GUIDELINES FOR PREPARING MINE CLOSURE PLANS IN QUÉBEC

ENSEMBLE on fait avancer le Québec

Québec

This document was prepared jointly by the Ministère de l'Énergie et des Ressources naturelles and the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques.

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FOREWORD

This document, *Guidelines for Preparing Mine Closure Plans in Québec* (hereinafter the "Guide"), is a work tool available to the mining industry to facilitate the preparation of the land rehabilitation and reclamation plan (hereinafter the "closure plan") required under the *Mining Act*.

The Ministère de l'Énergie et des Ressources naturelles (MERN) has revised the Guide in collaboration with the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC). This update takes into consideration recent legislative amendments governing mining activity in Québec.

The modifications to this Guide have a direct impact on the preparation of closure plans, which must incorporate these new mine site closure requirements.

The Guide is divided into three chapters. The first provides general information, the second deals with general closure requirements and, finally, the third sets forth the elements that must be included in the closure plan filed with the MERN.

Cautionary Statement

Legal and regulatory texts prevail over the provisions contained in this document.

LIST OF ABBREVIATIONS

CSA	Canadian Standards Association
AMD	Acid mine drainage
ASTM	American Society for Testing and Materials
BNQ	Bureau de normalisation du Québec
CDA	Canadian Dam Association
CND	Contaminated neutral drainage
COMEV	Comité d'évaluation (Evaluation Committee)
COMEX	Comité d'examen (Review Committee)
D019	Directive 019 pertaining to the mining industry
EQA	Environment Quality Act (chapter Q-2)
IES	Invasive exotic species
JBNQA	James Bay and Northern Québec Agreement
KEQC	Kativik Environmental Quality Commission
LPRR	Land Protection and Rehabilitation Regulation
MCE	Maximum credible earthquake
MDDELCC	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques
MERN	Ministère de l'Énergie et des Ressources naturelles
MFFP	Ministère de la Forêt, de la Faune et des Parcs
MMER	Metal Mining Effluent Regulations
PMF	Probable maximum flood
PMP	Probable maximum precipitation
RBQ	Régie du bâtiment du Québec
RCM	Regional county municipality
RCSSCST	Regulation respecting contaminated soil storage and contaminated soil transfer stations (chapter Q-2, r. 46)
Regulation	Regulation respecting mineral substances other than petroleum, natural gas and brine (chapter M-13.1, r. 2)
REIAR	Regulation respecting environmental impact assessment and review
RLIRM	Regulation respecting the landfilling and incineration of residual materials (chapter Q-2, r. 19)
SF	Safety factor
SI	International System of Units

INTRODUCTION

Under the *Mining Act*, a person who performs prescribed exploration or mining work must submit a closure plan for the land affected by their operations, subject to approval by the MERN. This approval is conditional upon receipt of a favourable decision from the MDDELCC.

This Guide was drafted to inform concerned persons about the particularities of preparing a closure plan and, in particular, the plan's technical content and closure requirements for mine sites in Québec. It is divided into three parts.

Chapter I: General Information

Chapter II: Closure Requirements

Chapter III: Contents of the Closure Plan

Since the first edition of the Guide, amendments have been made to the *Regulation respecting mineral substances other than petroleum, natural gas and brine* (hereinafter the Regulation) and the *Mining Act*. These changes have a direct bearing on the scope of the closure plan, its conditions of approval and the terms of payment of the financial guarantee.

An amendment to the legislative regime for the protection and rehabilitation of land was also introduced in 2003 with the addition of Division IV.2.1 of the *Environment Quality Act* (EQA), which contains provisions on land characterization and rehabilitation that are applicable to mining operations in particular.

A new version of the MDDELCC's Directive 019 (D019) pertaining to the mining industry was published in March 2012. New requirements for environmental monitoring in the post-closure period were introduced. This version also describes the procedure for the cessation of environmental monitoring once land rehabilitation and reclamation work reaches satisfactory conditions.

The Guide therefore reflects the latest legislative and regulatory amendments and takes into account the advancement of knowledge in the field of land rehabilitation (contaminated soils) and reclamation of mine tailings. It contains many links to acts, regulations, directives and guidelines that must be considered when preparing a closure plan.

It should be noted that the meaning of "tailings" in Chapter I of the Guide corresponds to that of the *Mining Act* and, as such, includes waste rock. For the remaining sections of the Guide, particularly those relating to reclamation, a distinction has been made between waste rock and tailings. This distinction is necessary to specify the reclamation methods applicable to each type of material. The definitions of these terms can be found in the glossary (Appendix 7 of the Guide).

CHAPTER I – GENERAL INFORMATION

1. Provisions of the Mining Act and the Environment Quality Act

This chapter outlines the persons, operations and mineral substances governed by the *Mining Act* (chapter M-13.1) and the EQA (chapter Q-2) that relate to mine site reclamation. For more details, the reader should consult those statutes and information brochures, as well as the websites of the MERN and the MDDELCC.

Hyperlinks

Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC)
mddelcc.gouv.qc.ca/index_en.asp

Ministère de l'Énergie et des Ressources naturelles (MERN)
mern.gouv.qc.ca/english/mines/index.jsp

Mining Act (chapter M-13.1)
legisquebec.gouv.qc.ca/en/ShowDoc/cs/M-13.1

Regulation respecting mineral substances other than petroleum, natural gas and brine (chapter M-13.1, r. 2)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/M-13.1,%20r.%202/

Environment Quality Act (chapter Q-2)
legisquebec.gouv.qc.ca/en/ShowDoc/cs/Q-2

Directive 019 pertaining to the mining industry (in French only)
mddelcc.gouv.qc.ca/milieu_ind/directive019/

1.1 Persons governed by the Mining Act

This document is for persons who, under section 232.1 of the Mining Act, are required to submit a closure plan to the MERN for approval, namely:

1. a holder of mining rights who engages in the exploration work indicated in Table I below or who agrees that such work be carried out on land for which he holds a mining right;

2. an operator who engages in the mining operations indicated in Table 1 concerning the mineral substances identified in section 110 of the Regulation;

3. a person who operates an ore treatment plant;

4. a person who engages in mining operations using tailings.

The persons governed by section 232.11 of the Mining Act must provide a closure plan and reclaim the site in accordance with the requirements described in Chapter II of this document.

In this Guide, a person for whom section 232.1 of the Mining Act applies will be called «the proponent.»

1.2 Work Governed by the Mining Act

Table 1 identifies the nature of exploration and mining operations that require the filing of a closure plan under sections 108 and 109 of the Regulation (chapter M-13.1, r. 2).

TABLE 1 – Nature of exploration and mining work requiring the filing of a closure plan

Type of work	Exploration	Mining
Line cutting (geochemical and geophysical surveys)	No	-
Survey work	No	-
Movement of material (on a single mining right)	Yes, if the volume is 5,000 m^3 or more, or the surface area is 10,000 m^2 or more	-
Drilling, tree cutting and skidder roads (except drilling in the tailings areas)	No	-
Surface sampling	Yes, if more than 500 metric tons (t)	-
Preparation of accumulation areas (waste rock and tailings)	Yes	Yes
All underground work (including dewatering)	Yes	Yes
Open pit mining	-	Yes
Treatment of ore or tailings	-	Yes
All work done on stored material	Yes	Yes
Preparation of accumulation areas for foundry and pellet plant operations	-	Yes

The provisions of the *Mining Act* do not affect or restrict the application of the EQA. It is the responsibility of the proponent to check with the MDDELCC, and any other municipal or government entity, whether additional authorizations are required to carry out these operations.

1.3 Substances Governed by the Mining Act

1.3.1 Exploration

For the exploration work listed in Table 1, all mineral substances within the public domain (belonging to the State) require the filing of a closure plan.

It does not apply to the mineral substances in the private domain referred to in section 5 of the *Mining Act*, namely sand, gravel, building stone and stone used for sculpture, limestone, calcite used as flux, millstones and grindstones, gypsum, common clay used in making building materials, firebrick, pottery, ceramic substances, mineral waters, infusory earths or tripoli, fuller's earth, peat, marl, ochre or soapstone, provided that, in their natural state, they are isolated from other mineral substances of the tilth.

1.3.2 Mining operations

For the mining work listed in Table 1, all mineral substances require the filing of a closure plan except petroleum, natural gas, brine and surface mineral substances. Inert mine tailings, where such tailings are used for construction purposes, the manufacture of construction materials or the amendment of soils, also require a closure plan (chapter M-13.1, r. 2, s. 110).

It also applies to mineral substances that are part of the private domain since the definition of «operator» in section 218 does not differentiate between deposits in public or private domains. Moreover, section 217 of the Mining Act states that Chapter IV, which contains the mine site closure provisions, also applies to mineral substances that are not part of the public domain.

1.4 Special Provisions of the Mining Act

1.4.1 Obtaining a mining lease

In order to carry out mining operations, the proponent must hold a mining lease. The granting of a mining lease is conditional upon the MERN's approval of the proponent's closure plan and the MDDELCC's issuance of a certificate of authorization.

However, the lease may be granted before a certificate of authorization is issued if the time needed to obtain the authorization is unreasonable (chapter M-13.1, s. 101).

1.4.2 Location of mining infrastructure

A proponent (the holder of a mining right) who operates a concentration plant, smelter or refinery shall, before commencing operations, have the site intended for tailings storage approved by the Minister (chapter M-13.1, s. 241).

The location of a concentration plant, a mill for the preparation of mineral substances, a refinery or a smelter must have been previously approved by the Minister or, in the case of a project subject to the environmental impact assessment and review procedure provided for in division IV.1 of chapter I of the EQA (chapter Q-2), by the Government (chapter M-13.1, s. 240).

The proponent may, in accordance with the Act Respecting the Lands in the Domain of the State (chapter T-8.1), have public lands transferred or leased to him to establish a storage site for tailings, or a site for a mill, workshop or any other facility necessary for mining operations (chapter M-13-1.1, s. 239).

Hyperlink

Act respecting the Lands in the Domain of the State (chapter T-8.1)
legisquebec.gouv.qc.ca/en/ShowDoc/cs/T-8.1

1.4.3 Measures applicable in the event of default

If a person fails to perform their obligations under sections 232.1 to 232.7 of the Mining Act, the Minister may enjoin him to do so within the time he fixes (chapter M-13.1, s. 232.8). If the person fails to comply, the Minister may, in addition to any other civil, administrative or penal sanction, cause the work required by the closure plan or, failing such a plan, the work considered necessary in the circumstances, to be performed at that person's expense.

Closure plan

A person who contravenes any of the provisions under sections 232.1, 232.2 and 232.6 of the Mining Act is guilty of an offense and is liable to a fine of $5,000 to $500,000 in the case of a natural person and to a fine of $15,000 to $3,000,000 in any other case (chapter M-13.1, s. 316).

Financial guarantee

A person who contravenes any of the provisions under sections 232.4, 232.5 and 232.7 of the Mining Act, or the standards prescribed by regulation for the guarantee required under the Act, is guilty of an offense and is liable to a fine corresponding to 10% of the total amount of the financial guarantee (chapter M-13.1, s. 318).

1.4.4 Information of a public nature

Pursuant to section 101 of the *Mining Act*, the MERN shall make public the closure plan as submitted to the Minister for approval and register it in the public register of real and immovable mining rights for public information and consultation purposes as part of the environmental impact assessment and review procedure provided for in the EQA. Similarly, for the purposes of this Act, the Minister shall make public all documents and information obtained from holders of mineral rights, including any closure plan filed and approved by the Minister after December 10, 2013 (chapter M-13.1, s. 215). Closure plans filed prior to December 10, 2013, are subject to the *Act respecting Access to Documents held by Public Bodies and the Protection of Personal Information* (chapter A-2.1).

Hyperlink

Act respecting Access to Documents held by Public Bodies and the Protection of Personal Information
legisquebec.gouv.qc.ca\en\ShowDoc\cs\A-2.1

1.5 Specific Provisions of the Environment Quality Act

1.5.1 Projects subject to an environmental and social impact assessment and review process

For projects subject to an environmental and social impact assessment and review procedure under the EQA, enforcement is subject to different jurisdictions.

Southern Québec

For mining projects subject to the procedure in the southern part of Québec, the MDDELCC provides the proponent with a directive that sets forth the nature, scope and duration of the impact assessment to be carried out in accordance with the *Regulation respecting environmental impact assessment and review* (REIAR) (chapter Q-2, r. 23). This directive requires that the proponent submit a preliminary version of the closure plan required under the *Mining Act*.

Northern Environment: James Bay and Northern Québec Regions

For mining projects subject to the procedure in the territory referred to in Chapters 22 and 23 of the *James Bay and Northern Québec Agreement (JBNQA) (EQA, chapter Q-2, Chapter II)*, once the proponent receives the recommendation of the Comité d'évaluation (COMEV - Evaluation Committee) or the decision of the Kativik Environmental Quality Commission (KEQC), the case depending on the location of the project, the MDDELCC will provide the proponent with a directive for carrying out the impact study. This directive generally requires the proponent to submit a preliminary version of the closure plan required under the Mining Act, which will then be submitted to the Comité d'examen (COMEX - Review Committee) as an integral part of the impact assessment, or to the KEQC for review and assessment, the case depending on the location of the project as provided for in the *Regulation respecting the environmental and social impact assessment and review procedure applicable to the territory of James Bay and Northern Québec* (chapter Q-2, r. 25). In addition, where applicable, and at the end of mining operations, the certificate of authorization generally requires the proponent to submit a final version of the closure plan to the COMEX or the KEQC for approval (chapter Q-2, Chapter II).

Moinier region

For mining projects subject to the procedure in the Moinier region, the assessment procedure is the same as for southern Québec, with some adjustments, including a special consultation in the Naskapi village of Kawawachikamach. The MDDELCC's directive for carrying out an impact study requires the proponent to submit a preliminary version of the closure plan in accordance with the *Regulation respecting the environmental impact assessment and review applicable to a part of the northeastern Québec region (chapter Q-2, r. 24)*.

Hyperlinks

Regulation respecting environmental impact assessment and review (chapter Q-2, r. 23)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2023/

Guidelines for environmental impact studies on mining projects (in French only)
mddelcc.gouv.qc.ca/evaluations/documents/Mines.pdf

Regulation respecting the environmental and social impact assessment and review procedure applicable to the territory of James Bay and Northern Québec (chapter Q-2, r. 25)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2025/

Regulation respecting the environmental impact assessment and review applicable to a part of the northeastern Québec region (chapter Q-2, r. 24)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2024/

1.5.2 Characterization and rehabilitation of contaminated sites

Division IV.2.1 of the EQA contains provisions dealing with land characterization and rehabilitation, including the soil, groundwater and surface water present.

The triggers that lead to the filing of a characterization study are the following:

- The definitive cessation of operations belonging to one of the categories of activities listed in Schedule III of the Land Protection and Rehabilitation Regulation (LPRR) (chapter Q-2, r. 37);
- A proposed change in the use of land on which an activity listed in Schedule III of the LPRR (chapter Q-2, r. 37) takes place.

The triggers that lead to the filing of a land rehabilitation plan are as follows:

- The exceedance in soil of one of the limit values in Schedule I or II of the LPRR (chapter Q-2, r. 37) for one of the aforementioned cases;
- Any voluntary land rehabilitation that leaves contaminants in the land in concentrations exceeding the limit values set out in Schedule I or II of the LPRR (chapter Q-2, r. 37).

In addition, where a characterization study performed pursuant to the EQA reveals the presence in land of contaminants in a concentration exceeding the regulatory limit values, a notice of contamination must be entered in the land register (chapter Q-2, s. 31.58).

Hyperlink

Land Protection and Rehabilitation Regulation (chapter Q-2, r. 37)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2037/

1.5.3 Permits for closure work

In the notice for the closure plan issued by the MDDELCC in accordance with its legal and regulatory responsibilities, the Ministry must include a list of permits that may be required before carrying out closure work pursuant to the EQA.

When applying for authorization to carry out the closure work, the proponent must provide the technical information detailed in Chapter 3 of D019. The contents of the closure plan approved by the MERN must serve as a frame of reference for these applications.

2. Measures Applicable in the Event of a Temporary Shutdown

In the event that mining operations are temporarily suspended more than for six months, a proponent engaging in underground exploration operations and the operator must, under section 226 of the *Mining Act*, advise the MERN and the MDDELCC within 10 days of the date operations ceased. Moreover, within four months following the date operations ceased, the proponent must forward certified copies, signed by an engineer or geologist, of plans of the underground workings, mining structures, surface facilities and existing tailings sites.

2.1 Exploration Project

For surface exploration projects, the proponent must provide a map that clearly indicates the location of all features used to restrict access and ensure the security of the site. Where applicable, the proponent must also describe the protocols for sampling and monitoring effluents that must remain in effect while mining operations are temporarily shut down. Finally, the proponent must provide a schedule detailing the installation of security measures and an inspection schedule.

For underground exploration, the proponent must describe the measures implemented to ensure public safety and environmental protection while mining operations are temporarily shut down. The proponent must provide a map (minimum scale of 1:5,000) that clearly indicates the location of all security features (barricades, fences, gates, concrete slabs, etc.). Surface openings and excavations must be sealed off or covered, where appropriate. A schedule detailing the installation of security measures and an inspection schedule must also be provided.

For both surface and underground exploration projects, the proponent must carry out the environmental monitoring procedures applicable in case of temporary cessation of mining operations, as set out in section 2.10 of D019.

2.2 Mining Project

For mining projects, the proponent must describe the intended measures to ensure public safety and environmental protection while mining operations are temporarily shut down. The document must cover the following:

1. measures to ensure the safety of surface openings;
2. measures to restrict access to the site, the buildings and other structures;
3. water management measures for the mine site;
4. environmental monitoring pursuant to section 2.10 of D019;
5. methods for storing all types of chemical and petroleum products and all hazardous waste;
6. measures to ensure the physical and chemical stability of the accumulation areas, particularly the tailings impoundment;
7. a schedule for installing security measures and an inspection schedule.

The proponent must provide an accurate map (minimum scale of 1:5,000) of the mine site and its various security features (barricades, fences, gates, concrete slabs, etc.).

