January 25, 2022

Mail to:
Statements of Concern
Environment and Parks, Approvals Unit
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Subject: Mountain Ash Limited Partnership, Summit Pit application to AEP,
Location (W1/2 31-026-03-W5). DAPP0001717 & EMS 001-00481044

Summary
This submission is my Statement of Concern which is provided to Alberta Environment & Parks expressing my serious concerns about the proposed Mountain Ash Summit gravel mine as it will impact on Big Hill Springs Provincial Park. I herewith as a senior-level geologist provide my technical analysis of the relevant ground water issues. *My recommendation is that the Summit gravel mine be not approved.*

How I Would be Personally Impacted by the Mountain Ash Summit Gravel Mine
I frequently visit the Bighill Creek valley in Cochrane. I also visit about twice per year Big Hill Springs Provincial Park and travel further northwards along the Bighill Creek valley into the Lochend area. These visits are in conjunction with field trips which I lead as volunteer as part of the Alberta Wilderness Association's "Adventures for Wilderness" program. I lead these field trips twice a year for groups of 10 to 15 attendees. These trips are open to the public. My field trips are focused on the glacial geology of the area, outcrop geology including the Paskapoo Formation, and water fowl and wildlife in the ponds in the glacial meltwater channels in the Cochrane North area.

I am very concerned that the Mountain Ash Summit mine will destroy the very fragile groundwater environment in Big Hill Springs Provincial Park as described below in this submission. How do I explain to my grandchildren that this park enjoyed by so many Albertans was sacrificed for financial gain of a few?

Water flows over lumpy deposits of tufa at Big Hill Springs Provincial Park

Source: By Ruben Lara - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=59716841

Figure 1. Source of this photograph is Ruben Lara, see above for details. The photograph highlights the water and tufas at Big Hill Springs Provincial Park. This water flows continuously, even in the depths of winter. The springs in this park are unique. There are no other comparable springs in Canada.

Hot Springs and Thermal Springs in Western Canada

Hot springs are common in the Canada's Rocky Mountains and also in the interior of British Columbia. Such springs are also called thermal springs due to the temperature of the water. They are also called mineral springs due to the high mineral content of the water. The minerals are commonly calcium carbonate (CaCO3). The hot springs at Banff and Miette are very hot as are other hot springs in the Rocky Mountains and in the interior of British Columbia such as the Radium Hot Springs, Harrison Hot Springs and others.

Big Hill Springs, Big Hill Springs Provincial Park – Unique Springs in Western Canada
The thermal springs at Big Hill Springs Provincial are unique because they are the only cool temperature thermal springs in the prairies of Western Canada. They are also unique because although they are cool temperature springs, they flow continuously even in the depths of winter. *Indeed, as described below and based on my research, I wish to inform Alberta Environment & Parks that there are no other springs comparable to Big Hill Springs anywhere in Canada.*

The water in the springs are rich in calcium carbonate and this is reflected by the outcrops of up to four meters of tufa which occur in the park. The tufa is a limestone which forms when carbonate minerals precipitate out of ambient temperature water typically around mineral springs.

The uniqueness of Big Hill Springs is highlighted in the paper by Philip Benham and Yingchun Guan (2019). Their paper states that the springs are active year around and create a microclimate that extends the growing season. They describe the tufa deposits and emphasize that the deposits are limited and fragile. They also point out that dendritic growth patterns in the tufa are related to tufa formation on mosses. Growth of tufa may be aided directly or indirectly by microbes that coat mosses, cyanobacteria (blue green algae) and other organic materials (Turner and Jones, 2005). Benham & Guan (2019) mention that calcium carbonate-bearing water flows through the Paskapoo Formation and into the gravels of the overlying Bighill Creek Formation. As the springs surface, the supersaturated waters degas CO2, triggering an increase in pH and then the precipitation of carbonates. The process may be influenced by air bubbles present in springs flowing over topography and mediation by biological entities. Bacterial activity and photosynthetic processes in blue green algae both contribute to deposit porous layers of tufa. A similar process occurs drip-by-drip in limestone caves to create stalactites. *The Benham & Guang (2019) paper highlights the very fragile and sensitive environment in Big Hill Springs Provincial Park.*

The unique nature of these springs is underscored by studies that show that these springs have the highest water flow rates of the region with a range of 20 – 1600 liters per minute (Garon, 2004).

The only other somewhat comparable thermal spring in Canada's prairies is at Manitou Beach in west central Saskatchewan which is a warm water thermal spring. However, Manitou Beach is different from the springs at Big Hill Springs Provincial Park because it is a warm water spring, not a cool water spring. It is also different from the springs at Big Hill Springs Provincial Park because salt is common in the water at Manitou Beach and not calcium carbonate as occurs in the Big Hill Springs.

