

Mine Reclamation and Closure Workshop

BACKGROUND REPORT

**Prepared in Support of the February 1 – 3, 2005
Mine Reclamation and Closure Workshop**

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Prepared for the Workshop Planning Committee*

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1. Purpose and Objectives of the Workshop

The purpose of the workshop is to initiate discussion and identify issues surrounding mine reclamation and closure.

Under the current regulatory regime in the Northwest Territories, companies are required to produce Mine Closure and Reclamation Plans. These may be a requirement under a water licence, issued by land and water boards, or under the environmental agreements (between companies, the Government of Canada and the Government of the Northwest Territories and, in some cases, Aboriginal groups), Mining companies are required to produce plans that detail how their mines will be closed, and how the land and water impacted by the mines will be reclaimed. However, there is much debate on the many issues surrounding reclamation and closure, and how these issues should be considered in the plan, and how reclamation should be implemented.

The 'Mine Reclamation and Closure Workshop' brings together Aboriginal members and Directors of the Independent Environmental Monitoring Agency (Agency) and of the Environmental Monitoring Advisory Board (EMAB), and representatives from the mining industry, government, and others, to share ideas on the objectives, issues, options and measures of success that can be included in mine closure and reclamation plans. The objectives of the Workshop are to:

- Identify and create a common understanding of terms used in mine reclamation.
- Bring together stakeholders for a three-day workshop to discuss and share community and industry issues related to minesite reclamation, and regulatory requirements related to reclamation. At the end of the workshop participants should have a general understanding of the issues and concepts associated with reclaiming common mine site components. This information will benefit future workshops, and help guide regulators, Aboriginal Peoples, and industry when developing guidance documents and reclamation plans.

2. Introduction to this paper

The Agency is hosting the 'Mine Reclamation and Closure' workshop in Yellowknife from February 1-3, 2005. The workshop planning committee (the Committee) commissioned this Background Report to facilitate and support the workshop's outcomes. This paper is to be used as a resource document throughout the course of the workshop.

The background report is presented in three parts. Part One examines the language and definitions used in mine reclamation and closure. Part Two provides a quick review of NWT, Nunavut and British Columbia mine Reclamation Plans; focusing on how the plans were prepared and what they considered. Part Three summarizes the British Columbia, Manitoba, and Ontario government Mine Reclamation and Closure guidelines and regulations.

3. Terminology

Many of the terms used in Closure and Reclamation Plans are used interchangeably. For example, the terms restoration, remediation, rehabilitation and reclamation have unique meanings, but are often used interchangeably. This section introduces terms used in mine reclamation to assist in the development of a universally acceptable set of terms applicable to the NWT.

It is important to establish consistent terminology at the beginning of the mine Reclamation Planning process so that all of the parties involved have a common understanding and 'speak the same language.' The following are examples of some terms used in policies, Guidelines, and Reclamation Plans, in the Northwest Territories (NWT) and Nunavut.

Restoration

1. Northwest Territories Water Board (1990): Restoration prevents progressive degradation, and enhances natural recovery of areas affected by mining. Restoration also means the return of the land to pre-mining contours, and includes surface and groundwater patterns as well as plant and animal ecosystems. This implies that there is no difference between pre-mining and post-mining land conditions.
2. BHP Billiton Interim Abandonment and Reclamation Plan (2003): In practice there are few instances where 100 percent restoration would be possible).

Remediation

3. Remediation means to correct problems at a site so that it is no longer considered a human or environmental health problem.
www.safertown.com/HTMLSrc/Glossary.html
4. Cominco Ltd., Polaris Mine Decommissioning and Reclamation Plan (2001): Remediation means any procedures or strategies used to address a hazardous waste site. For example, a proposed remedial action plan describes remedial actions (cleanup methods or corrective actions) recommended for a specific site; remediation of a site could include removing contaminated soil.
5. BHP Billiton Closure Standards (2004): Remediation also means the activities carried out to clean-up or mitigate contaminated land or water.
6. Remediation means to clean-up activities that contribute to the reduction of both liability and risk. http://www.ainc-inac.gc.ca/ps/nap/consit/14csrep0102_e.html

Rehabilitation

7. BHP Billiton Interim Abandonment and Reclamation Plan (2003): Rehabilitation can also mean the return of a disturbed site to a form and productivity level that conforms to a defined land use. This term suggests that alternative end land uses have

been examined, and the potential for reaching each of the land uses has been assessed. Rehabilitation is a term used more in Australia.

8. Commonwealth of Australia, Strategic Framework for Mine Closure (2000): Rehabilitation also means the return of disturbed areas to a safe, stable, productive and self-sustaining condition, consistent with the agreed end land uses.

9. BHP Billiton Closure Standards (2004) The return of disturbed land to a stable, productive and self-sustaining condition, after taking into account beneficial uses of the site and surrounding land.

Reclamation

10. CanZinco Ltd., Nanisivik Mine Reclamation and Closure Plan (2004): Mine Reclamation is an ongoing programme designed to restore the physical, chemical and biological quality of air, land and water regimes disturbed by mining to a state acceptable to the regulators, and to post-mining land users.

11. Reclamation aims to improve or make better, but not necessarily to make the same as before. Reclamation might involve returning the mine site to its natural state by planting vegetation or landscaping. For example, Reclamation could involve redevelopment of mine site with housing or recreational land.

www.ainc-inac.gc.ca/pr/pub/bldg/snd/glss_e.html.

12. Nunavut Water Board's Letter of approval for terms and conditions applying to the Nanisivik Mine 2004 Reclamation Plan and Closure Plan (July 2004): Reclamation is period of time that encompasses the active physical reclamation of the mine site and the completion of the major activities proposed in the Mine Closure Plan.

13. Indian and Northern Affairs Canada, Mine Site Reclamation Policy for the Northwest Territories (2002): Reclamation can also mean returning mine sites and affected areas to viable and, where practicable, self sustaining ecosystems that are compatible with a healthy environment and with human activities.

14. Whitehorse Mining Initiative (1994): Reclamation includes every process that transforms land which has been impacted by industrial use back into the flow of normal changes of the landscape and ends with the achievement of long-term site stability and the establishment of a self-sustaining ecosystem; however, continuing treatment and monitoring may be required.

15. BHP Billiton Interim Abandonment and Reclamation Plan (2003): Reclamation also means the return of the mine site to approximately pre-mining conditions and inhabited with ecosystem organisms of nearly the same composition and density as those prior to mining. In general, reclamation is interpreted as including every process that enhances soil conservation and productive land use to transform land which has been impacted by industrial use back into the flow of normal changes of the landscape. Reclamation is a term used in North America and Europe.

16. Tahera Jericho Project Mine Reclamation Plan (2003). Reclamation has the objective of maintaining the overall present productivity of the site so that the end-land use will enable disturbed areas to return as quickly as possible to productive wildlife habitat

Progressive Reclamation

17. Indian and Northern Affairs Canada, Mine Site Reclamation Policy for the Northwest Territories (2002): Progressive reclamation means ongoing reclamation throughout the life of a mine.

18. BHP Billiton Interim Abandonment and Reclamation Plan (2003): Some describe progressive reclamation as the incremental reclamation of a site in a manner consistent with sustainable development. It is also a process in which reclamation of mine site disturbances begins soon after disturbed areas are abandoned and no longer used to support mine operations, rather than delaying reclamation until mine closure.

19. BHP Billiton water licence, (2004b): Progressive reclamation means reclamation that is completed during the operational phase of the project on components of the mine that are no longer used or necessary.

Reclamation Plan Components

A mine site will consist of any number of components or facilities that have individual characteristics, risks, and impacts. In order to enable the development of a comprehensive reclamation plan, the site is typically broken out into components that share similar characteristics. The Reclamation Plans reviewed for this Background Report were each organized around mine components. The entire mine site was divided into components, and for each component, reclamation issues were defined.

20. Indian and Northern Affairs Canada, “Colomac Site Remediation Plan” (2004): Each individual component of the site has its own characteristics and issues; therefore, each requires its own detailed reclamation criteria. In one sense, the criteria could be thought of as describing exactly what standards must be met before the component can be considered to have been successfully reclaimed. Also please refer to the definition for criteria provided in this background report.

21. Indian and Northern Affairs Canada, Draft Mines Site Reclamation Guidelines (2004c): Mining closure activities can generally be divided into the following main components:

- underground mine workings;
- open pit mine workings;
- rock and overburden piles;
- Tailings impoundment system
- water management and treatment;
- buildings and equipment;
- land fills and other waste disposal areas; and
- infrastructure.

Criteria

Criteria are guidelines, rules, characteristics or dimensions that are used to judge the quality of performance (www.odedodea.edu/instruction/curriculum/glossary.htm). In the context of pollutants criteria provide information on health and/or environmental effects of pollution (www.aqd.nps.gov/ard/glossary.htm). Criteria are also statements of the conditions presumed to support or protect the designated use or uses of a water body (www.epa.gov/waterscience/biocriteria/glossary.html) and are standards, rules, or tests on which a judgment or decision may be based (www.wetlandtraining.com/glossary.html). Ultimately criteria are used to judge performance. (www.wrightslaw.com/links/glossary.assessment.htm).

Closure Criteria

22. Commonwealth of Australia, Strategic Framework for Mine Closure (2000): The terms closure criteria and reclamation criteria are used interchangeably in the literature reviewed. Closure criteria are used to define specific performance requirements for progressive reclamation and mine closure.