3. Administrative Process

3.1 Filing of Closure Plan and Correspondencee

The proponent must submit the closure plan to the MERN who approves it to the extent that it meets closure requirements and has received a favourable decision from the MDDELCC. The approval of the closure plan may be subject to other conditions, including the partial or full payment of the financial guarantee (chapter M-13.1, s. 232.5).

For new mining projects in southern Quebec, the closure plan submitted to the Minister for approval shall be made public for information and public consultation purposes at least 30 days before the consultation process begins.

The closure plan submitted by a proponent other than an applicant for a mining lease must be approved by the MERN before exploration or mining operations begin (chapter M-13.1, s. 232.2). In the case of an applicant for a mining lease, the closure plan must be approved before the lease is granted (chapter M-13.1, s. 101).

The closure plan must be written in French. Four copies of the paper document and one copy in electronic form (PDF format) must be sent to one of the following addresses:

Ministère de l'Énergie et des Ressources naturelles
Direction de la restauration des sites miniers
5700, 4e Avenue Ouest, bureau C-318
Québec (Québec) G1H 6R1

or

Ministère de l'Énergie et des Ressources naturelles
Direction de la restauration des sites miniers
400, boulevard Lamaque, bureau 1.02
Val-d'Or (Québec) J9P 3L4

In order to ensure the necessary basic information is included in the plan, the proponent must complete the validation grid presented in Appendix 2 of this Guide. Once completed, this grid must accompany the closure plan submitted to the MERN.

3.2 Evaluation and Approval of the Closure Plan

3.2.1 Departments and Organizations Consulted

The MERN must forward the closure plan to the MDDELCC for consultation, and, where applicable, any other government department or organization concerned.

The notice issued by the MDDELCC is based on its legal and regulatory responsibilities.

3.2.2 Closure Plan Approval Process

The main steps in the review and approval process for the closure plan are as follows:

- of the MERN verifies the admissibility of the closure plan and the validation grid;
- once deemed admissible, the MERN forwards the closure plan to the MDDELCC;
- the plan is evaluated by the MERN and the MDDELCC;
- the MDDELCC's sends its decision on the mine site closure plan to the MERN, along with a list of permits that may be required before closure work begins under the EQA;
- the MERN prepares a request for additional information, including, if applicable, any requests for information from the MDDELCC;
- the letter of authorization for the closure plan is sent to the proponent once the closure plan is deemed acceptable;
- the financial guarantee is deposited in accordance with the procedures set out in the Regulation (chapter M-13.1, r. 2, s. 111-119).

This consultation and approval process applies to the initial closure plan and any revisions.

3.3 Financial Guarantee

The financial guarantee ensures that funds will be available to carry out the work provided for in the closure plan in the event of default by the proponent. It covers the entire cost of land rehabilitation and reclamation work for the entire mine site as provided for in the closure plan (chapter M-13.1, s. 232.4).

The cost of all studies required for the closure of the mine site, including environmental characterization studies, must be taken into account when calculating the financial guarantee.

A proponent who engages or will engage in exploration work (see section 1.1 of the Guide) must submit their financial guarantee to the MERN before work begins (chapter M-13.1, r. 2, s. 112).

A proponent who engages or will engage in mining operations (see section 1.1, paragraphs 2 to 4 of the Guide) must pay the financial guarantee according to the following terms (chapter M-13.1, r. 2, s. 113):

- the guarantee must be paid in three installments;
- the first payment must be made within 90 days of receiving the plan's approval;
- each subsequent payment must be made on the anniversary of the plan's approval;
- the first payment represents 50% of the total amount of the guarantee, and the second and third payments represent 25% each.

3.3.1 Form of Financial Guarantees

The financial guarantee (chapter M-13.1, r. 2, s. 115) may be in one of the following forms or a combination thereof:

- a cheque made out to the Minister of Finance of Québec;
- bonds issued or guaranteed by Québec or another province of Canada, by Canada or by a municipality in Canada having a market value at least equal to the amount of the guarantee exigible;
- guaranteed investment certificates or term deposit certificates, in Canadian dollars, issued on behalf of the Minister of Finance of Québec by a bank, a savings and credit union or a trust company. Such certificates shall have a term of at least 12 months and shall be automatically renewable until the issue of a certificate of release provided for in section 231.10 of the Mining Act;
- an irrevocable and unconditional letter of credit issued to the Government of Québec by a bank, a savings and credit union or a trust company (see Appendix 5 of the Guide);
- security or a guarantee policy issued on behalf of the Government of Québec by a legal person legally empowered to act in that quality (see Appendix 6 of the Guide);
- a trust constituted with the provisions of the Civil Code of Québec and meeting the following requirements:
  - the purpose of the trust is to ensure completion of the work provided for in the closure plan under sections 232.1 to 232.10 of the Mining Act;
  - the Minister of Finance of Québec and the person referred to in section 232.1 of the Mining Act are joint beneficiaries of the trust;
  - the trustee is a bank, a savings and credit union or a trust company;
  - the trust patrimony is comprised only of sums in cash, or bonds or certificates of the same type as those referred to in subparagraphs 2 and 3 of section 115 of the Regulation.

The form of these guarantees must respect the conditions set out in sections 116 to 119 of the Regulation.

3.3.2 Terms of payment of the guaranteee

1. Cash Deposit, Bonds and Investment Certificates

Where the guarantee is submitted in the form of cash, a cheque, bonds or guaranteed investment certificates, the money or securities are deposited with the Minister of Finances of Québec in accordance with the Act respecting Deposits with the Bureau général de dépôts pour le Québec (chapter D-5.1), until acceptance of the closure work or until the certificate of release is obtained.

Hyperlink

Act respecting Deposits with the Bureau général de dépôts pour le Québec (chapter D-5.1)
legisquebec.gouv.qc.ca/en/ShowDoc/cs/D-5.1

2. Irrevocable and Unconditional Letter of Credit

An irrevocable and unconditional letter of credit is an agreement between a financial institution (bank, savings and credit union, trust company) and a company authorizing the bank to pay funds to a third party. The beneficiary of the financial guarantee for mine closure work is the Minister of Finance of Québec, subject to certain conditions stipulated in the letter of credit.

For as long as the letter of credit remains irrevocable and unconditional, the financial institution must honour any legitimate requests made by the beneficiary in keeping with the terms of the letter of credit. Any change in these terms must be approved by all parties involved. The letter of credit is normally valid for one year, although this period may be longer under certain conditions. The liability of the financial institution is limited to the amount provided for in the letter of credit. When the amount of the letter of credit is increased, only the amendment to the said letter of credit can be sent to the Minister of Finances of Québec (see Appendix 5 of the Guide).

3. Security

The security or the guarantee policy is the commitment of a third party, in favour of the Government of Québec, to defray the cost of the work in case of non-compliance with the commitments provided for in the closure plan by the proponent (see Appendix 6 of the Guide).

4. Trust

The trust must be constituted in accordance with the provisions of the Civil Code of Québec, and must indicate the following:

- the sums accumulated are to ensure completion of the closure work;
- the Minister of Finances of Québec and the person submitting the closure plan are joint beneficiaries of the trust;
- the trust patrimony is comprised only of sums in cash, bonds or guaranteed investment certificates.

Interest generated by the trust patrimony belongs to the trust. Interest kept as part of the trust patrimony may not be used to pay the guarantee.

3.3.3 Duration of the Guarantee

The guarantee must remain in effect until the certificate of release provided for in section 232.10 of the *Mining Act* has been issued. However, the amounts paid as financial guarantee may be revised as a result of the closure work carried out and provided for in the approved closure plan or following a revision of the closure plan if changes in the mining operations justify it.

3.4 Revision of Closure Plan

A proponent whose closure plan has been approved must submit a revised plan every five years to the MERN, unless the latter has set a shorter period on approving the closure plan or the revised plan. The closure plan must also be revised whenever changes in the mining operations justify an amendment, either at the request of the proponent or at the request of the MERN if the latter deems it necessary (chapter M-13.1, s. 232.6).

The MERN shall approve the revision of the closure plan to the extent it meets closure requirements and has received a favourable decision from the MDDELCC.

3.5 Review of the Financial Guarantee

In accordance with the closure plan, the financial guarantee must cover the full cost of the mine closure work for the entire mine site, including the cost of studies required for mine site reclamation, land rehabilitation and environmental characterization studies.

The amount of the financial guarantee may be increased or reduced (M-13.1, s. 232.7):

- based on the progress of the closure work;
- based on the amount of mine closure work completed when the mine is shut down;
- if the proponent intends to use different reclamation methods. These methods must yield a result equivalent to those presented in the closure plan and have been previously approved by the two ministries concerned;
- if the amount of the financial guarantee no longer represents all the anticipated costs of the work provided for in the closure plan;
- if new information becomes available, such as study results, advancement in knowledge or a change in the data, and this new information justifies a change in the mine site closure method.

The MERN may require payment of the full financial guarantee if it is of the opinion that the proponent's financial situation or a reduction in the anticipated duration of the operations may prevent the payment of all or part of the financial guarantee (chapter M-13.1, s. 232.7).

3.6 Assessment of Post-Closure Work

When carrying out post-closure work, an annual assessment must be filed with the MERN and the MDDELCC within 90 days of the end of the calendar year. The proponent does not have to submit such an assessment when the date of its submission coincides with that provided for the revision of the closure plan.

The annual assessment does not correspond to a revision of the content of the closure plan; it is only intended to inform the MERN and the MDDELCC of the state of progress of the closure work after the operation of the mine site.

The assessment should summarize:

- the work that has been done;
- the state of progress of the closure work in relation to the plan that was provided to the MERN;
- expenses incurred in accordance with the closure plan;
- where applicable, the results of:
  - research and development,
  - vegetation tests,
  - progressive monitoring of mine site closure work (quality monitoring);
- the results of the post-closure monitoring and follow-up program following the closure work on the entire mine site, including:
  - a presentation of the results of the environmental monitoring program carried out in accordance with the requirements of D019, detailed in sections 4.14 and 9.2 of the Guide;
  - an interpretation of the monitoring results and evaluation of the effectiveness of the reclamation techniques;
  - the results of physical integrity monitoring, maintenance and inspections;
  - the results of agronomic monitoring.

3.7 Deadline for Completion of Closure Work

Closure work must begin within three years of the cessation of operations (chapter M-13.1, s. 232.7.1).

The MERN may exceptionally require work to begin before this deadline or authorize an extension. An additional period may be granted, for the first time, for a period not exceeding three years, and for additional periods not exceeding one year.

3.8 Certificate of release

A certificate of release (chapter M-13.1, s. 232.10) may be issued when:

- the MERN is satisfied that the closure work has been completed in accordance with the closure plan approved by the MERN, and no sum of money is due to the MERN with respect to the performance of the work;
- the MERN is satisfied that the condition of the land affected by the mining operations no longer poses a risk for the environment or for human health and safety and, in particular, poses no risk of acid mine drainage (AMD).

The MERN may also release a person from the obligations set out in sections 232.1 to 232.8 of the *Mining Act* and issue a certificate attesting to that effect if the Minister agrees to let a third person assume those obligations.

The MERN issues the certificate of release after having received a favourable decision from the MDDELCC.

The certificate of release issued by the MERN relates only to the obligations under the *Mining Act* and does not release a person from the obligations under the EQA and its regulations. The release does not limit the powers of the MDDELCC, which remain complete, particularly with respect to its power to make orders provided for in sections 31.43 and 31.49 of the EQA (chapter Q-2). The same applies to the application of the *Act to Affirm the Collective Nature of Water Resources and Provide for Increased Water Resource Protection* (chapter C-6.2).

Hyperlink

Act to affirm the collective nature of water resources and to promote better governance of water and associated environments
legisquebec.gouv.qc.ca/en/ShowDoc/cs/C-6.2

CHAPTER II – GENERAL CLOSURE REQUIREMENTS

4. General closure requirements

This chapter presents the closure requirements for sites affected by mining operations. The requirements apply to both exploration and mine sites. Requirements may differ, depending on site characteristics. If the proponent's closure measures fail to meet the general requirements stipulated in this chapter, he must demonstrate the soundness (environmental, technical, financial, etc.) of the measures he proposes.

4.1 Definition of satisfactory condition

The aim of site closure is to return the site to a satisfactory condition by:

- eliminating unacceptable health hazards and ensuring public safety;
- limiting the production and spread of contaminants that could damage the receiving environment and, in the long term, aiming to eliminate all forms of maintenance and monitoring;
- returning the site to a condition in which it is visually acceptable (reclamation);
- returning the infrastructure areas (excluding the tailings impoundment and waste rock piles) to a state that is compatible with future use (rehabilitation).

4.2 Revegetation

All areas affected by mining operations (for example, building sites, tailings impoundments, waste rock piles, and road surfaces and shoulders) must be revegetated to control erosion and to return the site to a natural appearance that blends with its surroundings.

Revegetation of the site must be able to attain a satisfactory condition; that is, once planted, the vegetation must be hardy, viable in the long term, and able to grow without fertilizer or maintenance. Indigenous plants, herbaceous plants or shrubs are recommended. At operating mine sites, the proponent must provide a report written by an agronomist belonging to a professional order confirming the adequacy of the conditions to support sustainable vegetation in all revegetated parts of the site.

At exploration sites, if the MERN determines that the site has not attained a satisfactory state of revegetation following closure work, the Minister reserves the right to request a report from an agronomist confirming the adequacy of the conditions to support sustainable vegetation. If all or part of the mine site cannot be revegetated (for example, due to its geographic location or the reclamation technologies involved), the proponent must prove why revegetation is impossible and how the site will nevertheless attain a satisfactory condition.

During revegetation, it is important to adopt good practices to limit the introduction and spread of invasive exotic species (IES) by ensuring, in particular, that all soils to be used are free of IES and that no IES have been introduced. Any IES present on the site must be eliminated.

The use of fertilizing residuals or soils for revegetation purposes must comply with all laws, regulations, policies and guidelines. Several relevant links are provided below.

Hyperlinks

Intervention Guide – Soil Protection and Contaminated Sites Rehabilitation (in French only)
mddelcc.gouv.qc.ca/sol/terrains/guide-intervention/guide-intervention-protection-rehab.pdf

Degraded Sites – Guidelines for the use of fertilizing residuals for the restoration of plant cover (in French only)
mddelcc.gouv.qc.ca/matieres/mat_res/fertilisantes/vegetal/

Guidelines for recycling fertilizing residuals (in French only)
mddelcc.gouv.qc.ca/matieres/mat_res/fertilisantes/critere/

Invasive exotic species (in French only)
mddelcc.gouv.qc.ca/biodiversite/especes-exotiques-envahissantes/index.asp

4.3 Contaminated Land

4.3.1 Characterization and rehabilitation of contaminated land

Mine site closure includes the characterization and rehabilitation of land affected by mining operations.

If one of the triggers listed in section 1.5.2 of the Guide is present, a characterization study certified by an expert authorized under section 31.65 of the EQA must be submitted to the regional branch of the MDDELCC. If the study reveals the presence of contaminants in a concentration exceeding the regulatory limit values, the proponent must submit a request for the approval of a land rehabilitation plan. The same applies, where applicable, to the plan to dismantle installations and related equipment (chapter Q-2, s. 31.51).

4.3.2 Management of contaminated excavated soils

Pursuant to section 6 of the RCSSCST, excavated soils whose metal or metalloid contamination results from mining operations must be stored in the tailings areas related to those operations and for which conditions were established in the certificate of authorization issued by the MDDELCC.

To encourage onsite management of excavated soils, any rehabilitation scenario for weakly contaminated soils that does not contravene section 4 of the RCSSCST (chapter Q-2, r. 46, s. 4), but does not appear in the management grid for excavated contaminated soils (Appendix 5 from the Intervention Guide – Soil Protection and Contaminated Sites Rehabilitation), may be submitted to the MDDELCC for study.

The management of contaminated excavated soils must comply with the laws, regulations, policies and guidelines presented in the document titled *Intervention Guide – Soil Protection and Contaminated Sites Rehabilitation*.

Hyperlink

Intervention Guide – Soil Protection and Contaminated Sites Rehabilitation (in French only)
mddelcc.gouv.qc.ca/sol/terrains/guide-intervention/guide-intervention-protection-rehab.pdf

4.4 Buildings, infrastructure and equipment

4.4.1 Buildings and surface infrastructure

All buildings and surface infrastructure must be dismantled, including electrical and support infrastructure, unless the proponent can show that they are necessary to achieve and maintain a satisfactory condition, to monitor and maintain infrastructure, or to support the area's socio-economic development.

When buildings and surface infrastructure are dismantled, the foundations must be razed to the ground.

Concrete foundations in the ground may remain if:

- they are free of contamination and drilled with holes or broken up to allow efficient drainage, and covered by a material that promotes the growth of self-sufficient vegetation;
- they pose no risk to the environment.

The management of any materials produced by the dismantling work must comply with applicable laws and regulations, notably the *Regulation respecting the landfilling and incineration of residual materials (RLIRM) (chapter Q-2, r. 19)* and the good practices guide for managing dismantling materials, available in French from the MDDELCC (*La gestion des matériaux de démantèlement – Guide de bonnes pratiques*). The objective of the guide is to promote proper management of such materials in order to reduce their environmental impact. It describes each step in the dismantling process: exploratory phase, inventory, characterization of contaminated areas, dismantling, and materials management.

Hyperlink

Regulation respecting the landfilling and incineration of residual materials (chapter Q-2, r. 19)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2019

4.4.2 Underground infrastructure

Any opening or access to underground workings (service tunnels, pipelines) or any support infrastructure (waterworks, culverts) that will remain in place must be sealed off and decontaminated, if required. The proponent must provide a plan signed by an engineer indicating the location and nature of decontamination work, if applicable.

4.4.3 Transportation infrastructure

The main road access to the mine site must be kept in good condition, along with secondary roads used to monitor and maintain mine site infrastructure.

Mine site runways may be left intact (along with all related infrastructure) if they are in good condition and will not harm the environment.