A small number of cool water thermal springs also exist in Ontario and Quebec. But these are completely different from the Big Hill Springs since the bedrock there is part of the Precambrian

Shield which consists of very old Precambrian-age granites, volcanics and metamorphic rocks. The thermal springs in Ontario and Quebec do not have carbonate calcium rich water nor have the tufas which occur in Big Hill Springs Provincial Park.

In conclusion, there are no thermal springs Canada with the uniqueness of the springs in Big Hill Springs Provincial Park.

Impact of the Mountain Ash Gravel Mine on Big Hill Springs

The thick and high-quality gravel deposits in the area west of Big Hill Springs Provincial Park were laid down during the time of glaciation. An exceedingly thick deposit of gravel runs approximately from the northwest to the southeast. One half mile westwards of the Mountain Ash's proposed site is the active Hillstone Aggregate gravel mine which is an example of the richness of this gravel deposit. For anyone wishing to visualize the impact of the Mountain Ash Summit mine, I recommend they visit the Hillstone mine to see the industrial-scale activity and the impact on the area. Indeed, the operator of the Hillstone mine is currently building a high berm along the northern boundary of the mine along Highway 567 so that motorists on Highway 567 cannot see the mine.

My view as a senior-level geologist with five decades of work experience is that the Mountain Ash gravel mine will cause irreparable damage to the springs at Big Hill Springs Provincial Park. As shown in Figure 2, below, Mountain Ash shows that they will excavate an average of 20.5 meters (67.2 feet) of overburden and gravel. Of key relevance, however, is that the gravel deposit underlying the Mountain Ash land is exceedingly thick and rich in gravel and there will be great economic incentive for Mountain Ash to evacuate much more that the 20.5 meters (67.2 feet) of overburden and gravel. Accordingly, the maximum thickness excavated could be up to 30 meters (100 feet) of overburden and gravel. The environmental impact of this on the area's ground water will be huge.

As shown in SLR Consulting's Schematic Cross Section 09, please refer to Figure 2 below, the pit's floor will be 1 meter above the maximum ground water elevation. My view is that this is a very serious concern based on the known information on the ground water in this area. Ground water in this area is of two sources:

1.) <u>Snow melt and rainfall water</u>. Water is sourced from snow melt water in the winter and rainfall in the spring, summer and fall. This would flow along the surface from the northwest down to the southeast into the area defined by Soren Poschmann (2007) as the Big Hill Springs Discharge Zone. This information is in the thesis by Soren Poschmann for the Department of Geology and Geophysics, University of Calgary. This thesis is titled "*Establishing a Recharge Area for Big Hill Springs, Alberta, Canada*" and was completed in April, 2007. Please refer to Figure 3, below, which contains two maps obtained from Soren Poschmann's thesis.
2.) <u>Water in the Paskapoo Formation</u>. Water is also sourced from the Paleocene-age Paskapoo Formation. This formation underlies the glacial gravels and is the bedrock in this area. This formation consists of nonmarine sandstones, siltstones and shales. The

Paskapoo is water-bearing due to porosity occurring between the sand and silt grains. This inter-granular porosity is characteristic of the Paskapoo. The Paskapoo also is locally naturally fractured due to the effect of the up-thrusting of the mountains and foothills to the west. The Paskapoo is rich in shells. Abundant shells can be observed in outcrop along a road cut 100 meters north of Highway 567 and directly north of Big Hill Spring Park. These shells are composed of calcium carbonate. Dissolution of the calcium carbonate into the water which flows into the Big Hill Springs Discharge Zone is responsible for the calcium-rich water in the spring. The flow of water out of the springs over thousands of years has resulted in the outcrops of tufa which occur in the park. Studies by Soren Poschmann (2007) shows that the calcium-rich water flows from the top of the Paskapoo into an aquifer of glacial sands and gravels of a few meters thickness and flows downwards into the Big Hill Springs area.

Accordingly, these two separate supplies of water coalesce and commingle in the Discharge Zone and are the source for waters which emerge in the springs in the park.

My experience consists of a lifetime of working as a petroleum geologist with oil, gas and water saturated reservoirs in Canada and overseas (Indonesia and West Africa). I also have experience working with a water-focused nongovernmental organization (NGO) in Angola, West Africa. Details of my experience is mentioned below.

Mountain Ash has requested the approval from the Council of Rocky View County and Alberta Environment & Parks to excavate the aggregate to within 800 meters of Big Hill Springs Park and within one meter of the ground water level and stated that this will have no significant impact on the ground water. My view, based on my knowledge and experience is totally contrary for the following reasons.