23. Queensland Mining Council, Guidelines for Mine Closure Planning In Queensland (2001): They are also used to establish benchmarks to determine when reclamation and monitoring programs have been completed and are based on an agreed upon standard or level of performance that proves successful mine closure.

24. Indian and Northern Affairs Canada, Mine Site Reclamation Policy for the Northwest Territories (2002): for the NWT provides a broad objective for mines to reclaim to “self sustaining ecosystems”, but does not provide specific closure criteria because these must be site-specific. BHP Billiton is developing completion criteria for all the areas of the EKATI Diamond Mine undergoing reclamation.

Reclamation and Closure

25. Commonwealth of Australia, Strategic Framework for Mine Closure (2000): There are several different definitions associated with the terms reclamation and closure. For example, there is care and maintenance closure, temporary closure, long term closure, and permanent closure. There are also preliminary, interim and final closure plans; each of which involves reclamation. Closure itself is a milestone in a mine’s life when commercial operations cease and includes the act of taking a mine or processing facility out of production, either temporarily or permanently. With that basic definition in mind, here are other ways the word ‘closure’ is used and defined.

Objectives

Reclamation and Closure objectives establish a set of indicators that prove the successful completion of the Reclamation and Closure process. It appears the term is not used very often by government or in industry and it seems that the terms ‘Reclamation and Closure objectives’ are used interchangeably with the term ‘completion criteria’.

26. The typical Final Mine Reclamation and Closure Plan objectives for a typical hard rock mine include minimising long-term environmental liability, attaining regulatory compliance and maintaining geotechnical stability, while closing as quickly and cost effectively as possible - in a manner that returns the land to a safe and stable configuration for post-mining uses.

www.mineralresourcesforum.org/docs/pdfs/closure.pdf

Closure

a. Temporary/Short-term Closure

27. BHP Billiton Interim Abandonment and Reclamation Plan (2003): A temporary closure is a period when mining and operations are halted for some reason. These shutdowns are generally of short-term duration and full operation is anticipated to resume when the cause of the shutdown has been remedied/cleaned-up. During this period there is only equipment and site maintenance activity and environmental monitoring and administrative duties.

28. De Beers Canada Mining Incorporated, Preliminary Mine Closure and Reclamation Plan: Snap Lake Diamond Project (2003): A temporary shutdown can also be defined as a stop in mining and processing operations for between three to twelve months, with the intention of resuming operations as soon as possible after the reason for the shutdown has been resolved.

29. “Diavik Diamond Mine Inc. Interim Abandonment and Restoration Plan” (2001): A temporary shutdown occurs when mining and ore recovery are stopped temporarily, due to economic or other operational reasons, and re-commence under more favourable conditions, usually within one year.

b. Long Term or Indefinite Closure

30. De Beers Canada Mining Incorporated, Preliminary Mine Closure and Reclamation Plan: Snap Lake Diamond Project (2003): An indefinite closure is a period of time when a mine shuts down its mining and processing operations with the intention of resuming them in the future, sometimes up to 10 years. During an indefinite shutdown the mine is placed into a mode of minimal operating expense.

Care and maintenance

31. Commonwealth of Australia, Strategic Framework for Mine Closure (2000): Care and maintenance is a state the mine is in when it is closed with the intention of reopening at some future time. It involves the immediate implementation of a decommissioning plan, taking into account the potential for future operations at the site. The decommissioning plan includes details and procedures for ensuring the mine remains safe and environmentally stable during the care and maintenance period.

32. Commonwealth of Australia, Strategic Framework for Mine Closure (2000): The care and maintenance process involves the immediate preparation and implementation of a Reclamation Plan taking into account the potential for future operations at the site. If possible, and economically feasible, Reclamation should be undertaken on all disturbed

areas, even if it is likely that some of these areas will be disturbed in the future. Site Reclamation, and works to prevent potential off-site contamination, should be implemented as if for a final closure scenario.

33. Care and Maintenance means the works required at sites, primarily abandoned mines, where continual water treatment and maintenance work is essential to prevent migration of pollutants offsite, or to prevent structural failure, to protect human health and the environment, and to keep the liability from exponentially increasing. At times urgent work is required to immediately address an environmental risk. http://www.ainc-inac.gc.ca/ps/nap/consit/14csrep0102_e.html

Reclamation Plans

34. Commonwealth of Australia, Mine Decommissioning, (2002): The goal of mine closure is to achieve the long-term objectives that are selected for the site. This might be to prevent or minimise adverse long-term environmental impacts created by a mining operation, to create a self-sustaining natural ecosystem or alternate land use based on an agreed set of objectives, or, to restore the natural ecosystem. The Mine Closure Plan describes what the long-term objectives are, how they were selected, how they will be achieved, and how success will be measured.
<http://www.deh.gov.au/industry/industry-performance/minerals/booklets/mine/index.html>

35. Commonwealth of Australia, Strategic Framework for Mine Closure (2000): A Closure Plan should include a commitment to progressive Reclamation and detailed plan development and implementation. There may be a number of closure plans developed throughout the life of a mine, reflecting the stage of development of the mine. There may also be a number of subsidiary plans will need to be developed as the Closure Plan evolves. These typically include: a decommissioning plan and maintenance and monitoring plan.

- A decommissioning plan is a detailed component of the Closure Plan and is prepared towards the final stages of a mine's operation. The decommissioning plan includes details on things such as the demolition and removal or burial of all structures not required for other uses; removal, Reclamation/clean-up or encapsulation of contaminated materials; and the procedures for making safe and sealing, openings to underground workings.
- A maintenance and monitoring plan provides performance monitoring, which should be designed to demonstrate that the completion criteria are being met.

36. Northwest Territories Water Board, "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories" (1990): According to the "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories", the Closure and Reclamation Plan is required to be developed in three phases, as follows:

- Preliminary Closure and Reclamation Plan: required in support of the proponent's application for a water licence
- Interim Closure and Reclamation Plan required within one year of granting the initial water licence

- Final Closure and Reclamation Plan required at least three years before anticipated final closure.

a. Preliminary Reclamation Plan

A preliminary Closure Plan identifies the key objectives for mine closure to guide project development and design. It should include broad future land use objectives and preliminary closure costs. This should be completed, reviewed and approved as part of the mine's start-up authorization phase.

37. Commonwealth of Australia, Strategic Framework for Mine Closure (2000): Preliminary Reclamation Closure Plans are usually prepared before a mine is built. After it is built and operating, the Preliminary Plans are refined into Interim Reclamation Plans. A Preliminary Closure Plan identifies the key objectives for mine Reclamation and Closure to guide project development and design. It should include broad land use objectives and indicative closure costs. (This does not preclude land use objectives being varied during the mine life to reflect changes in both knowledge and technology)

b. Interim Reclamation Plan

38. Commonwealth of Australia, Strategic Framework for Mine Closure (2000): During the construction phase, the Preliminary Reclamation Plan should evolve into the Interim Reclamation Plan, and post-mining land use objectives should be refined at this time. This does not preclude land use objectives being varied during the mine life to reflect changes in both knowledge and technology.

39. The Interim Reclamation Plan refers to reclamation efforts on lands disturbed during the course of the Mine that may be redisturbed during mining activities. These lands, while not at final reclamation contours will not be redisturbed for a significant time period and therefore require interim stabilization.
www.kinross.com/misc/buckhorn/appendix-d.pdf

An Interim Closure and Reclamation Plan describes the reclamation of disturbed areas associated with mining, while the mine is operating. The Interim Closure and Reclamation Plan is a living document and subject to change as the mine changes its mining plans. Additionally, revisions to the reclamation plan may occur based on the results of ongoing reclamation research and technological improvements.

c. Permanent Reclamation Plan

40. CanZinco Ltd., Nanisivik Mine 2004 Reclamation and Closure Plan (2004): The closure period "immediately follows the reclamation period. During the Closure Period, only relatively minor maintenance work is planned at the mine site and monitoring will be focused on providing information for assessing the performance of the reclamation measures".

Permanent closure is an event that occurs when all economical ore reserves have been recovered and more mining is not considered feasible. Permanent closure occurs when the ore body is exhausted, or when, for other reasons, management judges that the

mine cannot be operated economically or safely at any time in the foreseeable future. Permanently closed mines should be physically, chemically, biologically, and geographically stable.

d. Final Reclamation Plan

41. New South Wales Department of Mineral Resources, Environmental Management Guidelines for Industry Format and Guideline for the Preparation of a Mining Operation Plan (2002). The Final Closure Plan describes the outcomes of final Reclamation, which includes progressive reclamation developed during the life of a mine, and the anticipated state of the site after Reclamation has been completed.

42. Commonwealth of Australia, Checklist for Mine Decommissioning Environment Australia, Sustainable Minerals Program (2003): The Final Reclamation and Closure Plan is prepared when the holder of a mine lease is preparing to return the lease and the environmental authority back to the landowner. In the NWT, the landowner is usually the Department of Indian and Northern Affairs and Northern Development (DIAND). The report contains information about the status of the Reclamation, a statement from the landowner and details of any residual monitoring or management requirements where relevant.

e. Post Reclamation Plan

43. Commonwealth of Australia, Checklist for Mine Decommissioning Environment Australia, Sustainable Minerals Program (2003): A Post Closure Plan is prepared if there are known or anticipated management requirements after the surrender of tenure. The Post Closure Plan details post-closure maintenance or monitoring responsibilities (if any) and identifies the person/s responsible for managing the liabilities, and develops as appropriate, Reclamation maintenance or monitoring plans, land management plans, or conservation guidelines for adoption by the subsequent landowner.

