

# Migration and gamma ray assessment of uranium on a gold tailings disposal facility

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## **Abstract**

This project aims to quantify natural gamma radiation in gold tailings disposal facilities (TDFs) relative to uranium concentration data in order to use natural gamma detection methods as alternative methods for uranium resource estimation modelling in gold tailings. Uranium migration within the New Machavie TDF was also investigated as migration affects both the grade of the TDF as a uranium resource and poses a threat to the environment. In order to determine the most appropriate radiometric testing procedure, various methods were employed for natural gamma detection, including surface natural gamma spectrometry, borehole natural gamma spectrometry and scintillometry, as well as incremental sampling. These measurements were then statistically compared to ICP-MS analyses to find the best method, and then modelled to apply volumetric resource estimation procedures. The oxidation reduction potential was also tested as uranium geochemistry is dependent on oxidation for mobilisation. Furthermore, leaching tests were employed to relate specific anions as a mode of transportation in solution. Results indicated that down-hole natural gamma spectrometry performed the best and that 2376.87 kg of uranium is present in the TDF. Migration modelling indicated that uranium is mobilised away from the oxidized top area of the TDF and that accumulation occurs in the saturated zone of the TDF under a reducing environment. Sulphate anions as the result of pyrite oxidation are primarily responsible for the mobilisation as radionuclides in New Machavie. The results of this project can be applied to the resource estimation of all uranium bearing tailings facilities prior to re-mining as a means to decrease exploration costs and to accurately model the distribution of uranium.

## **Keywords**

Gold tailings, Uranium, Resource estimation, Natural gamma spectrometry, Uranium migration, tailings oxidation

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## List of abbreviations

Ac.....	Actinium
Ar.....	Argon
Bi.....	Bismuth
Ca.....	Calcium
CPS.....	Counts per Second
DNA.....	Deoxyribonucleic acid
EC.....	Electrical Conductivity
ICP-ES.....	Inductive Coupled Plasma Emission Spectrometry
ICP-MS.....	Inductive Coupled Plasma Mass Spectrometry
IDW.....	Inverse Distance Weighting
K.....	Potassium
Pb.....	Lead
pH.....	Negative logarithm of the hydrogen concentration
ppm.....	Parts per Million
Ra.....	Radon
TDF.....	Tailings Disposal Facility
Th.....	Thorium
Tl.....	Thallium
U.....	Uranium
Wt%.....	Weight Percentage
XRF.....	X-ray Fluorescence