) Workplace Safety and Health, the failure to clear the “Blast Area,”⁹⁴ resulted in the greatest number of deaths and injuries from 1978 to 2001.

The law requires that the blast area be cleared. Yet 5 out of 10 blasting accidents in mining – deaths and injuries – occurred when the blast area had people in it. These people were not just the blast crew. They included contractors, road builders, miners, laborers, fishermen, and visitors. The Mine Safety and Health reported that during the years 1978 to 2001, 559 people were killed or injured in this way in mining.

In July 2022, the Ministry of Energy, Mines and Low Carbon Innovation, British Columbia, issued a Health & Safety Notice expressing concerns over a rise in blast-related incidents.⁹⁵

A rise in Blast-Related Incidents

Over the past six months, mines in British Columbia have experienced a higher number of blast-related Dangerous Occurrences, including misfired explosives and over pressurized blasts. Several incidents involve cut-offs and misfires in surface blasting operations. These incidents have ranged from one [blast] hole to entire rows of [blast] holes being cut off from a blast, sometimes going undetected until they are excavated. This has resulted in undetonated explosives being found on haulage roads, broken muck piles and stockpiles, and in some cases, inadvertently exploding while being dug up by mobile equipment. Blasting is one of the most hazardous activities taking place on a mine site. The following four recent events highlight the dangers of undetected misfired explosives and over pressurized blasts:

- At a surface mine, a shovel's bucket detonated an undetected explosive
- While working underground, a scoop's bucket detonated an undetected explosive on a haulage road
- A surface blast resulted in “fly rock” striking and damaging a vehicle
- A surface blast resulted in “fly rock” damaging several pieces of equipment and injuring two workers

On May 5, 2006, Nova Scotia, Canada, issued a Health and Safety advisory expressing concerns over several recent incidents of flyrock, an unavoidable by-product of blasting rock.⁹⁶

Flyrock Incidents

Between 2003 and 2005, there were at least five serious incidents or near misses involving flyrock. All of these incidents had the potential for very serious or fatal results. In some cases there was significant damage to property and structures.

Causes of Flyrock

The investigations of the recent [flyrock] incidents point to several causes:

1. blast holes loaded with excessive explosives
2. blast design omitting some design parameters, such as adequate burden
3. incomplete or poorly conducted hazard assessment prior to blasting
4. incomplete checking of hole placement and geological changes of the rock mass
5. no clear lines of responsibility and supervision for the whole blasting activity

The Virginia Department of Mines, Minerals and Energy, issued a “Flyrock Hazard Alert” following a series of flyrock incidents.⁹⁷

⁹⁴ *Blast Area*, the area including the blast site and the immediate adjacent area that is owned, leased, or controlled by the blast operation, Blast area Definition | Law Insider.

⁹⁵ [health_safety_notice_blasting_2022.pdf](https://www2.gov.bc.ca/gov/content/safety/health_safety_notice_blasting_2022.pdf) (gov.bc.ca).

⁹⁶ Nova Scotia, Canada, Health and Safety advisory, May 5, 2006, <https://novascotia.ca/lae/healthandsafety/flyrock.asp>.

⁹⁷ “Flyrock Hazard Alert,” FLYROCK SAFETY ALERT (virginia.gov).

“Flyrock” means any uncontrolled material (usually rock) that is thrown by a blast and is hazardous to persons, or property not owned or controlled by the mine operator. Flyrock can travel 3,000 feet [914 metres] or more, reach speeds of 400 miles [644 kilometres] per hour, and can penetrate buildings, smash vehicles, and cause great bodily harm.

From December 2003 through August 2006, 5 serious flyrock incidents have occurred from blasting at surface mineral mines/quarries in Virginia. All of these incidents had the potential for very serious or fatal results. Fortunately, no one was injured, though significant damage to property (vehicles and structures) did occur in each of these incidents.

Causes of Flyrock

Investigations have found that flyrock is often the result of:

- Blast holes with insufficient stemming
- Blast holes with excessive burden
- Blast holes with insufficient burden
- Secondary blasting with insufficient burden (toe holes, boulders)
- Weaknesses in the rock structure (mud seams, faults, cavities, fractures, etc.)
- Excessive energy due to high powder factors
- Insufficient energy due to low powder factors

On July 18, 2008, the Kentucky Energy and Environment Cabinet, Department for Natural Resources, issued a “Blasting” Reclamation Advisory Memorandum (RAM 140), in response to 22 flyrock incidents in surface coal mines during 18 months from January 1, 2007, to the end of June, 2008.⁹⁸ As noted below, flyrock is a major concern of the Kentucky Department of Natural Resources, but because of how flyrock is defined, the number of flyrock incidents is understated or underreported.

