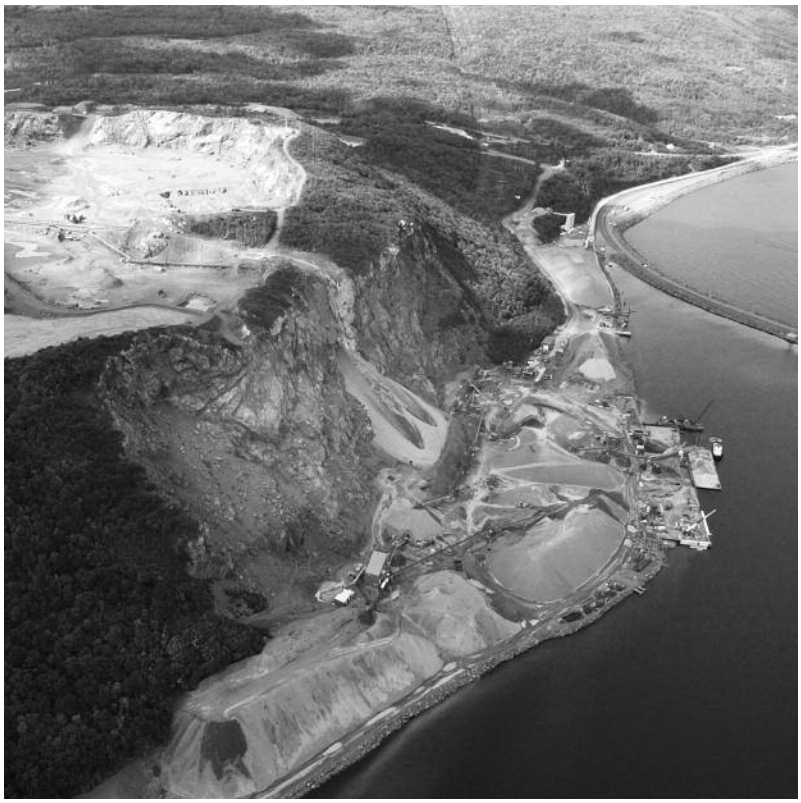
Minerals

A Natural Foundation for Nova Scotia's Future

A PANEL OF EXPERTISE REPORT ON MINERALS TO THE STEERING PANEL
February 2010



The Martin Marietta quarry on the Strait of Canso—*Department of Natural Resources*

MINERALS PANEL OF EXPERTISE

This report was authored by the Minerals Panel of Expertise as part of the Nova Scotia Natural Resources Strategy 2010 process. Panel members include:

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ACKNOWLEDGEMENTS

This document would not have been possible without the input of various geoscientists and experts in the scientific and academic community, industry, nongovernmental organizations, and federal and provincial government departments, who generously offered their time and shared with us their expertise, in addition to records of Phase One of this consultative process. We have attempted to interpret and combine diverse opinions.

The sections on Groundwater and Coastal Geoscience drew heavily from communications with Terry Hennigar and Bob Taylor, respectively.

The report and any errors or omissions within are the sole responsibility of the Minerals Panel.

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EXECUTIVE SUMMARY

Geological processes influence *all* ecological processes on earth. The connection between ecology and geology is not adequately recognized by the public or policy makers. Modern society is totally dependent on geological resources, but their vital contribution to our basic standard of living is not well understood and therefore not appreciated. Additionally, these resources will be critical in the implementation of *any* future sustainable society scenarios.

Nova Scotians face serious challenges related to environmental health, community well-being, and economic prosperity. Geological information will be a critical component of addressing serious risks facing the province, such as supply and quality of drinking water, and the impact of coastal erosion and sea level rise. Geoscience must also play a role in characterizing and preserving Nova Scotia's mineral potential. This includes metals that will be vital to the implementation of green technologies associated with alternative energy production, positioning the province as a world leader in this area.

At the Department of Natural Resources, the role of the Mineral Resources branch has changed from the promotion of mineral development to stewardship, but the resources provided to the branch are insufficient to fulfill this role. Undervaluing of geosciences in the province has resulted in inadequate long-term funding for the characterization and safeguarding of groundwater and geothermal resources, coastal hazards, historical mine site reclamation, and the preservation of mineral deposits to supply raw materials to sustain even the most basic infrastructure (such as roads and buildings).

Sustainable mineral resource development should be considered an investment by the current generation in the long-term prosperity of future generations. Minerals included under the Mineral Resources Act belong to all Nova Scotians by law. Modern mining practices, followed by proper restoration of the land to pre-mining conditions, could be considered the ultimate contributor to sustainable development. Future generations could enjoy benefits from minerals that have made their way into our infrastructure but they are not saddled with the entire costs associated with current mining.

Unfortunately, past practices have resulted in a mistrust of industry and regulatory authorities. Now public trust must be restored. Today, the consequences of geoscience decisions on our society are recognized by law under the Geoscience Profession Act of Nova Scotia.

Under the Environmental Goals and Sustainable Prosperity Act, 12 per cent of the province's lands must be protected by 2015. Any recommendations involving the protection, characterization, and utilization of lands consider knowledge of geology and geological processes, and the mineral development or geohazard potential of those areas.

While a high level of geoscience competence exists within the Department of Natural Resources, lack of resources has limited the potential of many high-priority projects (groundwater, coastal hazards assessment, and remediation and reclamation). Additionally, regulatory issues and a lack of stimulus funding impact investment in the province, compromising opportunity for mineral development. Finally, the lack of awareness and understanding of geology's impact on daily life highlights the need for outreach and education activities.

The Minerals Panel has identified a number of recommendations in the areas of: education, awareness, and relationship building; geosciences information; regulatory issues; groundwater resources; coastal geosciences; protection and promotion of mineral resources; remediation and reclamation; and management and branch funding that address key issues.

- Additional resources (funding and staff) are required to address the following critical geoscience issues: (1) systematic and comprehensive (province-wide) groundwater mapping is needed to identify the resource potential and the risks to that resource by 2020, and (2) an integrated, province-wide coastal geology mapping and hazard assessment program should be in place by 2020.
- A comprehensive and effective communications, advisory, and education strategy is required for school curriculum, communities, planners, Regional Development Authorities, politicians, other departments, and nongovernmental organizations to increase awareness of the vital importance of geoscience and geological resources in society. In this process, the Department of Natural Resources must strive to promote informed stakeholder

engagement as a critical element in the sustainable development of mineral resources. The strategy would also include the appointment of geoscientists to a permanent, external science advisory panel to the minister by 2012.

- There is a need to identify and prioritize opportunities in historical areas of mineral resource production for immediate reclamation and remediation. Sites with recoverable resources (e.g., gold in mine tailings) or environmental stressors (e.g., arsenic and mercury in mine tailings) should be evaluated for reclamation potential.
- The Prospector's Assistance Program should be reinstated to encourage mineral resource development in Nova Scotia. The total value of this program should be restored to at least 1997-2002 levels ($600,000) with a goal to match New Brunswick levels by 2015.
- The outdated Mineral Resources Act requires updating to reflect present and future economic, social, and environmental priorities. This must include consideration by all relevant stakeholders that aggregates, gypsum and quarry stone, non-Crown limestone, and groundwater be declared as "minerals" under the Act.
- An externally managed annual review process is required to monitor implementation of strategy recommendations, to be in place by 2012.