Where existing roads or railway lines are deemed no longer necessary, the land must be reclaimed as follows:

- any tailings, waste rock or other contaminated material used in their construction must be removed and properly managed in accordance with applicable regulations;
- bridges and culverts must be removed to restore the natural flow. The banks of rivers and streams must be stabilized by planting vegetation;
- road drainage ditches must be filled in unless they are needed to access the site. Natural flow should be restored and backfilled surfaces should be levelled and planted to prevent any erosion;
- ditches left in place must be stabilized. Suitable granular material or riprap must be used if there is potential for erosion or where ditch design requires it;
- in general, road surfaces and shoulders must be scarified, levelled, planted and landscaped to prevent erosion.

4.4.4 Surface equipment and heavy machinery

Mining equipment (headframes, hoists, pumps, conveyors, etc.), ore processing equipment (grinding mills, flotation cells, cyanidation tanks, thickeners, etc.) and heavy machinery (motor vehicles, drills, shovels, etc.) must be removed from the site.

4.4.5 Underground equipment and heavy machinery

Mining equipment (conveyors, jackleg drills, etc.), heavy machinery (crushers, rails, metal crusher room structures, water pipes, air and compressed air pipes, etc.) and equipment (fans, pumps, etc.) must be removed from the site unless it can be shown that they are not a potential source of contamination.

4.5 Securement of excavations

The following securement measures must be implemented in excavated areas to ensure public safety.

4.5.1 Stripped areas and excavations (bulk sampling)

Excavations and stripped areas must be backfilled, where appropriate, and slope gradients reduced and the land levelled to blend with the surrounding topography.

4.5.2 Open pits

In the case of an open pit mine, the closure plan must include a cost-benefit analysis for backfilling the pit. Pits can be filled with unconsolidated deposits, mineral substances, tailings or waste rock. However, in order to be considered environmentally acceptable, the chemical and physical stability of the backfill must be demonstrated in the short and long term. The land must be levelled to blend with the surrounding topography and revegetated, unless the backfilled areas lie below the water table. In certain cases where the MERN deems the conditions suitable and an analysis has shown that backfilling is not possible, all access roads shall be condemned and a fence meeting MERN regulatory standards (chapter M-13.1, r. 2, Chapter IX, Division II) shall be erected around the pit. In some cases, the fence may be replaced by the following if the MERN deems the conditions suitable:

- an embankment with a ditch in front. The embankment must be 2 m high and have an equivalent crest line, and it must be made of unconsolidated deposits or inert mineral substances. It must be located at a sufficient distance from the pit, have a ditch in front, and be designed on the basis of geotechnical considerations;
- a barrier made of rocks with an average diameter of 1.5 m (and spaced no more than 30 cm apart). The barrier must be placed a sufficient distance from the pit and designed on the basis of geotechnical considerations.

In all cases, the distance at which these measures must be installed shall be supported by a geotechnical study demonstrating the stability of the underlying ground.

Signs warning of the danger should be posted around the pit at reasonable intervals to ensure visibility, at a distance that may not exceed 30 m (chapter M-13.1, r. 2, s. 104).

Signs shall be made of non-corrosive metal and be at least 30 cm on each side. The background colour should not be white and they must display the word "Danger."

Where signage must be erected in places other than a fence, it must comply with the standards of the Ministère des Transports, de la Mobilité durable et de l'Électrification des transports du Québec.

All open pit excavations (open pit mines) are subject to a stability study that must be presented to the MERN. The study must cover slope stability in the case of an unfilled excavation, or physical stability in the case of a backfilled pit (settling, risk of rotational and translational landslides, etc.). Stability studies and calculations must be signed by an engineer with recognized expertise and adequate knowledge in the field of mining geotechnics.

For any other type of backfill material, the proponent must check with the MERN and the MDDELCC beforehand to determine whether the material to be used is acceptable.

4.5.3 Safety of mine openings

The openings of shafts, raises, adits, declines or all other means of access to underground worksites must be secured in accordance with the Regulation (chapter M-13.1, r. 2, Chapter IX, Division II). Where bats may be present, a suitable installation must be developed in collaboration with the wildlife department (*Secteur de la faune*) of the Ministère des Forêts, de la Faune et des Parcs (MFFP).

The closure plan must include an assessment of a backfill option for underground worksites with surface openings. In such cases, the backfill must consist of unconsolidated deposits, mineral substances, tailings or waste rock, as appropriate. The proponent must check with the MERN and the MDDELCC to determine whether the material to be used is acceptable.

The land must be levelled to blend with the surrounding topography, and revegetated according to the specifications presented in section 4.2 of the Guide.

In certain situations, after approval from the MERN, backfill may be replaced by a fence meeting MERN regulatory standards (chapter M-13.1, r. 2, Chapter IX, Division II). The fence must be erected around the opening at a sufficient distance from the latter, established according to geotechnical considerations of the rocky walls or the soils on which the fence will be built.

4.5.4 Stability of crown pillars

Crown pillars must be stable in the long term. They must be able to support their own weight and, if applicable, the weight of unconsolidated deposits, water bodies and all other surface loads.

For underground workings where pillar stability cannot be insured on a long-term basis, the first consideration should be physical reinforcement measures (steel cables, anchor bolts, etc.) or backfilling of the underlying mine workings. In some situations, after approval from the MERN, these measures can be replaced by a fence meeting MERN regulatory standards (chapter M-13.1, r. 2, Chapter IX, Division II), established according to geotechnical considerations of the bedrock or the soils on which the fence will be built. The fence must be erected around the problem area at a sufficient distance to ensure it will not be pulled into the subsidence zone in case of crown pillar failure.

To ensure long-term crown pillar stability, the stability studies and calculations must be signed by an engineer with adequate education and knowledge, including recognized expertise in rock mechanics.

4.6 Accumulation areas

The reclamation of accumulation areas must attain technical, environmental and social objectives. Containment structures, waste rock piles, tailings areas and all retention structures related to the site must be stable. Accumulation areas must be reclaimed to a state in which effluents satisfy post-closure criteria and all applicable provincial and federal laws and regulations. Finally, reclamation must consider the potential future uses for the site and the reclaimed areas must blend in with the landscape.

These reclamation objectives are inextricably linked and involve different disciplines. For example, the physical stability of infrastructure primarily deals with geotechnics, whereas the chemical stability of tailings and waste rock deals with geochemistry. Reclamation techniques may affect wildlife, plants and the social environment. Experts from each discipline must work together to develop scenarios that will lead to the best solutions that meet all reclamation objectives for the accumulation areas.

4.6.1 Physical stability

4.6.1.1 General information

The choice of design criteria and reclamation techniques for accumulation areas must minimize the risks related to the physical integrity and possible failure of the infrastructure. At all times, the infrastructure must be stable, safe and compatible with the surroundings. Technical studies demonstrating stability must be carried out by an engineer with recognized expertise and adequate education and knowledge for the type of study to be signed. The studies must incorporate the following:

- climatic conditions, including the effects of critical events and the notion of climate change;
- the geotechnical properties of the waste rock, tailings, foundation soils and any construction materials to be used. For potentially high-risk infrastructure, these properties must be properly characterized according to industry standards;
- the specificities of the accumulation area, such as topography, hydrology, hydrogeology, underlying soils (foundation soils), seismic effects, characterization and instrument data, etc.

Throughout the construction of containment structures or any other structure subject to physical stability assessments, the proponent must ensure quality control regarding the construction work and materials, and this falls under the responsibility of the design engineer, when required. The final plans (as-built) or details of the plans for tailings and waste rock storage may be requested by the MERN if needed during its review of the dossier.

During operations and closure, the proponent must implement an infrastructure monitoring and maintenance program. The proponent must ensure that the management of tailings and waste rock is consistent with the planned approach of the design phase, and that it includes, if appropriate, the implementation of progressive reclamation. He must also ensure safe and responsible management in the case of a temporary cessation of mining operations, and plan for reclamation in the case of a premature closure of the mine.

In designing structures for long-term water retention, such as a tailings impoundment using water as a cover material or a raised water table with a monolayer cover to control the oxidation of reactive minerals, the selection of recurrent events must be based on extreme events that may be expected to occur, such as the probable maximum precipitation (PMP), the maximum credible earthquake (MCE), the probable maximum flood (PMF) and the most critical extended period of drought.

Design criteria and signed stability studies must be presented as an appendix to the closure plan, along with any other details needed to reach a decision on the results.

Design criteria for accumulation areas are presented in Appendix 1.

Changes to the design during construction or operation must be approved by an engineer with recognized expertise and adequate education and knowledge.

Following closure, a dike or any other structure designed to retain water that receives new natural inputs may be subject to the Dam Safety Act (chapter S-3.1.01) and the Dam Safety Regulation (chapter S-3.1.01, r. 1). Therefore, insofar as the proponent intends to maintain such structures, the dam safety department (*Direction de la sécurité des barrages*) of the MDDELCC must be consulted before carrying out closure work.

Hyperlinks

Dam Safety Act (chapter S-3.1.01)
legisquebec.gouv.qc.ca/en/ShowDoc/cs/S-3.1.01

Dam Safety Regulation (chapter S-3.1.01, r. 1)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/S-3.1.01,20r.201

4.6.1.2 Geotechnical characterization

The proponent must set up onsite testing equipment and collect data to assess the geotechnical properties of materials currently stored or to be stored in accumulation areas. The proponent must develop an instrumentation and sampling program in which stratigraphic units are well represented and the installed instruments and collected samples are adequate and sufficiently representative for characterization of the materials. The choice of materials and the selection of samples and representative tests must be supervised by an engineer with recognized expertise and adequate education and knowledge for a geotechnical characterization study.

The geotechnical characterization of materials must be carried out according to industry-accepted work specifications, such as those set forth in the *Canadian Foundation Engineering Manual*. In specific cases, the MERN reserves the right to request additional characterization tests.

4.6.1.3 Waste rock piles

The process for selecting the location of the waste rock pile (or piles) must be the subject of an options analysis. For all options studied, the design must consider realistic potential reclamation scenarios. The design and operation of a waste rock pile has an impact on the choice of reclamation technique. Certain waste rock management methods can reduce the geotechnical risks associated with waste rock and, in some cases, closure costs. For example:

- The use of waste rock as underground backfill or moving waste rock into the pit, if applicable.
- Pile construction using benches and compacted layers.
- Various methods for co-depositing tailings and waste rock that can help improve the geotechnical stability of the pile.

Design criteria are presented in Appendix 1.

4.6.1.4 Tailings areas

The siting of the tailings impoundment and sedimentation basins as well as the choice of the tailings storage and management methods (pulp, thickened, paste or filtered) must be the subject of an options analysis. For all options studied, the design must consider potential reclamation scenarios. The design and operation of the tailings impoundment and the characteristics of the tailings will affect the choice of reclamation technique. Certain tailings management methods can reduce the geotechnical risks associated with tailings and, in some cases, closure costs. For example:

- The use of tailings as underground backfill or the transfer of tailings into the open pit.
- Tailings management methods that reduce the retention structures required (for example, filtered tailings).
- Various methods for co-depositing tailings and waste rock that can help improve the geotechnical stability of the tailings areas.

The basins must be designed by an engineer with recognized expertise and adequate education and knowledge for the type of structure to be designed. When such structures are expected to retain water during the post-closure period, the signed design criteria and stability studies must be presented as an appendix to the closure plan.

4.6.2 Chemical stability

4.6.2.1 General information

The reclamation of tailings areas and waste rock piles must prevent the generation of AMD and CND. It must also prevent contaminated water from entering the receiving environment and must allow for the collection and treatment of such water. In all cases, mining effluents must at least meet the requirements set forth in D019 and the Metal Mining Effluent Regulations (MMER).

The main factors in attaining chemical stability objectives for tailings and waste rock are:

- the relevant education and expertise of the professionals responsible for the geochemical characterization protocol for tailings and waste rock (sample selection, choice of tests and analysis of the results);
- the recognition of climatic conditions and the physical characteristics of the accumulation area (for example: precipitation, temperature, topography, hydrology, hydrogeology and soil properties);

- tailings and waste rock management methods implemented during the operations phase that are consistent with the planned approach of the design phase, including the use of progressive reclamation. Design changes must be implemented and incorporated into the tailings and waste rock management method in response to the specific characteristics of the site and any advances in knowledge;
- controls on geochemical behaviour, which also take into account geotechnical behaviour (stability).

The reclamation of accumulation areas should preferably be implemented while the mine is operating and, when possible, this should be specified as a design parameter to encourage the adoption of progressive reclamation and to reduce the potential for AMD and CND.

Hyperlink

Metal Mining Effluent Regulations (SOR/2002-222)
laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/

4.6.2.2 Geochemical characterization

The proponent must collect data to assess the acid-generating and leaching potential of all waste rock and tailings stored or to be stored in accumulation areas. The proponent must justify the selected sampling protocol and demonstrate that geological units are adequately represented in collected samples. Lithology identification and sample selection must be supervised by a geologist or a geological engineer with recognized expertise and adequate education and knowledge in mineralogy and geochemistry. A sufficient and representative number of samples must be selected and analyzed for each zone (lithology), taking into account heterogeneity and uncertainty.

Data on the acid-generating and leaching potential of waste rock and tailings must be updated each time the closure plan is revised as mining operations progress.

The geochemical characterization of samples must satisfy at all times the specifications of D019. In specific cases, the MERN reserves the right to request additional characterization tests.

4.6.2.3 Waste rock piles

Some available reclamation techniques for waste rock piles can minimize the potential for AMD and CND.

Certain waste rock management methods, if implemented during mining operations, can help reduce the risk of generating AMD and CND and thus reduce closure costs. For example:

- The use of waste rock as underground backfill material or moving waste rock into the pit, under certain hydrogeochemical conditions and if applicable. For tailings that generate AMD, moving the latter before acid generation begins may facilitate management and closure work.
- Sorting and managing waste rock according to its acid-generating potential or its metal-leaching potential. Separating problematic materials and placing them in an optimal configuration may help minimize AMD generation and metal leaching.

Reclamation techniques implemented after mine closure or during mining operations (progressive reclamation) may help reduce the risks associated with geochemical reactions in waste rock piles. For example:

- Covering waste rock with layers of geologically derived materials (soil, waste rock, tailings) or with a multilayer covering including a geosynthetic layer when conditions allow. These coverings must be designed to limit water seepage or reduce the flow of oxygen in the waste rock, thereby limiting the production of contaminated water in the pile. These coverings must also be designed to yield an

adequate safety factor (SF) against slope instability, provide protection from erosion, minimize long-term maintenance requirements, maintain long-term stability and integrity, and provide adequate support for vegetation.

- Submerging waste rock when topographic, hydrologic, hydrogeologic and geochemical conditions allow. Returning waste rock underground (or into a pit), below the water table, can reduce the flow of oxygen in reactive waste rock, thereby limiting sulphide oxidation. This technique must be evaluated to ensure it will not contaminate the groundwater.

4.6.2.4 Tailings areas

Many reclamation techniques for tailings areas can successfully minimize the potential for AMD and CND.

Certain tailings management methods, if implemented during mining operations, can help reduce the risk of generating AMD and metal leaching and thus help reduce closure costs. For example:

- The desulphurization of tailings, to separate sulphides and produce tailings with a sufficiently low sulphide content, which will prevent or minimize AMD potential.
- The use of tailings as underground backfill material or moving tailings into the pit, under certain hydrogeochemical conditions and if applicable. For tailings that generate AMD, moving the latter before acid generation begins may facilitate management and closure work.

Reclamation techniques implemented after mine closure or during mining operations (progressive reclamation) may help reduce the risks associated with geochemical reactions in the tailings areas. For example:

- Covering tailings with layers of geologically derived materials (soil, waste rock, tailings) or with a multilayer covering including a geosynthetic layer when conditions allow. These coverings must be designed to limit sulphide oxidation and metal leaching. These coverings must be also designed to yield an adequate safety factor (SF) against slope instability, provide protection from erosion, minimize long-term maintenance requirements, maintain long-term stability and integrity, and provide adequate support for vegetation.
- The complete and permanent saturation of tailings to reduce the diffusion of oxygen through reactive sulphide-bearing tailings, thereby limiting sulphide oxidation. With some reclamation techniques, saturation is possible under certain conditions, such as submergence or a monolayer cover with an elevated water table. This can be done with or without containment structures, depending on the conditions of the site. Physical stability risks, monitoring requirements and long-term material durability should be taken into consideration when choosing a reclamation technique. Assessments must be conducted to ensure this technique will not contaminate groundwater.

4.6.3 Reclamation techniques

The selection reclamation techniques must be proven and suited to the conditions of the site. As needed, several different techniques may be presented to take into account the specificities of the areas to be reclaimed.

The design must use the best available reclamation techniques and be both technically and economically realistic. Validation through laboratory and field tests may be required to confirm certain elements of the design. In some cases, modelling may be useful in assessing the effectiveness of specific parameters of the proposed method, and should be performed for a range of conditions. For example, simulations of climate change and geochemical behaviour may be required for the short, medium and long term. Technological innovation is encouraged, but these must be supported by scientific and technical studies conducted by professionals that demonstrate their potential to attain the reclamation objectives, thereby ensuring long-term effectiveness and reliability.

Progressive reclamation should be envisioned for all types of mining development. If progressive reclamation is not prioritized, the proponent must provide reasons to justify the decision.

Reclamation techniques must be selected and designed with the help of members of a professional order who have the necessary relevant expertise, education and experience. The basis for the design of a reclamation technique and the assumptions used in its selection and design must be presented with the appropriate documentation as an appendix of the closure plan.

4.6.4 External consultants

In the case of projects characterized by significant technological or environmental risks, a peer review committee may be required by the MERN to review the design of certain reclamation techniques or infrastructure that will remain after mine site closure. This type of committee review may also be required when significant changes are proposed to infrastructure or reclamation techniques. The main elements of risk namely include the presence of dikes designed for long-term water retention, structures that pose a risk to public safety or the environment, technologies and concepts that may pose a risk for the structure or reclamation technique, external or new elements that may introduce a significant risk for the structure or reclamation technique, etc.