1.) I would expect that the removal by Mountain Ash of so much overburden and gravel will significantly affect the complicated and highly sensitive ground water network which flows into the park. My view is there would be a disastrous immediate impact on the flow of ground water into the spring.
2.) The tufa formation was laid down in Big Hill Spring Provincial Park over thousands of years. However, this depositional process could be destroyed in a year or two due to the impact of the very large and very deep proposed Summit mine.
3.) Also dramatically altered will be the water chemistry due to the immediate introduction of silt into the ground water. Within the gravels and sands are minerals such as arsenic, cadmium, chromium and selenium (Fennell, 2021). The sand and gravels located above the bedrock act as buffers and filter these minerals. The effect of gravel extraction increases the risk of groundwater pollution and may cause difficulties in the treatment of water abstracted from a groundwater intake, as described in a generalized paper by Hatva (1994).
4.) With the proposed Mountain Ash gravel mine, the excavation of the aquifer above the bedrock will result the water from the gravel mine *sluicing down* unimpeded into Big Hill Springs and then further down into Bighill Creek. Also surface water consisting of snow melt water and rain water will sluice down into the park.

5.) A little recognized environmental issue associated with the Mountain Ash gravel mine is that the excavation of an average of 20.5 meters of overburden and gravel will greatly affect the temperature of water flowing down into the park. Under normal circumstances such a blanket of overburden and gravel will lessen the effect of the summer's heat on the ground water in the subsurface. But the consequences of its excavation will be that the ground water and surface water will be much warmer and this could be disastrous for the fish downstream whose existence depends on the water being cold.
6.) The Mountain Ash gravel mine will be a mega-large industrial scale operation using a lot of heavy equipment including bulldozers, graders, heavy trucks, rock crushers and large conveyor belts. Details of this is included on Mountain Ash's website. Leakage of gasoline, diesel and lubricants from this machinery will flow unimpeded into Big Hill Springs. This possibly contaminated water will also flow into Bighill Creek which flows down into the heart of Cochrane and into the Bow River.
7.) Continuous dust blowing from this huge mining operation will settle down into the park since it is located eastwards and down-wind from the proposed gravel mine. This dust will also become silt within the springs. The noise from the heavy equipment and rock crushers will undoubtedly be heard by visitors in the park.

The Importance for Cochrane of Clean Water

Approximately 50% of the water in Bighill Creek is sourced from Big Hill Springs. Bighill Creek flows into the center of Cochrane. I am certain that clean water is very important for the residents of Cochrane. The predicted effect of the Summit mine on the quality of the water in Bighill Creek cannot be over-emphasized.

There are few if any publicly accessible natural areas close to Calgary that are heavily treed and have a picturesque creek running through the park. Big Hill Springs Provincial Park is one of the closest parks to Calgary. Its beauty and accessibility are the reason why it receives 250,000 visitors per year. This park must not be destroyed by the proposed nearby and massive Mountain Ash Summit gravel mine.

This Statement of Concern is based on my analysis and professional experience. *I strongly recommend that the Mountain Ash gravel mine not be approved.*

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Background information on Tako Koning

Mr. Koning is a 1971 graduate of the University of Alberta with a B.Sc. in Geology and a 1981 graduate of the University of Calgary with a B.A. in Economics. He worked for the multi-national oil company Texaco Inc as a geologist, manager and vice-president exploration from thirty years from 1972 to 2002 living and working in Canada, Indonesia, Nigeria and Angola. Thereafter, he worked extensively as a geological consultant. He also obtained experience with water since in Angola he was involved for a decade (2003 – 2013) with Yme Foundation, a Norwegian NGO developing drinking water projects in Africa. He is a member of the Canadian Society of Petroleum Geologists, Canadian Society of Exploration Geophysicists, the Alberta Paleontological Society and the Society of Petroleum Engineers. He was a member of the Association of Professional Engineers & Geoscientists of Alberta for fifty years from 1971 to 2021.

