# Unleashing Uranium in Lanark Highlands

## *... A Risky Business*

Concerns have been raised around potential exposure to the uranium that is known to exist in the bedrock in this part of Lanark County. This fact sheet is meant to put these concerns into perspective in relation to the proposed aggregate extraction by Thomas Cavanagh Construction Limited, as well as the current extraction and proposed expansion of the McKinnon Pit owned by Arnott Brothers Construction Limited. Both companies are asking to dig below the water table. These sites are along Highland Line near McDonalds Corners village in the southwest corner of the Township of Lanark Highlands. Both sites are adjacent to wetlands, with the proposed Cavanagh site adjacent to Barbers Lake. Each of these sites is beside one of the two branches of Long Sault Creek, which join together near County Road 12 (McDonalds Corners Road) and flow into the Mississippi River, which itself flows into the Ottawa River.

**Is there uranium in Lanark Highlands?**
Compared to average granite, the Barbers Lake granite body is rich in uranium. The marble bedrock around the margins of this host granite is thought to be sporadically intruded by pegmatite offshoots that have greater uranium content than the granite itself. Due to the original physical orientation of this billion-year-old granite, as it intruded into this area, its western flank is more enriched in uranium.

The gravel pits proposed by the two construction companies lie on both the western flank of the Barbers Lake granite intrusion and its host marble. It is very likely that enriched pegmatite offshoots of the granite have intruded into that marble.

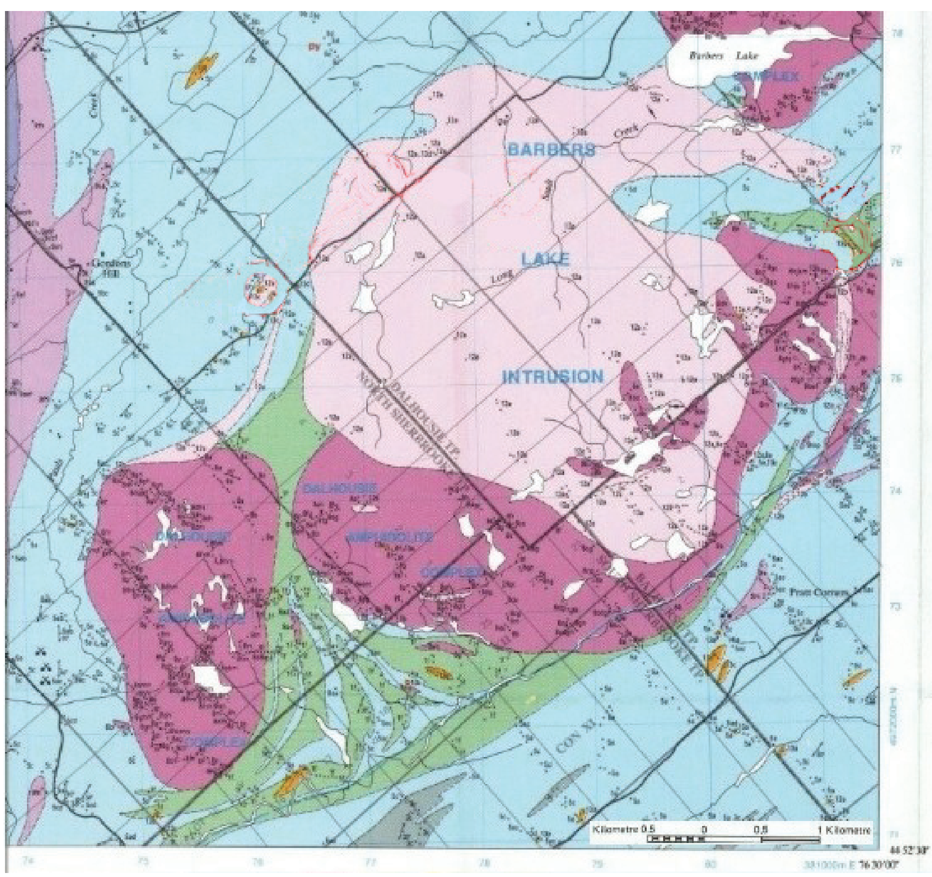
*What expert scientific studies have been done by each company to establish the degree of uranium-enriched pegmatite intrusions into the marble bedrock underlying these gravel pits? What efforts have been undertaken to determine the extent of uranium-enriched rock on the surface of these sites?*

In 2007-2008, an exploration site for a proposed uranium mine was established in the Mississippi River watershed in North Frontenac Township. After a great deal of public protest and the collapse of the dollar value for uranium, the mining company backed off and left the area.

