An Analysis for Revegetation Plant Species Selection to Optimize Carbon Sequestration for the Casino Mine Project

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Abstract

As the world moves towards sustainability, the need for raw materials is going to increase exponentially. Mining is the most common way used to extract the minerals and metals from the earth's surface. The Casino Mine Project is a proposed mine located in the Yukon territory, and it is determined to bring economic prosperity to the Yukon, whilst also being environmentally cautious. The literature research-based capstone project examined which revegetation trial will sequester most carbon dioxide at the tailings management facility. The results show that native plants, found on the site, will sequester around 115 kt of CO_2, imported plants, not found on site but present in Yukon, will sequester around 504 kt of CO_2. Whilst the numbers are accurate, the calculations assume that all the plants will reach their full growth potential and there is no reversal of sequestration. Future research should include planting trials to verify the calculations.

Research Question

Which revegetation trial would serve as the best carbon sequestration, or even carbon sink, for the Casino Mine Project tailings management facility (TMF).

The Capstone study examined three revegetation scenarios for carbon sequestration potential:

- Revegetation using native plant species from the mine site area
- Revegetation using imported, non-invasive plant species from the Yukon and
- Natural revegetation

Introduction

Mining is an incredibly energy intensive industry that play's a significant role in Canada's economy. In 2024, the mineral sector contributed 6%, or $42 billion indirectly and $117 billion directly, to the country's GDP (Government of Canada, 2025). While the industry generates substantial economic benefits, it has a wide range of social impacts. The negatives include health risks, social disruptions and oftentimes displacement of Indigenous communities, whilst the positives consist of job creation and investments in the surrounding communities.

It is also known for its negative environmental impacts, such as habitat destruction, land degradation, loss of biodiversity, air pollution via particulate matter, as well as enormous GHG emissions (Matschullat and Gutzmer, 2012). However, due to ever-increasing global population and the demand for raw materials, mining industry will not decrease, and it must do better for the sake of the planet.

Key part of reclamation of a mining site, or a series of strategically planned steps and procedures to reduce the impact on the environment and to return the landscape to its original state, is revegetation of it. According to the guidelines by the Government of Canada (2025), the operator of a mine has to return the surface of an area to its nearest original state and utilize the plants that are local to the area. What if those plants could be optimized to sequestrate, or capture and store atmospheric carbon dioxide?

Proposed Casino Mine

The Casino Mining project is a proposed mine 300km northwest of Whitehorse in the Yukon Territory. Newest metallurgic studies show that the site contains strong recovery for high-grade, minimal impurity gold, copper and molybdenum. It is estimated that the mine will contribute $1.3 and $1.5 billion to the Yukon's and Canada's GDP annually respectfully.

The Casino Mine Project is a member of the Mining Association of Canada's Towards Sustainable Mining standard, which supports mining companies in managing environmental and social consideration. The project recognizes the importance of responsible mining, especially regarding transition towards low carbon economy, keeping to the mining standards to ensure responsible mine management and engagement with communities. The company further complies with Global Industry Standards on Tailings Management to ensure safer management of the tailings and reclamation of the mining site. The capstone analysed biological carbon sequestration of the TMF.

Methods

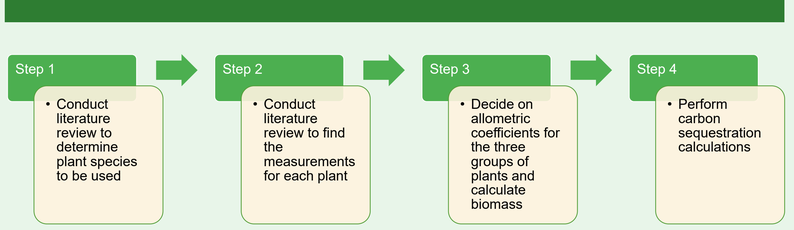

Table 1: The species and groupings of the plants for the Casino Project. The table on the left shows the native plants that were found on site, which would be the same for natural revegetation trial. The table on the right shows imported plants that were used for imported revegetation trial calculations.

Species	English Common Name	Grouping
Alnus viridis ssp. crispa	Mountain alder	shrub
Arctostaphylos rubra	Alpine bearberry	shrub
Arctostaphylus uva ursi	Kinnikinnick	shrub
Artemisia frigida	Pasture sage	shrub
Betula glandulosa	Scrub birch	shrub
Dryas integrifolia	Mountain aven	shrub
Empetrum nigrum	Crowberry	shrub
Juniperus communis	Common juniper	shrub
Rosa acicularis	Wild rose	shrub
Shepherdia canadensis	Soapberry	shrub
Vaccinium uligonosum	Bog blueberry	shrub
Betula neoalaskana	Alaska paper birch	tree
Agrostis scabra	Ticklegrass	grass
Calamagrostis canadensis	Canada bluejoint reedgrass	grass
Calamagrostis lapponica	Lapland reedgrass	grass
Calamagrostis purpurescens	Purple reedgrass	grass
Carex conccina	Low northern sedge	grass
Carex lugens	Spruce muskeg sedge	grass
Achillea millefolium	Yarrow	herbaceous
Artemisia tilesii	Caribou weed	herbaceous
Galium boreale	Northern bedstraw	herbaceous
Solidago simplex	Little goldenrod	herbaceous

