ANNEXE QC-84

Procédure pour la valorisation des stériles

EcoMetrix INCORPORATED

MEMO

To:	Sandra Pouliot, Canadian Malartic	From:	Sarah Barabash Ron Nicholson
Ref:	**Procedure for "Valorisation des stériles" for the Foundation Aggregate Required for the Trans-Canada Highway – Canadian Malartic Extension**	Date:	05 August 2015

The mine Canadian Malartic (CM) has proposed an Extension plan to increase production, expand the open pit and extend mining to 2028. The pit expansion requires a realignment of the Trans-Canada highway. It is estimated that about 2 Mtonnes of rock will be required as aggregate for foundation of the roadway. Other construction materials may be required and CM is proposing to gain a permit for 10 Mt of construction-grade rock. Malartic would like to make use of waste rock (stériles) from the Canadian Malartic pit for this construction material. The purpose of this memo is to describe the approach to the valuation of the waste rock for construction.

The regulatory requirements to have the waste rock accepted for construction include several chemical tests with various criteria as well as physical tests. The rock can be assessed from existing drill core samples from the pit that may be augmented by additional samples, if required. The suggested approach also includes a protocol to verify the acceptability of the waste rock for construction during excavation.

Testing Requirements for Construction Materials

The government of Quebec encourages the use of waste for construction provided that the material passes various tests related to chemical and physical stability. The test requirements for construction materials are provided in the guidance document;

Guide de Valorisation des Matières Résiduelles Inorganiques Non Dangereuses de Source Industrielle Comme Matériau de Construction - Ministère de l'Environnement - Direction des politiques du secteur industriel, Service des matières résiduelles, 19 juin 2002 (MENV, 2002).

The waste material can be classified into one of three categories for construction purposes. Categories I and II are acceptable for foundation material under asphalt roads. Category III material is not acceptable for road foundations. The results of the various tests determine which category applies to the waste rock.

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The test descriptions and requirements are summarized in **Table 1**. Additional tests may be warranted depending on the particle size of the aggregate material to be used for construction. The concentrations of leachate that define hazardous material are listed in **Table 2**. There are other concentration limits related to soil criteria as well as potable water limits that apply to leachate concentrations that need to be compared as well. It is not likely that the waste rock from Canadian Malartic will be classified as hazardous waste based on the TCLP leach test results and the concentration values shown in **Table 2**. However, some test may cause the rejection of some waste rock materials for construction based on sulphide content and perhaps TCLP and SPLP results.

The process of classifying rock into categories is shown as a logic diagram in **Figure 1**. This process will be followed in the classification of rock from the Malrtic mine that will be approptiate for construction of the highway.

Table 1: Summary of tests and requirements for the valuation of wastes as construction material.

Test	Measurement	Criteria
Hazardous Material	TCLP Leach test	Defined concentrations – (see Table 2)
Organic Carbon	C-org	C-org<1%
Total Sulphur	S-total	S-total<0.2%
Metal Contents	Metals – Categories A and C for soil Criteria	Criteria A – Unrestricted Criteria C – Category II
Alteration	Freeze-thaw Artificial Gelation	12 cycles with <10% weight loss 5 cycles with <10% weight loss
Neutralization	Acetic acid leach	>3 eq/kg
Acid Generation	Sulphide-S	Non potentially acid generating
Water Leach	Metals	< potable water concentrations
Acetic acid Leach	TCLP Leach Tests	<10x potable water
Acid Rain Leach	SPLP Leach Tests	< potable water concentrations

Figure 1: Logic diagram to classify waste rock for potential construction material (Adapted from MENV, 2002).