In 2014, Dr. Jamie Cutts submitted his thesis on the geochemical character of granite and syenite plutons in southeastern Ontario to the Department of Earth Sciences at Carleton University.

A pluton starts off in a melted form, called magma, several kilometers underground in the Earth's crust and solidifies near the surface to form a gigantic body of igneous rock, which over time, becomes exposed when uplift and erosion remove the overlying rock.

Cutts examined nine plutons, including those near Skootamatta, Wolf Lake, Rideau Lake, Barbers Lake, Elphin, Foley Mountain, Leggat Lake and Cranberry Lake. Among other things, his research concluded that compared to the other rock formations studied, the Barbers Lake pluton had significantly greater enrichments of uranium, thorium and lead.



**What happens when bedrock containing uranium is disturbed?**
Granitic rock containing uranium tends to break down to clay, particularly in the presence of water. In an undisturbed situation, this clay largely stays put. When disturbed or exposed, particularly if exposed to water, it will start to move, carrying its uranium and other decay-chain elements loosely bound to these fine particles. Any increased water flow, even from a heavy rain, to this newly exposed clay may set this uranium in motion.

*Will there be radioactive clay and silt in the sand and gravel dredged up? Will it be washed? What source of clean water will be used to wash the clay? How will the possibly radioactive wash water be disposed of? How will the surrounding wetlands be monitored for contamination? Will the sand and gravel contain radioactive material? Will this aggregate be shipped off the site? How will workers be protected when they extract, crush and wash this potentially radioactive material?*

**What happens when uranium is in water?**
Uranium can combine with other elements in the environment to form uranium compounds. The solubility of these uranium compounds varies greatly. Uranium in the environment is mainly found as a uranium oxide, typically as UO2, an insoluble compound found in minerals, and sometimes as UO3, a moderately soluble compound found in surface waters. Soluble uranium compounds can combine with other chemical elements and compounds in the environment to form more complex uranium compounds. The chemical form of the uranium compounds determines how easily the compound can move through the environment, as well as how toxic it might be. Some forms of uranium oxides are very inert and may stay in the soil for thousands of years without moving downward into groundwater.

Both Thomas Cavanagh Construction Limited and the Arnott Brothers Construction Limited have not yet been given approval to go below the water table. If either one or both companies are given permission to go below the water table, the dissolved uranium in the runoff could migrate into Barbers Lake, Long Sault Creeks and adjacent wetlands and cause the amount of uranium to increase in those waters to a level higher than current baseline conditions.

*How are these companies proposing to track the transport and dispersion of uranium in surface water and groundwater?*

Both dissolved and suspended uranium in surface water, such as in a creek, stream, river and lake, can be transported long distances. In a lake, some of the suspended uranium in the water will stick to the sediment and other particles.  If the sediment is disturbed, the uranium becomes exposed and begins to migrate.

*How will these companies track contamination levels of the relevant isotopes on their sites, in the adjacent wetlands and along the truck routes? Will monitoring be done on uptake of uranium by plants or animals near these extraction sites? What precautions will be taken to protect nearby residents and species at risk?*

**What is Uranium?**

Uranium is a trace mineral widely found in nature. Rocks, soil, surface water, groundwater, air, plants and animals all contain varying amounts of uranium. This mineral is found in Canada and elsewhere in the world. A few places, such as Australia and northern Saskatchewan, have large quantities of high grade uranium ore with concentrations as high as 20 percent. This uranium is processed to create fuel for nuclear reactors.

All forms of uranium are radioactive. That is, they are constantly emitting particles such as neutrons, protons and/or electrons and thereby transforming the original element into subsequent elements.

Natural uranium exists in three forms: uranium-238, uranium-235, and uranium-234. All of these forms, called *isotopes*, are chemically similar, but each has a different number of neutrons in their nucleus. All three isotopes are radioactive; the most common one being uranium-238. According to the American National Library of Medicine, uranium-238 makes up about 99 percent of natural uranium.