During calendar year 2007, the Commonwealth of Kentucky had a total of thirteen (13) flyrock events on surface coal mining sites, including one (1) that resulted in a fatality. To date, in calendar year 2008, there have been nine (9) flyrock events, including one that resulted in minor injury that very easily could have resulted in a fatality. The Department for Natural Resources believes that one flyrock event is too many, and to that end, has prepared this RAM to further define steps this Department will require of the coal industry in eliminating flyrock events [defined as follows]:

“Flyrock” is defined as “blasted material cast into the air, or traveling along the ground, that is cast from the blasting site more than half the distance to the nearest dwelling, public building, school, church; commercial, community or institutional building; or any occupied structure; or that is cast beyond the permit boundary.

In 2013, Virginia Department of Mines Minerals and Energy (DMM) issued a Safety Alert in response to Flyrock Impacting Highways, while describing four flyrock incidents,⁹⁹ which are:

Two flyrock incidents have occurred at Virginia mineral mines in 2013. On both occasions flyrock was thrown onto a busy highway where traffic had not been stopped prior to initiating the blast. In May, [2013] flyrock traveled approximately 400 feet [122 metres] striking one vehicle and damaging another when it ran over a football size rock that had landed in the highway. In August, [2013] flyrock traveled approximately 1,200 feet [366 metres] and landed in the roadway.

In a 2005 incident in Virginia, rock flew 1,400 feet [427 metres] and penetrated a commercial building’s roof. In 2007, rock traveled 1,700 feet [518 metres] and landed near a primary crushing plant that was in operation.

It is the duty of the certified blaster to delineate the blast area, which should include all areas on and off the mine site, including highways that might be impacted by flying material. Virginia Safety and Health Regulations for Mineral Mining, 4 VAC 25-40-830, states, “prior to blasting near a mine haul road or public highway, traffic shall be stopped at a safe distance”. Blasters can minimize the risk of flyrock through careful planning and by following the recommendations below, especially when blasting near highways.

⁹⁸ RAM #140, Reclamation Advisory Memoranda - Kentucky Energy and Environment Cabinet.

⁹⁹ DMM Safety Alert: Flyrock Impacting Highways, <https://energy.virginia.gov/mineral-mining/documents/SAFETY/ALERTS/blastingflyrock/FlyrockHighway.pdf>

- The Blasters should pay close attention to stemming issues with top level shots when there are varying amounts of weathered or unconsolidated material present.
- The blaster must closely examine the drill log and blast site geology and make adjustments when loading to account for significant changes in geology.
- When angled holes are used, the blaster must be certain the burden and spacing has not been affected by improper drill set up or drill string wander.
- Regardless of actual distance, if there is anything about the shot that causes the blaster concern, traffic on nearby highways must be stopped at a safe distance. Personnel performing traffic control must be certified by VDOT [Virginia Department of Transportation] and follow their procedures.
- Certified blasters and mine management must always remain aware of their responsibility for blasting effects on and off the mine site.

In March 2021, the New South Wales Resources Regulator issued an advisory on the importance of Blast exclusion zones in small mines in response to four flyrock incidents within the past year.¹⁰⁰ The advisory describes the impacts of flyrock and speculates on some factors that contribute to injuries from flyrock, as follows:

Blasting activities are frequently conducted in hard rock quarries to break the rock for further processing in crushing/screening plants. Blasting accidents may result in critical injuries or fatalities. During a blast, flyrock may be ejected further than anticipated, which can affect people, property and the environment.

Flyrock and lack of blast area security were identified as the primary causes of blasting-related injuries in surface mining. With four flyrock incidents in the past year, some sites may not be correctly calculating exclusion zones and/or effectively maintaining an exclusion zone during a blast.