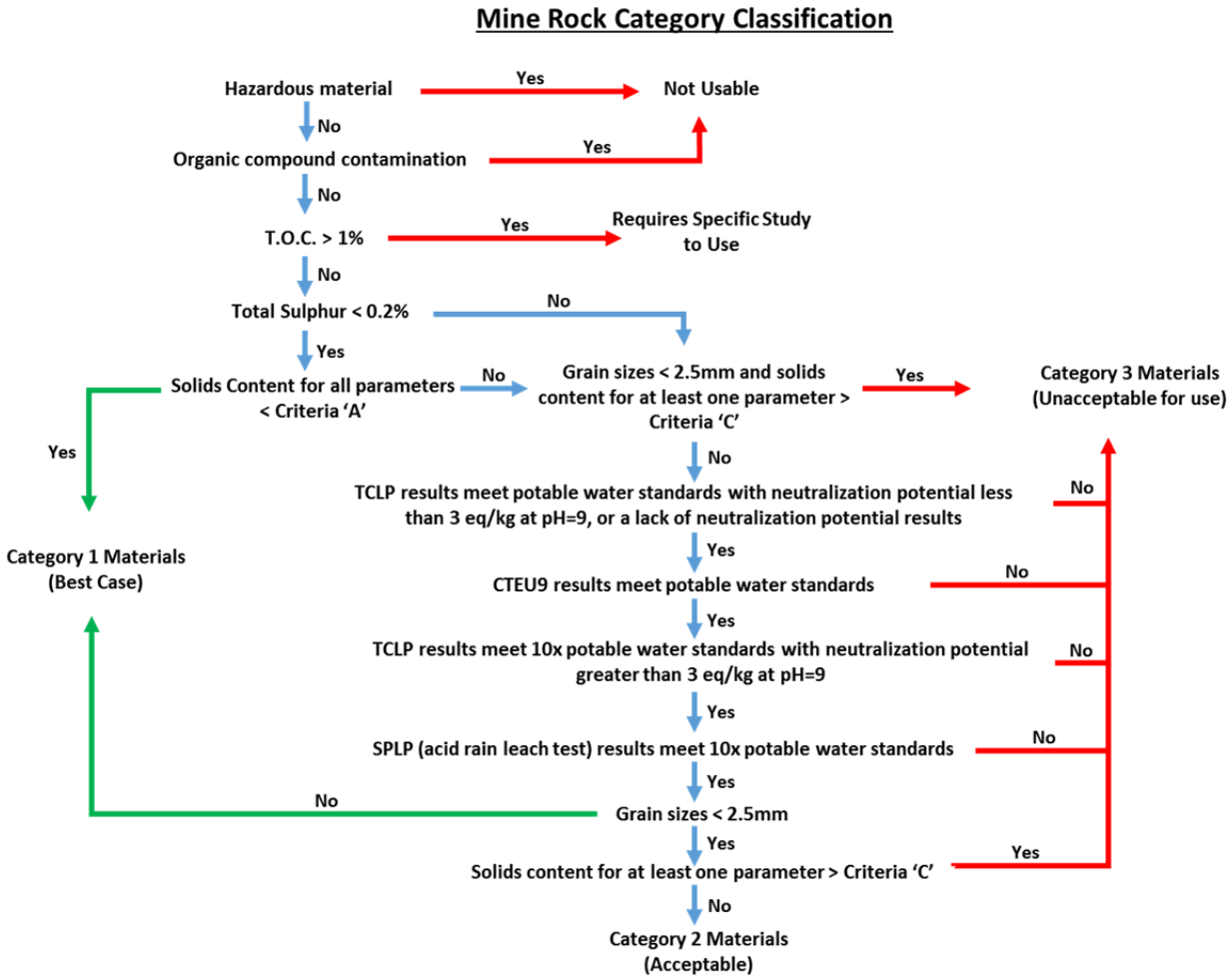

Table 2: Maximum concentrations in a leachate for solids to define hazardous material.

Constituent	Concentration in Leachate (mg/L)
Arsenic	5.0
Barium	100
Boron	500
Cadmium	0.5
Chromium	5.0
Fluoride	150
Lead	5.0
Mercury	0.1
Nitrate+Nitrites	1,000
Nitrites	100
Selenium	1.0
Uranium	2.0

Proposed Test Program

The test program will be completed in four main phases that are summarized as;

1. Review of Existing Data
2. Selection of Drill Core Samples
3. Testing and Analysis
4. Preparation of Technical Report and Permit Application

Phase I –Review

There are guidelines for sampling of rock that suggest that 80 samples may be appropriate for quantities of rock between 1 Mt and 10 Mt. These are guideline values for greenfields mine sites only and can be modified if there is other information available for the rock. In the case of Malartic waste rock, there is a sizable database of information including results from many of the tests that are required for the valuation of waste rock for construction use as well as a block model that contains information on the neutralization potential (NP) and sulphur contents that are necessary for this evaluation.. Therefore, the maximum use will be made of the existing information to reduce the need for an unnecessary number of samples.

There were 108 samples of waste rock collected from the Canadian Malartic (CM), 114 samples from Barnat and 23 samples from Gouldie pits. The samples were tested for all acid base accounting (ABA) as well as several leach tests that are required for the valuation of waste for construction, including water leach, SPLP and TCLP leach tests. The results from the 108 CM samples show that there are materials that are suitable for construction (Categories I and II) and that there are also materials that may not be suitable based on exceedences of sulphur and/or potential for acid generation as well as results of some of the leach tests (TCLP and SPLP).