The peer review committee must be independent from the proponent and those responsible for the design, and must have access to all information required to review the design. Depending on the risks identified, the committee may be called upon to focus on specific elements, namely relating to mining operations likely to affect post-closure infrastructure stability, water management, design flood, the impacts of seismic activity, and long-term stability including during the post-closure period; all such considerations must be compliant with applicable standards, laws and regulations and in keeping with best practices in the specific field of expertise.

The recommendations of the peer review committee must be documented and submitted to the MERN, and must be included in each revision of the closure plan.

The proponent is responsible for the creation of the peer review committee, and related activities are included in the closure costs. Members of the committee must be selected by the proponent after consulting with the MERN. Members must have recognized expertise, adequate experience and the necessary skill set to raise relevant questions and formulate appropriate recommendations, and must belong to a professional order.

4.6.5 Dewatering, sedimentation and polishing basins

Dewatering, sedimentation and polishing basins must be emptied and reclaimed, unless they are still needed. Dikes must be levelled, where applicable.

Ideally, the natural flow should be re-established. Where impossible to do so, the proponent must set up a new system to deal with runoff that reproduces the natural flow as faithfully as possible and suits the reclamation technique employed. Treatment sludge and sediments that accumulate on the bottom of basins are considered tailings; they must therefore be stored in the tailings areas or left in place and managed according to the requirements presented in section 4.6 of the Guide. If the site does not have any areas for storing tailings, the material must be sent to a landfill site governed by the RLIRM, as long as they satisfy admissibility criteria.

Hyperlink

Regulation respecting the landfilling and incineration of residual materials (chapter Q-2, r. 19)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2019

4.6.6 Overburden, ore and concentrate storage areas

Overburden, when removed during mine site preparation, must be managed according to the requirements of section 2.6 of the D019. Uncontaminated overburden must be kept and used for closure work. If an overburden pile is left in place on the mine site, it must satisfy the same chemical and physical stability criteria as those for tailings areas and waste rock piles. Unused overburden piles must be protected against wind and water erosion using plant cover.

Typically, ore and concentrate are temporarily stored in stockpiles near the mill or loading station. These materials must be managed according to the requirements of section 2.8 of the D019. Following closure work, no ore or concentrate shall remain on the site. The footprint of the stockpiles must be rehabilitated according to the requirements described in section 4.3 of the Guide.

4.7 Water collection systems

Collection systems must be implemented to collect contaminated percolation waters and divert uncontaminated runoff. These systems must require minimal maintenance.

Water collection systems that are no longer needed, including ditches and retention basins, must be dismantled and backfilled, if necessary.

To promote overflow drainage from the tailings impoundment, drainage culverts and spillways are recommended. These structures must require minimal maintenance.

In all cases, collection systems left in place must be stable and safe, requiring minimal maintenance. They must be protected against long-term erosion.

Any structure subject to the Dam Safety Act (L.R.Q., chapter S-3.1.01) and the Dam Safety Regulation (chapter S-3.1.01, r. 1) must be confirmed by the dam safety department (*Direction de la sécurité des barrages*) of the MDDELCC.

4.8 Mining effluents

Mining effluents must satisfy the discharge requirements of D019 as well as those of the MMER. Depending on the nature of contamination at the mine site following closure work, other requirements may apply to the final effluent discharge under section 20 of the Environment Quality Act.

A permanent active treatment plant cannot constitute a final reclamation measure for mining effluents. However, it can be considered as a temporary measure to enable compliance with discharge standards.

A temporary passive system to treat effluents may be included in the final reclamation scenario when the concentration of effluent contaminants allow it.

Hyperlink

Metal Mining Effluent Regulations (SOR/2002-222)
laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/

4.9 Groundwater

Groundwater quality in the vicinity of any developed area at risk must comply at all times with the protection requirements set forth in D019, as well as those in the rehabilitation plan for contaminated land, if applicable.

4.10 Sanitary installations

After being emptied, all decommissioned septic tanks must be filled with gravel, sand, earth or inert material as stipulated in the Regulation respecting waste water disposal systems for isolated dwellings (chapter Q-2, r. 22). Leaching fields need not be removed. Waste water treatment ponds should be emptied and backfilled so as not to create pools of stagnant water.

Sludge and other residue collected during the accumulation or disposal of waste water, grey water or toilet effluents must be treated, recovered or disposed of in compliance with the EQA.

Any other waste water treatment equipment (biodisks, etc.) must be removed if the proponent does not intend to use it again. The dismantled materials must be disposed of in compliance with all applicable regulations.

Hyperlinks

Regulation respecting waste water disposal systems for isolated dwellings (chapter Q-2, r. 22)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2022

Laws and regulations relating to the management of residual materials (in French only)
mddelcc.gouv.qc.ca/matieres/loi-reg/

4.11 Petroleum products

In April 2007, responsibility was divided between the Régie du bâtiment du Québec (RBQ), the MDDELCC and the MERN. The MERN retained responsibility for the marketing of petroleum products, the RBQ became responsible for all matters related to petroleum equipment, and the MDDELCC became responsible for the environmental aspects. The EQA was modified (section 31.51.1) to allow the MDDELCC to carry out its new responsibilities. The management of petroleum products must comply with applicable laws and regulations, and the links to some of these are provided below.

Hyperlinks

Petroleum Products Regulation (chapter P-30.01, r. 2)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/P-30.01,20r.202

Land Protection and Rehabilitation Regulation (chapter Q-2, r. 37)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2037

Regulation respecting hazardous materials (chapter Q-2, r. 32)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2032

4.12 Waste

Waste management must comply with the provisions of the Québec Policy on Residual Materials and the RLIRM in the case of non-hazardous waste, and the Regulation respecting hazardous materials in the case of hazardous waste.

The siting of a landfill on a mine site and related closure measures must comply with the RLIRM.

Pursuant to section 160 of the RLIRM, disposal sites that were permanently closed before 19 January 2006 continue to be governed by the Regulation respecting solid waste (chapter Q-2, r. 13) and by their certificates of authorization or conformity, as long as they remain closed.

Hyperlinks

Québec Policy on Residual Materials
mddelcc.gouv.qc.ca/matieres/pgmr/

Laws and regulations relating to the management of residual materials (in French only)
mddelcc.gouv.qc.ca/matieres/loi-reg/

Recovery of non-hazardous residual materials (in French only)
mddelcc.gouv.qc.ca/matieres/valorisation.htm

Regulation respecting solid waste (chapter Q-2, r. 13)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.2013

4.13 Quarries and sand pits

During closure, it is preferable to use materials derived from the mine as long as they are compatible with the use envisioned. However, if it becomes necessary to open a quarry or sand pit to proceed with reclamation work (for example, to obtain cover material), a certificate of authorization issued under the EQA is required and the quarry or sand pit must meet all the provisions of the Regulation respecting pits and quarries.

When the location of a quarry or sand pit, or the site where the extracted materials are used, remains within the boundaries of the mining title granted for mining operations, the proponent does not have the right to request the MERN or a regional county municipality (RCM) to assume responsibility for managing the surface mineral substances. On the contrary, the proponent must apply for a mining lease from the agency in charge of administrating surface mineral substances.

Hyperlink

Regulation respecting pits and quarries (chapter Q-2, r. 7
legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,20r.207

4.14 Post-closure monitoring and maintenance

The objective of implementing a post-closure monitoring and maintenance program is to track the environmental performance of the closure work. It also aims to ensure the sustainability of the infrastructure and plant cover, and to assess whether the mine site has attained a satisfactory condition. The program must include the assessment and environmental monitoring of the reclamation techniques employed, the monitoring and maintenance of infrastructure integrity and associated risks, and agronomic monitoring.

It is expected that the post-closure monitoring and maintenance program presented in detail at the time of filing the closure plan will be refined through subsequent revisions.

The post-closure monitoring and maintenance program must be adapted to the areas to be reclaimed, to the reclamation techniques employed, and to any contaminants present. It must be implemented according to the provisions under section 2.11 of the D019.

4.15 Climate change considerations

Climate change must be taken into consideration in the design phase when selecting reclamation techniques and infrastructure that will remain after mine closure.

A climate change adaptation approach that is applicable to the mining sector will generally include the following:

- the definition of current climate impacts and an assessment of future climate impacts that takes into account the effect of various climate scenarios on the reclamation technique;
- the determination of the vulnerability of mining infrastructure to climate change and the identification of risks;
- the designer's knowledge of appropriate adaptation solutions and their integration into the design.

In Québec, the anticipated impacts of climate change namely include: melting permafrost, increased frequency of frost/thaw cycles, increased frequency and severity of extreme weather events such as heavy rainfall and flooding, modified precipitation regimes (including more intense precipitation), rapid thaw events, less days below freezing, increased periods of drought, higher sea level, changes in wildlife and vegetation, and/or higher temperatures.

Appendix 8 of the Guide provides some references on this topic that may prove useful.

4.16 Considerations relating to mine site closure in northern environments

Northern environments are defined as any area located north of the 55th parallel. Mine site closure in northern environments must take into account the main challenges associated with the harsh weather conditions, remote geographic location and access difficulties, the thin layer of unconsolidated deposits and the presence of permafrost.

The near-absence of roads, the seasonal access to mine sites, and issues relating to the availability of natural construction materials must be considered when estimating closure costs for mine sites in northern environments.

CHAPTER III – CLOSURE PLAN CONTENT

5. Closure plan content

This chapter outlines the compulsory elements of the closure plan.

Existing and planned mining operations (underground and surface) must be described in sufficient detail to allow a proper assessment of the scope of work (chapter M-13.1, s. 232.5). Some information may not be available at the time of writing. This information may be supplied as revisions to the closure plan are made. The minister may request any additional information, research or studies he deems necessary to approve the closure plan.

5.1 Exploration project

For any exploration project requiring a closure plan (see Table 1 of the Guide), it must contain the information requested in the following sections of the Guide.

Section 2: Measures applicable in the event of a temporary shutdown

Section 6: General information

Section 7: Exploration project

Section 9: Post-closure monitoring and maintenance program (for underground operations)

Section 10: Emergency plan (for underground operations)

Section 11: Economic and scheduling considerations

The closure plan must be accompanied by a detailed description of closure costs and the content validation grid presented in Appendix 2 of the Guide.

5.2 Mining project

For any mining project requiring a closure plan (see Table 1 of the Guide), the latter must contain the information requested in the following sections of the Guide.

Section 2: Measures applicable in the event of a temporary shutdown

Section 6: General information

Section 8: Mining project

Section 9: Post-closure monitoring and maintenance program

Section 10: Emergency plan

Section 11: Economic and scheduling considerations

The closure plan must be accompanied by a detailed description of closure costs and the content validation grid presented in Appendix 2 of the Guide.

5.3 Revised closure plan content

When a revised closure plan is required under section 232.6 of the Mining Act, it must cover all elements modified since the last revision and must include an update of anticipated closure costs. Where applicable, an update on the progress and results of ongoing or completed studies should be included in the revision.

Note that it is possible to refer to sections of previous versions of the closure plan and their already approved revisions. To facilitate the work, it is advisable to retain the original structure of the document whenever possible.

The revision of the closure plan should be accompanied by the content validation grid presented in Appendix 2 of the Guide.

Revisions to the closure plan must be numbered for reference purposes.

Notwithstanding the above, the MERN may request the filing of a complete revision of the closure plan when the modifications are too extensive.

6. General information

6.1 Closure plan summary

The proponent must briefly describe all completed and planned mining activities, as well as the nature, schedule and costs of the proposed closure activities, whether this work will take place after mine closure or during its operating mine life (progressive reclamation).

A cost assessment for all closure work and supporting studies must be briefly outlined in this section.

6.2 Identification of proponent

The contact information of the proponent must be provided in the submitted document. When the contact information for the main office of the proponent is different from that of the mine site, both sets of contact information must be provided.

A copy of the resolution of the Board of Directors authorizing the proponent to submit the closure plan must be included in the document. The basic content of a resolution of the Board of Directors is presented in Appendix 4 of the Guide.

When an external firm has prepared the closure plan, it must be accompanied by a letter clearly indicating that the proponent has mandated the firm to submit the closure plan on his behalf.

The names, contact information, occupations and functions of all persons who prepared the closure plan or any document related thereto must be indicated in the document submitted to the MERN.

For certain types of exploration work (bulk sampling, for example), if the work described in the closure plan was not carried out by the holder of the mining rights, the proponent must provide the agreement binding the two parties, in particular their respective responsibilities for carrying out the closure work.

The contact information of the persons responsible for the site must be indicated, whether for a temporary cessation of operations or a definitive closure. At least one person must be designated until the MERN issues a certificate of release.

In the event of a change in the contact information of the person(s) responsible for the mine site, or a change of responsible person, the MERN must be notified within ninety days.

6.3 Site location

The proponent must provide a location map for the mine site indicating where closure work is taking place or will take place. This map must comply with the provisions of sections 90 and 91 of the Regulation (chapter M-13.1, r. 2).

All mining titles (mining concessions, mining leases or claims) and all surface rights must be clearly marked on the map.

For exploration projects subject to a closure plan (see Table 1 of the Guide), the map must also indicate access roads.

6.4 Geology and mineralogy

The proponent must collect data to assess the acid and leachability potential of waste rock and tailings stored or to be stored in the accumulation areas to ensure proper waste rock and tailings management and thus achieve the general objectives described in section 4.6.2.

Specifically, the proponent must describe the process for classifying tailings, waste rock, ore and concentrates, if present. Depending on the nature of the mining operations, the information to be included in the closure plan is as follows:

- The different types of mineralization present in the deposit, and their petrographic and chemical descriptions (major and trace elements).
- The different minerals contained in the host rock, and their petrographic and chemical descriptions (major and trace elements).
- A description of the physical characteristics of the tailings, ore and waste rock (grain size, water content, unit weight, relative density).
- A description of the metallurgical process, in the case of tailings.
- A description of the main chemical elements and any radioactive elements, if present, in the tailings after ore treatment and metallurgical processing.
- A detailed description of the AMD and CND potentials for tailings, waste rock and ore. The number of samples on which the description is based must be sufficient and representative of the geological units to be mined.
- The test results (tabulated) and their interpretation that led to the classification of tailings, waste rock and ore according to Appendix II of D019. The tests required for each type of classification must be preformed, unless the proponent can provide justification for not having done so.
- The presence of areas deemed "uncertain" based on laboratory or onsite test results, and the approach used to classify the tailings, waste rock and ore in such areas.

6.5 History of the site

A review of all information relating to ownership history, mining or otherwise, must be provided. Emphasis should be placed on areas likely to have been contaminated by previous mining operations, as well as on the types of contaminants potentially present on the site.

6.6 Authorizations

The closure plan must contain an appendix that lists subject, reference number and date of issue for any certificate, certificate of authorization, certificate of conformity or any other authorization or permit obtained from a governmental (provincial or federal), regional (RCM) or municipal agency, as well as from any surface landowners, if applicable.

7. Exploration project

7.1 Site description

7.1.1 General description

The general description must contain the following:

- a general plan of the facilities on the exploration site;
- the type of work (drilling, surface sampling, access shaft, etc.). For underground exploration activities conducted from a decline or shaft, the proponent must briefly describe the underground workings and surface openings, and their location must be indicated on a map;
- for activities governed by the Regulation respecting standards of forest management for forests in the domain of the State, adopted under sections 38, 29 and 44 of the Sustainable Forest Development Act and requiring a permit, the proponent must provide technical data on deforestation of the site, such as the extent of deforested areas, cutting limits, openings onto water bodies, spillways, bridges, ditches, decks and any other pertinent information requiring management in a forest setting;
- the planned period of activity and exploration work schedule.

Hyperlinks

Sustainable Forest Development Act (chapter A-18.1)
legisquebec.gouv.qc.ca/en/ShowDoc/cs/A-18.1

Regulation respecting standards of forest management for forests in the domain of the State (chapter A-18, r. 7)
legisquebec.gouv.qc.ca/en/ShowDoc/cr/A-18.1,20r.207

7.1.2 Site description and location of facilities, buildings and infrastructure

The objective is to present a current list or, in the case of new projects, an anticipated list of all facilities, infrastructure and buildings involved in exploration work and to indicate their location on a surface plan, along with descriptions that make it possible to identify areas likely to cause environmental contamination or hazardous situations so they may be considered in any closure scenario. The location map must indicate the position of streams, rivers, lakes, ponds, marshes, swamps and peatlands, as well as the current drainage configuration and general topography of the land.

7.1.2.1 Buildings and surface infrastructure

The document must describe the buildings and surface infrastructure involved in the exploration work, including their components (foundations, structures, coverings, claddings and dimensions), as well as any other buildings erected on the mine site (administrative buildings, camp, etc.). It must also include a surface plan indicating their location.

7.1.2.2 Electrical, transportation and support infrastructure

The proponent must provide a map of the location and layout of all electrical, transportation and support infrastructures (roads, electrical transmission lines, railway lines, gas and water pipes, waterworks and sewer systems, electrical and telephone cables, reservoirs, bridges, culverts, etc.). A brief description must accompany the plans specifying the dimensions of the infrastructure components and, where applicable, their composition (materials).

7.1.3 Water management

The proponent must describe the water management facilities (retention structures, water collection systems, collection and diversion ditches, sedimentation basins, pumphouses, sanitary facilities, etc.) and indicate their location on a map. Where applicable, the location of the final effluent and monitoring stations must also be indicated.

7.1.4 Accumulation areas

The proponent must indicate accumulation areas for ore, waste rock, or overburden generated by exploration work. The following information must be provided:

- a current topographic map of the site showing the layout of accumulation areas used during during the exploration stage, along with the surface area occupied by each;
- the geology of surface deposits and the bedrock;
- the management method for the material in the accumulation areas;
- the tonnage and volume of material stored or to be stored;
- if the ore or waste rock in an accumulation area is considered high-risk, radioactive or AMD/CND generating according to section 6.4, a description of the method for managing water in and around the accumulation area, and any effluent monitoring methods.

7.1.5 Other areas used

The proponent must include a plan indicating the location of any other areas used, such as ore transfer sites, hoists, scrap metal storage areas and garages.

7.1.6 Storage and disposal sites

The document must describe all storage and disposal sites on the mine site and specify the nature and quantity of any substances present. The sites must be indicated on a plan.