On June 26, 2024, WorkSafe Tasmania, issued a “Flyrock from blasting” advisory, in response to safety concerns over several flyrock incidents.¹⁰¹ The advisory describes the nature of the flyrock incidents and outlines the contributing factors as follows:

Several incidents involving flyrock have occurred in Tasmania. In the example below [photo], a large amount of flyrock from a quarry blast was projected several hundred metres from the blast site, injuring people and causing property damage:

Flyrock is created when pieces of rock are thrown from the blast site by the force generated by the explosives. It’s commonly created when the force used is more than what’s needed to fragment the rock and displace the muckpile.¹⁰²

Situations that can cause flyrock include inadequate burden, particularly of front-row holes, inadequate or ineffective stemming, and firing drop cuts, oversized boulders or toes. Flyrock can travel a considerable distance from the blast site, and can cause death, serious injury and property damage.

15. INDEPENDENT QUANTITATIVE ANALYSIS OF FLYROCK INCIDENTS: THE ‘HITS’ JUST KEEP ON COMING!

From the beginning of 2020 to the end of August 2024, Sevelka (2022, 2023) has documented 240 (known) individual *flyrock* incidents from various sources (e.g., news releases, published investigations, published journals, case law, etc.), with details of the flyrock incidents documented and summarized below.

Summary of Flyrock Incidents

- Previously, a total of approximately 195 flyrock incidents had been discovered and analyzed (Sevelka, 2022). Of the 195 flyrock incidents discovered, 33 resulted in death, indicating an overall kill rate of 16.9%, and 40 people were injured in the same 33 flyrock incidents.

¹⁰⁰ NSW Resources Regulator, Compliance Priorities Outcomes, Blast exclusion zone management, March 2021, <https://www.resourcesregulator.nsw.gov.au/sites/default/files/2022-05/Compliance-priorities-report-blast-exclusion-zones-small-mines.pdf>

¹⁰¹ “Flyrock from blasting,” Worksafe Tasmania, June 26, 2024, [Flyrock from blasting \(worksafe.tas.gov.au\)](https://www.worksafe.tas.gov.au)

¹⁰² When explosives are used to break apart rock, the fragmented material is displaced and forms a pile, which is known as the muckpile. The pile is then typically loaded and transported for further processing or use.

- An additional 24 flyrock incidents were added to the “running list” of flyrock incidents bringing the total to 219 (Sevelka, 2023). Of these additional 24 flyrock incidents, 10 people were injured, and 4 people were killed, indicating a kill rate of 16.7% ($4 \div 24$). Of the 219 flyrock incidents documented, 37 resulted in death from being struck by flyrock debris, reflecting a “kill” rate of 16.9% ($37 \div 219$), and 41 more people were injured in the same 37 flyrock incidents.
- The following 21 flyrock incidents have been added to the “running list” increasing the total of known flyrock incidents from 219 to 240 as of August 31, 2024. In 8 of the 21 additional flyrock incidents documented, 12 people were killed and 8 people were injured. Of the total 240 flyrock incidents, 45 resulted in death, indicating a “kill” rate of 18.8% ($45 \div 240$). In those 45 flyrock incidents, 49 people were killed and an equal number were injured.

Individual Flyrock Incidents

- *Flyrock 220*: On July 3, 2012, a blast at a quarry in Rumney, New Hampshire, launched *flyrock debris* hundreds of feet through the air. A 40-pound (18.14-kilogram) rock ripped through a shed and punched a 2-foot hole (0.61-metre) in the ground of the property of Dean Kenneson at 22 Groton Hollow Road. Doug and Gail Sanborn’s home across the street from Kenneson’s home was also showed with flyrock debris, some of which penetrated the roof and landed in the basement (Tracy, 2012).
- *Flyrock 221*: On May 7, 2007, a blast at a quarry in southwest China’s Yunnan Province launched *flyrock debris* that killed five people and injured six others sheltering in a shed that was crushed by the rocks from the blast. The injured were taken to a local clinic and were reported to be in stable condition.¹⁰³
- *Flyrock 222*: On April 29, 2024, a blast at the Taunton Quarry in Massachusetts launched *flyrock debris* onto a nearby neighborhood, with one rock landing on a homeowner’s property at 175 Freemont Street, 700 feet (213 metres) from the quarry, nearly striking Scott Schofield. Some flyrock debris struck railway cars loaded with CO2 tanks parked on nearby railway tracks. Jeremiah Elsinger’s children, who are home-schooled, heard rocks hitting their property at 175 Freemont Street and smashing against the train. Other rocks hit trees (Schemer, 2024).