1.0 STAKEHOLDER INPUT

The Minerals Panel received submissions (written and oral) from over 80 stakeholders to help inform the discussion and recommendations in this report. Stakeholder input focused on a number of critical issues:

- There is a lack of appreciation of the contribution of geology and minerals to modern society. This has resulted in poor land use decisions costing millions of dollars to tax payers, potential health risks to citizens, and negative publicity directed at the mining industry and the government.
- While there is generally seen to be a high level of geoscience competence and a high quality of regional geological services in the Mineral Resources branch of the Department of Natural Resources, limited staffing and financial resources are compromising the ability of the branch to involve communities in land use planning and to provide accessible geological information for use in planning.
- Many stakeholders are not aware of the current role of the department's Mineral Resources branch and their shift in focus from promotion of mineral resource development to these new areas of priority in recent years.
- The competition for limited mineral exploration investment dollars between jurisdictions is very high. Mineral resource development opportunities for the province have been seriously compromised by regulatory problems, lack of stimulus funding, and lack of public support due to mistrust of industry based on poor past mining practices.

2.0 GEOSCIENCE AND MINERAL RESOURCES

2.1 Introduction

Geological processes shape our world on many levels. Major events such as earthquakes, sea level rise, landslides, drought, volcanic eruptions, and tsunamis remind us that our earth is dynamic, scary at times, and ever changing. In contrast, Nova Scotia seems quite stable – a place where life unfolds each day and its people feel a sense of good fortune in light of these devastating events in less fortunate areas.

> "We learn geology the morning after the earthquake."
>
> Ralph Waldo Emerson

These dramatic events, however, do not accurately reflect our intimate and pervasive relationship with our physical environment. Although we remain untouched by tragic geological events, we unknowingly interact each and every day with a variety of geological process and resources, from the chemical composition of the air we breathe, to the quality of the water we drink, and the unique properties of minerals we use every day.

Most Nova Scotians are unaware that we have finite groundwater resources, and that portions of the coastline will undoubtedly suffer infrastructure damage and water-quality issues due to subsidence and sea level rise. They are also unaware of their demand and reliance on mineral and energy resources, and many are unaware of the impact of poor planning decisions that omit geological information and place the health and welfare of individuals at risk, or render mineral resources inaccessible due to land protection.

It is clear from stakeholder submissions and background materials that the billion years of geological history underlying Nova Scotia has left us with a rich tapestry of rock types, unique landscapes and ecosystems, and a wide assortment of mineral deposits. Along with this geological diversity, there are a number of issues that need to be addressed in the short term, as well as over long-term planning periods that span decades.

To address these issues, an integrated approach will be required to sustain efforts to build understanding of geosciences and appreciation for the geoscience discipline, proactive planning, research, and partnership building with non-traditional colleagues such as researchers and policy makers in the biological and conservation fields.

Even if these efforts come to fruition, there is a long road ahead to characterize the geology of the province, inventory hazards, water supplies, and mineral deposits, and require all land planning activities to include geoscience information in the planning process.

2.2 Minerals resources branch - background

The Department of Natural Resources Mineral Resources branch is responsible for a number of programs that focus on geoscience in Nova Scotia. They are the main contacts for geological information and expertise in government, and manage programs involving mineral deposit studies, groundwater, bedrock and surficial mapping, environmental geology, energy resources, economic development, core storage, geoscience publications, and geographic information systems.

The branch is also responsible for the development of policies and regulations to manage all exploration and mining activities in the province. Authority to explore and mine is granted under the Mineral Resources Act, through exploration licences and mining leases. The Act establishes a framework for the administration of licences and leases and sets out regulations to guide the orderly development of the province's mineral resources.

The branch provides leadership at every phase of the mineral development process from exploration, through feasibility, development, reclamation, and sequential land use. They work closely with Nova Scotia Environment as well as other departments to guide proponents through the "One Window" Process for Mine Development Approvals.

Thus, two main areas of concern emerged from submissions and discussions. One focused on basic geology and the application of geoscience information to help solve a variety of issues. The second area focused on the understanding of mineral resource development, and the social and environmental issues associated with those activities.

2.3 Applied geoscience

In recent years, the Mineral Resources branch has moved away from its role as an economic development-oriented agency by broadening its mandate to meet client demands. These activities had their roots established in the early 1990s and included projects on mining and land use, and the application of geoscience in development planning, reclamation planning, and the role of mining in sustainable development.

There are many examples of land activities that did not include appropriate geoscience information during the planning process. These examples are associated with ongoing coastal problems, acid rock drainage from new subdivisions, water quality issues, and the loss of mineral development opportunities through conservation initiatives. While some stakeholder submissions highlighted the existence of data and opportunity to consult with the department, the fact that certain development planners ignored or didn't know of these opportunities points to an obvious disconnect between the data generators and the users.

There is also strong concern among some stakeholders regarding planning at local, provincial, and national levels that omitted or ignored vital geoscience information. Society is currently facing some its greatest challenges, and the inclusion of geoscience information and expertise is critically important to developing solutions at the local, regional, and global levels.

Discussions on climate change highlighted the precarious nature that Nova Scotia may find itself in. Surrounded by water, Nova Scotia's low-lying coastal areas will be subjected to seawater inundation as a result of sea-level rise, land subsidence, and storm events. Impacts to coasts and their communities could be significant with respect to sea encroachment and salt-water intrusion of drinking water supplies.

> "Civilization exists by geological consent, subject to change without notice."
>
> Will Durant

2.4 Mineral resource development

Mining has been a part of Nova Scotia's culture and history dating back over 300 years. During this time, dozens of commodities have been produced throughout the province that included precious metals, base metals, industrial minerals, and coal/petroleum. This is an impressive list for such a small province, and yet the social and economic contribution of minerals to Nova Scotia is largely unknown and unappreciated.

Minerals permeate every single aspect of our modern society, however the lack of appreciation coupled with a poor record of environmental performance at many past operations has resulted in societal attitudes ranging from apathy to complete mistrust in many cases. This attitude has led to poor resource management and land planning decisions, numerous community conflicts, lost economic opportunities, and, overall, lost opportunities to meet sustainable development goals in Nova Scotia.

Mineral resources make a significant contribution to the provincial economy. A report by Gardner Pinfold Consulting and Conestoga-Rovers and Associates (2008) puts the annual contribution at almost $490 million. Yet this is only a small part of the true contribution of mineral resources to our province and to society. The simple fact that minerals stay in circulation for generations and that they enable new strategic technologies and direction is perhaps their greatest value to the province. Mineral resource development must be considered as an investment by the current generation in the long-term prosperity of future generations. Past investments in most aspects of the economy (infrastructure, medical facilities, and engineered structures to name a few) have been made possible by mining that took place generations ago.