Species	English Common Name	Grouping
Salix alaxensis	Feltleaf willow	shrub
Betula nana	Dwarf birch	shrub
Alnus tenuifolia	Grey alder	shrub
Spiraea stevenii	Beauverd spiraea	shrub
Elaeagnus commutata	Wolf willow	shrub
Lonicera caerulea	Sweetberry honeysuckle	shrub
Amelanchier alnifolia	Saskatoon	shrub
Acer ginnala	Amur maple	shrub
Alnus viridis ssp. sinuata	Sitka alder	shrub
Populus tremuloides	Quacking aspen	tree
Picea glauca	White spruce	tree
Pinus contorta	Lodgepole pine	tree
Poa alpina	Alpine bluegrass	grass
Arctagrostis latifolia	Polargrass	grass
Festuca saximontana	Rocky mountain fescue	grass
Trisetum spicatum	Spike trisetum	grass
Deschampsia caespitosa	Tufted hairgrass	grass
Elymus alaskanus	Violet wheatgrass	grass
Dryas octopetala	Mountain avens	herbaceous
Lupinus arcticus	Arctic lupine	herbaceous
Epilobium angustifolium	Fireweed	herbaceous
Rubus chamaemorus	Cloudberry	herbaceous

The main assumptions for carbon sequestration calculations in the capstone were:

- There are only three groups of plants in the area: woody (consisting of trees and shrubs), grasses and herbaceous plants
- All the plants survive planting and seeding
- There is no carbon sequestration reversibility

The typical calculation of carbon sequestration included finding the biomass of a plant (from its height, diameter and allometric coefficient), from there calculating the dry weight and the mass of carbon. The value was then calculated as carbon dioxide equivalent.

Afterwards, the value was scaled up and adjusted for the specifications for the Casino Project.

Results

Table 2: Carbon sequestration of the native plants for the Casino Project . The difference between grass and herbaceous values are due to different numbers of seedlings used in the scenario.

Scenario	Woody Plants/kg	Grass/kg	Herbaceous/kg	Total/tonnes
1	114761.445	94.661	130.069	114.986
2	114761.445	157.768	216.782	115.136
3	114761.445	236.652	325.173	115.323

Table 3: Carbon sequestration of the imported plants for the Casino Project . The difference between grass and herbaceous values are due to different numbers of seedlings used in the scenario.

Scenario	Woody Plants/kg	Grass/kg	Herbaceous/kg	Total/tonnes
1	503808.003	22.275	193.761	504.024
2	503808.003	37.958	322.936	504.169
3	503808.003	56.937	484.404	504.349

Table 4: The results of natural revegetation of the Casino Project. The coverage area, found in literature, was used to determine carbon sequestration and the number of plants that it would take to sequester it.

Plant group	Total Sequestration/kg	Coverage	Carbon Sequestered in Area/kg	Number of Plants
Shrubs	954	0.00018	0.17172	8.58
Grasses	0.068838	0.0035	0.000240933	0.23
Herbaceous	0.063064	0.00058	3.65771E-05	0.01

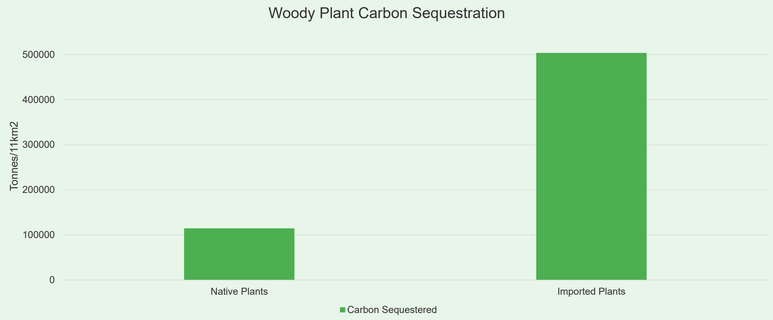

Figure 1: The woody plant carbon sequestration of native and important plants

Conclusions and Recommendations

The results show that imported plants will sequester more carbon than native plants in the tailings management facility of Casino Project. Natural revegetation cannot be compared to the two other trials due to the number being significantly lower than the native and imported trials.

Mining companies should aim to carry out planting trials to determine accurate coverage of plants. Further planting trials could combine native and imported plant species to optimize carbon sequestration.

References

Government of Canada. (2025). *Mining and mineral resource development in Canada - Natural Resources Canada*. Canada.ca. https://natural-resources.canada.ca/minerals-mining/canadian-mineral-exploration

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