Jason Guilmette, of Maine Blasting and Drilling, who conducted the blasting at the quarry that day, said in a letter to fire prevention, that it is believed the incident with “fly rock” occurred due to the timing sequence of the blast, which resulted in debris flying vertically and off the property, instead of horizontally and staying within the quarry, as intended. He added, “I will be working with our technical services department on a timing sequence to avoid this on future blasting.”...[underscoring added]

[My kids were out playing and they actually heard large stones smashing against the train,” Elsinger said. “I’ve served my country. I went to Iraq and coming back and having to deal with explosions is one thing, but now you’re throwing projectiles at me and my family’s house. That can’t happen again (Eliopoulos, 2024).”

- *Flyrock 223*: On January 29, 2024, a blast at the Anthony Bhoir Quarry, India, launched *flyrock debris* 1,500 feet (457 metres) that struck and killed 32-year-old Avinash Keshav Kujar, an excavator operator, and injured two other employees, Ankitkumar Sunil Sah, 18, a helper, and Suresh Ambaji Nirgud, 27, a supervisor, at the quarry site (Assainar, 2024):¹⁰⁴

Sah and Nirgud, who worked as the supervisor sustained head injuries after a piece of stone hit them on their head. Meanwhile, Kujar suffered severe head injuries due to which he was pronounced dead upon arrival at the hospital.

Raut [53, the blaster] has been booked under section 304 (A) (causing death by negligence) of the IPC [Indian Penal Code].¹⁰⁵ “We have booked the person who was doing the blasting and is also the contractor of the work. If we find more people responsible, we will book them as well. As of

¹⁰³ “Quarry Blast Kills Five, Injures Six in Yunnan,” *Xinhua News Agency*, May 9, 2007, Quarry Blast Kills Five, Injures Six in Yunnan -- china.org.cn.

¹⁰⁴ “3 workers hit by rocks at quarry site, 1 dead,” *The Times of India*, Feb 3, 2024. <https://timesofindia.indiatimes.com/city/navi-mumbai/tragic-incident-3-workers-hit-by-rocks-at-quarry-site/articleshow/107375135.cms>

¹⁰⁵ Section 304A of the Indian Penal Code (IPC) causing death by negligence: Whoever causes the death of any person by doing any rash or negligent act not amounting to culpable homicide, shall be punished with imprisonment of either description for a term which may extend to two years, or with fine, or with both.

now, no arrests have been made,” senior police inspector Nitin Thackeray from Panvel City police station said.

- *Flyrock 224:* On June 29, 2007, a blast at the Waihi Gold Mine in New Zealand launched *flyrock debris* including a 2-kilogram (4.41-pound) rock that crashed through the roof of a residence narrowly missing the occupants, 200 metres from the blast site.¹⁰⁶
- *Flyrock 225:* On March 27, 2013, a blast at Weber’s North Stone Quarry in St. Louis County, Missouri, launched *flyrock debris* amounting to 8,900 tons of broken rock, some of which landed on a front-end loader killing the operator. Almost 10 hours after the blast was initiated, rocks about 30 feet (9.14 metres) from the highwall were removed from the front-end loader, and the body of 61-year-old William Sievert was recovered.¹⁰⁷
- *Flyrock 226:* On April 1, 2008, a blast at a quarry in Priest River, Idaho, launched *flyrock debris* that broke the arm and injured the leg of a woman at approximately 1,000 feet (305 metres) from the blast site. The woman was taken to Bonner General Hospital for treatment.¹⁰⁸
- *Flyrock 227:* On July 22, 1996, a blast at the Island Quarry, Bailey’s Bay, Bermuda, launched *flyrock debris* including a seven-by-three-inch rock that smashed through the windshield of a parked car, ricocheted off the dashboard and into the driver’s seat. The driver of the vehicle, Dallen Martin, had just exited the vehicle, and was fortunate to have escaped unharmed (Williams, 1996).
- *Flyrock 228:* On August 24, 2015, a blast at a construction site in Cape Ray, Newfoundland and Labrador, launched *flyrock debris* that included a 7-kilogram (15.4-pound) rock that penetrated the roof of the Wall family home and landed on the floor not far from their dining-room table, about half-a-kilometre (500 metres) from the blast site.¹⁰⁹ A second flyrock incident occurred on September 25, 2017 (Flyrock 71).
“You want the rock to move because that’s the point of blasting – to fragment and heave the rock – but you want that body of rock [flyrock debris] to remain on site and not go on adjacent properties,” Hammoud [an Engineer] said... “It’s not a very good experience,”...
- *Flyrock 229:* On May 12, 2024, a blast at a quarry in Edapalayam Village, India, launched *flyrock debris* throughout the quarry, some of which travelled offsite and struck a 38-year-old dairy farmer, whose farm is 300 metres from the quarry, and who succumbed to his injuries at a private hospital.¹¹⁰
- *Flyrock 230:* On April 30, 2021, a blast at a stone quarry in Senemal Village, India, launched *flyrock debris* that struck and killed 36-year-old Harekrishna Bhoje, a supervisor at the quarry.¹¹¹
- *Flyrock 231:* On September 12, 1994, Mr. Slater, safety advisor, lost his life and Mr. McGuinness, workplace trainer, was exposed to serious risk due to the exposure to *flyrock debris* from an unconfined blast and the deliberate detonation of an unknown quantity of deteriorated explosive at the Tick Hill Gold mine in Australia. Flyrock debris was scattered more than an estimated 300 metres and the accident site was 42 metres from the point of detonation. No action was taken to reduce the size of the blast or to confine it in a way which would reduce the quantity of flyrock [p. 168].¹¹²
- *Flyrock 232:* On April 10, 2024, a blast at a Marichmal stone quarry in India launched *flyrock debris* offsite that struck and killed 14-year-old Ritesh Majhi. Ritesh and his brother Pritam Khara were standing on a bridge overlooking a river, and according to the brother “all of a