> "There are plenty of ruined buildings in the world, but no ruined stones."
>
> Hugh Macdiarmid (Christopher Murray Grieve)

Technologies in the green economy rely heavily on a wide range of minerals and constitute an important sector of potential economic growth. Metals (rare-earth metals, copper, platinum-group elements) will be vital to province's successful implementation of alternative-energy technologies in the future (wind, solar thermal, tidal turbine) as we will likely be required to meet maximum emissions targets from the burning of fossil fuels set in

motion by the Copenhagen Accord. Nova Scotia has already committed in the Environmental Goals and Sustainable Prosperity Act (EGSPA) to reducing greenhouse gas emission to 10 per cent below 1990 levels by 2020, and the province could be strategically positioned to provide raw materials from a geological perspective to meet not only provincial, but also global mineral resource requirements.

Additionally, the need for aggregate resources is greater than ever, not only for new developments but for maintenance and renewal of existing roads, highways, and infrastructure. For each Nova Scotian, this alone requires approximately 10 to 15 tons of aggregate per year. The long-term demand for aggregates may also be significant in urban centres where they may play a critical role in mitigating the passive effects of sea-level rise as well as storm surges.

2.5 Geoscience and sustainability goals

Most discussions focus on the role of protection and conservation to meet sustainability goals. Unfortunately, the geosphere, its processes, and resources are often ignored or overlooked as essential components and, instead, are viewed as in conflict with or in competition with sustainability. This section reviews the role of geoscience in sustainable communities. It pays particular attention to mineral resource development and sustainability as this aspect of geoscience is often the most difficult concept for protection and conservation proponents to recognize and accept.

Geoscience plays one of the most critical roles in planning a sustainable future because geology and geological processes are the foundations for all ecosystems. The underlying geology ultimately dictates the composition of soils and water quality and is as important as climate in the development of a particular ecosystem. Therefore, it should be the foundation for all land planning decisions from both the conservation and development perspectives.

> "We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology."
>
> Carl Sagan

Yet geoscience is greatly undervalued. A basic understanding of the earth's processes is not required in schools and therefore many of the discussions on sustainability start with the biological aspects of an ecosystem. While the tendency is often to place conservation goals ahead of economic goals, it is possible (and necessary) to strike a balance between development and protection through rigorous environmental planning.

There are diverse opinions among stakeholders of how to achieve sustainability goals. Regarding geoscience and minerals, the role of geoscience in planning decisions was acknowledged, but examples focused mainly on the connection to development. There is clearly a sense among some stakeholders that mining is not sustainable.

> The widely accepted definition of sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
>
> Brundtland Commission, 1987

"Sustainable mining" is not equivalent to "mining within the framework of sustainable development." In order to fully understand this distinction, the intimate relationship between minerals and modern society must also be understood.

The discussion regarding sustainability does not start with a new mine or quarry being planned - rather the whole industry has to be considered within a historical context. We must refrain from separating specific aspects of industry in order to truly appreciate and understand minerals' contributions to sustainable development and a sustainable future.

In order to do that we must look to the past and acknowledge how past mining from all over the world has benefited Nova Scotia over generations. To begin, minerals permeate virtually every aspect of our daily lives. Our roads, buildings, and other infrastructure form our mineral legacy.

Mining could be considered one of the most important contributors to sustainable development as the cumulative benefits to future generations is actually greater than the benefits to the generation that did the mining. Mining actually increases the ability of future generations to meet their needs – a fact seldom recognized by society.

To illustrate this point, consider the transportation networks in the province. The materials needed for this infrastructure (concrete, metals, aggregate) were mined or quarried decades ago and yet we still enjoy the benefits of that investment today. The benefits of minerals have enriched our lives to an incredible extent. This simple fact must be considered as a fundamental pillar of sustainable development as it has long-range implications for future generations.

Many aspects of our province's sustainable development also rely on green technologies. These technologies will heavily rely on a wide range of minerals for energy production and graphite for automobile batteries/fuel cells. In addition, many of the technological tools that Nova Scotians have come to depend on (e.g. computers, cell/smart phones) use minerals in their production. New technologies will bring new demands for minerals.

Mineral development in the context of sustainability faces unique challenges regarding the mineral stewardship component of mining as well as the environmental/community management side as highlighted by the following:

- Mineral deposits are rare and can only be developed where they occur. This point cannot be overstated.
- Mineral resources are vested in the Crown so that all Nova Scotians can benefit from the economic and community benefits they bring. Obviously, there are costs associated with mineral resource development as well, and under an equitable system, costs and benefits should be distributed in a way so that no one community bares the brunt of all the costs.
- Reclamation brings degraded areas back to productive ecosystems. Reclamation planning is an important step in the land cycle process and is a pillar of a sustainable land strategy.
- Discussions and submissions also brought up the notion of social responsibility. The development of mineral resources "in our own back yard" for our consumption is environmentally and socially preferable to diverting costs to other countries while we enjoy the benefits.

Minerals enable modern society. Responsible mineral development in the context of sustainability, therefore, focuses on the long-term benefits of minerals in society, the minimizing of social and environmental disruption, and the return of land to a productive state.

3.0 EDUCATION, AWARENESS, AND RELATIONSHIP BUILDING

> "Research informs education and education informs research. Without both, each will suffer."
>
> David C. Gosselin Professor, University of Nebraska, Lincoln, 2003
>
> Preparing the Geoscience Workforce workshop

Background

Nova Scotians are, for the most part, unaware of the importance of both geoscience information and mineral resources in their daily lives. For example, geology can affect our water quality, yet many people buy houses without consideration for the area's geology. We continue to buy coastal properties without regard for the inevitable impacts of severe weather events and climate change on the shoreline. We also demand more infrastructure to meet our needs (e.g. roads, housing, retail) without acknowledgement that mining and quarrying is required for the aggregate, stone, and other materials used in these developments.

Education is critical if we are going to protect vital resources like groundwater, and prepare for impacts to our extensive coastline. It is also key to engaging Nova Scotians in informed discussions on the risks and benefits of mineral resource development in Nova Scotia.

Basic geosciences (earth sciences) education needs to start during childhood, through the development of geology lesson plans and experiential learning opportunities from grades primary to 12, building on those provided through the Natural Resources Education Centre and drawing on the expertise of geologists within and outside of government.

Geosciences education in the post-secondary environment also needs to be strengthened, as geology is equally undervalued at this level. As an example, geology is not included in the mandatory curriculum for degrees in science in Canada. Geosciences expertise can be further developed at the post-secondary level by providing opportunities for collaboration between the Department of Natural Resources and universities to provide practical research opportunities for students and additional capacity for the department.

Outside of the formal education system, hands-on learning opportunities are needed in provincial parks or other similar sites for adults, as well as children and youth. The geosciences community and the mining industry could also look at opportunities to share their knowledge through outreach activities such as open houses or tours of reclaimed mines.

Education and awareness are critical if communities are going to be engaged in meaningful discussions around mineral resource development. Two policy initiatives in the 1990s contained provisions calling for increasing environmental and community interests in the mineral development process. In 1992, the government tabled the Sustainable Development Strategy for Nova Scotia. Land access was identified as an important issue and the strategy also touched on the need for increased communications and education. The Minerals Policy was released in 1996 and contained additional initiatives calling for more education, public awareness, and increased consultation among all stakeholders.