Reclamation Research Plan

A Reclamation Research Plan provides the information necessary to advance mine component reclamation options from a preliminary or interim concept, to a viable option. The objective of the Reclamation Research Plan is to develop an environmentally acceptable, practical and cost-effective reclamation technique. These are a requirement of the BHP Billiton, Diavik and the Snap Lake Diamond Mines Water Licences.

http://collections.ic.gc.ca/abresources/inventory/PopUp_Coal.html

4. Summary of Mine Reclamation and Closure Practices in Nunavut, the NWT and British Columbia

The following provides a summary of the reclamation practices, objectives, and consultation of various operating and reclaimed mines in the NWT, Nunavut and British Columbia.

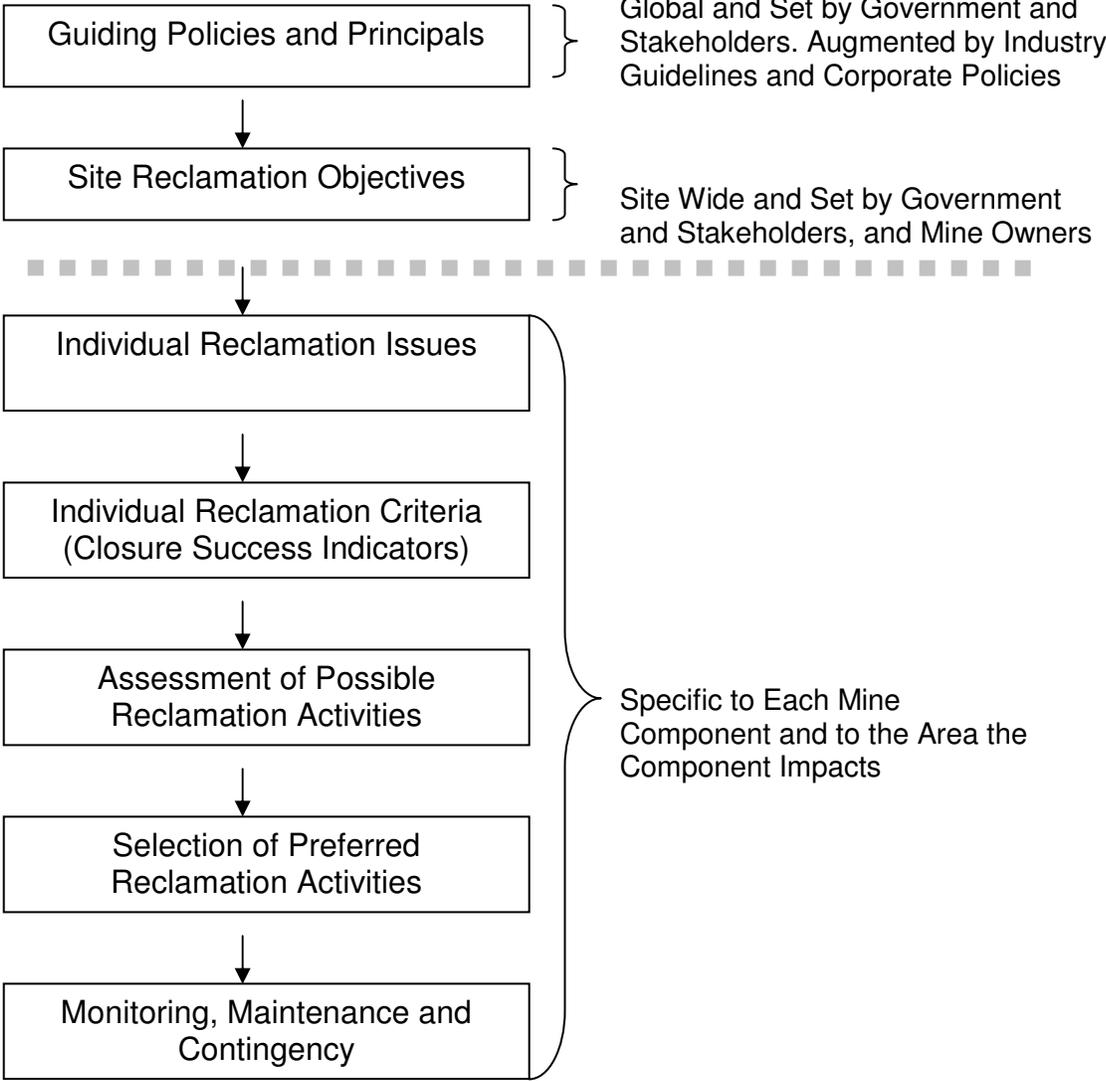
For the most part, each of the mine Reclamation Plans considered was prepared using very similar steps. The Reclamation and Plan usually starts with an understanding of the broad government expectations about what a reclaimed mine should achieve, and what a restored mine site should look like. This information can be found in mine reclamation regulations or guidelines for a particular province or territory. Next, the plans include a closer look at the actual mine itself and the area it has affected. In this step, mine site objectives that are acceptable to government and affected stakeholders are developed. Again, these site-wide objectives can be prescribed by government regulations or guidelines with considerable public input.

Once site specific objectives are developed, component specific reclamation criteria are developed. These are usually based on 'issues' associated with the components. For example, key issues associated with the Colomac Mine waste rock piles focused on surface reclamation and physical concerns; i.e., rock piles are almost entirely un-vegetated and they act as impediments to wildlife (INAC, 2004).

The mine component criteria address the issues identified for each mine component and are used to find out if the reclamation of each component is working. Alternative ways of meeting the component criteria are then considered, usually in consultation with government and the public. (Government includes Federal, Territorial, Provincial, and First Nations governments). Once there is agreement on what will be done to achieve the component criteria, a Reclamation Plan is prepared, and the actual work on the ground starts. A flow chart of the generalized mine reclamation process applied to almost all the mines reviewed in this background paper is provided.

Following the flow chart, the reclamation objectives, options, and criteria, for tailings, pits, waste rock, and road components of nine mines are compared.

Figure 1: Mine Reclamation and Closure Path



Source: Indian and Northern Affairs Canada, (2004) Discovery Mine Reclamation Plan

BHP Billiton Ekati Diamond Mine

The NWT Diamonds Project (now the BHP Billiton EKATI Diamond Mine) permitting process concluded with a Class “A” Water License granted by the Northwest Territories Water Board in January 1997. As part of the conditions for Water License an “Interim Abandonment and Restoration Plan” (A&R Plan) was submitted to the Northwest Territories Water Board on October 1, 1997 and approved on February 19, 1998. As part of the Environmental Agreement, a Reclamation Plan is also required.

BHP Billiton’s reclamation goal is to prevent progressive degradation, and to enhance natural recovery of areas affected by mining. Landscape (site) reclamation is driven by the following specific objectives:

- To re-establish stable landforms;
- To protect the water resources in the local area;
- To facilitate natural recovery of areas affected by mining; and
- To re-establish productive use of the land (Aboriginal and wildlife)¹

In the recent A&R Plan revision provided to the MVLWB (2003) BHPB noted that a targeted consultation plan would be developed which would attempt to reflect the needs of the stakeholder groups and other interested parties and that closure information distributed to stakeholders will be provided in a timely and coordinated manner and, when a response is requested, adequate time will be provided. This is particularly important when post-mining land use involves community input, or where post-mining land use is different from pre-existing land use” (BHP Billiton, 2003).

In the same A&R Plan BHPB also maintains that “adequate resources will be allocated to ensure the effectiveness of the consultation process [as] proper mine closure is the result of a combination of innovative concepts, long-term commitments, and multi-party cooperation. The objective should be to ensure that all stakeholders have the necessary information and resources to participate meaningfully in the closure process” (BHP Billiton, 2003).

Diavik Diamond Mine

The goals of Diavik’s Reclamation are to develop and implement responsible progressive reclamation strategies for cost effective closure of facilities and final site closure and to reduce exposure to environmental and third party liabilities during operations, and beyond closure, after the site has been rehabilitated and closed.

Diavik’s Reclamation and Closure objectives are:

1. for the mine site and each of its facilities to be physically and geochemically stable over the long term

¹ Two revised reclamation plans were submitted by BHP Billiton, one in 2003 and one in 2004. The 2004 included the 4th objective.

2. for the mine site and each of its facilities to be safe for human and wildlife use over the long term
3. for run-off from the mine site and each of its facilities to be of sufficient quality to be safe for the aquatic ecosystem of Lac de Gras.
4. to have a final surface condition over all mine infrastructure and roads which will support natural revegetation and, if practical, enhance natural revegetation

Diavik's Interim Reclamation Plan "presents concepts for reclamation strategies for reclamation and closure of each significant project component. In this context, "reclamation" refers to re-grading of disturbed land, placement of engineered covers and, in targeted areas where technically feasible, the establishment of initial pockets of indigenous vegetation. Specific closure tasks are described for each operational and support component of the project. Methods of closing the proposed operational facilities and supporting infrastructure at the end of mine production are presented. Interim closure plans include methods aimed at minimizing post-closure maintenance and monitoring requirements, and complete abandonment of the property" (Diavik, 2001).