¹⁰⁶ PDF - Neil Mansell & Neil Mansell Concrete P/L v Maroochy Shire Council & Ors [2007] QPEC 86 | PLANNING AND ENVIRONMENT COURT (queenslandjudgments.com.au).

¹⁰⁷ Final Report – Fatality #3 – March 27, 2013, Mine Safety and Health Administration, <https://www.msha.gov/data-reports/fatality-reports/2013/fatality-3-march-27-2013/final-report>.

¹⁰⁸ “Rock blasting injures woman,” *Bonner County Daily Bee*, April 1, 2008, <https://bonnercountydailybee.com/news/2008/apr/01/rock-blasting-injures-woman-7/>.

¹⁰⁹ “Incidents like Cape Ray blasting mishap deemed rare,” *CBC News*, August 27, 2015, <https://www.cbc.ca/news/canada/newfoundland-labrador/incidents-like-cape-ray-blasting-mishap-deemed-rare-1.3205477>.

¹¹⁰ “Dairy farmer dies after being hit by rock from quarry blast near Vandavasi,” *The Hindu Bureau*, May 13, 2024, <https://www.thehindu.com/news/national/tamil-nadu/dairy-farmer-dies-after-being-hit-by-rock-from-quarry-blast-near-vandavasi/article68167787.ece>.

¹¹¹ “1 killed in Jharsuguda quarry blast,” *the pioneer*, March 3, 2021, <https://www.dailypioneer.com/2021/state-editions/1-killed-in-jharsuguda-quarry-blast.html>.

¹¹² Mining warden inquiries 1972-2001, Kenneth Slater 1994- Mining Accident Database (mineaccidents.com.au).

sudden a blasting occurred, and a stone hit the left side of Ritesh's head" killing him on the spot (Mishra, 2024). After the death of the 14-year-old-boy, the quarry owner Sudhak Srihariya was arrested and taken to court by the police (Senapati, 2024).

- *Flyrock 233*: In September 2021, a misfire during a blast at a pit and quarry along the Trans-Canada Highway near St. John's, Newfoundland, launched *flyrock debris* beyond the onsite safe zone that damaged four vehicles, two loaders and a crusher.^{113,114}

...[On June 13, 2024, Explosives company Dyno Nobel, a supervisor, and the certified blaster each pleaded guilty to safety violations and were slapped with fines of \$18,400, \$1,000 and \$3,000 respectively. The other two companies charged in the blast – Weir's Construction and Triple F Aggregates, along with Weir's owner Bill Weir – have maintained their innocence and pleaded not guilty. Their trial is scheduled for November [2024].

- *Flyrock 234*: On March 31, 2021, a blast at a limestone quarry in Paoli, Indiana, launched *flyrock debris* that destroyed the quarry owner's asphalt plant, which was located within the "radius of risk."¹¹⁵

[4] Cave Quarries extricates limestone from its quarry for use as gravel and asphalt. To get the limestone, [blast] holes are drilled in the stone according to a "shot design" created by the blaster identifying – among other things – the number, diameter, depth, and location of the holes. Explosives are then placed in the holes to blast the stone loose...At some point, Cave Quarries decided to blast the high wall so it would have a stockpile of stone near the [crushing and asphalt] plants and could maintain production during the winter when weather conditions prohibited transporting stone from the back of the quarry.