The Department of Natural Resources has made great strides with a few Regional Development Authorities (RDAs) and are engaged in constructive dialogue with several nongovernmental organizations. The Mineral Resources branch could play a key role in relationship building between aboriginals, nongovernmental organizations, industry, and communities in the mining sector by providing a balanced account of the roles and responsibilities of the Mineral Resources branch and their connection to other regulating bodies such as Nova Scotia Environment. Emphasis should be placed on the interdepartmental relationships in government to demonstrate the balance between the promotional and sustainable management aspects of the department.

Objective

To build capacity for engagement with stakeholders, and to ensure that community and government decisions related to geological resource conservation and development are made with current scientific information.

Discussion

Stakeholder engagements highlighted a variety of issues associated with past mining practices, investment opportunities, land ownership conflicts, and competing land uses and philosophies that have left many Nova Scotians with a generally negative impression of mining. This has also resulted in reluctance to accept that the attraction of investment and enhancement of potential for future resource developments can successfully take place within the context of robust policy and legislation that protects the public and minimizes detrimental environmental impact.

A prevalent mistrust of industry as well as government has led to conflicts with community and special-interest groups as new mining operations were proposed. The public seems generally unaware of positive experiences regarding mining, whereas wide publicity is given to negative impacts.

Yet there is little recognition of the fact that the most damaging impacts to the environment in the last 50 years in terms of hazards such as acid rock drainage and wildlife degradation have not come from mining but from large construction sites such as the airport, malls, and roads. This type of infrastructure development should be scrutinized to the same extent as mining operations, yet the public does not appear to view this type of development in the same way as mineral resource development.

Currently, the Department of Natural Resources has no effective strategy in place to increase awareness of the need for sustainable mineral resource development. In order for communities to support mineral resource development, they must understand the benefits of modern mining in society and be willing to be engaged in planning processes. In order for Nova Scotia to benefit from the economic potential (new jobs in rural areas, stronger provincial economy, reduced dependence on other countries for minerals), communities must become more informed about mineral resource development potential as a reasonable and valid component to any sustainable development initiative.

Aside from mineral resource development, there is a need for current and accurate geoscience information to be provided more effectively to the public, and to planners and decision makers within and outside of the provincial government. This information is required for land use planning decisions and to manage resources. However, there is not currently enough consultation between geoscientists in the Mineral Resources branch, and the communities, planners, RDAs, and other government departments that require the information. As professional geoscientists, Mineral Resources branch staff must be able to give sound science-based advice to stakeholders related to land use planning initiatives, including those from other departments.

There is currently no effective strategy in place to provide geosciences information to these varied audiences. This must be addressed with the creation and implementation of an effective and comprehensive communication and education strategy that strives to promote stakeholder engagement as a critical element in the sustainable development equation. The messages that must be conveyed in educational materials are:

- the vital importance of geological resources in society and our province's mineral needs
- the links between geoscience and biodiversity
- the importance of self-sustainability and the provision of geological resources for Nova Scotians from our own geological resource inventory
- the importance of the Mineral Resources branch's geoscience consultation in land use planning and legislation
- the current (rather than historical) practices with respect to environmental protection in mineral development and the legislation in place to ensure safe practice
- recent success of responsible mineral development and reclamation within the province
- the role of the Mineral Resources branch and its capabilities relative to branches of the Department of Natural Resources, and other government departments
- existing synergies between the Mineral Resources branch and other branches of the Department of Natural Resources, and other government departments

Recommendations

- Change the branch title to Geological Resources branch. The title Mineral Resources branch does not adequately represent the spectrum of areas of priority that this branch has recently engaged in or will be engaged in in the future.
- Develop comprehensive and effective communications and education strategies including education and awareness materials targeted at a variety of audiences and age groups to increase awareness of the vital importance of geoscience and geological resources in society. The approach to developing these materials must be science- and policy-based, non-partisan, and focus on the topics outlined in section 3.0. The development and implementation of the program should be carried out as a collaboration between the Department of Natural Resources and key groups including: academic institutions; the Mining Society of Nova Scotia; Prospectors and Developers Association of Canada; Canadian Institute of Mining, Metallurgy and Petroleum; Mining Association of Nova Scotia; Association of Professional Geoscientists of Nova Scotia; Canadian Land Reclamation Association; industry; and the Department of Education. The continued participation of the Department of Natural Resources in current outreach activities (e.g., Mining Matters) must be balanced with new outreach and awareness initiatives delivered to the various publics through workshops, the creation of Memorandums of Understanding (MOUs), and at unconventional engagements (e.g., annual conference of the Atlantic Planners Institute).
- Create new and dedicated positions for outreach and community awareness liaisons and planning services personnel.
- Create an external scientific advisory panel to the minister that will include geoscientists.
- Increase geosciences in school curricula, by working with universities, and the Department of Education to include geosciences as part of regular (not optional) elementary and high school curriculum.

4.0 GEOSCIENCE INFORMATION

Background

The Department of Natural Resources plays a vital role in providing free geoscience information to community, planning, and industry-based clients in the form of paper- and web-based access to dynamic geological maps, assessment reports, geological data, and educational materials to name only a few. Their efforts to develop and maintain extensive Geographic Information System (GIS) resources are leading edge and received recent national recognition by Environmental Systems Research Institute Inc. Canada (ESRI), a provider of enterprise geographic information system solutions, in the form of an Award of Excellence.

Many stakeholders noted the high quality of this service. More than 15,000 maps and publications are available online to the public, and the service sees a high level of usage with hundreds of thousands of download requests for GIS products tracked since 1997. Current projects include the development of a geological resource atlas to assist planners and communities in land use planning.

In addition to providing geoscience information to the public, the department is responsible for ongoing characterization of the province's geological resources through field work and research. A variety of collaborations between the department, the federal government, and universities (among other participants) have been highly successful in generating and interpreting geoscience data and providing that data to planners, developers, municipalities, and communities.

Objective

To improve, and build capacity for, research and knowledge and data transfer between the Department of Natural Resources, academia, and clients (the public, RDAs, industry, etc.) in key areas of priority.

Discussion

Accessible and current geoscience information is an essential component for making informed decisions regarding land use planning and management. Web-based geoscience information needs to be accessible (i.e., user-friendly) to many groups and not just industry. It must be designed to target specialists and the layperson. An effort must be made to make these Internet resources better known and appreciated by the public.

> "I am convinced that, at its best, science is simple — that the simplest arrangement of facts that sets forth the truth best deserves the title of science. So the geology I plead for is that which states facts in plain words -- in language understood by the many rather than by the few."
>
> George Otis Smith

Stakeholders expressed concern that some online resources were incomplete and not user-friendly, requiring some software and knowledge of GIS to use effectively. Additionally, there was concern that some geological data (e.g., from large-capacity wells logged by consultants) are not captured in the current database and could contribute to the updating of existing maps or producing new maps of both bedrock and surficial geology.

Some GIS products needed by planners were noted by stakeholders as being either not up to date or unavailable. This is due to a lack of resources to generate these products quickly as there is a backlog of historical data that has yet to be converted to a GIS-compatible form.