7.1.6.1 Chemical, petroleum and explosive products

The proponent must provide the following details regarding the storage and disposal of chemical, petroleum and explosive products used during exploration activities, or any other chemical product used at an industrial scale:

- a list of the chemical, petroleum and explosive products;
- the location and description of the storage sites;
- the storage methods;
- the recovery or disposal method(s) for the products, where applicable.

7.1.6.2 Non-hazardous waste

For every non-hazardous waste disposal site on the mine site, the proponent must provide a brief description of its characteristics and location. If the waste is disposed of or recovered outside the site, the proponent must only indicate where the disposal or recovery takes place and the name of the company contracted to carry out the work, where applicable.

7.1.6.3 Hazardous waste

The proponent must describe the management method for hazardous waste (e.g., used oils or other waste as defined in the Regulation respecting hazardous materials) and indicate the location of all hazardous waste storage sites on the mine site.

7.2 Protection, rehabilitation and closure measures

7.2.1 Safety of work areas, surface openings and crown pillars

The proponent must explain how he will secure surface openings (shafts, stopes that reach the surface, declines, etc.) and excavation sites pursuant to the Regulation (chapter M-13.1, r. 2, Chapter IX, Division II). In addition, if exploration work requires the use of galleries or surface openings of a former mine, the document must contain an assessment of the long-term stability of every crown pillar, the assessment method used and, where applicable, the support and stabilization methods that will be implemented based on the information obtained. The stability studies and calculations must be signed by an engineer with recognized expertise and adequate education and knowledge. The signed documents must be presented as an appendix to the closure plan.

For surface sampling work, the proponent must specify the measures he intends to implement to restore work areas (excavation sites, strippings and trenches, other areas where unconsolidated deposits were moved, etc.).

7.2.2 Dismantling of buildings and infrastructure

The document must describe the methods used to dismantle and dispose of buildings (structures and foundations of administrative and accommodation buildings, etc.), other facilities and support infrastructure (gas and water pipes, waterworks and sewer systems, telephone cables, underground reservoirs, etc.), transportation infrastructure (roads, bridges, culverts, ditches, etc.), and electrical equipment and infrastructure (power lines, pylons, electrical cables, transformers, etc.). It must also describe how the materials produced by the dismantling work will be recovered or disposed of, and the methods for rehabilitating the adjacent land.

The proponent must provide a list of components that will be removed from the site. In addition, a plan must show the layout of the buildings, support infrastructure, electrical equipment, electrical infrastructure and transportation infrastructure to be removed or left in place. The proponent must justify the decision to leave any buildings, equipment or infrastructure in place.

7.2.3 Equipment and heavy machinery

The proponent must draw up a list of equipment and heavy machinery and how he intends to dispose of it.

7.2.4 Accumulation areas

The document must provide a complete and detailed description of all closure work that will take place on accumulation areas that receive ore, waste rock or overburden generated by exploration work. Where applicable, the closure plan must include the following:

- physical stability studies on infrastructure components related to managing the accumulation area or water;
- the type of cover, its components (unconsolidated deposits, topsoil, vegetation, etc.), its thickness and a physical characterization of the materials used for reclamation;
- planned solutions to deal with waste rock that is likely to produce contaminants (AMD or CND generators, radioactive waste rocks, or other problems);
- the intended reclamation technique for accumulation areas used during the exploration phase, along with a schedule and description of progressive reclamation activities and the management of waste rock and any other materials present in accumulation areas, if applicable, and the expected progress.

7.2.5 Water management infrastructure

Water management infrastructure includes dikes, embankments, collection and diversion ditches, culverts, pipelines, pumphouses, sedimentation basins, etc.

The document must include:

- a topographic map showing the location of any infrastructure components to be used after operations are shut down;
- a detailed description of any infrastructure the proponent intends to leave in place after operations are shut down;
- a description of infrastructure closure work that will no longer be needed after operations are shut down;
- closure plans for the sanitary facilities.

7.2.6 Land rehabilitation

When submitting a rehabilitation plan or a revised version of the plan, the document must include the measures that will be implemented to meet the land characterization and rehabilitation requirements described in section 4.3.1 of the Guide.

7.2.7 Petroleum and chemical products, and hazardous and non-hazardous waste

The document must describe the proposed methods for managing each of these substances after work is discontinued.

8. Mining project

8.1 Description of mining operations

8.1.1 Description of current and planned operations

The proponent must describe activities related to extraction, ore processing and, where applicable, tailings treatment. The information must provide an overview of the site and the scope of such activities.

This section of the document must specify the following:

- the average extraction rate (metric tons per day) of ore and waste rock, the average processing rate (metric tons per day) if the ore is processed onsite, and the tailings production rate;
- the expected mine life based on proven and probable reserves as defined by National Instrument 43-101;
- the tonnage and volume of overburden and topsoil stored, or to be stored, for later use during closure work;
- the tonnage and volume of tailings or waste rock stored, or to be stored, until operations are shut down;
- the tonnage and volume of tailings or waste rock that will be used as underground backfill until operations are shut down;
- the layout and surface area of the site's components (infrastructure, accumulation areas, sedimentation basins, etc.).

If mining operations have not yet begun, the document must include the schedule for site preparation work and the commencement of mining operations.

Hyperlink

National Instrument 43-101
ccmr-ocrmc.ca/wp-content/uploads/43-101_ni_en.pdf

8.1.2 Nature of mining operations

The proponent must describe the mining methods, specifically mentioning whether any waste rock or tailings will be used as backfill, and he must indicate the locations of surface openings and crown pillars (pillar geometry, length, width and height). For open pit mining, the proponent must provide a surface plan showing the pit's benches and access roads, and a vertical cross section through the pit. Slope stability studies must also be included.

8.1.3 Description and layout of facilities, infrastructure and buildings

The proponent must provide a current list or, in the case of new projects, an anticipated list of mining infrastructure and facilities, accompanied by descriptions and a surface plan indicating their locations. The location map must indicate the position of streams, rivers, lakes, ponds, marshes, swamps and peatlands, the current drainage configuration and the general topography of the land.

8.1.3.1 Buildings and mining infrastructure

The document must describe the buildings and mine infrastructure, including their components (foundations, structures, coverings, claddings and dimensions), and must also describe any crushers, ore transport units (conveyors) and hoists (shafthouse). It must be accompanied by a surface plan showing their location.

8.1.3.2 Ore processing plant and related buildings

If applicable, the document must describe the ore processing plant and related buildings, including their components (foundations, structures, coverings, claddings and dimensions). It must also include a comprehensive plan showing the location of the ore processing plant and related buildings, and indicating their components.

A short explanation of the processing plant's operations must also be provided, along with a process flowsheet. In addition, the proponent must indicate the main operating data.

8.1.3.3 Electrical, transportation and support infrastructure

The proponent must submit a surface plan showing the location and layout of all electrical, transportation and support infrastructures (roads, electrical transmission lines, railways, gas and water pipes, waterworks and sewer systems, electrical and telephone cables, reservoirs, bridges, culverts, etc.). A brief description must accompany the plans specifying the dimensions of the infrastructure components and, where applicable, their composition (materials).

8.1.3.4 Other buildings (administrative buildings, accommodations, cafeteria, etc.)

The document must describe other facilities and buildings erected on the mine site (administrative buildings, accommodations, cafeteria, etc.), including their components (foundations, structures, coverings, claddings and dimensions). It must be accompanied by a surface plan showing their location.

8.1.4 Accumulation areas

8.1.4.1 General information

The following elements must be presented in detail for each existing or planned accumulation area:

- a topographic map of the site showing the location and detailed geometry of each component of an accumulation area (with certain elements shown at a precision of 1 m), as well as the surface area occupied by each;
- the geology of the bedrock and unconsolidated deposits;
- the physical characteristics of the soils underlying the accumulation areas on the site (detailed descriptions of the geotechnical, hydrological and hydrogeological properties);
- the approach and recommendations from peer review studies of the designs, where applicable.

8.1.4.2 Waste rock piles

The following elements must be included for waste rock piles:

- a summary of the main criteria and calculations used to design the waste rock piles. Stability studies and design plans must be drawn up and signed by an engineer with recognized expertise and adequate education and knowledge for the type of structure to be built or the reclamation engineering techniques to be used. The signed documents must be presented as an appendix to the closure plan;
- if the waste rock stored in the accumulation area is considered high-risk, radioactive or AMD/CND generating, a description of the method for managing water in and around the accumulation area, and any effluent monitoring methods;
- a complete list of materials other than waste rock to be stored in the accumulation areas;
- the waste rock management method and a description of any measures to be implemented during operations to reduce the geotechnical and geochemical risks. The proponent must justify the absence of any prevention measure or progressive reclamation method during operations.

8.1.4.3 Tailings areas

The following elements must be included for the tailings areas (tailings impoundment and sedimentation basins):

- a summary of the main criteria and calculations used to design the tailings impoundment, including any sedimentation basins equipped with water retention structures. Stability studies and design plans must be drawn up and signed by an engineer with recognized expertise and adequate education and knowledge for the type of structure to be built or the reclamation techniques to be used. The signed documents must be presented as an appendix to the closure plan;
- the type of materials used to build the tailings impoundment, including the sedimentation basins, and their physical and chemical characteristics;
- the management method for materials in the tailings areas, the storage capacity and a description of measures to avoid overflows, particularly during transport;

- the measures to be implemented during operations to reduce geotechnical and geochemical risks. The proponent must justify the absence of any prevention measure or progressive reclamation method during operations;
- a complete list of materials other than tailings to be stored;
- if the tailings are considered high-risk, radioactive or AMD/CND generating, a description of the method for managing water in and around the storage area, and any effluent monitoring methods.

Data on the tailings areas must be updated each time the closure plan is revised as mining progresses.

8.1.4.4 Ore, overburden and concentrate storage areas

The following elements must be included for ore, overburden and concentrate accumulation areas:

- if the materials are considered high-risk, radioactive or AMD/CND generating, a description of the method for managing water in and around the storage area, and any effluent monitoring methods;
- if applicable, the management method and a description of any measures to be implemented during operations to reduce the geotechnical and geochemical risks;
- in the case of overburden, a description of its future use.

8.1.5 Water management

The document must describe the onsite water management system during mining operations. The description must include the following:

- the surface hydrological system (streams, rivers, lakes, etc.);
- watershed demarcation;
- a hydrogeological map illustrating the flow direction of all waters, as well as the results of a groundwater quality assessment and the location of observation wells;
- the location of water management structures (dikes, collection and diversion ditches, spillways, sedimentation basins, pumphouses, etc.). This information must be accompanied by a map showing the layout of such structures at the appropriate scale;
- all catchment structures for managing water around accumulation areas and how they connect during normal mining operations to the accumulation areas, the water management system for the rest of the site, and the effluent;
- the design criteria for the water management infrastructure (sedimentation basin capacity, freeboard, water collection system, capacity of water treatment system, etc.);
- the mine site water balance, including all water management infrastructure, the ore processing plant and the accumulation areas;
- a description of the final effluent sampling station (instrumentation, etc.) and the effluent monitoring methods, if applicable.

8.1.6 Wastewater treatment site

The description of treatment facilities for wastewater generated by mining operations must include the following:

- the wastewater treatment processes (with a flowsheet of the treatment circuit), including any issues the water treatment method may have in meeting D019 requirements during mining operations or, if applicable, during post-closure monitoring;
- maintenance and operation requirements;
- the daily and annual capacity of the wastewater treatment plant and the period of use;
- the volume of sludge produced annually, its physical and chemical characteristics, and the onsite management method, if applicable;
- if a passive treatment system is used, it must be described along with maintenance and monitoring requirements;
- the various sedimentation basins (surface areas, retention capacities, average retention times, embankment descriptions and freeboard heights.

8.1.7 Storage and disposal sites

The document must describe all storage and disposal sites on the mine site and specify the nature and quantity of any substances present. These sites must be indicated on a plan.

8.1.7.1 Chemical, petroleum and explosive products

The proponent must provide the following details regarding the storage and disposal of chemical, petroleum and explosive products used during mining operations, or any other chemical product employed at an industrial scale:

- a list of the chemical, petroleum and explosive products;
- a description of their use and the areas where they will be used (underground, pit, plant, etc.);
- the location and description of the storage sites;
- a final inventory of stored products;
- the storage methods;
- the recovery or disposal method(s) for the products, where applicable.

8.1.7.2 Non-hazardous waste

For every non-hazardous waste disposal site on the mine site, the proponent must provide a brief description of its characteristics and location. If the waste is disposed of or recovered outside the site, the proponent must only indicate where the disposal or recovery takes place and the name of the company contracted to carry out the work, where applicable.

8.1.7.3 Hazardous waste

The proponent must describe the management method for hazardous waste (e.g., used oils or other waste as defined in the Regulation respecting hazardous materials) and indicate the location of all hazardous waste storage sites on the mine site. Where applicable, the proponent must provide the information required under section 8.1.7.1.

8.2 Protection, rehabilitation and closure measures

8.2.1 Safety of work areas, surface openings and crown pillars

The proponent must explain how he will secure surface openings (shafts, stopes that reach the surface, etc.) and excavation sites in accordance with the Regulation (chapter M-13.1, r. 2, Chapter IX, Division II).

The proponent must demonstrate the stability of both surface (horizontal berms and vertical benches in the open pit) and underground structures (crown pillars), or present the methods to be used to support and stabilize them. If the structures cannot be supported and stabilized, all access routes must be condemned and a physical barrier must be erected around the pit or the hazardous area, as per MERN regulatory standards (chapter M-13.1, r. 2, Chapter IX, Division II).

For open pits, stopes reaching the surface or areas where the stability of the crown pillar presents a risk, securement measures must be based on a geotechnical study. Stability studies and calculations must be signed by an engineer with recognized expertise and adequate education and knowledge for the type of structure to be secured. The signed documents must be provided as an appendix of the closure plan.

8.2.2 Dismantling of buildings and infrastructure

The document must describe the methods used to dismantle and dispose of buildings (structures and foundations of administrative, accommodation and service buildings, including those in accumulation areas, the shafthouse, the processing plant, etc.), as well as support facilities and infrastructure (gas and water pipes, waterworks and sewer systems, telephone cables, underground reservoirs, etc.), transportation infrastructure (roads, bridges, culverts, ditches, etc.), and electrical equipment and infrastructure (power lines, pylons, electrical cables, transformers, etc.). It must also describe how the materials produced by the dismantling work will be recovered or disposed of, and the methods to reclaim the adjacent land.

The proponent must provide a list of components that will be removed from the site. In addition, a plan must show the layout of the buildings, support infrastructure, electrical equipment, electrical infrastructure and transportation infrastructure to be removed or left in place. The proponent must justify the decision to leave any buildings, equipment or infrastructure in place.

8.2.3 Disposal of equipment and heavy machinery

The proponent must provide an inventory of mining equipment, ore processing equipment and heavy machinery located on the site. The proponent must indicate how he intends to dispose of these, on or off the site, after mining operations are shut down.

8.2.4 Accumulation areas

8.2.4.1 Comparative assessment of reclamation scenarios and selection of reclamation scenario

The proponent must present the evaluation criteria for each proposed reclamation technique considered, and how the selected reclamation scenario was chosen. The design criteria and working assumptions used to select and develop the reclamation techniques must be presented in an appendix of the closure plan. As needed, several reclamation techniques may be presented to account for the specificities of each sector to be reclaimed, collectively constituting the reclamation scenario for the accumulation area.

For each accumulation area, the document must outline the following:

- all reclamation scenarios taken into consideration;
- the procedure and criteria used to select the reclamation scenario. The proponent must demonstrate how the scenario incorporates preventive measures during mining operations, progressive reclamation, and the reduction at source of elements responsible for potential contamination;
- a demonstration of the effectiveness and reliability of the selected reclamation techniques (completed and ongoing studies, similar cases, literature, etc.);
- an assessment of the anticipated performance in terms of the selected scenario's expected environmental conditions (water balance, chemical and physical stability, groundwater levels, etc.) in the short, medium and long term, including the notion of climate change;
- an assessment of anticipated performance that takes into account the ageing of materials and the changes in their properties over time, including aspects such as settling, degradation, etc.

The proponent must provide a list of all information sources and references used to document the proposed scenarios. At this stage, the estimate of indirect costs (see Appendix 3) should be accurate to within 30%.

8.2.4.2 Detailed description of the selected reclamation scenario

As the level of engineering progresses, the closure plan and its revisions must include a detailed description of the selected reclamation scenario. The proponent must describe in detail the closure work to be performed on waste rock piles and tailings areas, as well as all related infrastructure (processing ponds, drainage and water management systems, decant tower, dikes, embankments, spillways, etc.). Studies and scientific demonstrations must be conducted to confirm working hypotheses used during the design phase.

The level of detail to be provided by the proponent for each revision of the closure plan depends on the amount of data and information available. The level of engineering detail for the selected scenario must be demonstrated in the closure plan. All validation studies for the scenario must also be disclosed, including the results. The studies and calculations provided in an appendix of the closure plan must validate the working hypotheses used in the design phase. Indirect closure costs (see Appendix 3) may be adjusted as the level of engineering for the closure work progresses, to an accuracy of 10% or better when the construction plans and specifications are issued.

The detailed description of closure work must include at least the following:

- a description of the closure scenario, including the type of cover to be used (if any), a description of the materials (borrow pits, unconsolidated deposits, topsoil, vegetation, etc.), the thickness and stratigraphy of each layer, the physical and chemical characteristics of materials used for closure (grain size, mineralogy, water retention capacity, hydraulic conductivity, etc.), and any other information required to approve the scenario;

- an updated assessment, based on studies, knowledge and engineering progress, of the expected performance of the environmental predictions in the closure scenario (water balance, chemical and physical stability, groundwater levels, etc.) in the short, medium and long term, including the notion of climate change;
- studies of the physical and structural stability of infrastructure that will remain in place after closure work. These studies must be conducted and signed by an engineer with recognized expertise and adequate education and knowledge for the type of structure and its functions. The signed documents must be provided as an appendix in the closure plan. The studies must take the following into consideration, when applicable:
  - monitoring and maintenance requirements,
  - hazards and risks related to the structure,
  - size and geometry, including, for example, bench height,
  - the safety factors taken into account,
  - the properties of materials,
  - plans for mining waste disposal (tailings or waste rock, or any other materials),
  - final plans (as built) of infrastructure already in place.
- plans and specifications for the selected closure scenario, including the location of water management structures. The plans should indicate the location of sampling stations used for environmental monitoring and a description of the monitoring work required to ensure the physical stability of infrastructure (testing, instrumentation, sampling, inspections), if any;
- a description of the floodwater management system and related monitoring, maintenance, and emergency measures;
- an assessment of maintenance requirements for all infrastructure components present in accumulation areas.