References:

1. "*Big Hill Springs (Provincial Park, West of Airdrie, AB),* Philip Benham & Ying Chunguan, 2019. Article published in *Go Take A Hike, the Geology of Trails in the Canadian Rocky and Sorrounding Areas*", published by the Canadian Society of Petroleum Geologists, Calgary.
2. "*Microscopic Calcite Dendrites in Cold-Water Fufa: Impllications for Nucleation of Micrite and Cement*". Turner & Jones, 2005, Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton. Published in *Sedimentology* (2005), 52, pps 1043 – 1066.
3. "*Hydrology of Big Hill Spring"*, Marie-Eve Garon, 2004. Thesis for Environmental Sciences 505.22, University of Calgary.
4. "*Establishing a Recharge Area for Bill Hill Springs, Alberta, Canada*", Soren Poschmann, 2007. Thesis for the Department of Geology and Geophysics, University of Calgary.
5. *"Mountain Ash Limited Partnership Summit Gravel Pit, Review of hydrogeology, geochemistry, fish and aquatices, and climate change"*, Dr. Jon Fennell, M.Sc., Ph.D., P.Geol. 2021. A report prepared for the Friends of Big Hill Springs Provincial Park and Bighill Creek Preservation Society.
6. "*Effect of Gravel Extraction on Groundwater*", Tuomo Hatva, 1994. Published in *Future Groundwater Resources at Risk*, Proceedings of the Helsinki Confence, June 1994. IAHS Publication no 222, 1994.

Please note that this submission includes Figures 2 and 3 on page 8 and 9, below.

Note: Below are the two relevant technical documents, Figures 2 & 3 which I have referenced above in my Statement of Concern.

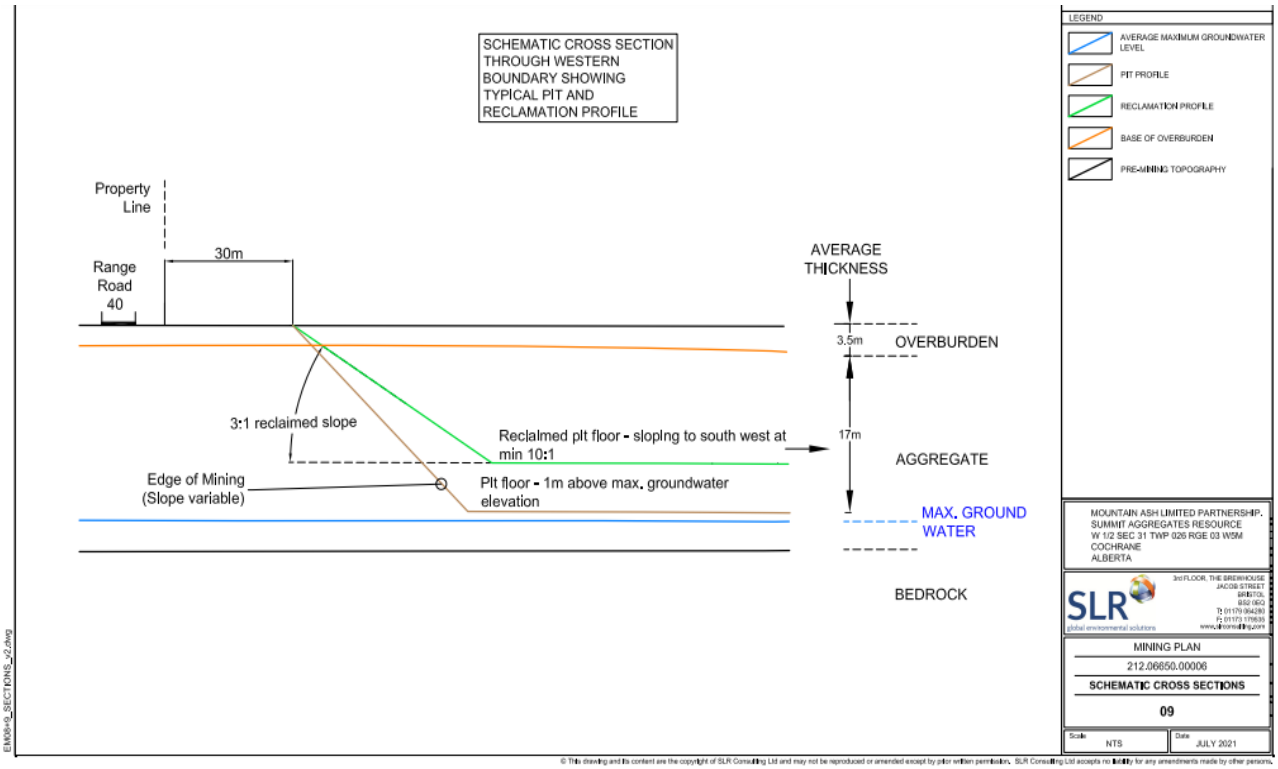

Figure 1. From: Mountain Ash Website. SLR Consulting (Canada) Ltd. Report: Mining & Excavation Plan for the Mountain Ash Limited Partnership, Rocky View County, Alberta, April 2021, Revision 1 - August 2021, Revision 2 - December 2021

Tako Koning, Senior Geologist has analyzed this data shown above in Figure 1 from SLR Consulting. He notes that an average thickness of 3.5 meters (11.5 feet) of overburden will be removed and an average of 17.0 meters (55.8 feet) of aggregate will be removed. Accordingly, an average total thickness of 20.5 meters (67.2 feet) of overburden and aggregate will be removed. This thickness is equivalent to the height of a 6-story building. This is the *average* amount of thickness to be removed. The maximum thickness to be removed may be substantially greater and will add to the serious impact on the ground water flowing downstream into Big Hill Springs Provincial Park and into Bighill Creek which drains down into Cochrane and into the Bow River.