Building capacity to provide geoscience information to a variety of potential clients must involve interaction between government, academic, and industrial partners, and the integration of different types of scientific data. These collaborative activities can only be adequately developed and sustained if long-term financial resources are made available for data gathering and interpretation associated with routine operations at the department's Mineral Resources branch, as well as through new initiatives.

Collaborations between the department and university research groups are required to provide additional and specific expertise and technical resources that may not be present within government. Such collaborations also serve an important role as training exercises for students who may one day work in natural resource management and characterization in the province.

The availability of sustained special projects funding would enable a variety of groups to assist departmental staff in collecting, interpreting, and presenting data (including underutilized historical data) and to undertake special research in critical areas of priority.

Specific initiatives for which special projects funding to universities should be considered include:

a) site-specific mine tailings remediation projects including evaluation of the potential of bioremediation and biometallurgy; mineralogical studies of long-term, low-disturbance vs. short-term, heavy-disturbance tailings interactions with groundwater; and the application of specific materials (e.g., limestone) in mitigating acid rock drainage

b) specialized geochemical, geomorphological and mineralogical mapping campaigns to build and interpret regional data sets that can be used by scientists and planners (e.g., soil chemistry, regional airborne LiDAR, CO2 sequestration potential)

c) mapping and geochemical exploration to create an inventory of mineral resources within the province considered to be strategic

In some cases, this work is already occurring, but not in a comprehensive manner or on a provincial scale.

Recommendations

- Track and improve geoscience information usage by monitoring precisely what stakeholders are using the geoscience information, and how this information is being used. This must include regular assessment of client satisfaction through the creation and implementation of online surveys and face-to-face engagements with clients at all levels (government including other departments, planners and RDAs, communities, prospectors, industry). Identify stakeholders that are not using the information but should be, and determine

opportunities to disseminate digital data to them. Use this information to improve Geographic Information Systems (GIS) products.

- Improve GIS products by creating resources to develop new web-based applications for students and laypersons to use geoscience information effectively, to train clients to use the applications effectively (e.g., GIS orientation workshops with communities and planners, online tutorials), and to decrease the amount of time for GIS products to become available through increased staffing.
- Build capacity for research by creating and sustaining resources to enable special research projects between the Department of Natural Resources, universities, and other government departments. Research initiatives should encompass both the review and interpretation of historical data, and new endeavours. Areas of focus should be planned through interaction with communities and planners in order to identify their specific needs.
- Enhance resources for existing areas of strength in geoscience information (e.g., mineral deposit mapping, surface and coastal mapping, geochemistry). Additional funding is needed for basic geological mapping at a more detailed level than is currently available.

5.0 REGULATORY ISSUES

Background

Several regulatory issues were noted by stakeholders as requiring change. However, concerns in some cases were based on lack of understanding of the mineral resource development legislation and regulations that are enforced by the Department of Natural Resources. There is clearly a lack of awareness by some stakeholders that the Mineral Resources Act is not intended to address environmental issues.

The Department of Natural Resources administers the Mineral Resources Act and regulates, manages, and promotes mineral resource development and associated activities from an administrative and policy perspective. Conversely, Nova Scotia Environment regulates the actual activities associated with mining, quarrying, and a whole host of other industrial projects through the Environment Act. In short, the Mineral Resources Act regulates the activities associated with the administrative side of mineral resource management while the Environment Act regulates activities that may impact the environment.

Objective

To evaluate the need for developing provisions in the Mineral Resources Act to guide the protection and responsible development of the province's aggregate resources.

Discussion

The Mineral Resources Act needs to be reviewed and updated. The three main areas of concern are: provisions related to exploration and assessment reporting activities; the inclusion of non-designated geological materials such as non-Crown limestone (certain areas of Crown land contain limestone deposits that are regulated under the Mineral Resources Act), groundwater and gypsum; and the possible inclusion of pits and quarries (aggregate resources) in the Act. A fourth area of concern is future technologies, such as groundwater use for geothermal heating.

There has been suggestion by stakeholders that some aspects of pit and quarry regulation be brought under the Mineral Resources Act. The issue concerning the sharing of economic benefits remains an important one to consider. Given that communities have expressed an interest in a much greater say in the environmental assessment process, it would make sense to have provisions in the Mineral Resources Act to include aggregates as minerals and be subject to royalties similar to other jurisdictions. Inclusion in the Act would also enable government to implement financial instruments to address abandoned aggregate sites that could be reclaimed to become functioning ecosystems again, and subject future operations to the same stewardship standards as the mining industry.

The definition of a mineral under the Mineral Resources Act and the exclusion of certain minerals or geological materials from the Act is another important consideration raised by stakeholders. Similar to the pit and quarry assertion, there are benefits to bringing limestone, gypsum, and even groundwater under the administration of the Mineral Resources Act. Oil and gas is currently administered, but not managed, under the Mineral Resources Act.

Minerals defined under the Act are vested in the Crown for the benefit of all Nova Scotians, whereas, gypsum, non-Crown limestone, and aggregates are owned by the land owner. Royalties are not collected by the province and some argue that this limits the overall benefits to the community hosting the operation.

Mineral exploration, assessment reporting, and the preservation of precious mineral resources for future development should also be addressed in updated legislation. Many aspects of the Mineral Resources Act were discussed regarding exploration and development. A committee of interested stakeholders could provide valuable input on these topics, as well as on the topic of land access for mineral exploration. A dwindling land area for exploration may result in fewer opportunities to discover precious resources (see Section 2.5 regarding the contribution of minerals to sustainable development). The Act could contain provisions to protect certain areas for future mineral development.

Recommendations

- Review and update the Mineral Resources Act through the establishment of a working group with industry, nongovernmental organizations, exploration companies, prospectors, and public members. Dialogue and consultation with other departments (Nova Scotia Environment, Economic and Rural Development) should ensure that policies and regulations are not contradictory.
- Declare new minerals under the Mineral Resources Act through the establishment of a working group with Nova Scotia Environment, the Mining Association of Nova Scotia, and the Department of Transportation and Infrastructure Renewal representatives to evaluate the need, benefits, or desire to declare aggregate resources, non-Crown limestone, gypsum, quarry stone, and groundwater as minerals under the revised Mineral Resources Act (consistent with the aims of the *Drinking Water Strategy* 2002).
- Provide regulatory education through workshops for all affected stakeholders to educate them on new regulations and guidelines for pit and quarry operations.
- Form a working group to evaluate the effectiveness of the "One Window" Process for Mine Development Approvals and to update the approach where necessary. The working group should include all interested stakeholders, such as Nova Scotia Environment, and a variety of mineral and non-mineral industry representatives.

6.0 GROUNDWATER RESOURCES

Background

Groundwater is a critically important natural resource in Nova Scotia (Nova Scotia's Water Strategy 1992) and also one of the most misunderstood. There is an alarming lack of modern data and information about this resource.

Groundwater that supplies wells occurs beneath the earth's surface, below what is called the water table, filling the spaces in soil, porous strata (aquifers), and interconnected rock fractures. Where the water table intersects the surface, it forms springs or merges with the surface of streams and lakes.