8.2.5 Water management infrastructure

The proponent must describe the closure work for water treatment facilities and water management infrastructure, such as dikes, embankments, spillways, diversion and collection ditches, culverts, water pipelines, pumphouses, etc.

If effluent treatment must continue after closure of the mine site, the proponent must refer to section 9.2 of the Guide for a list of required information.

8.2.6 Climate change

In light of climate change, the closure plan must include the following:

- a list of infrastructure vulnerable to the impacts of climate change, namely those relating to water management and accumulation areas;
- the climate change model used in calculations and predictions, if any;
- the hazards and risks identified and measures taken, namely in infrastructure engineering and the closure scenario for accumulation areas;
- measures to adapt to the forecasted climate changes in the proposed closure scenarios.

The proponent may refer to section 4.15 of the Guide and to Appendix 8 for references on climate change in Québec and elsewhere.

8.2.7 Land rehabilitation

When submitting a closure plan or a revised version of the plan, the document must include the measures that will be implemented to meet the land characterization and rehabilitation requirements described in section 4.3.1 of the Guide.

8.2.8 Petroleum and chemical products, and hazardous and non-hazardous waste

The document must describe the proposed methods for managing each of these substances when mining operations are shut down.

9. Post-closure Monitoring and Maintenance Program

The objective of implementing a post-closure monitoring and maintenance program that complies with the requirements set out in Section 4.14 of the Guide is to ensure the physical stability of infrastructure and the effectiveness of any remedial measures applied at the site.

9.1 Physical stability monitoring and maintenance

The proponent must present a monitoring and maintenance program that includes the following:

- the monitoring and maintenance objective;
- the location of the monitoring station(s);
- the work schedule (monitoring period and inspection frequency);
- the type of monitoring required (visual inspections, measurements, parameters, etc.);
- the field instrumentation (observation wells, automated sampling stations, flow sensors, survey markers);
- the inspection methods and the methods for compiling the data and evaluating the results;
- the contact information of the persons responsible for the monitoring work.

9.2 Environmental Monitoring

The proponent must present an environmental monitoring program that includes the following:

- the monitoring objective;
- the location of the control stations (onsite, upstream of the discharge point and downstream of the receiving environment, the location of the observation wells, etc.);
- the parameters (physical, chemical and biological);
- the description of sampling tools and measurement systems (pH, flow, etc.);
- the work schedule (sampling frequency);
- the compilation and evaluation of the results;
- the contact information of the persons responsible for environmental monitoring.

If effluent treatment facilities need to be maintained in working order, the proposed environmental monitoring program must include:

- a description of the facilities (including sedimentation basins and testing equipment) and the treatment processes used or to be implemented (including the effluent treatment plant, if applicable);
- an evaluation of the annual period of use of the treatment equipment and their maintenance and operation requirements;
- the estimated volume and characteristics of the water to be treated and the quality of the effluent produced;
- for sludge:
  - the estimated annual production rate and the chemical and physical characteristics of the sludge;
  - the description of the treatment, storage or disposal methods;
  - a brief description of the characteristics of the sludge disposal site if it is stored or eliminated onsite;
- the contact information for the persons responsible for the maintenance and operation of the water treatment facilities.

9.3 Agronomical Monitoring

The agronomical monitoring program must include the following:

- the monitoring objective;
- the type of monitoring (visual inspections, measurements, soil and plant tissue sampling and analysis, etc.);
- the application of fertilizer (type, frequency, surface area involved, etc.);
- if needed, repeat fertilizers, shrubbery and herbaceous planting (species, surface area involved, etc.), invasive alien species detection and control, and general maintenance requirements;
- the contact information for the persons responsible for agronomical monitoring and maintenance.

10. Emergency Plan

The proponent must prepare a simple, functional and effective emergency plan to manage any hazards that might occur during the closure and post-closure periods. Every hazard, even the least likely, must be identified, along with the measures and actions to take.

Even if all stability criteria have been satisfied, there remains a probability that exceptional or unforeseen events will provoke a partial or total failure of one or more retention structures. For this reason, the proponent or an authorized representative must prepare an emergency plan and define the appropriate measures to take in order to ensure the safety of workers, the neighbouring population and the environment. The emergency plan is based on the hazards associated with each type of infrastructure. For each component, an inventory must be made of the hazards and risks related to its use during the production phase and following closure. This information will determine the response procedures. The hazards associated with any degree of structural failure (rupture) should be examined.

The emergency plan must include the following:

- a detailed list of hazards associated with each type of infrastructure and a description of intervention measures;
- preventative measures to ensure rapid and effective responses to emergency situations (training, public signage);
- the actions to take immediately following an accident, including the list of emergency equipment and the location of such equipment;
- hazard zones identified according to the severity and consequences of a dike failure (evacuation, barriers, etc.);
- a list of the contact information for the mine site persons responsible for immediately implementing the response measures;
- a list of the organizations to contact along with their contact information (municipality, police, provincial environmental emergency agency Urgence-Environnement, Public Safety Canada, etc.).

11. Economic and scheduling considerations

11.1 Detailed cost assessment of closure work

The cost of closure work must be based on all quantifiable information available when the closure plan is submitted (Appendix 3 of the Guide). During subsequent revisions, the cost estimate must become increasingly accurate.

The proponent must assess the cost for mine site closure work in current dollars for all areas of land affected at the end of mine life (including the cost of all studies), and the assessment must cover the mining facilities and accumulation areas. Costs must be detailed for each activity as if all work will be carried out by a third party. For the mining facilities, the dismantling costs must be given as gross amounts and must not take into account any revenue that may be earned from the sale of equipment, property, steel or any other materials that could be recovered during demolition.

Administration fees and design and implementation fees for the monitoring program (physical stability inspections and environmental and agronomic monitoring) must be included in the closure cost.

Indirect costs (engineering and supervision) and a contingency must be added to the total of the estimate (see Appendix 3 of the Guide for more information on calculating closure costs).

The contingency must be applied to all closure costs, including post-closure monitoring and maintenance costs.

11.2 Work schedule

For each component of sections 7.2 (Exploration Project) and 8.2 (Mining Project), which deal with protection, rehabilitation and closure measures, the document must provide a detailed schedule of the closure work involved (progressive and after mining operations are shut down), including the human and material resources required to carry out the work.

The proponent must also provide the schedule for dismantling the wastewater processing plant (sections 7.2.5 and 8.2.5) and other buildings once they are no longer operational.

An implementation schedule for post-closure inspections and monitoring and maintenance work (section 9) must also be included in the final closure plan.

APPENDIX 1: GEOTECHNICAL STABILITY OF ACCUMULATION AREAS – SUPPLEMENTARY INFORMATION

Introduction

This appendix presents the main structural stability criteria applicable to accumulation areas, particularly to waste rock piles and tailings impoundments. It is meant to serve as a guide for the construction of such areas so that closure can be planned during the initial design phase. The criteria presented here in no way limit the guidelines given elsewhere in other government documents concerning the management of waste rock and tailings. For infrastructure that is subject to the *Dam Safety Act*, the design criteria (applicable standards) may differ from the criteria presented in this appendix. Unless otherwise specified, it is recommended that designs meet the most conservative criteria. Proponents may use analytical methods and approaches other than those suggested here as long as they show that these procedures are recognized and appropriate.

1. Parameters to consider when designing the infrastructure of accumulation areas

1.1 General Information

The site investigation techniques, the methods for determining the properties of materials (foundations, backfill and infrastructure) and the procedures for setting up and compacting accumulation areas must comply with industry standards. To do so, a minimum level of characterization must be achieved, defined by the number and frequency of specific tests.

Where applicable, the design must follow standards established by the Bureau de normalisation du Québec (BNQ), the Canadian Standards Association (CSA) and the American Society for Testing and Materials (ASTM), and must comply with all laws and regulations in force, as well as the recommendations of specialists in the field, the Canadian Dam Association (CDA) and D019 pertaining to the mining industry (MDDELCC).

To ensure the structural stability of accumulation areas, geotechnical integrity must be maintained (internal erosion, surface erosion, particle size of the materials, hydraulic gradient, etc.), particularly when it comes to retention and containment structures, flood control structures, and the materials constituting tailings and waste rock.

The following principles apply to infrastructure design for accumulation areas.

- Infrastructure must be built on competent foundation materials that have undergone adequate characterization to define their bearing capacities and their ability to withstand movement. Soft ground, such as certain types of clay deposits or waterlain silt, should be avoided.
- Stability calculations must be done using suitable analytical techniques that employ methods and tools commonly used by specialists in the field, supported by an adequate determination of the properties of construction and foundation materials.

- Stability calculations must be based on conditions that may have an impact on the infrastructure, using conservative estimates of anticipated static and dynamic loads. Among other things, they must include an overall assessment of physical stability of infrastructure and ground integrity in the event of liquefaction by considering the properties of the materials when interstitial overpressures are generated. The ageing of materials and the changes in their properties over time must also be taken into account.

  The standards set out in the National Building Code of Canada and the data provided by the Geological Survey of Canada must form the basis for determining seismic parameters.

Hyperlink

Geological Survey of Canada
nrcan.gc.ca/earth-sciences/science/geology/gsc/17100

- In designing infrastructure and evaluating its stability, a minimum service life of 100 years must be assumed for the duration of mining operations.
- The service life of any structure that will remain in place following closure and reclamation work must be at least 1,000 years. The service life of sites that are potential AMD or CND generators must be even longer.
- Another key element to take into account when determining the loading conditions for each infrastructure component is the acceptable probability of failure. The probability of failure determines the magnitude of intermittent or recurrent critical events using the annual probability of occurrence (the inverse of the return period).
- An accurate risk assessment is recommended to determine the category of a water retention structure. In the absence of such an assessment, the CDA's recently proposed classification (CDA-ACB 2014), comprising five risk levels from low to extreme, can be used to assess the conditions that would apply during mining operations and at the time of closure.
- Surface erosion problems should be controlled by placing a vegetative cover over a suitable substrate (nature of the material, thickness, drainage, protection, durability, etc.) and by ensuring adequate surface drainage through means that reduce slope length (drainage berms, ditches in slopes, etc.), thereby reducing runoff speed and lowering the risk of erosion.
- The upstream construction method should be avoided, and additional information will be requested if the proponent intends to employ this method.
- The infrastructure monitoring program must meet the requirements presented in Chapter 9 of the Guide. The monitoring period (mining and post-mining, including long-term monitoring and maintenance) and the nature of the monitoring and maintenance activities (visual observations, maintenance work, instrumentation, monitoring) should be adapted to the scale of the infrastructure, the characteristics of the site, the consequences of failure, and the risks associated with the site's components. The information must be compiled in a compendium that will be consulted regularly to assess the response of infrastructures. This compendium must be made available to the person in charge of infrastructure monitoring and maintenance, as well as during any external consultation, such as peer reviews, when deemed necessary. A copy of the compendium must be submitted to the MERN, as needed, including during the post-closure monitoring and maintenance period.

1.1.1 Waste rock piles

Classification

In addition to the classification proposed by the CDA (CDA-ACB 2014), a waste rock pile can also be classified using the Piteau approach (1991). The latter is based on pile size (height and volume), geometric configuration (slope angles, presence of benches and berms), properties of the waste rock and foundation soils, hydrological conditions, and nature of the local environment.

Closure design

Local (bench) and overall (pile) stability must satisfy the recommended safety factor values. If possible, to promote overall stability, the slope should have benches and berms (terraces that allow vehicles to safely circulate) with a geometry and emplacement that maximizes surface drainage and thus minimizes water infiltration.

Factor of safety

Table 1 presents the recommended minimum factor of safety values for waste rock piles and analogue surface infrastructure where granular materials are stockpiled, such a low-grade ore.

TABLE 1 - Recommended minimum factors of safety for the stability analysis of waste rock piles

Condition	Factor of safety
Bearing capacity of the foundation (ground) beneath the pile*	1.5 to 2.0
Local pile stability (for each bench)	
Short-term static analysis*	1.0 to 1.1
Long-term static analysis	1.2
Overall pile stability, failures at depth or in the foundation (ground)	
Short-term static analysis*	1.3 to 1.5
Long-term static analysis	1.5
Pseudo-static analysis*	1.1 to 1.3

*Based on the risk and confidence level.

1.1.2 Tailings impoundments and water retention basins

Selection of recurrence events

The design of long-term water retention structures, such as basins that use water as a cover material or an elevated water table with a monolayer cover to control the oxidation of reactive minerals, must be based on extreme events that may be expected to occur, such as probable maximum precipitation (PMP), probable maximum flood (PMF) and periods of drought.

The selection of the design flood that should be able to accumulate in basins following mine site closure should be based on an annual probability of ≤ 10-4. From a practical view point, critical recurrent events with return periods of 10,000 years should be used.

Safety factors

Table 2 presents the recommended minimum safety factors for the design of tailings dikes and associated infrastructure.

TABLE 2 – Recommended minimum safety factors for the stability analysis of tailings dikes and water retention basins

Zone	Condition	Safety Factor
Upstream and downstream	Slope stability at the end of each stage of construction (short term)*	1.3 to 1.5
	Pseudo-static analysis (short term)	1.1
	Slope stability in the presence of the design flood*	1.3 to 1.5
	Slope stability in stationary conditions (long-term)	1.5
	Post-seismic analysis	1.3
	Pseudo-static analysis	
	Long-term stationary state	1.25
	With basin filled and resistance reduced by overpressures	1.1
Upstream	Rapid draining, static analysis	1.3
	Rapid draining, pseudo-static analysis	1.1
Central	Horizontal sliding of the dike as a result of static loading	1.5
	Horizontal sliding of the dike as a result of pressure generated during tailings liquefaction	1.3
	Bearing capacity of the ground beneath the dike*	1.5 to 2.0

*Based on the risk and confidence level. The risk is considered high for dikes intended for long-term water retention.

For AMD/CND generating tailings that are maintained in a saturated state using wet or dry covers or by means of an elevated water table, conservative safety factors should be applied due to the increased risk.

A list of references on the subject of geotechnical stability is provided in Appendix 8.

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APPENDIX 2: CLOSURE PLAN VALIDATION GRID – TO BE FILLED OUT BY THE APPLICANT

A – Exploration Project

Exploration Project	✓*	N.A.**	Available information (references)***
General Information			
Summary of the closure plan			
Identity of the proponent			
Resolution of the board of directors			
Location of the property in annexed surface plans			
Geology and mineralogy, notably: > Tests of metal grades, AMD potential and leaching potential, tables of results and interpretation of results			
History of the site			
Authorizations			
Site Description			
General description and nature of current and future exploration activities			
Description and location of the site			
Description of buildings and surface infrastructure, with annexed plans			
Description of electrical, transportation and support infrastructures			
Water management			
Accumulation areas			
Other areas to be used			
Storage and disposal sites			
> Chemical and petroleum products, explosives			
> Non-hazardous waste			
> Hazardous waste			
Protection, rehabilitation and closure measures			
Work site safety, securement of mine openings and stabilization of crown pillars			
Dismantling of surface buildings			
Dismantling of surface infrastructure			
Equipment and heavy machinery disposal			
Accumulation areas			
Water management infrastructure			

Exploration Project	✓*	N.A.**	Available information (references)***
Land rehabilitation (contaminated soils)			
Post-closure monitoring and maintenance program, if applicable			
Physical stability monitoring and maintenance			
Environmental monitoring			
Agronomic monitoring and maintenance			
Economic and scheduling considerations			
Detailed cost assessment of closure work			
Implementation schedule of closure work			
Emergency plan			
Applicable measures in case of a temporary shutdown of exploration activities			

* Item included

** Not applicable

*** If the information is not included in a revision of the submitted closure plan, indicate where the information can be found (reference and page).

B – Mining Project

Exploration Project	✓*	N.A.**	Available information (references)***
General information			
Summary of the closure plan			
Identity of the proponent			
Resolution of the board of directors			
Location of the property with annexed surface plans			
Geology and mineralogy, notable: > Tests of metal grades, AMD potential and CND potential, tables of results and interpretation of results			
History of the site			
Authorizations			
Description of mining operations			
Description and nature of current and future mining operations, notably: > Average ore extraction and milling rates > Estimated life of mine > Tailings production rate > Surface area of the accumulation areas			
Description of buildings and surface infrastructure, with annexed plans, notably: > Buildings and infrastructure used in the extraction of ore > Description of the ore processing plant			
Description of electrical, transportation and support infrastructures			
Description of other buildings (administrative and accommodation buildings, cafeteria, etc.)			
Accumulation areas			
> Description of waste rock piles, ore stockpiles and overburden piles			
> Description of tailings management facility			
Description of site water management, notably: > Hydrologic system and watershed > Water balance for accumulation areas and plant > Schematic of water management and emplacement of final effluent > Groundwater quality			
Description of wastewater treatment site, notably: > Wastewater treatment processes > Description of sedimentation basins > Effluent sampling station			

Exploration Project	✓*	N.A.**	Available information (references)***
Storage and disposal sites			
> Chemical and petroleum products, explosives			
> Non-hazardous waste			
> Hazardous waste			
Protection, rehabilitation and closure measures			
Work area safety, securement of mine openings and stabilization of crown pillars			
Dismantling of surface buildings and infrastructure, notably: > Buildings and infrastructure used in ore extraction > Description of the ore processing plant			
Dismantling of electrical, transportation and support infrastructures			
Dismantling of other buildings (administrative and accommodation buildings, cafeteria, etc.)			
Equipment and heavy machinery disposal			
Reclamation of the accumulation areas, notably: > Comparative analysis of reclamation scenarios > Selected reclamation scenario			
Water management infrastructure			
Land rehabilitation (contaminated soils)			
Management and disposal of petroleum products, chemical products, hazardous waste and non-hazardous waste			
Climate change			
Post-closure monitoring and maintenance program, if applicable			
Physical stability monitoring and maintenance			
Environmental monitoring			
Agronomic monitoring and maintenance			
Economic and scheduling consideration			
Detailed cost assessment of closure work			
Implementation schedule for closure work			
Emergency plan			
Measures applicable in case of a temporary shutdown of mining operations			

* Item included

** Not applicable

*** If the information is not included in a revision of the submitted closure plan, indicate where the information can be found (reference and page).