Consultation in support of Diavik's Interim Reclamation Plan occurred during the preceding environmental assessment and subsequent regulatory process including the knowledge gained from initial operations. The environmental review took place over the course of 18 months, beginning in March 1998, and was one of the most complex comprehensive studies to be initiated under the Canadian Environmental Assessment Act. Consultation on the project was extensive. From the exploratory phase when the proponent, Diavik Diamond Mines Inc., initiated public meetings in late 1993 to the completion of the comprehensive study report in June 1999, more than 300 meetings took place. http://www.ceaa-acee.gc.ca/017/0003/fea12_e.htm

De Beers Snap Lake Diamond Mine

De Beers prepared a Preliminary Mine Reclamation Plan for its Snap Lake Diamond Project in 2003, midway through the environmental assessment of the proposed mine. As a requirement of their water licence, De Beers submitted a Preliminary Mine Reclamation Plan for the project.

De Beers incorporated, where applicable, the principles, objectives and standards set out in the DIAND Reclamation Policy and Guidelines. De Beers used the following principles to guide the development of the overall Reclamation Plan:

- plan and implement procedures in accordance with all applicable regulations
- apply cost-effective and appropriate Reclamation and Closure practices to reduce environmental risks and allow traditional use of the land
- conduct studies to predict post-closure environmental effects
- maintain a program of progressive Reclamation and Closure as an integral part of project operations
- incorporate new reclamation methods and procedures.

Tahera Jericho Diamond Project

The Jericho project is completing its regulatory phase and anticipates beginning construction in 2005. The Preliminary Mine Closure & Reclamation Plan was prepared in February 2003. Consultation on the Preliminary Reclamation Plan occurred through the environmental assessment and regulatory proceedings. The reclamation plan for the mine has the objective of minimizing the environmental impact of mining operations to the extent practical, and of maintaining the overall present productivity of the site.

Colomac Mine

Colomac is the site of an abandoned open pit gold mine, which operated between 1990 and 1997. INAC) had been looking after the site since shortly after the owner became insolvent in 1999. The principal concern at the site is the presence of water that was contaminated by the processing of gold ore with cyanide. Natural processes have reduced the cyanide and metal concentrations in the water to very low levels. However, ammonia has been produced by the break-down of cyanide, and this is now the main contaminant of concern in the water.

Many studies have been completed to assess the effect mining has had on the environment in the Colomac area. These studies have indicated that the effects of the development have been limited, and confined to small areas adjacent to the mine facilities. In general, the environment around the site is pristine.

The process to select Reclamation methods for the site began in 2001, when a workshop was held to review all potential Reclamation measures and identify any uncertainties that would need to be resolved before selections could be made. This led to the development of a technical work program and a series of studies conducted in 2001 and 2002. The results of these studies produced a short-list of Reclamation methods for each major site component, which were evaluated by INAC and Tli Cho representatives in 2003. The evaluation process produced a clearly preferred Reclamation method for most of the site components. Conceptual designs were prepared for the preferred Reclamation methods, as well as any options that remained under consideration.

Discovery Mine

The Discovery Mine is an abandoned underground gold mine and town site located approximately 85 km north of the City of Yellowknife. There are approximately 60 buildings in the townsite that include houses, school house, curling rink, offices, assay office, machine shop and headframe. The mine was closed permanently in 1969. A power line runs from the Bluefish hydro-electric generating station to the mine site following roughly the same route as the winter road. The mine tailings contain mercury as a result of the gold separation process that was used. As a result, mercury became high enough in fish in Giaouque Lake to trigger government mercury warnings and consumption restrictions.

INAC is trying to make sure that the final Reclamation of the site meets the expectations and needs of people who use the mine area for hunting, trapping and fishing. To do this,

INAC has held site tours and meetings with First Nations groups and federal and territorial agencies.

Once the Reclamation work is completed, INAC will conduct at least five years of follow up monitoring. This will include a minimum annual inspection of water quality, cover performance and all other aspects of testing the success of the Reclamation work. An annual meeting will be held with First Nations representatives to review the monitoring information and discuss any new issues. At the end of the initial five-year monitoring period (i.e., in 2010), INAC will prepare a “Comprehensive Remediation Performance Assessment report”. This study will provide recommendations to the Mackenzie Valley Land and Water Board (MVLWB) and the First Nations on what additional monitoring is necessary, if any.

The “Discovery Mine Remediation Plan” was submitted to the MVLWB on December 31, 2005 and pending its approval the reclamation work is scheduled for 2005.

Breakwater Resources Nanisivik Mine

The Nanisivik mine located on the south shore of Strathcona Sound near the community of Arctic Bay in the North Baffin region of Nunavut. The Nanisivik mine began production of zinc and lead concentrates in 1976. The mine was permanently closed in September 2002. An interim mine reclamation plan was developed and updated on a regular basis by the mine owner, CanZinco, in response to terms of the Water Licence. However, the announcement of permanent closure in September 2001 triggered a requirement in the (then) current water licence for submission of a Final Reclamation Plan. In response to this trigger, CanZinco submitted a Reclamation Plan in February 2002 that described the approaches and plans for reclamation of the mine site. Subsequent to a Public Hearing on renewal of the water licence held in the community of Arctic Bay in July 2002, and a technical meeting held in August 2003, the Nunavut Water Board (“NWB”) issued a Water Licence with an expiry date of May 1, 2008.

Consultations during mine operations carried forward through the Reclamation Planning and approvals process, and into the plan’s implementation. In this case, the Nunavut Water Board also provided a community liaison officer dedicated to consulting on the Closure Plan.

The Government of Nunavut undertook extensive research into possible alternative and on-going uses for some of the mine facilities, especially the town site. Ultimately, no feasible alternative uses were identified, however, the deep-sea dock is to remain in place for continued use by the Coast Guard and the mill is to be relocated to a new mining development in Nunavut.

The Nanisivik Reclamation Plan (“RCP”) provided the framework for the engineering work needed to close the mine and then for on-going environmental protection measures while closure was carried out. The RCP is composed of a series of stand-alone documents, with each document providing, in detail, information and proposed closure measures for a specific mine component. The individual reports for the various mine components are listed below.

- Underground mine solid waste disposal plan

- Waste rock and open pit Closure Plan
- Reclamation cover designs
- Borrow areas development and Closure Plan
- West twin disposal area surface cell spillway design
- West twin disposal area talik investigation
- Human health and ecological risk assessment (HHERA)
- West twin disposal area Closure Plan
- Landfill Closure Plan
- Annual reclamation liability cost update
- Reclamation and closure monitoring plan
- Report on environmental site assessment (ESA) program

The RCP was approved by the Nunavut Water Board after extensive community consultations and is currently being implemented by the mine owner.

Teck Cominco Polaris Mine

Polaris Mine is located on Little Cornwallis Island (LCI) in Nunavut approximately 100 km northwest of Resolute. Polaris Mine was an underground zinc-lead mining operation. Construction of the mine and facilities began in 1980 and it closed in 2002. The Polaris mine is an extremely compact mining operation with the process barge containing the mill and most of the service facilities including powerhouse, maintenance shops, warehouse and offices.

Starting in 1999, Cominco initiated an environmental assessment of the Polaris Mine site to aid in the planning for closure. From the beginning of this process, Cominco ensured that at least one member of the team conducting the site assessment was a local northern resident. This was to ensure that the process of evaluating the site was done in an open manner and that the local communities would have first hand knowledge and involvement in the process. As the planning process progressed, consultations with communities were conducted in 2000 through Hamlet meetings and through informal discussions with the residents in Resolute and Grise Fiord about reclamation planning for the Polaris Mine. Formal presentations were made in September 2000 to the Resolute Hamlet Council summarizing the Draft Reclamation Plan, including the results of the Environmental Site Assessment (ESA) Program. In November 2000, a meeting was held with the Grise Fiord Hamlet Council. During this meeting, Cominco outlined the Draft Reclamation Plan and the results of the ESA Program. At the Grise Fiord meeting, members of the Hunter-Trappers Organization and QIA were present. In both cases, copies of the draft Plan were provided along with Inuktitut translations of the Executive Summary.

In addition to the meetings, a series of community interviews with elders, hunters, political leaders and other residents from Resolute and Grise Fiord were also held in November 2000 to discuss land use activities at and around the Polaris Mine site. An interview form was used to guide the discussions and a translator in both Resolute and Grise Fiord participated in the process.

The Polaris Decommissioning and Reclamation Plan's general objectives were based on Cominco Ltd.'s Environmental Policy, the regulatory requirements specified on the Land

Leases administered by Department of Indian Affairs and Northern Development (DIAND), and the Water License requirements now administered by the Nunavut Water Board (NWB):

- To ensure that the site returns to a condition such that public health and safety, and the environment are protected;
- To provide a working document that addresses the concerns and requirements of all stakeholders during the consultation and implementation stages;
- To ensure that the planned activities during decommissioning are such that the requirements for long term care and maintenance are minimized or eliminated;
- To identify those activities required to return the site to an aesthetically acceptable condition.

Cominco Ltd. completed three aspects of the Closure Planning process:

1. Completing an Environmental Site Assessment;
2. Developing a decommissioning and reclamation plan (the 'Plan');
3. Seeking regulatory and stakeholder input for the Plan.