Groundwater provides the bulk of clean, cool water to our streams and lakes in the absence of precipitation. It is essential for biodiversity. Deforestation, paving, and urban development can affect groundwater and stability of water levels. Dewatering for quarrying and mining also lowers the water table, leading to dry wells and streams in an area larger than the footprint of the operation. Groundwater does not respect property lines or political boundaries.

Objective

To provide all resources necessary to acquire and regularly update data so as to enable permanent proper management of groundwater.

Discussion

Groundwater interacts with soils and rock particles and acquires its distinct mineral content and chemistry depending on the geology: clean and safe in most areas; laden with salts (*"hard"* water) where there is gypsum or limestone; acidic and enriched in heavy metals (and damaging to metal pipes) in others. Furthermore, groundwater is easily contaminated by human activities such as mining, quarrying, road construction, chemical and fuel spills, and by road salt, fertilizers, pesticides, and agricultural, industrial, and domestic wastes.

Many parts of the province with the best and most productive aquifers (known to occur in glacial deposits of sand and gravel to depths of approximately 60 metres below ground surface) have not been mapped in 40 years when the responsibility was with the Department of Mines and Energy. We do not know with certainty the sustainability of these aquifer systems, nor do we understand the risk of man-made contaminant impacts on the precious resource. The mapping of glacial deposits, surficial sand, and gravel and strata where groundwater occurs is within the mandate of the Department of Natural Resources, and includes the study and recording of these materials in both Crown and private lands.

Fresh (drinking) groundwater is lighter than, and floats over, salty groundwater. This provides a safe supply in coastal areas, as long as the two types of water remain separate. Once disrupted, it can take several decades to restore a safe supply. Global warming implies sea-level rise and more frequent flooding during storm surges, meaning saltwater invasion is a real threat for coastal communities.

Many billions of dollars of taxpayers' money have been invested in water supply infrastructure that depends on both good quality and adequate quantity of groundwater for public, commercial, and industrial use. Yet, in most cases we know very little about the extent, nature, and natural protection from contamination of the aquifer system providing the water, or the sustainability of the resource based on its future demands.

> "In an age when man has forgotten his origins and is blind even to his most essential needs for survival, water, along with other resources, has become the victim of his indifference."
>
> Rachel Carson

One of the fastest growing uses of groundwater in Nova Scotia is for geothermal (or "earth energy") heating and cooling of home residences, commercial, institutional, and industrial buildings. There are two main methods: 1) open-loop technology, which poses demands on the groundwater system that are very high in comparison to domestic use, and 2) the closed-loop application, which introduces a potential contaminant into the sub-surface that may threaten a very valuable aquifer system. This industry is way ahead of present-day environmental

regulations, and poses a real threat to the sustainability and quality of our groundwater resources. This is a growing issue that must be addressed by Nova Scotia Environment in consultation with the Department of Natural Resources.

Finally, spring and groundwater are the most sought after types of drinking water in countries where the supply is dwindling. Nova Scotia (with its deep ports) is strategically located for its pure water supplies to be under increasing demand from overseas. The trade in drinking water must be regulated to safeguard supply for Nova Scotians.

While the chemical aspects of water quality now fall under Nova Scotia Environment, the fundamental physical aspects of amount, distribution, and consumption budget of groundwater remain in a state of uncertainty.

Recommendations

- Update the provincial groundwater database. More field work is required to update and complete higher-quality mapping of both quaternary-age sand and gravel deposits, and bedrock areas where major groundwater supply systems have been developed, with an understanding of potential risks for contamination of these aquifers. The water-well records database should be complemented with diamond-drilling records, geotechnical-borehole data, and other mineral, natural gas, and petroleum drilling data on relevant geologic information.
- Develop more detailed mapping of both the quaternary and bedrock geology of urban centres that currently depend on groundwater for municipal water supplies.
- Conduct risk assessments to evaluate all projects that impinge on groundwater resources (quantity and quality) including potential interaction of groundwater with: industrial, mine, and domestic wastes; or geothermal energy and carbon dioxide, liquefied natural gas, natural gas storage, or sequestration systems. Buffer zones should be expanded as necessary, and long-term monitoring of effectiveness of controls should be evaluated as part of the Environmental Assessment Process. This must be a collaborative effort between Nova Scotia Environment and the Department of Natural Resources.
- Strengthen relationships between Department of Natural Resources and Nova Scotia Environment to develop human resources capacity and a more coordinated plan for better management and safeguarding of precious groundwater resources. A Memorandum of Understanding that exists between both organizations to this effect is a good example of what can be done.

7.0 COASTAL GEOSCIENCES

Background

Rising sea levels and increased frequency of major storms in recent years have caused problems of coastal erosion, flooding, and property damage: wharves, roads and aquaculture operations, tourism, public access to the coast, transportation, cultural heritage, safety and security have all been affected. Despite the utmost importance of coastal issues, Nova Scotia lacks a coastal management plan.

Our coastal areas and resources have played an essential role in making Nova Scotia what it is today. The coast is where we live, work, and play. It's vital to the character and way of life that is valued by Nova Scotians. If we want to pass this coastal legacy on to our children and grandchildren, we must take action now to better understand our coast and to ensure its sustainability for future generations.

2009 State of Nova Scotia's Coast Report

Studies led by the Geological Survey of Canada using state-of-the-art surveying technology (LiDAR) were focused on communities that asked for the information because of their planning concerns. These studies predict that areas currently at five metres above sea level can expect to experience serious flooding and wave damage in future decades. As discussed above (see Section 6.0 Groundwater Resources), coastal surges will compromise drinking water supplies by mixing them with saltwater, and these effects can be very difficult to reverse.

Many beaches get their sand from glacial deposits that are undergoing erosion. The movement and natural distribution of this sand in the coastal zone regulate the rates of attrition of the coast and the quality of beaches and related wetlands, as well as the rich life they sustain. Any human disruption of these natural processes, such as armouring with rocks or the construction of piers to defer erosion in one place, will have detrimental effects in another.

Steep slopes resulting from glacial erosion are prone to instability. Artificial fill used for port facilities and development is likely to become unstable during flooding surges and major seismic events such as the 7.2-magnitude Grand Banks earthquake of 1929. Finally, the Bay of Fundy affords a world-class laboratory to understand the interaction of rivers and their sediment load with sea-level variations, as well as the energy potential of coastal systems, yet no coordination of research on coastal issues exists.

Objective

To have a comprehensive and robust plan to manage the coastal zone in terms of geological resources and hazards, including those associated with sea-level rise.

Discussion

Understanding the geological, biological, and process complexities of the shores and managing their use by diverse interest groups will require an integrated effort and better financial support. There is a lack of sound scientific background in many cases to make informed decisions on applications to justify designating a piece of shore property as a protected beach. There is no complete inventory of shore types and their stage of natural development and evolution around the province to enhance our scientific understanding and provincial policies. Ineffective management of coastal resources by government has led to distrust by the public regarding resource or infrastructure development along the coast.

Follow up investigations are required by the Department of Natural Resources on the consequences of decisions related to coastal development. Learning the consequences of decisions and making them available to the public would improve transparency and inform future decision making. Regulations can only be effective if their consequences are reviewed and our knowledge improved.