The results from the 108 CM waste rock samples will be reviewed and assessed in terms of the criteria for the valuation of waste for construction materials. The purpose of the review would be to determine if there are important variables such as sulphide content or contents of certain metals that correlate with the results of the more complex tests such as the TCLP and SPLP tests. For example, EcoMetrix completed an extensive review of the waste rock results for potential acid generation and metal leaching for samples from the CM, Gouldie and Barnat pits and developed criteria based on the total sulphur (S) and total carbon (C) contents. The sulphur and carbon contents were strongly correlated to the acid generating potential of the rock so that the simple and less expensive S and C analyses can be completed rather than the complex and more expensive ABA analyses. Criteria for selection of construction material "on site" were developed and were based on the S and C criteria.

Table 3 shows the approximate distribution of rock materials from the three deposits at Canadian Malartic. The acid generating potential was used as the main criteria to classify the waste rock. When the carbonate neutralization potential (Carb-NP) to acid potential (AP) ratio is greater than 3, the material is classified for construction on-site. This criterion translates to a C/S ratio of 1.3. With the existing samples, the approximate quantities of construction grade waste rock were calculated to be about 22% from CM, 52% from Barnat and only 8% from the Gouldie deposits.

Table 3: Waste rock classification criteria.

Class	Description	Carb-NP/AP	C/S Criteria (%C/%S)	All	CM	Ba	Go
A	**Construction**	**>=3**	**>=1.3**	34%	22%	52%	8%
B	**Low Risk**	**>=2 and <3**	**>=0.9 and <1.3**	17%	23%	10%	23%
C	**Standard**	**>=1 and <2**	**>=0.5 and <0.9**	7%	4%	10%	15%
D	**Higher Risk**	**<1**	**<0.5**	42%	52%	29%	54%

Notes: All= all deposits, CM=Canadian Malartic, Ba=Barnat, Go=Gouldie

Phase II – Selection of Drill Core Sample

The selection and classification of waste rock materials for construction will be completed as part of an iterative process, beginning with the selection of existing drill core samples from the diamond drilling program within the CM deposit. The purpose of this program is to identify materials that can be used safely for construction of the highway, according to MENV (2002). This program will build on the results of the Phase I assessment, filling in any data gaps as necessary.

Phase III – Testing and Analysis

Samples collected during this program will be subjected to targeted analytical testing, based on the results of the Phase I analysis and the requirements outlined in MENV (2002). It is anticipated that the testing program will begin with the analysis of carbon and sulphur contents, corresponding to the proposed waste rock test program. The potential construction material must meet the criterion of tha Carb-NPR greater than or equal to 3 and therefore, a C/S ratio greater than or equal to 1.3. This will be used as a screening criterion and only material meeting this criterion will be considered as potential construction material for further testing.

The guidelines for the valuation of waste for construction (MENV, 2002) involve several chemical and physical tests as summarized in Table 4. Analyses obtained from the analysis of the samples will help to verify the assumptions and proposed relationships developed in Phase I and will identify additional testing needs, if required.

Table 4: Summary of Analytical Test Methods (MENV, 2002)

Analysis Required	Title of the Method	Reference
Alteration	Freeze/thaw weathering	Environment Canada WTC-7 CSA A23.2-24A
	Determination of resistance to disintegration by a magnesium sulphate solution	BNQ 2560-450
Acid Base Accounting	Solid Residues Neutralization Capacity	MA 110 - C.neu. 1.0
	Acid Neutralization Capacity	Environment Canada WTC-11
	Total Organic Carbon	MA 405 - C1.1
	Carbon and Sulphur	MA. 310 - CS 1.0
	Sample Preparation	Crushing
Leach Testing	Toxicity Characteristic Leaching Procedure	EPA SW-846 Method 1311
	Leaching Protocol for Inorganic Species	MA. 100 - Lix.com 1.1
	Synthetic Precipitation Procedure	EPA SW-846 Method 1312
Total Metals Content	Total content in mg/kg	MA.200 - Mét.1.2
	Mercury	MA.200 - Mét.1.2

Phase IV – Preparation of Technical Report and Permit Application

A technical report will be prepared following the completion of the analytical testing program. The report will include a summary of the data review, details of the sampling program, results (including all analytical data in an appendix) and interpretation of the laboratory testing to evaluate the acceptability of the waste rock for construction during excavation. The report will serve as documentation of the actual procedures and will represent a quality assurance (QA) measure for the program.

The test results will then be used to prepare an application for a certificate of approval (C of A) or permit for the use of waste rock for highway construction. It is anticipated that the technical report will be appended to the permit application.