The subsequent stages of the process included regulatory approval, continued community consultation, and the preparation of detailed schedules and contracts for the decommissioning and reclamation work.

Demolition, reclamation work commenced immediately upon regulatory approval and was completed by September 2004 and monitoring is on going.

BHP Billiton Island Copper Mine

The Island Copper Mine, located near Port Hardy on northern Vancouver Island is owned and operated by BHP Base Metals Canada Ltd. The mine began production in October 1971 and operated continuously until closure in December 1995. Island Copper began its formal Closure Planning in 1988. The initial Closure Plan report was submitted to the Vancouver Island Mine Development Review Committee, chaired by the Ministry of Energy, Mines and Petroleum Resources in October 1990. This report discussed the closure strategies for the waste rock dumps, open pit, acid rock drainage, water management and the marine environment. Meetings were held with the committee in November 1990 and July 1991, to discuss the report. From these discussions it was decided that Island Copper would develop a final plan for submission by December 31, 1994.

BHP Billiton's mine site reclamation and closure objectives were:

- To ensure that the site returns to a condition such that public health and safety, and the environment are protected;
- To provide a working document that addresses the concerns and requirements of all stakeholders during the consultation and implementation stages;
- To eliminate or minimize the requirements for long term care and maintenance; and
- To identify those activities required to return the site to an aesthetically acceptable condition.

The Closure Plan considered the issues and described closure arrangements for the following five distinct areas or zones of impact at Island Copper:

- Plant site;
- Land dumps;
- Beach dump;
- Open pit and passive ARD treatment system; and
- Marine environment.

Mine reclamation began shortly after start-up with the recontouring and replanting of waste rock deposits. Plant facilities not sold for other uses were dismantled; fuel and other contaminants were disposed of to regulatory standards and operating machinery and equipment sold.

A unique feature of the Closure Plan was the flooding of the 1,320-foot deep open pit with seawater from adjacent Rupert Inlet. The Island Copper Mine was instrumental in attracting and encouraging entrepreneurs who purchased buildings, docks and other facilities to establish wood processing and aquaculture operations – “sustainable industries made viable by the availability of the mines infrastructure. This was in addition to the return of 480 ha of disturbed land to productive woodland and wildlife habitat. Island Copper received five environmental performance awards from the British Columbia government and the Mining Association of British Columbia and a national award post-closure from the Prospectors and Developers Association of Canada.

TABLE 1: SUMMARY OF SELECTED RECLAMATION METHODS

Mine	Tailings	Mine (pit or underground)	Waste Rock	Roads
Ekati Diamond Mine	Revegetate and Rock Cap	Construct rock berm around pits Fill with water and selectively filled with processed kimberlite	Cap and grade	Scarify and remove culverts and leave intact
Diavik Diamond Mine	Rock Cap	Fill with water	Cap and grade	Scarify and restore natural drainage,
Snap Lake Diamond Mine	Rock Cap	Fill with water	Cap and grade	Scarify and restore natural drainage
Jericho Diamond Mine	Rock Cap	Construct rock berm around pits Fill with water	Cap and grade	Scarify and restore natural drainage
Colomac Mine	Rock Cap and Enhanced natural reclamation of tailings lake water with runoff diversions	Construct rock berm around pits and fill with water and tailings	Cap and grade	Scarify, and restore natural drainage
Discovery Mine	Rock Cap	Permanently seal all openings to the mine	Not applicable	Scarify, and restore natural drainage
Nanisivik Mine	Cap and ensure no exposure to air (cover with water where applicable)	Backfill open pits and cap. Permanently seal all openings to the mine	Put into open pits and/or underground	restore natural drainage
Polaris Mine	Not applicable was under water tailings disposal	Permanently seal all openings to the mine	Backfilled into the mine	Scarify, re-contour, and restore natural drainage
Island Copper Mine	Placed in the Ocean Dirt Cap and revegetated	Flood	Cap and revegetate	Not applicable

For details on the reclamation objectives, issues, options, and criteria for the four selected mine components reviewed in Table 1 for each of the mines please refer to Appendix Two.

5. Mine Reclamation Criteria in Other Canadian Jurisdictions

Mine Reclamation and Closure legislation and supporting tools such as regulations and guidelines were considered for British Columbia, Manitoba, Ontario and the NWT. All jurisdictions except the NWT have a Mining Act. All jurisdictions except the NWT have regulations governing mine closure; the NWT has policies governing Mine Reclamation and Closure. BC provides the least guidance and legislative/regulatory control, and Ontario the most. The NWT and Manitoba have comparable levels of guidance and policy level information available, however, Manitoba guidelines are more explicit regarding Closure criteria.

British Columbia (BC)

Primarily three provincial statutes regulate mining practices in BC: approval for mine development is regulated by the BC Environmental Assessment Act; general environmental protection obligations are set out in the Waste Management Act; and permitting, construction operation and mine closure are regulated under the Mines Act.

The British Columbia 1999 mine closure regulations apply to Advanced Exploration Projects and developed mines. They generally require the reclamation of mine sites to an acceptable state of use, with land productivity at least as high as what existed before mining. Mining companies are required to post a bond to ensure they undertake the following. The regulations support the 1996 British Columbia Mining Act and require the following:

- The salvage and replacement soils after mining.
- Management of all water quality and drainage on the mine site and water moving off the mine site.
- Acid rock drainage management.
- Erosion control.
- Progressive reclamation.
- Revegetating land to a self-sustaining state that satisfies water quality and land use objectives.
- Removing buildings, equipment and machinery.
- Ensuring waste dumps are stable and erosion is controlled.
- Stabilizing and revegetating tailings ponds and impoundment structures to an approved standard land use.
- Properly closing pits and underground workings
- Returning water courses to their original condition, or stable configuration, that ensures water quality.
- Decommissioning roads as needed.
- Monitoring race elements in soils and update in vegetation.
- Properly dispose of toxic chemicals.
- Monitor the site to prove the reclamation objectives are met.

The Mine Closure regulations provide comparatively little guidance regarding Mine Completion criteria. They do however provide a list of Mine Closure measures that must be undertaken. They are as follows.

- Cap all underground openings to the surface
- Seal all mine entries
- Stabilize and secure all openings to the surface that create a hazard
- Dismantle all buildings, power lines, pipelines and other structures
- Remove or cover all concrete structures so that natural process can occur
- Remove all petroleum products, chemical and waste
- Rehabilitate landfill and other waste management sites
- Test soil in the immediate vicinity of storage sites and appropriate control or disposal of contaminated soil
- Management of tailings for erosion and stability
- Breach all dams or structures used to control tailings or water
- Restore all watercourses to their original courses or directed to new courses that sustain themselves
- Remove roads, rail, paths, airstrips and promote revegetation

Manitoba

The Mine Closure Regulations and accompanying guidelines (1999) under the Mines and Minerals Act (1992) outlines the reclamation, closure and financial security requirements for operating and suspending mining operations in Manitoba. The regulations define what is required to satisfy the Mines and Minerals Act and provide guidance and closure criteria for the following mine components and reclamation activities.

- Revegetation
- Contaminated soils
- Buildings and surface infrastructure
- Underground and open pit work
- Mine dewatering ponds
- Mine rock piles
- Tailings and sedimentation ponds
- Water collection
- Mining effluent
- Sanitary installations
- Petroleum products
- Hazardous waste

Ontario

Part VII of the Ontario Mining Act and the supporting Ontario Mining Development and Closure Regulations are used to manage mine closure in Ontario. The Regulations provide extensive detail regarding acceptable Mine Closure criteria. For example, where the BC Mine Closure regulations require “the solid bulkheading of all shafts and raises open to the surface with reinforced concrete,” the Ontario Mine Development and Closure regulations provide a Mine Reclamation code that includes a schedule dedicated to the Protection of Mine Openings to Surface that is four pages long. <http://www.canlii.org/on/laws/regu/2000r.240/20041104/whole.html>

NWT

In the NWT Mine Reclamation and Closure is co-managed by the MVLWB and DIAND. Policy and guidance documents include the Indian and Northern Affairs (2002) Mine Site Reclamation Policy for the Northwest Territories, and the Draft Indian and Northern Affairs Mines Site Reclamation Guidelines for the Northwest Territories and Nunavut. There are also “Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories” (Northwest Territories Water Board, 1990) and the (1992) Northern Water Resources Study entitled Mine Reclamation in the Northwest Territories and Yukon. The NWT does not have legislation (Acts) governing mine reclamation and closure.

6. Example of How Mines Organize to Close a Mine

Kinross Gold formed the Reclamation Operations Business Unit to meet Reclamation obligations at its mine sites and ensure that these efforts improved the company's overall fiscal bottom line. As liabilities were decreased at mine sites awaiting closure, financial guarantees became to be less punitive. The initial three-person unit has developed into an in-house group of mine closure experts.

Like any mining operation, the Reclamation Operation Business Unit (ROBU) has a vice president and general manager, its own dedicated engineering and environmental staff, and its own separate budget. This business group directs the required financial, management, and technical resources needed to address difficult closure issues. Meanwhile, the group has developed a significant knowledge base in Reclamation and Closure technologies including covers, pit lake treatment, passive biological systems for drainage management, land application, infiltration, erosion control, tailings management, and other techniques.