Uranium-238 releases its radiation with a half-life of 4.5 billion years. Half-life is defined as the amount of time needed for half of the isotope to give off its radiation and change into a different element.

| Uranium Isotope | % in natural uranium | Number of protons | Number of neutrons | Total neutrons and protons | Half-Life (in years) |
|---|---|---|---|---|---|
| U-238 | 99.27% | 92 | 146 | 238 | 4.46 billion |
| U-235 | 0.72% | 92 | 143 | 235 | 706 million |
| U-234 | 0.0055% | 92 | 142 | 234 | 245,000 |

**Why is uranium radioactive?**

When an element is radioactive, the nucleus of each atom is unstable, and by giving off particles and energy, it is transformed into another element. For example, when an atom of uranium-238 gives off two protons and two neutrons (known as an alpha particle), it becomes the radioactive element thorium-234.

When that subsequent element is radioactive, the spontaneous process of radioactive decay continues until a non-radioactive isotope is reached. The 14-step uranium-238 decay series ends in the non-radioactive element lead-206.

**What is the uranium decay chain?**

The accompanying chart maps the atomic changes that radioactive uranium-238 undergoes as a series of neutrons, protons and/or electrons are released to form new elements.

With the exception of the last element, lead-206, all the other elements in this decay series are radioactive. All are solid, with the exception of radon-222, which is a noble gas. Noble gases are chemically inert and cannot react with other chemicals to form compounds. In the ground, radon decays and the subsequent radioactive elements follow the decay-chain series ending with lead-206. Once radon gas is airborne, the single atom decay products attach themselves to dust particles which fall to the ground.

Each atom contains protons and neutrons in the nucleus, which is surrounded by electrons. When a radioactive atom “decays” to form a different element or isotope, it releases alpha and/or beta particles and electromagnetic radiation.

**Uranium-238 Decay Chain Series**

Uranium-238 (half life: 4.46 billion years)
↓ → alpha
Thorium-234 (half life: 24.1 days)
↓ → beta and gamma
Proactinium-234 (half life: 1.17 minutes)
↓ → beta and gamma
Uranium-234 (half life: 245,000 years)
↓ → alpha and gamma
Thorium-230 (half life: 75,400 years)
↓ → alpha and gamma
Radium-226 (half life: 1,600 years)
↓ → alpha and gamma
Radon-222 (half life: 3.82 days)
↓ → alpha
Polonium-218 (half life: 3.11 minutes)
↓ → alpha
Lead-214 (half life: 26.8 minutes)
↓ → beta and gamma
Bismuth-214 (half life: 19.9 minutes)
↓ → beta and gamma
Polonium-214 (half life: 163 microseconds)
↓ → alpha
Lead-210 (half life: 22.3 years)
↓ → beta and gamma
Bismuth-210 (half life: 5.01 days)
↓ → beta and gamma
Polonium-210 (half life: 138 days)
↓ → alpha
Lead-206 (stable)

*credit: Gordon Edwards*

Alpha particles, which consist of two protons and two neutrons, are the most damaging to tissues; however, since they do not penetrate skin, they must be ingested or inhaled to cause damage. When an alpha particle is given off, the atom becomes a new element in the decay chain series and has a lower atomic weight.

Beta particles typically result from decay of neutrons in the atomic nucleus with the emission of high-energy electrons.

This atomic decay process is often accompanied by a release of penetrating ionizing electromagnetic energy in the form of *gamma radiation*, which is similar to X-rays.

In summary, the only mechanism for decreasing the radioactivity of uranium is radioactive decay. Since all three of the naturally occurring uranium isotopes have very long half-lives, the rate at which the radioactivity diminishes is very slow. In other words, the radioactivity of uranium remains essentially unchanged over thousands of years.

*Given that there are higher than background concentrations of uranium on and below the surface near Highland Line, what is the justification of disturbing that radioactive area to create a new set of health-related and environmental problems?*

**References:**


https://www.epa.gov/sites/default/files/2016-12/documents/2016_a_citizens_guide_to_radon.pdf

BEIR VII Phase 2 Health Risks from Exposure to Low Level Ionizing Radiation, National Academy of Sciences, 2006.


Prepared by Save Long Sault Creek.ca, April, 2024

**Danger: Do not disturb**