Scientific and technical experts within the department could benefit from improved collaborative efforts within its divisions. For instance, Parks and Recreation appear well equipped in forestry aspects and work closely with biological groups, but is lacking expertise in coastal geology or geomorphology. As an result, current efforts by the department are focused on acquiring land along the present outer coastline, but as the sea level rises, some of the best beaches in the future will be developing in the estuaries.

The complexity of provincial jurisdictional aspects for the coastal zone also needs to be addressed. Conflicting users and regulators, in particular the departments of Transportation and Infrastructure Renewal, Environment, Aquaculture and Fisheries, and Natural Resources, should strive for improved collaboration and consultation.

Recommendations

- Promote and safeguard all provincial coastal resources through guidelines to protect against the adverse effects of development. Coastal management policies enforced by the Department of Natural Resources must be consistent province wide and based on scientific principles so that they can be justified and better explained to the public.
- Map coastal zones using a systematic and comprehensive geological mapping plan for the coastal zone, in close communication with federal, provincial, and municipal planning organizations, and industrial and community groups affected by coastal processes. The mapping should be conducted at a scale appropriate to identifying site-specific coastal hazards and be linked to a GIS database with integrated coastal geoscience including ranked geohazards risk.
- Conduct a geohazard assessment that gauges and prioritizes potential geohazards (such as flooding, storm surges, saltwater contamination of aquifers, tsunamis, and slope failure) and provide guidance to municipal and regional planners. Addressing issues of coastal stability, geohazards, and safety and security before they reach crisis stage is important in gaining public trust.
- Coordinate coastal studies by drawing on vast geoscience and oceanographic expertise existing in the scientific and academic communities (professionals and students). The Department of Natural Resources should lead and coordinate efforts to synergistically exploit this human resource.

8.0 MINERAL RESOURCE PRESERVATION, DEVELOPMENT AND PROMOTION

Background

The current and future development of mineral resources in Nova Scotia faces many challenges. The need to reinforce the value of minerals in everyday life, awareness of the preservation role and necessary protection of mineral development capability are pressing issues that were identified by stakeholders. One very timely issue is the protection of lands that may include valuable mineral resources. While the protection of land for parks and other uses is an important initiative for the province, identification of mineral resources and their potential benefits to the province must be considered in the process of selecting lands for preservation.

Submissions relating to resource development also commented on prospectors' assistance and the need to attract investment to Nova Scotia. The discovery, extraction, and utilization of mineral resources are absolutely critical to a sustainable, technologically oriented modern society.

> "Minerals represent one of the few engines of economic growth and wealth generators in Nova Scotia."
>
> Minerals Panel stakeholder

Unfortunately, a variety of issues associated with past mining practices, investment opportunities, land ownership conflicts, and competing land uses and philosophies leave many Nova Scotians with a generally negative impression of mining. In addition, a prevalent mistrust of industry, as well as government, often leads to conflicts with community and special interest groups as new mining operations are proposed.

Objective

To promote mineral resource development and preservation opportunities in Nova Scotia according to policies based on sustainable development principles, a fair and equitable business climate, and the development of a comprehensive communications strategy.

Discussion

Attracting investment in Nova Scotia to discover and develop mineral resources requires three basic components: 1) geological settings that have potential to host economic mineral deposits, 2) a hospitable and competitive investment climate, and 3) a culture that embraces mining as a valuable contributor to the overall economy.

Nova Scotia indeed enjoys highly varied geological settings with potential for numerous types of mineral deposits. Finding those deposits is extremely challenging as they are rare and hidden from view. Exploration companies heavily rely on historical geological data and on the people who produce this geological data over time to develop theories regarding where deposits may be found.

Even with a large amount of geological data available, however, deposits are still analogous to finding the proverbial "needle in a haystack." Companies also heavily rely on on-the-ground prospectors who are, to a degree, the initial eyes and ears of industry in the search for mineral deposits covering vast tracts of land. Basic geological studies, prospecting, and data analysis are the backbone of the mineral industry.

Additionally, the province discontinued the Prospector's Assistance Program in 2002, which put Nova Scotian prospectors at a disadvantage compared to other provinces. The program, funded under the Canada-Nova Scotia Economic Diversification Agreement, was responsible for significantly increasing investment in Nova Scotian companies by providing funds to enable those companies to market the mineral potential of their properties, and to explore their properties.

> "So the major obstacle to the development of new supplies is not geology but what happens above ground: international affairs, politics, investment and technology."
>
> Daniel Yergin

A hospitable investment climate is really about being competitive with other jurisdictions regarding taxation, financial assistance, and tax breaks. According to the Prospectors & Developers Association of Canada, Nova Scotia has the highest combined federal-provincial tax rate in Canada and has the second highest provincial tax burden. While the province finishes in the middle of the pack regarding total costs of investment in mineral exploration, other factors may influence a company's final decision to invest in Nova Scotia, in spite of, or due to, these costs.

Given that the demand for various mineral commodities changes over time as technology changes, industry grapples with the loss of available lands for exploration through conservation goals and objectives. A deposit that may have been economically viable at one point may no longer be - and vice versa. An area once considered with little mineral potential and placed under protected area status may one day become both economic and strategic for the province. This is the temporal and spatial reality of mineral deposit distribution and is another point that cannot be overstated.

Recommendations

- Promote our mineral diversity through a comprehensive communications strategy (see 3.0 Education, Awareness and Relationship Building). An industry-oriented component should be aimed at the promotion of the geology, mineral deposit types, and opportunities in Nova Scotia.
- Preserve strategic mineral resources by ensuring that protected-areas planning utilizes mineral-potential maps so that areas containing strategic mineral resources that may be vital to the province's economy and environmental sustainability are preserved for future use.

- Reinstate the Prospector's Assistance Program to encourage mineral resource development, assist prospectors in the promotion of their mineral properties, and attract investment to Nova Scotia. The total value of this program should be restored to at least 1997-2002 levels ($600,000) with a goal to match New Brunswick levels.
- Make mineral exploration in Nova Scotia nationally and globally competitive by developing a mineral resources strategy modelled after those in provinces that have had hallmark success on all fronts related to mineral resource development (e.g., British Columbia, Ontario, Newfoundland and Labrador; see Fraser Institute scores) and other countries (e.g., Sweden, Australia).

9.0 REMEDIATION AND RECLAMATION

Background

Coal mining, dating back over 300 years, has shaped the economic and social development of northern Nova Scotia and Cape Breton Island, while the southern mainland had several gold rushes since the late 1800s. Old mining practices and poor environmental regulation in the past led to a legacy of scarred landscapes, abandoned underground workings and environmentally degraded sites, leaving the public with a negative mindset toward the mining industry.

This legacy contributes to mistrust of government with respect to mining as companies are perceived by the public and nongovernmental organizations as avoiding their responsibility with no consequences or punishment by government. Reclamation has an extremely important role to play in addressing many issues associated with environmental degradation, community concerns and sustainability. This section highlights the issues and opportunities for reclamation from an environmental, as well as a community, sustainable development perspective.