C – Format specifications for documents

Sizes and scales	√
Four paper copies and one electronic document	
Document presented on standard size paper: 216 mm by 279 mm (8.5 in by 11 in)	
Plans and graphs presented on paper 216 mm by 356 mm (8.5 in by 14 in) or 279 mm by 432 mm (11 in by 17 in), or larger size paper, if appended	
Measurement units on the plans follow the International System of Units (SI)	
Graphics comply with scale specifications to ensure clarity	
Content of the closure plan	
Plans certified, dated and signed by an engineer	
Names and contact information of the company, and the names, professions and duties of the people involved in producing the document	
Signatures of authors and reviewers	

APPENDIX 3: GUIDELINES ON THE COST ASSESSMENT TO BE SUBMITTED IN THE CLOSURE PLAN

The cost assessment of closure work must include the following information:

- The assessment must cover all areas of land affected at the end of mine life.
- The cost assessment must be presented as a table, sorted by type of activity or by sector (buildings, processing plant, tailings facility, etc.).
- Each component of an activity must be presented separately. For example, an amount cannot cover both levelling and revegetation. Each amount must therefore represent a single activity.
- The unit costs of each activity, if applicable, must be provided in the table.
- The base unit (m, m2, m3, ha, year, number of samples, etc.) used to calculate the cost of the activity must be shown in the table.
- The costs of dismantling buildings and infrastructure must be based on a quote from a firm specialized in the field, and a summary of the limitations and assumptions of the quote must also be provided.
- The resale value of equipment and materials cannot be deducted from the dismantling costs.
- Indirect costs (engineering and supervisory fees) and contingency costs should reflect the stage of completion of the project and be integrated into the closure costs. Indirect costs (including post-closure monitoring and maintenance program) related to closure work must be at least 10% (30% at the conceptual design stage of the reclamation scenario and 10% at the issuance of plans and specifications), and contingency costs must be at least 15%. The contingency is applied to the sum of all costs preceding it and is added to the subtotal.
- Post-closure and post-reclamation costs related to monitoring and maintaining infrastructure integrity must be included.
- Post-closure and post-reclamation costs related to agronomic and environmental monitoring (surface and groundwater) must be included. Monitoring must minimally meet the requirements of D019 on the mining industry (number of samples and frequency).
- Post-closure and post-reclamation costs related to land characterization and the rehabilitation of contaminated land must be included.
- In some cases, where the proposed closure measures are to be validated through studies or cannot be immediately implemented (for example, due to the unavailability of equipment or materials), a reclamation scenario applicable upon implementation of the closure plan or a mark-up may be added to the total cost of the proposed reclamation concept. The cost estimate should be based on available information and should take into account the cessation during mining operations. The MERN must be able to carry out the complete closure of the site using the amounts of the financial guarantee deposited upon each revision of the closure plan.
- All costs must be reported in current dollars.

APPENDIX 4: MINIMUM REQUIREMENTS CONCERNING THE RESOLUTION OF THE BOARD OF DIRECTORS

The resolution of the board of directors must specify the name of the person and his or her position within the organization, and must stipulate that the organization is authorized, in the name of the person, to present the closure plan or its revision to MERN. The text of the resolution may be drafted in French, English or in both languages. The resolution must be signed by the person's representative(s), and be dated.

APPENDIX 5: TEMPLATE FOR IRREVOCABLE AND UNCONDITIONAL LETTER OF CREDIT

Place and date of issue:

Place and date of expiry:

Client: (Name and address of mining company)

Property: (Name of mine site or description of mining title)

Recipient: Ministère de l'Énergie et des Ressources naturelles

5700, 4e Avenue Ouest, Suite C-318,

Quebec, Québec G1H 6R1

Guarantor: (Name and address of financial institution)

Amount: Canadian dollars

This letter constitutes a guarantee for the payment of the cost of the work on land affected by (client)'s mining operations in the event of non-compliance with the obligations set out in sections 232.1 to 232.10 of the Mining Act (chapter M-13.1). The guarantor undertakes to remit the amount of the guarantee to the Ministère de l'Énergie et des Ressources naturelles, upon request, in the event section 232.8 of the Mining Act applies.

The letter of credit has a minimum term of twelve months. It will be automatically renewed until a certificate of release is issued under section 232.10 of the Mining Act.

In the case of non-renewal, termination, revocation or cancellation of the letter of credit, the guarantor shall notify the Ministère de l'Énergie et des Ressources naturelles at least 60 days before the date fixed for the expiry, termination, revocation or cancellation of this letter.

In the case of non-renewal, termination, revocation or cancellation of the letter of credit, the guarantor remains responsible, where the requirements of sections 232.1 to 232.10 of the Mining Act are not met, for the payment of the cost of the work involved in mining operations carried out before the date of expiry, termination, revocation or cancellation up to the amount covered by the letter of credit. That responsibility shall hold until the issue of a certificate of release provided for in section 232.10 of the Mining Act, unless (client) has deposited an alternative guarantee with the Ministère de l'Énergie et des Ressources naturelles that complies with the Regulation respecting mineral substances other than petroleum, natural gas and brine.

The obligation is solidary, with a waiver of the benefits of discussion and division.

The guarantor consents to the Ministère de l'Énergie et des Ressources naturelles being able at any time after the sending of a notice of 60 days to make changes to the rehabilitation and restoration plan and waives pleading against the Minister any ground of defence pertaining to the content of the plan.

In case of dispute, the courts of Québec are the sole competent courts

Signed at (place), on (date)

Authorized Signatory

APPENDIX 6: TEMPLATE FOR SECURITY OR GUARANTEE POLICY

Place and date of issue:

Place and date of expiry:

Client: (Name and address of mining company)

Property: (Name of mine site or description of mining title)

Recipient: Ministère de l'Énergie et des Ressources naturelles

5700, 4e Avenue Ouest, Suite C-318,

Quebec, Québec G1H 6R1

Guarantor: (Name and address of financial institution)

Amount: Canadian dollars

This security or guarantee policy constitutes a guarantee for the payment of the cost of the work on land affected by (client)'s mining operations in the event of non-compliance with the obligations set out in sections 232.1 to 232.10 of the Mining Act (chapter M-13.1). The guarantor undertakes to remit the amount of the guarantee to the Ministère de l'Énergie et des Ressources naturelles, upon request, in the event section 232.8 of the Mining Act applies.

The security or guarantee policy has a minimum term of twelve months. It will be automatically renewed until a certificate of release is issued under section 232.10 of the Mining Act.

In the case of non-renewal, termination, revocation or cancellation of the security or guarantee policy, the guarantor shall notify the Ministère de l'Énergie et des Ressources naturelles at least 60 days before the date fixed for the expiry, termination, revocation or cancellation of this security or guarantee policy.

In the case of non-renewal, termination, revocation or cancellation of the security or guarantee policy, the guarantor remains responsible, where the requirements of sections 232.1 to 232.10 of the Mining Act are not met, for the payment of the cost of the work involved in mining operations carried out before the date of expiry, termination, revocation or cancellation up to the amount covered by the security or guarantee policy. That responsibility shall hold until the issue of a certificate of release provided for in section 232.10 of the Mining Act, unless (client) has deposited an alternative guarantee with the Ministère de l'Énergie et des Ressources naturelles that complies with the Regulation respecting mineral substances other than petroleum, natural gas and brine.

The obligation is solidary, with a waiver of the benefits of discussion and division.

The guarantor consents to the Ministère de l'Énergie et des Ressources naturelles being able at any time after the sending of a notice of 60 days to make changes to the rehabilitation and restoration plan and waives pleading against the Minister any ground of defence pertaining to the content of the plan.

In case of dispute, the courts of Québec are the sole competent courts.

Signed at (place), on (date)

Authorized Signatory

APPENDIX 7: GLOSSARY

A

Accumulation area: Land on which mineral substances, overburden, concentrates, waste rock or tailings have been, are or will be piled or accumulated. Mining water, sedimentation and polishing basins are also considered accumulation areas.

Acid mining drainage: Outflow of acid water containing dissolved metals as a result of natural oxidization of sulphides found in waste rock, ore and tailings exposed to air and water.

B

Backfilling: Within the meaning of backfilling underground openings, this term signifies returning tailings or waste rock underground to ensure the stability of underground worksites.

Basin: Structure for accumulating solid, semi-liquid or liquid substances to prevent them from spreading into the environment, or to reduce spreading.

Bench: In an open pit, the vertical distance between two berms (horizontal floors).

Berm: In an open pit, the horizontal distance between two benches, measured perpendicular to the pit's perimeter.

Bulk sampling: Sampling of more than 50 metric tons of mineral substances.

C

Chemical characterization: Chemical features that define material (pH, alkalinity, acidity, adsorption, nutrients, exchangeable cation, chemical composition, acid mining drainage, metal grade, mineral and chemical compound content, etc.).

Clay cell: Cell made using clayey material in order to limit the spread of contamination beyond the cell.

Concentrate: Valuable substance produced by physical and/or chemical treatment of ore enabling the separation of economic minerals from gangue**.**

Conceptual design: Plan chosen from among various possible options, outlining the main points without including details (specifications).

Contaminant: A solid, liquid or gaseous matter, a microorganism, a sound, a vibration, rays, heat, an odour, a radiation or a combination of any of them likely to alter the quality of the environment in any way (EQA section 1, paragraph 5).

Contaminated neutral drainage: Outflow of water containing dissolved metals in concentrations above environmental standards under near-neutral pH conditions.

Contaminated soil: Soil whose chemical content is notably higher than the background concentration due to mining operations, or which contains substances that do not occur naturally.

Cover: Soil cover comprising a multi-layer system with or without vegetation, a moisture barrier or any other contaminant containment process.

Crown pillar: Rock mass of variable geometry; may contain minerals or not; on top of underground mine workings**.**

Culvert: A small bridge allowing traffic to travel over streams and brooks.

D

Decant tower: Structure for evacuating flood waters and maintaining water levels in the tailings impoundment.

Dike: Structure design for containing tailings and mining effluent.

E

Electrical infrastructure: Electrical systems, facilities and equipment; i.e., transmission lines, electrical cables, pylons, transformers, etc.

Environmental characterization: Actions comprising a process for determining the presence of contamination and the attendant risks and impacts. The purpose of characterization is to define site-specific contamination issues.

The work required is determined by the extent of contamination and may range from basic sampling to borehole programs, including the setup of observation wells.

Equipment: Any device or fixed tool used in mining operations (hoists, cranes, underground hydraulic gates, underground rails, underground water and air pipes, various reservoirs, fans, pumps, crushers, flotation cells, cyanidation tanks, thickeners, etc.)

Evaluation: Any survey, monitoring, inspection, testing or data collection activity designed to determine:

1. the existence, source, nature and extent of contamination resulting from the discharge of hazardous material or chemical substances into the environment;
2. the extent of the hazard to human health, public safety and welfare and to the environment.

Evaluation includes studies, services and surveys designed to organize, manage and direct assessment, industrial site decommissioning, and clean-up operations.

Excavation: Any man-made surface opening or depression; i.e., trench, open pit, opening, etc.

Exploration: Mining activity aimed at discovering deposits or evaluating them (feasibility study); includes development work.

Extraction: The act of extracting ore, waste rock or tailings from an underground or open-pit mine. Extraction also refers to the treatment process by which a substance to be concentrated or eliminated is extracted from solids, liquids or gases.

F

Final effluent: Mining wastewater requiring no further treatment before its discharge into the receiving environment.

Foundation: The term encompasses the concrete slab forming the supporting base of a structure and the concrete walls on which it sits.

G

Geotechnical study: Theoretical and applied evaluation of the physical and mechanical characteristics of soils and rock, and the stability of structures.

Guarantee: The proponent's legal and financial obligation to ensure the Government that money is available to carry out closure work should the proponent fail to honour his commitments. See section 3.3.1 of Chapter 1 for a description of the different types of financial guarantee.

Guarantor: Person who signs an agreement with a third party agreeing to honour the obligations of a debtor.

H

Habitat: Ecosystem in which organisms, populations, species and groups of species live.

Hazardous waste: A material which, by reason of its properties, is a hazard to health or to the environment and which is explosive, gaseous, flammable, poisonous, radioactive, corrosive, oxidizing or leachable, as well as any material or object classed by regulation as a hazardous material. Such substances are stipulated under the Regulation respecting Hazardous Materials. Note that tailings are not considered hazardous waste under the Environment Quality Act.

Heavy machinery: Any mobile equipment that moves independently or can be moved by a motor vehicle and is not permanently attached to the bedrock. Heavy machinery includes rail trains, motor vehicles (automobiles, trucks, scoop trams, power shovels, bulldozers, etc.), drills on wheels, tracks or skids, fork-lifts, etc.

Host rock: Term generally used to describe the rock that forms a wall supporting the ore deposit or mineralized zone.

I

Invasive exotic species: A plant, animal or microorganism (virus, bacteria or fungus) introduced beyond its natural range. Its establishment or spread may pose a threat to the environment, the economy or society. A plant introduced beyond its natural range.

L

Levelling: Grading the land to make it blend with the surrounding landscape.

Lithology: Nature of the rocks composing a rock formation in terms of their macroscopic characteristics (mineralogical composition, texture, colour, etc.).

M

Mine: Any opening or excavation made for the purpose of searching for or mining mineral substances or operating an underground reservoir, including a well used to maintain water pressure, to dispose of or inject water or to create a water supply source, passageways, works, machinery, plants, buildings and furnaces below or above ground and forming part of a mining operation (M-13.1, s. 218).

Mine site: Any land that is or could be used for exploration or mining**.**

Mine water or dewatering: Water pumped from a mining excavation to keep the mine workings dry.

Mineral substances: Within the meaning of the Mining Act (chapter M-13.1, s. 1), natural mineral substances in solid, gaseous or liquid form, except water, and fossilized organic matter.

Mining: Extracting, concentrating, smelting or refining mineral substances from an ore deposit.

Mining method: Technique used to extract ore from an underground or open-pit mine.

Mining operations: Activities aimed at increasing or mining mineral resources, including prospecting, exploration, bulk sampling, ore extraction, ore processing and tailings processing.

N

National Instrument 43-101: Instrument relating to a regulation governing the public disclosure of mining projects. The regulation falls under the Securities Act.

Natural flow: Pre-mining flow of water.

Non-hazardous waste: Any waste generated by a production, transformation or utilization process, or any substance, material, product or, in a broader sense, belonging that has been or will be abandoned. Among the materials constituting non-hazardous waste are household garbage, tires, paper, cardboard, glass, construction and demolition debris, metals, plastic, non-hazardous industrial waste, non-hazardous sludge, incineration residue from burning household waste or municipal sludge, etc.

O

Openings: Shafts, raises, adits, ramps and underground worksites with surface openings, and any other access to underground structures.

Operator: Any person who, as owner, lessee or occupant of a mine or underground reservoir, performs or directs mining operations, or causes them to be performed or directed (M-13.1, s. 218).

Ore: Rock mass containing valuable minerals in sufficient concentrations and volumes to justify mining.

Ore processing: Operation that consists of extracting valuable substances from ore, concentrate or tailings.

Ore reserves: Mineral reserves for an existing mining activity or for a deposit for which mining is being considered and is deemed profitable based on a feasibility study.

Overburden: Any mineral substance covering bedrock (unconsolidated deposits), excluding substances in accumulation areas.

P

Person: Individual, society, cooperative or corporation other than a municipality. Except where inconsistent with the statute or with the circumstances of the case, extends to heirs and legal representatives (chapter I-16, s. 61, p. 16).

Petroleum products: Includes fuel (gas, diesel and airplane fuel), combustibles (light and heavy heating oil), lubricants (new or used oils, greases). Liquefied gas (propane, natural gas, etc.), oils used in hydraulic and cooling systems, and mineral and vegetable oils used to work metals and PCBs (chapter U-1.1, r.1) are not considered petroleum products.

Physical properties: Physical features that define a material (colour, structure [microporosity and macroporosity], hydraulic conductivity of soil (compacted and in situ), air and water content, compressibility, plasticity, cohesion, consistency, swell, capillarity, hardness, particle size, texture, porosity, etc.).

Processing plant: Surface facilities used for upgrading ore. The facilities are used to recover metals or to concentrate valuable minerals for smelting or any other type of reduction.

Proponent: Person who, in his capacity as operator or mining title holder, submits the mine site closure plan.

Proven reserves: Mineral deposit whose volume, boundaries, mass and ore grades have been established and detailed through drilling and sampling at tight and regular spacings, and through mining work and systematic comprehensive sampling programs and bulk sampling. Access to the ore and the level of knowledge is sufficient for making detailed mining plans.

R

Receiving environment: Natural aquatic or land ecosystem into which gases, liquids and solids from mining operations are emitted, discharged or deposited.

Reclamation: Operation consisting of returning a mine site to a satisfactory condition. In this document, the term "restoration" is included under reclamation.

Recurrence: Period during which an event is likely to happen again.

Rehabilitation: In the Guide, the term rehabilitation has the same meaning as in the Soil Protection and Contaminated Sites Rehabilitation Policy of the MDDELCC. It designates the actions of managing the impacts and risks associated with contaminated land.

Reserves: Mineral deposit for which a feasibility study has proven and established characteristics such as mass, ore grade, mineralogy, size, boundaries, distribution, variability. The level of knowledge is adequate and explicit enough to establish potential profitability.