Their work actually begins before a mine is even permitted or before an expansion is planned in the case of an operating mine. They ensure that the mine planning accounts for its final impacts as the site approaches closure years into the future. During mine operations, the team will assist in planning for concurrent reclamation, reclaiming waste dumps and exploration roads, and reducing the general footprint of the mine during mine life. Even after the mine is closed, the team conducts an audit program.

The team also conducts risk-based analyse for each site, conducts life-of-mine planning and scheduling for closure, benchmarks its progress, and assesses and seeks the technology that works best in individual situations. Post-closure issues involving mines may include maintaining wildlife, rangeland or fishery habitat, ensuring land usage on the site is compatible with nearby state and federal lands, or developing the land for future use to benefit the economy of a nearby community.

The unit developed a template for mine closure, to streamline the process. For instance, they determine what data gaps exist at a mine site and try to fill them in. The critical component of post-closure water uses is always a major concerns for the closure of sites http://www.mineweb.net/sections/sustainable_mining/330624.htm

APPENDIX ONE - MINE RECLAMATION AND CLOSURE COMPONENTS

BHP Billiton Ekati Diamond Mine

BHP Billiton's Reclamation Plan addresses the following mine reclamation components.

- Pit lakes
- Underground mines
- Processed kimberlite containment areas
- Waste rock storage areas
- Water management structures (dams, dykes and berms)
- Water diversion structures
- Sediment ponds
- Water management projects (eg. pit flooding, Grizzly Lake)
- Quarry sites
- Bridges and culverts
- Camp pads and laydowns
- Fuel tank farm (includes all camps)
- Roads and airstrip

Diavik Diamond Mine

Diavik's Preliminary Reclamation Plan addresses the following mine reclamation components.

- Underground workings
- Open Pit workings
- Enclosure dikes
- On-land dredged sediment storage facility
- Till storage areas
- Country rock storage areas
- Processed kimberlite containment area
- Site wide plant and infrastructure
- Hazardous chemicals and wastes
- Water management facilities
- Site water management

De Beers Snap Lake Diamond Mine

De Beers' Preliminary Reclamation Plan addresses the following mine reclamation components.

- Underground mine
- Process facilities
- Surface infrastructure
- Roads and airstrip
- Quarries
- Fuel storage tanks
- Power plant
- Accommodations complex

- Site support facilities (water and sewage)
- Solid waste management facilities
- Berm stability
- Erosion of process kimberlite material
- Drainage of surface water
- Encapsulation of potentially acid generating (PAG) rock
- Visual impact of post closure topography
- Mine waste rock and processed kimberlite (North Pile)
- Water management facilities
- Burial of inert solid materials in the North Pile
- Sedimentation ponds, sumps and ditches
- Water management pond
- Water supply and distribution
- Hazardous and salvageable materials

Tahera Jericho Diamond Project

Tahera's preliminary Reclamation Plan addresses the following mine reclamation components.

- Waste rock dumps and low grade ore stockpile
- Open pit
- PKCA coarse kimberlite and recovery plant reject stockpiles
- North ore stockpile pad
- Mine and access roads
- Sedimentation ponds, berms and ditches
- Borrow areas
- Airstrip
- Infrastructure
- Soils testing

Colomac Mine

For final Reclamation Planning the Colomac site was considered as a collection of the following interrelated components.

- Tailings containment area
- Open pits
- Waste rock piles
- Roads and storage yards
- Airstrip
- Quarries and soil borrow areas
- Sewage lagoon
- Buildings and equipment
- Spilled materials
- Waste materials

Discovery Mine

For Final Reclamation Plan for the Discovery Mine site was considered as a collection of the following interrelated components.

- Infrastructure (includes the airstrip, Rock Quarries, Silty-clay Borrow Pit, dock, Roads and power line).
- Tailings (includes the existing tailings cover and left over exposed tailings).
- Underground Mine (includes mine openings, crown pillar and mine water).
- Buildings and Equipment (includes hazardous building materials, buildings and miscellaneous structures).
- Waste and Contaminated Soil (includes metal contaminated soil, hydrocarbon contaminated soil, bagged asbestos, lead-based paint, liquid hydrocarbons and other regulated wastes, demolition debris, inert solid waste, and operation and closure of the on-site Reclamation landfill).

The “Discovery Mine Remediation Plan” was submitted to the Mackenzie Valley Land and Water Board on December 31, 2005 and pending its approval the reclamation work is scheduled for 2005.

Breakwater Resources Nanisivik Mine

For Final Reclamation Plan for the Nanisivik mine site was considered as a collection of the following interrelated components.

- West Twin Disposal Area (tailings)
- Landfill facility
- Rock Piles & open pits
- Borrow areas
- Industrial structures
- Town site
- Hydrocarbon storage & dispensing facilities
- Industrial complex yard area
- Other disturbed areas
- Chemical
- Contaminated soil volumes

Teck Cominco Polaris Mine

For Final Reclamation Plan for the Polaris Mine was considered as a collection of the following interrelated components.

- Mine workings which includes the following (underground workings, subsidence, mine portals, waste rock dumps and surface stockpiles, surface quarries, and metal leaching /acid rock drainage issues).
- Garrow Lake tailing impoundment which includes the following (tailing disposal history and methods, Garrow Lake stability and chemistry, and the frozen core dam)
- Major Surface Structures which includes the following (process barge, concentrate storage building, cemented rockfill plant, accommodation complex, tailing thickener)
- Fuel storage and handling areas and distribution lines, bulk chemical storage areas

- Concentrate load-out conveyors and miscellaneous outbuildings).
- Support infrastructure which includes the following (dock site and shoreline, airstrip, tailing lines, freshwater line and pumphouse, access roads and ramps, sewage system,
- Heating (glycol) distribution lines, electrical and communications cables).
- Solid waste management operations including the following (construction landfill, operational landfill, reclamation landfill, LRD quarry, disposition of chemicals, reagents, fuel and lubricants).
- Management of hazardous Materials.
- Procedures for handling hazardous materials.
- Contaminated soil management including the following (human health and ecological risk assessment, metal contaminated soils, petroleum hydrocarbon contaminated soils).

BHP Billiton Island Copper Mine

The Final Closure and Reclamation Plan considered the issues and described closure arrangements for the following five distinct areas or zones of impact at Island Copper:

- Plant site;
- Land dumps;
- Beach dump;
- Open pit and passive ARD treatment system; and
- Marine environment.

Mine reclamation began shortly after start-up with the recontouring and replanting of waste rock deposits. Plant facilities not sold for other uses were dismantled; fuel and other contaminants were disposed of to regulatory standards and operating machinery and equipment sold.

A unique feature of the Closure Plan was the flooding of the 1,320-foot deep open pit with seawater from adjacent Rupert Inlet. The Island Copper Mine was instrumental in attracting and encouraging entrepreneurs who purchased buildings, docks and other facilities to establish wood processing and aquaculture operations – “sustainable industries made viable by the availability of the mines infrastructure. This was in addition to the return of 480 ha of disturbed land to productive woodland and wildlife habitat. Island Copper received five environmental performance awards from the British Columbia government and the Mining Association of British Columbia and a national award post-closure from the Prospectors and Developers Association of Canada.

APPENDIX TWO – RECLAMATION OBJECTIVES, ISSUES, OPTIONS AND CRITERIA

TABLE 2: Ekati Diamond Mine Interim Reclamation and Closure Plan

Mine Component	Reclamation Objectives ²	Reclamation Issues	Reclamation Options	Reclamation Criteria
Processed Kimberlite Containment Areas	<ul style="list-style-type: none"> • Physical Stability • Chemical Stability • Biological stability • Climatic and geographic stability 	Not applicable	<ul style="list-style-type: none"> • Direct vegetation of the processed kimberlite and establishment of a wetland ecosystem. • Rock capping 	<ul style="list-style-type: none"> • Physical Stability <ul style="list-style-type: none"> ○ Functional stabilizing cover and no significant wind or water erosion • Chemical Stability <ul style="list-style-type: none"> ○ Effluent quality requirements as required by the Water License • Biological stability <ul style="list-style-type: none"> ○ Sustainable cover that provides for wildlife habitat • Climatic and geographic stability <ul style="list-style-type: none"> ○ Permafrost development within processed kimberlite ○ Established surface flow from surrounding tundra ○ Hydrologic flow established with watershed downstream of the LLCF
Open Pit	Same as above	Not applicable	<ul style="list-style-type: none"> • Fill pits with water • Fill select pits with processed kimberlite 	<ul style="list-style-type: none"> • Physical Stability <ul style="list-style-type: none"> ○ Pit walls geotechnically stable ○ No significant wind or water erosion • Chemical Stability <ul style="list-style-type: none"> ○ Effluent quality requirements as required by the Water License • Biological stability <ul style="list-style-type: none"> ○ Riparian vegetation ○ Beach areas supporting aquatic vegetation if possible ○ Fish habitat, benthos, limnology, phytoplankton, zooplankton ○ Access for wildlife (including birds) • Climatic and geographic stability <ul style="list-style-type: none"> ○ Overland flow from surrounding tundra into pit lakes ○ Integration of surface flow with interconnecting drainage

² These are the objectives of the Reclamation Criteria and apply to all BHP Billiton Ekati Diamond Mine reclamation component.