[6]...In early 2021, Cave Quarries erected steel plates around the bottom of the asphalt plant to protect the natural gas lines and gauges and meters from damage "just in case a big rock [flyrock debris] were to go over there."...Cave Quarries knew the asphalt plant was within the "radius of risk" from high wall blasts.

[7].On March 3, 2021, Warex conducted a blast on the high wall at Cave Quarries' request. Joshua Collins, A Warex employee and licensed blaster, was in charge that day and had the "final say-so."...But many aspects of the blast were "mutual decision[s]" between Collins and Randy Key, Cave Quarries' superintendent, including the decision to have a larger blast....Cave Quarries had become concerned about the cost of smaller blasts because it paid "so much [per] shot fee."...The blast did not go as planned and the asphalt plant was destroyed. [underscoring added]

[8] The blast was designed to "draw itself away from the plant and...fold into itself as it continued[d]."...Collins explained the blast did not perform as designed because "[t]here was a mud seam."...In this context, "mud" means "any kind of a soft material."...The mud seam was unknown before the blast – "all the holes were drilled solid according to the drill reports" provided by the third-party drilling company....

- *Flyrock 235*: In March 2005, a blast at a surface mine in the Bowen Basin of Australia launched *flyrock debris* with rocks up to 80 kilograms (176 pounds) found 900 metres from the blast site. Rocks landing on the adjacent Peak Downs Highway caused damage to the road surface and to powerlines associated with the railway. Both the railway and the Peak Downs Highway were closed for a large part of the day. Significant airblast and vibration associated with the blast triggered complaints from neighbouring properties.¹¹⁶
- *Flyrock 236*: In October 2005, a trench blast in Queensland, northeastern Australia, launched *flyrock debris* that caused damage to some houses. Although the blaster (shotfirer) used blast mats and other means to prevent such an occurrence, local geological conditions in part of the trench caused the blast mats to lift and for the flyrock debris to escape.¹¹⁷

¹¹³ "Guilty Pleas and Fines Meted Out in Blast-Gone-Wrong OHS Case," *VOCM*, Jun 14, 2024, Guilty Pleas and Fines Meted Out in Blast-Gone-Wrong OHS Case | VOCM.

¹¹⁴ "Public Advisory: Blast at Construction Pit Leads to Multiple Occupational health and Safety Charges," *Digital Government and Service NL*, September 21, 2023,

¹¹⁵ *Cave Quarries, Inc. v. Warex LLC*, 219 N.E.3d 221 (2023), <https://casetext.com/case/cave-quarries-inc-v-warex-llc>

¹¹⁶ Explosives summary of reported serious accidents and high potential incidents 2005 (rshq.qld.gov.au).

¹¹⁷ Explosives summary of reported serious accidents and high potential incidents 2005 (rshq.qld.gov.au).

- *Flyrock 237*: In November 2005, a blast at a south-east Queensland quarry launched *flyrock debris* that resulted in damage to an onsite plant 150 metres from the blast.¹¹⁸
- *Flyrock 238*: In June 2008, a blast at a surface mine in Queensland, Australia, launched *flyrock debris* that injured an excavator operator when flyrock, up to 20 kilograms (44 pounds), crashed through the windscreen and showered him with glass. The excavator bucket struck a primer/detonator in an unidentified, misfired shot. The contact caused the primer to initiate which caused the bulk product, about 50 kilograms, to detonate. The operator was approximately 10 metres away from the blast and debris was thrown up to 230 metres away. Teeth from the excavator bucket were also blown off from the force of the blast.¹¹⁹
- *Flyrock 239*: On August 22, 2023, a blast at a stone quarry in Kowali near Jamshedpur, India, launched *flyrock debris* that struck and killed 55-year-old Manoj Puran, while shepherding goats near the quarry (Jenamani, 2023).

The explosion caused boulders and stones to fly up, causing one of them to hit Manoj in the chest. As a result of it, the victim fell down. Soon some of the mining workers rushed him to Tata Main Hospital where the doctors on emergency duty declared him as brought dead.