The feasibility study requires sufficient quantitative knowledge to justify the investments needed to mine the deposit.

Riprap: Surficial cover of rocks intended to stabilize the shores of water courses and to control erosion.

S

Sand pit: Location from which unconsolidated mineral substances are extracted by open pit; substances include sand, gravel, clay and other unconsolidated mineral substances.

Securement: Implementation of the measures described in Chapter X of the Regulation (M-13.1. r.1) and the techniques used to implement the provisions under Section 232 of the Mining Act.

Scarify: Break up the soil before harrowing.

Schedule: Time allocated for the various stages of work, a program of activities, actions, etc.

Sedimentation basin: Pond or basin for disposing of suspended solids or processing sludge.

Service buildings: All buildings other than those used for mining, such as workshops, garages, warehouses, stores, powder magazines, gatehouses, compressor rooms, generator rooms, etc.

Shutdown: Complete stoppage of mining operations under Section 232.1 of the Mining Act without any anticipated resumption of activities.

Slope: Any sloping area. Slopes of 10° to 40°, especially those located below a smaller slope, waste rock or backfill. Usually refers to unconsolidated deposits.

Sludge: Fine water-laden material resulting from effluent processing or mine drainage sedimentation.

Spillway: A structure designed to release the overflow from a water retention structure, generally consisting of a watertight curtain covered by a layer of stones over which the retained water freely flows.

Stockpile: Accumulation of ore or concentrate.

Support infrastructure: Any structure needed for mining operations, including buildings, gas and water pipes, waterworks and sewer systems, telephone cables and reservoirs. Support infrastructure may be underground or on the surface.

Surface mineral substances: Within the meaning of the Mining Act (Chapter M-13.1, s. 1), these substances include peat; sand including silica sand; gravel; limestone; calcite; dolomite; common clay and argillaceous rocks used in the manufacture of clay products; all types of rocks used as dimension stone, crushed stone or silica ore or in the making of cement; and every mineral substance that is found in its natural state as a loose deposit, except the tilth, as well as inert mine tailings, where such substances and tailings are used for construction purposes, for the manufacture of construction materials, or for the improvement of soils.

T

Tailings impoundment: All structures, components and facilities where rejected mineral substances and waters from ore treatment are stored. The tailings impoundement and adjoining basins constitute the tailings areas.

Tailings: Rejected mineral substances, sludge and water, except the final effluent, from extraction operations and ore treatment, and slag from pyrometallurgy operations. (M-13.1, s. 1)

Tailings: Rejected crushed and finely ground rocks from ore treatment, and slag from pyrometallurgy operations.

Temporary shutdown: Complete stoppage of operations under section 232.1 of the Mining Act. However, one or more mining activities is expected to resume within a specific time frame: generally less than six months.

Topsoil: Cover of organic material conducive to the growth of vegetation. Nitrogen, potassium and phosphate content must be well-balanced.

Transportation infrastructure: Systems and structures that constitute the transportation network; i.e., roads, railways, airports, bridges, culverts, ditches, etc.

W

Waste rock: Rock extracted during mining operations containing insufficient minerals to be mined for profit.

Waste rock pile: Accumulation of waste rock extracted during mining operations or overburden removed during mining operations.

Water retention basin: Structure for accumulating solid, semi-liquid or liquid substances to prevent them from spreading into the environment, or to reduce spreading.

APPENDIX 8: BIBLIOGRAPHY

Climate Change

AULD, H., D. MACIVER and J. KLAASSEN. Les options d'adaptation des infrastructures à l'évolution du climat, Adaptation and Impact Research Division (ed.), 2007, 24 p.

AULD, H. and D. MACIVER. Changing weather patterns, uncertainty and infrastructure risk: emerging adaptation requirements, Adaptation and Impact Research Division (ed.), 2007, 24 p.

AULD, H., D. MACIVER, and J. KLAASSEN. Les options d'adaptation des infrastructures à l'évolution du climat, Environment Canada, 2006.

BOURQUE, A. and G. SIMONET. Québec, in From Impacts to Adaptation: Canada in a Changing Climate, 2007, Government of Canada, Ottawa, 2008, p. 171-226.

CANADA. True North: Adapting Infrastructure to Climate Change in Northern Canada, in National Round Table on the Environment and the Economy (ed.), Ottawa, 2009a, 176 p.

CEMI. Workshop: Weather Variability and Climate Change: Challenges and solutions for the Mining Sector Mining and Climate Change, 2012.

CHIOTTI, Q. and B. LAVENDER. Ontario, in From Impacts to Adaptation: Canada in a Changing Climate, 2007, Government of Canada, Ottawa, 2008, p. 227-274.

COMITÉ SUR LA VULNÉRABILITÉ DE L'INGÉNIERIE DES INFRASTRUCTURES PUBLIQUES (CVIIP). pievc.ca/fr.

DAMIGOS, D. Monetizing the impacts of climate change on the Greek mining sector, Mitigation and Adaptation Strategies for Global Change, 17, 2012, p. 865-878.

DESJARLAIS, C., M. ALLARD, D. BÉLANGER, A. BLONDLOT, A. BOUFFARD, A. BOURQUE, D. CHAUMONT, P. GOSSELIN, D. HOULE, C. LARRIVÉE, N. LEASE, A.T. PHAM, R. ROY, J.P. SAVARD, R. TURCOTTE and C. VILLENEUVE. Savoir s'adapter aux changements climatiques, Ouranos, Montréal (Québec), Canada, 2010, 137 p. ouranos.ca/fr/pdf/53_sscc_21_06_lr.pdf.

FORD, J.D., C. CHAMPALLE, P. TUDGE, R. RIEDLSPERGER, T. BELL and E. SPARLING. Evaluating climate change vulnerability assessments: a case study of research focusing on the built environment in northern Canada, Mitigation and Adaptation Strategies for Global Change, 2014.

FORD, J.D., T. PEARCE, J. PRNO, F. DUERDEN, L.B. FORD, M. BEAUMIER and T. SMITH. Perceptions of climate change risks in primary resource use industries: A survey of the Canadian mining sector, Regional Environmental Change, 10, 2010, p. 65-81.

FORD, J.D., T. PEARCE, J. PRNO, F. DUERDEN, L.B. FORD, T.R. SMITH and M. BEAUMIER. Canary in a coal mine: Perceptions of climate change risks and response options among Canadian mine operations. Climatic Change, 109, 2011, p. 399-415.

FRASER BASIN COUNCIL. A Climate Adaptation Case Study in Canada's Mining Sector: Climate Change Planning at Glencore in Sudbury, Ontario, Fraser Basin Council, MIRARCO, OCCIAR, 2013, 8 p.

FRASER BASIN COUNCIL. A Climate Adaptation Case Study in Canada's Mining Sector Enhancing Weather Resiliency at Nyrstar Myra Falls, Fraser Basin Council, MIRARCO, OCCIAR, 2013, 8 p.

FURGAL, C. and T.D. PROWSE. Northern Canada, in From Impacts to Adaptation: Canada in a Changing Climate, Government of Canada, Ottawa, 2008, p. 57-118.

GOVERNMENT OF BRITISH COLUMBIA. Policy Issues and Barriers to Climate Change Adaptation for the BC Mining Sector, 2013.

GOVERNMENT OF NUNAVUT. Engineering Challenges for Tailings Management Facilities and Associated Infrastructures with regard to Climate Change in Nunavut, 2012, 110 p.

GOVERNMENT OF NUNAVUT. Vulnerability Assessment of the Mining Sector to Climate Change, 2012.

IMG-GOLDER. Good Environmental Practices for Northern Mining and Necessary Infrastructure, Government of Nunavut, Cambridge Bay, 2012a, 110 p.

IMG-GOLDER. Vulnerability Assessment of the Mining Sector to Climate Change, Government of Nunavut, Cambridge Bay, 2012b, 98 p.

INTERNATIONAL COUNCIL ON MINING & METALS (ICMM). Adapting to a changing climate: implications for the mining and metals industry, 2013, 64 p.

INTERNATIONAL COUNCIL ON MINING & METALS (ICMM). Policy on climate change, 2009, 4 p.

JOURNEAUX ASSOC. Engineering Challenges for Tailings Management Facilities and Associated Infrastructures with regard to Climate Change in Nunavut, Government of Nunavut, 2012b, 110 p.

KAINUMA M., T. KRAM, G.A. MEEHL, J.F.B. MITCHELL, N. NAKICENOVIC, K. RIAHI, S.J. SMITH, R.J. STOUFFER, LAVALIN, S. Policy Issues and Barriers to Climate Change Adaptation for the BC Mining Sector, Ministry of Environment of British Columbia (ed.), Burnaby, 2013, 48 p.

MINING ASSOCIATION OF CANADA, MEND. Climate Change and Acid Rock Drainage – Risks for the Canadian Mining Sector, 2011, 56 p.

MOSS, R.H., J.A. EDMONDS K.A. HIBBARD, M.R. MANNING, S.K. ROSE, D.P. VAN VUUREN, T.R. CARTER, S. EMORI.

NATURAL RESOURCES CANADA. Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, 2014.

NELSON, J. and R. SCHUCHARD. Adapting to Climate Change: A Guide to the Mining Industry, BSR, 2011.

NORDSTROM, D.K. Acid rock drainage and climate change, Journal of Geochemical Exploration, 100, 2009, p. 97-104.

NUNAVUT REGIONAL ADAPTATION COLLABORATIVE (ICAR). Good Environmental Practices for Northern Mining and Necessary Infrastructure, Government of Nunavut, 2012, 110 p.

OURANOS. Synthèse des changements climatiques au Québec, (ed.), 2015.

OURANOS. Synthèse des changements climatiques pour le secteur minier (publication forthcoming), 2015.

PEARCE, T., J. FORD, J. PRNO and F. DUERDEN. Climate Change and Canadian Mining: Opportunities for Adaptation, 2009, 160 p.

PLUMMER, D.A., D. CAYA, A. FRIGON, H. CÔTÉ, M. GIGUÈRE, D. PAQUIN, S. BINER, R. HARVEY and R. DE ELIA. Climate and climate change over North America as simulated by the Canadian RCM, Journal of Climate, 19, 2006, p. 3,112-3,132.

RODGERS, C., E. SPARLING, A. DOUGLAS and A. WILES. Understanding Mining Policy Drivers and Barriers in the Context of Climate Change Impacts and Adaptation, report presented to the Climate Change Impacts and Adaptation Division, Government of Ontario, 2014, 39 p.

STRATOS and BRODIE CONSULTING. Climate Change and Acid Rock Drainage – Risks for the Canadian Mining Sector, Mining Association of Canada, Ottawa, 2011.

THOMSON, A.M., J.P. WEYANT and T.J. WILIBANKS. The next generation of scenarios for climate change research and assessment, Nature, vol. 463, no. 7,282, 2010, p. 747-756.

UNITÉ DE RECHERCHE ET DE SERVICE EN TECHNOLOGIE MINÉRALE (URSTM). Analyse de risques et de vulnérabilité liés aux changements climatiques pour le secteur minier québécois (final document forthcoming).

WARREN, F.J. and D.S. LEMMEN. Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, Natural Resources Canada (ed.), Government of Canada, Ottawa, 2014, 286. p.

Physical stability

ADAMS, J. et S. HALCHUK. *Implications of Canada's 4th generation hazard model for Canadian Dams,* compte rendu de la Conférence annuelle de l'Association canadienne des barrages, Ottawa, 2004, 10 p.

ASSOCIATION CANADIENNE DES BARRAGES – CANADIAN DAM ASSOCIATION (ACBCDA). Directives sur la sécurité des barrages, 2007.

ASSOCIATION CANADIENNE DES BARRAGES – CANADIAN DAM ASSOCIATION (ACBCDA). *Application of 2007 Dam Safety Guidelines to Mining Dams – Design Considerations*, ébauche, 2014.

AUBERTIN, M. *Waste rock disposal to improve the geotechnical and geochemical stability of piles*, compte rendu du Congrès minier mondial, Montréal, 2013, ICM.

AUBERTIN, M., B. BUSSIÈRE et B. BERNIER. *Environnement et gestion des rejets miniers*, manuel sur cédérom, Presses internationales Polytechnique, 2002a.

AUBERTIN, M., B. BUSSIÈRE, M. JAMES, E.M. JAOUHAR, V. MARTIN, N. PÉPIN, M. MBONIMPA et R.P. CHAPUIS. *Vers une mise à jour des critères de stabilité géotechnique pour la conception des ouvrages de retenue de résidus miniers*, C.R. Symposium sur les mines et l'environnement, RouynNoranda, ICM, CD ROM, 2011, 38 p.

AUBERTIN, M., J. DIONNE et L. MARCOUX. *Design guidelines and stability criteria of engineering works for water covers*, compte rendu de la 4e Conférence internationale sur le drainage rocheux acide (ICARD), vol. IV, Vancouver, 1997, p. 1851-1866.

AUBERTIN, M., M. JAMES, M. MAKNOON et B. BUSSIÈRE. *Recommandations pour améliorer le comportement géotechnique et géochimique des haldes à stériles*, GéoMontréal 2013, compte rendu de la Conférence canadienne de géotechnique, 2013, CGSSCG.

AUBERTIN, M., M. MBONIMPA, D. JOLETTE, B. BUSSIÈRE, R.P. CHAPUIS, M. JAMES et O. RIFFON. *Stabilité géotechnique des ouvrages de retenue pour les résidus miniers : problèmes persistants et méthodes de contrôle*, Défis et perspectives : Symposium 2002 sur l'environnement et les mines, RouynNoranda, ICM, 2002b, comptes rendus sur CD ROM.

AUBERTIN, M., O. FALA, B. BUSSIÈRE, V. MARTIN, D. CAMPOS, A. GAMACHEROCHETTE, M. CHOUTEAU et R.P. CHAPUIS. *Analyse des écoulements de l'eau en conditions non saturées dans les haldes à stériles,* Défis et perspectives : Symposium 2002 sur l'environnement et les mines, RouynNoranda, ICM, 2002c, comptes rendus sur CD ROM.

AUBERTIN, M., T. PABST, B. BUSSIÈRE, M. JAMES, M. MBONIMPA, M. BEZAAZOUA et A. MAQSOUD. *Revue des meilleures pratiques de restauration des sites d'entreposage de rejets miniers, générateurs de DMA*, Symposium 2015 sur l'environnement et les mines, RouynNoranda, 2015.

BAECHER, G.B. et J.T. CHRISTIAN. *Reliability and statistics in geotechnical engineering*, John Wiley & Sons, Ltd, 2003, 618 p.

BENZAAZOUA, M., B. BUSSIÈRE, I. DEMERS, M. AUBERTIN, É FRIED et A. BLIER. « Integrated mine tailings management by combining environmental desulphurization and cemented paste backfill: Application to mine Doyon, Quebec, Canada », *Minerals Engineering*, 21, 2008, p. 330-340.

BLIGHT, G.E. *Geotechnical engineering for mine waste storage facilities*, CRC Press, TaylorFrancis, 2010.

BUSSIÈRE, B. « Colloquium 2004: Hydrogeotechnical properties of hard rock tailings from metal mines and emerging geoenvironmental disposal approaches », *Revue canadienne de géotechnique*, vol. 44, 2007, p. 1019-1052.

CHOWDURY, R., P. FLENTJE et G. Bhattacharya. *Geotechnical slope analysis*, Londres, CRC Press, Taylor & Francis, 2010.

CONSEIL NATIONAL DE RECHERCHES DU CANADA. *Code national du bâtiment* (CNB), 2005 et 2010.

DAY, R.W. *Foundation engineering handbook – Design and construction with the 2009 International Building Code*, 2e édition, New York, McGrawHill, 2010.

DUNCAN, J.M. et S.G. WRIGHT. *Soil strength and slope stability*, Wiley, 2005.

FELL, R., P. MACGREGOR, D. STAPLETON et G. BELL. *Geotechnical engineering of dams*, Londres, A.A. Balkema – Taylor & Francis, 2005.

FENTON, G.A. et D.H. GRIFFITH. *Risk assessment in geotechnical engineering*. Wiley, 2008.

HUSTRULID, W.A., M.K. MCCARTER et D.J.A. VAN ZYL. *Slope stability in surface mining*, Littleton, Colorado, SME, (éd.), 2000.

IDRISS, I.M. et R.W. BOULANGER. *Soil liquefaction during earthquakes*, Berkeley, Californie, Earthquake Engineering Research Institute, 2008.

INDEPENDENT EXPERT ENGINEERING INVESTIGATION AND REVIEW PANEL. *Report on Mount Polley Tailings Storage Facility Breach*, 30 janvier 2015.

JAMES, M. et M. AUBERTIN. « On the dynamic response of tailings and the stability of tailings impoundments for hard rock mines », *Geotechnical News*, sept. 2010, p. 39-43.

JAMES, M., M. AUBERTIN et B. BUSSIÈRE. 2013. *On the use of waste rock inclusions to improve the performance of tailings impoundments*, compte rendu de la 18e Conférence internationale sur la mécanique des sols et la géotechnique, Paris, 2013, SIMSG.

JAMES, M., M. AUBERTIN, D. WIJEWICKREME, G.W. WILSON. « A laboratory investigation of the dynamic properties of tailings », *Canadian Geotechnical Journal,* vol. 48, 2011, p. 1587-1600.

KRAMER, S.L. *Geotechnical earthquake engineering*, Prentice Hall, 1996.

PITEAU. *Investigation and design of mine dumps – Interim Guidelines*, BC Mine Dump Committee, Piteau Associates Engineering Ltd., 1991.

READ, J. et P. STACEY. *Guidelines for open pit slope design*, CRC Press, (éd.), 2009.

SOCIÉTÉ CANADIENNE DE GÉOTECHNIQUE (SCG). *Manuel canadien d'ingénierie des fondations*, 4e édition, 2006.

SOCIÉTÉ CANADIENNE DE GÉOTECHNIQUE. *Manuel canadien d'ingénierie des fondations*, 4e édition, 2013.

VICK, S.G. *Planning, Design, and Analysis of Tailings Dams*, Vancouver, BiTech Publishers Ltd., 1990.

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