TABLE 2: Ekati Diamond Mine Interim Reclamation and Closure Plan

Mine Component	Reclamation Objectives ²	Reclamation Issues	Reclamation Options	Reclamation Criteria
				<ul style="list-style-type: none"> basin <ul style="list-style-type: none"> ○ Exiting stream from watershed returned as close as possible to baseline hydrograph conditions
Waste Rock	Same as above	Not applicable	<ul style="list-style-type: none"> • Reclamation actions provided, but alternative options to reclaim waste rock piles are not discussed 	<ul style="list-style-type: none"> • Physical Stability <ul style="list-style-type: none"> ○ Stable slopes ○ No significant wind or water erosion ○ All landfill sites and land farms have been buried and the surface stabilized • Chemical Stability <ul style="list-style-type: none"> ○ No Acid Rock Drainage ○ No surface or groundwater seepage concerns • Biological stability <ul style="list-style-type: none"> ○ Wildlife access ○ Wildlife habitat ○ If lake sediment not used as a reclamation amendment the storage area would have a stabilizing vegetative cover • Climatic and geographic stability <ul style="list-style-type: none"> ○ Permafrost development within the waste rock pile Misery rock pile has 5-m granite cap
Roads	Same as above	Not applicable	<ul style="list-style-type: none"> • Reclamation actions provided, but alternative options considered to reclaim the roads are not discussed 	<ul style="list-style-type: none"> • Physical Stability <ul style="list-style-type: none"> ○ No significant erosion along road and airstrip banks and areas where culverts have been removed • Chemical Stability <ul style="list-style-type: none"> ○ All chemical spills and contaminants remediated or removed • Biological stability <ul style="list-style-type: none"> ○ Sustainable vegetation cover ○ Wildlife habitat • Climatic and geographic stability <ul style="list-style-type: none"> ○ Re-establishment of stream flow through road and airstrip

Source: BHP Billiton, (2003). Ekati Diamond Mine: Interim Abandonment and Reclamation Plan

TABLE 3: Diavik Diamond Mine Preliminary Reclamation and Closure Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Tailings	Not Applicable	<ul style="list-style-type: none"> • Prevent surface water from being contaminated by coarse processed kimberlite. • The major factor to consider in reclamation of the processed kimberlite containment pond is the soft unfrozen nature of the slimes Thermal analyses has shown that permafrost development will take more than 100 years for complete freezing to occur. Continual consolidation will emit seepage water that may not meet discharge quality criteria and could result in cracks in the surface cover. 	Not Applicable	Not applicable
Open Pit	<ul style="list-style-type: none"> • Physical Stability • Chemical Stability 	<ul style="list-style-type: none"> • Physical Stability <ul style="list-style-type: none"> ○ None since flooding will increase the stability of the pit walls • Chemical Stability <ul style="list-style-type: none"> ○ residual ammonium nitrate and fuel oil ○ pit wall geochemistry ○ saline groundwater 	Not Applicable	Not Applicable
Waste Rock	<ul style="list-style-type: none"> • Physical Stability • Chemical Stability • Permafrost Development • Environmental Aspects 	<ul style="list-style-type: none"> • Physical Stability <ul style="list-style-type: none"> ○ Short term and long term stability of large rock dumps on ice rich soil in some areas ○ Surface erosion and sediment yield. • Chemical Stability <ul style="list-style-type: none"> ○ Acid rock drainage potential ○ Metal mobilization and migration • Permafrost Development <ul style="list-style-type: none"> ○ Maintaining permafrost at the pile 	Not Applicable	Not Applicable

TABLE 3: Diavik Diamond Mine Preliminary Reclamation and Closure Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
		<ul style="list-style-type: none"> ○ perimeter for stability ○ Development of permanent permafrost within the rock dump • Environmental Aspects <ul style="list-style-type: none"> ○ Caribou migration across the dumps 		
Roads	Same as above	Not applicable		

Source: Diavik Diamond Mine Inc., (2001). "Interim Abandonment and Restoration Plan" EMS File # 6.6.2 NKSL 4200-41EG-1019 Rev.0.

TABLE 4: Snap Lake Diamond Mine Preliminary Reclamation and Closure Mine

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Tailings and	<ul style="list-style-type: none"> • Wind and water erosion control 	<ul style="list-style-type: none"> • Erosion of processed kimberlite materials • Drainage of surface waters • Potentially acid generating rock • Visual impact of topography 	Not applicable	Not applicable
Underground Mine	<ul style="list-style-type: none"> • Remove all major structures, and fixed and mobile equipment • Close and seal all mine openings 	<ul style="list-style-type: none"> • Water quality in the flooded mine 	Not applicable	Not applicable
Roads	Not applicable	Not applicable	Not applicable	Not applicable

Source: De Beers Canada Mining Incorporated, (2003). *Preliminary Mine Closure and Reclamation Plan: Snap Lake Diamond Project*. Prepared by AMEC E&C Services

TABLE 5: Jericho Diamond Mine Preliminary Reclamation Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Tailings	<ul style="list-style-type: none"> • Maintain or improve the level of wildlife habitat • To the extent practical create an aesthetically pleasing environment 	Not applicable	Not applicable	Not applicable
Open Pit	See above	Not applicable	<ul style="list-style-type: none"> • Flood with water • Backfill with waste rock 	Not applicable
Waste Rock	See above	<ul style="list-style-type: none"> • Stability • Wind and water erosion 		Not applicable
Roads	See above	Not applicable	<ul style="list-style-type: none"> • Leave intact • Scarified or ripped 	Not applicable

Source: Tahera, (2003). Jericho Project Mine Reclamation Plan.

TABLE 6: Colomac Preliminary Reclamation and Closure Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Tailings Lake Water	<ul style="list-style-type: none"> • Take immediate action to protect human health • Protect the environment • Meet legal obligations • Develop solutions that are technically sound and fiscally responsible 	<ul style="list-style-type: none"> • Water has some metals elevated with respect to CCME criteria for protection of aquatic life • The lake will reach its maximum permitted level as soon as 2008, and will need to be discharged at that time • Tailings directly accessible to wildlife • Water seepage containing thiocyanate 	<ul style="list-style-type: none"> • Enhanced natural contaminant removal (phosphorus addition) • Enhanced natural removal with additional runoff diversions • Enhanced natural removal with additional storage of water in Zone 2 Pit • Enhanced natural removal with active treatment of annual excess water • Enhanced natural removal with wetland polishing of annual excess water • Rapid active treatment of all water 	Not applicable
Open Pits	See Above	<ul style="list-style-type: none"> • Steep unsafe pit walls unsafe for wildlife and humans • Steep pit walls not visible by human or wildlife approaching the walls from the pit crest 	<ul style="list-style-type: none"> • Construct rock berms around pits • Construct fences around pits • Re-contour edges of pits • Backfill pits 	Not applicable
Waste Rock	See Above	<ul style="list-style-type: none"> • Unvegetated waste rock piles • Impede wildlife passage • Caribou may be forced to climb over rock piles 	<ul style="list-style-type: none"> • Flatten tops, scarify compacted surfaces and partially revegetate • Contour tops and side-slopes, scarify 	Not applicable

TABLE 6: Colomac Preliminary Reclamation and Closure Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
			compacted surfaces and partially revegetate • Construct wildlife access ramps onto piles • Remove French Drain, re-establish natural drainage and enhance stream fish habitat • Clear vegetation to create wildlife trails around waste rock piles	
Roads	See Above	<ul style="list-style-type: none"> • Effect on surface drainage • Three streams that may provide fish habitat or migration filled with rock • Inadequate drainage in several locations could lead to erosion of road materials and associated contaminants and metals 	<ul style="list-style-type: none"> • Leave roads and yards in place, restore natural drainage, scarify compacted surfaces • Re-contour roads, cover with soil and fully revegetate • Remove roads and yards 	Not applicable

Source: Indian and Northern Affairs Canada, (2004). "Colomac Site Remediation Plan".

TABLE 7: Discovery Mine Final Reclamation and Closure Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Tailings	<ul style="list-style-type: none"> • Provide conditions that allow long-term use of the area for: <ul style="list-style-type: none"> ○ traditional First Nations activities (including hunting, fishing, gathering and camping); ○ recreational use (including hunting, fishing and camping); ○ wildlife habitation; and ○ fish habitation in Giauque Lake. • Provide a safe environment for people; • Provide for protection of wildlife and the environment; • Eliminate any requirements for long-term care and maintenance • Minimize, as much as possible, the requirements for long-term inspections, monitoring and maintenance; • Ensure that all proposed activities and Reclamation methods are technically feasible • Minimize Reclamation costs as much as possible without compromising the other objectives 	<ul style="list-style-type: none"> • Minor settlement and frost boil issues on the existing cover may represent a risk of contaminants entering the environment if maintenance work is not undertaken • Tailings in Giauque Lake may represent a risk to aquatic life and habitat • Tailings in Round Lake may represent a risk to aquatic life and habitat • Continued or expanded use of roads over the tailings cover may represent a risk that the performance of the cover for environmental protection will be compromised through settlement, compaction, rutting and erosion • Small areas of residual exposed tailings represent a risk of contaminants leaching into the environment or as a possible attractant for wildlife due to a high salt content 	<ul style="list-style-type: none"> • Do nothing • Conduct maintenance work on the existing tailings cover • Remediate frost boils in tailings cover • Remediate frost boils in tailings cover with a liner placed over the silty clay • Remove select vegetation (deeper root) • Remove all vegetation from tailings cover • Conduct a aquatic assessment of Giauque Lake • Conduct water, fish and sediment Reclamation in Giauque Lake • Conduct an aquatic assessment of Round Lake and Winter Lake • Conduct water and sediment Reclamation programs in Round Lake • Carry out a follow up monitoring program 	<ul style="list-style-type: none"> • Undertake maintenance work on the existing tailings cover such that the original design objectives are preserved • Protect water quality, fish and other organisms in Giauque Lake • Protect water quality in Round Lake • Protect water quality, fish and other organisms in Winter Lake; • Protect the long-term environmental performance of the tailings cover against use of the cover as a travelway by INAC and others • Protect the environment from possible release of contaminants from residual exposed tailings