- *Flyrock 240*: On November 17, 2004, a blast at a construction site on Route 144, Benson, Vermont, launched *flyrock debris* that struck a few homes and scattered small and large rocks weighing as much as 100 pounds (45.36 kilograms) up to 200 feet (61 metres) from the blast site. The roof of one of the homes struck by the rocks, the Drabing residence, was penetrated in about a dozen locations. According to another resident, Bohannon, Route 144 was covered with rocks (McKenna, 2004).

Drabing said she returned home from work Wednesday afternoon [November 17, 2004] to find a massive mess in her living and dining rooms. "From the outside all I saw was the broken window, but inside the living room was just covered in glass," she said. "The dining room was the worst. There was a hole in my ceiling huge enough that I could climb through it. "There were pictures, decorations, flower pots just smashed on the floor," she said. Drabing added that the rock which came through the roof into her dining room could have weighed as much as 100 pounds [45.36 kilograms]. It broke in two upon smashing part of the slate floor, she said. In addition to the dining room damage in the single-story part of the house, Drabing said falling rocks broke through to living spaces in two other places and pierced the roof nine other times in the two-story section.

Roy Lewis was the contractor for residential driveway project. George Roberts, the subcontractor who designed and set the explosion, said it was his own mistake that led to the blast getting out of hand. "I'm the guy who drilled it, I'm the guy who loaded it and I'm the guy who fired it," he said. "I'm the guy who sent rocks flying through the air. I'm the one to blame." Roberts said the blasting Tuesday [November 16, 2004] likely caused more cracks in the bedrock than he had anticipated. "I tried to tie it in where I left off the day before, but the blasting the day before made cracks in the rock," Roberts said. "The charge always goes the weakest way and I misinterpreted how far the fractures and cracks went. It blew out more ground on the weak side." Roberts said he'd expected any debris to be thrown to the north or west, not east towards the road and other houses. "I didn't expect it. Some rocks flew over my head, that's how confident I was. Foolishly confident," he said. "The first shot went so well it kind of blinded me a bit." Roberts added that they could have prevented any flying debris by completely clearing the original blast site and putting down a load of sand, but the construction team had been hurrying to take advantage of ideal weather for the project. Roberts, a quarry-man and farmer in his 80s, said he's been working with explosives since he was about 15 and has been licensed to work with explosives ever since Vermont instituted that requirement.

16. CONCLUSIONS

Flyrock, an uncontrollable and inevitable by-product of blasting rock, can never be mitigated and poses significant risks despite claims to the contrary by the aggregate industry and their Explosives Engineers. Flyrock remains the most dangerous and deadly consequence of blasting (detonation of explosives), an ultra-hazardous activity held to strict liability. The “kill” rate of 18.8% from flyrock

¹¹⁸ Explosives summary of reported serious accidents and high potential incidents 2005 (rshq.qld.gov.au).

¹¹⁹ Significant explosives accidents and incidents report 2007 (rshq.qld.gov.au).

debris is based on an analysis of a running total of 240 (known) documented flyrock incidents, in which 45 of the incidents resulted in the death of 49 individuals and injury to another 49 individuals. Death from flyrock is permanent, with no prospect of rehabilitation. The emotional pain and suffering and financial impact on those left behind to mourn the loss of their loved ones is immeasurable, and, unfortunately, is of little or no concern to the aggregate industry and their Explosives Engineers. Only a permanent minimum onsite setback (i.e., excavation limit) of 500 metres, coupled with a permanent minimum offsite separation distance of 1,000 metres from sensitive land uses, and prohibiting contaminants (e.g., vibrations,¹²⁰ noise, toxic fumes, flyrock debris, etc.) from leaving the boundaries of an existing or proposed pit or quarry, can reduce, but not necessarily eliminate, all the adverse effects of a blasting quarry on the environment and its inhabitants, human and non-human. All adverse effects must be eliminated, avoided or reduced to a “trivial” level to protect and sustain the health, safety and welfare of the environment, including its inhabitants, human and non-human, in perpetuity. Aggregate extraction operations are not entitled to the free use, directly or indirectly, of third-party property to internalize and maximize profits while externalizing costs and victimizing innocent third parties, robbing them of their use and enjoyment, and diminishing the value of their properties, their most valuable asset and a major source of wealth.

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AUTHOR'S DECLARATIONS AND ESSENTIAL ETHICAL COMPLIANCES

Author's Contributions (in accordance with ICMJE criteria for authorship)

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