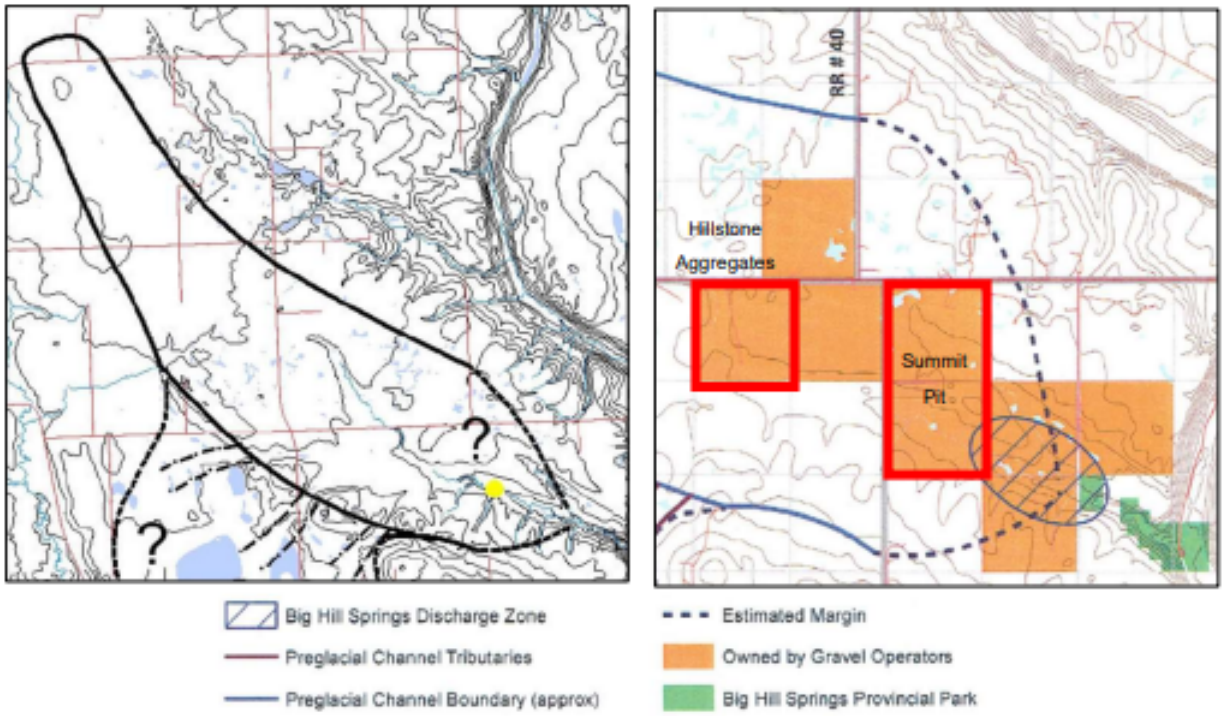

Figure 1. Mapped preglacial channel for Big Hill Springs (left)[1], where dot-dashed lines indicate extent of buried tributaries, and extent of lands owned by gravel operators near Big Hill Springs Provincial Park (right)[2] *Note: MALP property outlined in red.*

Figure 2. From Dr. Jon Fennell, PhD., P. Geol. Internal Report, June 23, 2021, reproduced with permission. The left map is from Soren Poschmann's 2007 University of Calgary thesis for the Department of Geology and Geophysics, University of Calgary. The map to the right is a topographic map with the land owned by gravel mining companies highlighted in orange. Mountain Ash's proposed Summit Pit is outlined in red. The Big Hill Springs Discharge Zone extends into the eastern margin of the Summit pit. Also outlined in red is the active gravel mine operated by Hillstone Aggregates. The quarter-section owned by McNair is northeast of the Hillstone mine. LaFarge Canada is owner of the quarter-section east of the Hillstone mine and west of the proposed Mountain Ash Summit pit. Burnco Rock Products Ltd owns the 3 quarter-sections of land east of the proposed Mountain Ash Summit gravel pit. Burnco's land directly overlies the Big Hill Springs Discharge Zone.