TABLE 7: Discovery Mine Final Reclamation and Closure Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Underground Mine	See Above	<ul style="list-style-type: none"> • Openings into the underground mine may be unsafe for people or wildlife • Surface subsidence over the underground workings related to instability of the crown pillar may create an unsafe surface environment • The underground mine water may be a source of contaminant release to the environment. 	<ul style="list-style-type: none"> • Do nothing – 4 of 6 located mine openings are temporarily capped; 2 are fenced and partially backfilled with debris • Complete a professional investigation/assessment of mine openings, including possibly opening/removing the existing caps to allow direct examination of collar conditions • Fencing and signage of openings • Leave the “low risk openings as is and upgrade the caps on the “medium risk” openings to achieve the same “low risk” standard • Install “semi-permanent” seals in all openings • Install permanent seals in all openings into the underground mine 	<ul style="list-style-type: none"> • Provide safe seals over all openings into the underground mine following industry best practices • Implement a plan for assessment and mitigation of risks of surface subsidence following industry best practices • Protect the environment from the risk of contaminated seepage from the underground mine

Source: Indian and Northern Affairs Canada, (2004b). “Discovery Mine 2004 Remediation Plan”

TABLE 8: Nanisivik Mine Final Reclamation Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Tailings	<ul style="list-style-type: none"> To minimize the risk of acid rock drainage and metal leaching from the tailings To provide for a safe surface environment that resembles the natural conditions 	Not applicable	<ul style="list-style-type: none"> Provide a thermal barrier cover over tailings in the Surface Cell and Test Cell areas such that they become frozen into permafrost and to provide a water cover over tailings in the Reservoir such that they are safely protected from oxidation. Utilize local, natural materials for reclamation and to return the Reservoir pond to the original elevation of West Twin Lake. 	<ul style="list-style-type: none"> Removal of residual surface water Preparation of the tailings surface Placement of a minimum thickness of 1.0 m of shale Placement of a minimum thickness of 0.25 m of Twin Lakes sand & gravel Installation of geothermal monitoring instrumentation
Open Pit	<ul style="list-style-type: none"> Reclaim the remnant waste rock from the rock pile into the pit Cover the pit and consolidated pile at the portal with a thermal barrier cover of shale with a durable cap of Twin Lakes sand and gravel Consolidate residual mineral contaminated soil at the portal site into one discreet area Execute all activities according to a quality control program Conduct performance monitoring as laid out in the Closure Performance Monitoring Plan. 	Not applicable	<p>Waste rock has been relocated from the rock pile into the pit, as part of the mine's progressive waste rock reclamation program, such that all but a remnant quantity of waste rock remain and the pit has been backfilled to provide positive drainage.</p>	<p>Reclamation activities will be to reclaim the remnant waste rock from the rock pile into the pit and to consolidate residual mineralized material at the portal site such that they can then be covered with the a 2.2 m thick thermal barrier cover</p>

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Waste Rock	See above		<p>Apply the most appropriate combination of one or more of the following reclamation measures:</p> <ul style="list-style-type: none"> • Relocate waste rock to eliminate or reduce the requirements for surface reclamation at the pile location • Fill open pits to achieve a smooth surface contour that prevents surface ponding and provides a safe surface environment • Provide a thermal cover such that the covered materials freeze into permafrost • Assess the net negative effects of intrusive reclamation work against the potential long term • Environmental risk Institute a monitoring and contingency program 	<ul style="list-style-type: none"> • Water quality in Twin Lakes Creek and Chris Creek to identify any observable influence in the creeks from reclaimed areas • Water quality in any direct seeps from the reclaimed areas • Ground temperatures within the covers and within the waste to bedrock to confirm that the covers are keeping the waste materials below zero • Physical condition of the covers so that any initial settlement is quickly identified and repaired.
Roads	See Tailings Objectives	Not applicable	Not applicable	<ul style="list-style-type: none"> • Roadbed that causes an interruption to natural drainage will be breached and contoured • Culverts will be removed.

Source: CanZinco Ltd., (2004). Nanisivik Mine 2004 Reclamation and Closure Plan.

TABLE 9: Polaris Mine Final Reclamation Plan

<i>Mine Component</i>	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Tailings	<ul style="list-style-type: none"> • To ensure that the site returns to a condition such that public health and safety, and the environment are protected • To provide a working document that addresses the concerns and requirements of all stakeholders during the consultation and implementation stages • To eliminate or minimize the requirements for long term care and maintenance • To identify those activities required to return the site to an aesthetically acceptable condition 	Not applicable	Not applicable	Not applicable
Under Ground	See Above	Not applicable	Not applicable	Not applicable
Waste Rock	See above	Not applicable	Dispose underground	Not applicable
Roads	See above	Not applicable	Not applicable	Not applicable

Source: Cominco, (2001). Polaris Mine Decommissioning and Reclamation Plan, Volume 1 of 4. Prepared for Cominco Ltd. Prepared by: Gartner Lee Limited.

TABLE 10: Island Copper Mine Final Reclamation Plan

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Tailings and waste rock	<ul style="list-style-type: none"> To ensure that the site returns to a condition such that public health and safety, and the environment are protected To provide a working document that addresses the concerns and requirements of all stakeholders during the consultation and implementation stages To eliminate or minimize the requirements for long term care and maintenance To identify those activities required to return the site to an aesthetically acceptable condition Land use objective of wildlife habitat Secondary land use objective of forestry and recreation 	<ul style="list-style-type: none"> Marine environment Acid rock drainage 	<ul style="list-style-type: none"> Flow from waste rock dumps collected and directed to the open pit Inject acid rock drainage to the bottom of the flooded pit that will become meromictic. Lime treatment Recontour and vegetate Recolonize the intertidal zone 	Not applicable
Open Pit	See Above	<ul style="list-style-type: none"> Pit water quality Pit wall stability Pit wall geochemistry 	<ul style="list-style-type: none"> Flood the pit with seawater and connect to Rupert Inlet Flood with seawater and do not connect to Rupert Inlet Turn the open pit into a municipal solid waste disposal area 	Not applicable

Mine Component	Reclamation Objectives	Reclamation Issues	Reclamation Options	Reclamation Criteria
Roads	See above	Not applicable	Not applicable	Not applicable

Source: BHP Minerals Canada Ltd. (1994). Island Copper Mine Closure Plan.

GLOSSARY

Acid Drainage

Any drainage from mine workings, waste or tailings with pH levels below 7. May also refer to ground water pumped to the surface from the mine.

Canadian Mining Regulations

Federal regulations respecting the administration and disposition of mineral belonging to her Majesty in right of Canada and all lands forming the Northwest Territories.

Capping System

An impermeable system designed to reduce surface water infiltration, control gas and odour emissions, improve aesthetics, and provide a stable surface cover.

Crown Lands

Lands to which the federal government owns the surface and/or subsurface rights.

End Land Use (Equivalent Land Capability)

The allowable use of disturbed land following reclamation. Municipal zoning and/or approval may be required for specific land uses.

Environmental Assessment

Examination of a development proposal's environmental, social and economic effects.

Erosion

The wearing away for rock, soil or other surface material by water, rain, waves, wind or ice; the process may be accelerated by human activities.

Kimberlite

A type of rock (produced by volcanic activity) that can contain diamonds.

Minewater

Water that is pumped or flows out of any underground working or open pit.

Open Pit Mine

Any open surface excavation for the extraction of minerals/ore by drilling, blasting or cutting.

Ore

A mineral or solid material containing a precious or useful substance in a quantity and form that makes its worth extracting.

Processed Kimberlite

The portion of washed or milled kimberlite that is regarded as too poor to be treated further and has little or no economic value.

Progressive

reclamation

Reclamation that can be carried out during the construction and operation phases of a mine prior to final closure. Typical examples include borrow pits and rock waste dumps.

Regulatory Authority

Refers the person or group responsible for issuing licences, permits or other authorizations required for development under any federal or territorial law. This excludes designated regulatory agencies or local government.

Revegetation

Replacing original ground cover following a disturbance to the land.

Scarification (soil)

Seedbed preparation to make a site more amenable to plant growth.

Tailings

Material rejected from a mill after most of the recoverable valuable minerals have been extracted.

Topography

The shape of the ground surface, such as hills, mountains, or plains. Steep topography indicates steep slopes or hilly land; flat topography indicates flat land with minor undulations and gentle slopes.

Underground Mine

Also known as a “deep mine”. Usually located several hundred feet below the earth’s surface, an underground mine’s coal is removed mechanically and transferred by shuttle car or conveyor to the surface.

Waste Rock

All rock materials, except ore and tailings that are produced as a result of mining operations.

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