Objective

To educate mining companies and communities on best practices in reclamation and restoration and to identify reclamation opportunities at degraded sites through multi-stakeholder engagement.

Discussion

As a result of stakeholder discussions, two main issues were identified: 1) reclamation of abandoned sites, and 2) reclamation planning for new proposals. The environmental and regulatory issues associated with mining tailings at historical, and, in some cases, reclaimed sites is also a concern.

Abandoned sites are a significant issue to many stakeholders including the mineral industry and government. Many abandoned sites remain unproductive from a biodiversity perspective. However some have experienced various levels of natural reclamation. Some sites, for example, continue to cause acidic drainage that impact watercourses. While the majority of abandoned

sites are actually as a result of aggregate production, a number of old mine sites around the province need to be reclaimed and restored. Some jurisdictions impose a levy on each tonne of aggregate produced to contribute towards cleaning up abandoned sites (see 5.0 Regulatory Issues).

With regards to new developments, well-thought-out reclamation plans need to be incorporated into all new mine/quarry proposals that focus on long-term sustainability of ecosystems and communities. Reclamation plans should be considered as a company's assurance to stakeholders of protecting the environment and maintaining social integrity. These should be prepared at the outset and be required as part of the approval process before mining begins, with regular reviews. Nova Scotia Environment's Guide for Surface Coal Mine Reclamation Plans could serve as a model for a Department of Natural Resources' guide.

Where reclamation has occurred, success stories have not been recognized in the media or by government as significant achievements. Reclamation success stories should be promoted to the public (on the department's website, for example). Connections to the local nongovernmental organizations (such as the Canadian Land Reclamation Association) and other government departments (both federal and provincial) involved with reclamation should be strengthened, to share experiences.

The Department of Natural Resources should be commended for their work on the remediation of old mine openings on Crown land. These activities have gone a long way to decrease public danger and negative impacts.

Mining efficiency (recovery) was historically low, and valuable resources may exist in old tailings. Furthermore, many of these sites may also have substantial concentrations of contaminants causing impacts to the local environment. These sites should be catalogued and assessed for both environmental ongoing impacts and potential for economic recovery of minerals, which could contribute to reclamation costs. For example, collaborative studies championed by the Geological Survey of Canada (NRCAN) in historic mine camps such as Goldenville and Seal Harbour have been successful in delineating and preventing health hazards arising from old mines.

Mineral licences can still be granted under the Mineral Resources Act over previously reclaimed sites or sites in the process of being reclaimed. This raises a concern for those companies that are responsible for reclamation, but that no longer hold the mineral licences. This situation needs to be addressed to ensure effective resource management as well as long-term mine reclamation and environmental protection.

Recommendations

- Promote remediation and reclamation success by developing and promoting a best practices database that is accessible on the department's website and that celebrates remediation and reclamation successes (e.g., East Kemptville, Goldenville, Cape Breton, Springhill).
- Develop a reclamation working group to design a multi-stakeholder program (relevant government departments and agencies, industry and communities) to systematically assess the environmental and economic state of old mine sites and develop a reclamation implementation plan where opportunities exist. This must include evaluation of mine tailings for recoverable resources, and consideration of the long-term risks of leaving existing tailings undisturbed relative to short-term disturbance to dispose of contaminated tailings permanently.
- Develop a database on abandoned quarries and degraded mined areas to delineate areas with highest acid rock drainage potential and contamination potential of groundwater and surface waters (see Section 4.0 Geoscience Information).
- Investigate a levy system (including costs and benefits) to fund the reclamation of abandoned pits and quarries.
- Consider mineral recovery under reclaimed lands and the protection of reclaimed lands in the review of the Mineral Resources Act and other relevant legislation.

10.0 MANAGEMENT AND FUNDING

Background

The success of the recommendations outlined in the previous sections will rely on appropriate resourcing and the capacity of staff and management within the Department of Natural Resources to effectively plan and implement them. Several issues were identified and reinforced from the majority of stakeholder engagements that highlight areas of concern related to implementation and sustainability of the strategy.

Objective

To ensure that the Mineral Resources branch has adequate resources and capability to implement and sustain the recommendations identified by the Minerals Panel, to monitor the success of activities, and to be accountable to the public.

Discussion

Aside from the Mineral Resources branch, mineral resources and geoscience appear to be undervalued by other branches of the department. Shrinking staff levels and reductions in budget are clear indicators of this. Funding for general operations within the Mineral Resources branch represents a disproportionately low percentage of the overall departmental budget. This prohibits long-term planning for projects in critical areas of priority, and will not be adequate to make the necessary changes identified in the recommendations.

It is also perceived by many stakeholders that expertise in the Mineral Resources branch is underutilized in key areas of priority managed by other departments. Other government departments rely largely on their own expertise, even though that expertise is often lacking geological perspective. For example, Nova Scotia Environment manages aspects of groundwater resources (e.g., industrial withdrawal) but does not map its distribution. Mineral Resources branch staff have the capability and expertise to do that. Additionally, Natural Resources staff must rely heavily on external budgets in other departments to complete work in many key areas.

In order to ensure that the department can maintain the expertise required to effectively manage mineral resources, adequate knowledge transfer must take place as staffing requirements change and retiring staff are replaced within the Mineral Resources branch.

Additional funding and dedicated staffing will be required to address some key priority areas such as geosciences information and groundwater protection.

At the same time, it will likely be necessary for the Mineral Resources branch, as well as other branches, to assess and prioritize initiatives (new and ongoing) to ensure that they use resources effectively, and that they meet the objectives of the new Natural Resources Strategy.

Recommendations

- Identify special projects budgets and equalization of funding relative to other branches of the Department of Natural Resources. A special projects fund will enable new geoscience initiatives to be undertaken (see section 4.0 Geoscience Information) and eliminate financial dependence on other departments while maintaining those highly productive collaborations.
- Develop a biennial review process led by an external management consultancy to evaluate the performance of the Mineral Resources branch in implementing the recommendations of the new Natural Resources Strategy, identify gaps in performance, and establish new goals and funding needs in deficient areas. This process must include the evaluation of client satisfaction (see section 4.0 Geoscience Information).
- Improve knowledge transfer for retirements/replacements through improved documentation and information sharing, and overlap of staff whenever possible.
- Encourage external consultation between Mineral Resources branch experts and other departments. The Department of Natural Resources should work with other departments to revise existing Memorandums of Understanding to enable more expert consultation where geological expertise is required in the Environmental Assessment Process (e.g., pit and quarry development; groundwater and coastal resources; geothermal; mineral deposits).

11.0 LIST OF RECOMMENDATIONS

1. Change the branch title to Geological Resources branch. The title Mineral Resources branch does not adequately represent the spectrum of areas of priority that this branch has recently engaged in or will be engaged in in the future.

2. Develop comprehensive and effective communications and education strategies including education and awareness materials targeted at a variety of audiences and age groups to increase awareness of the vital importance of geoscience and geological resources in society. The approach to developing these materials must be science- and policy-based, non-partisan, and focus on the topics outlined in section 3.0. The development and implementation of the program should be carried out as a collaboration between the Department of Natural Resources and key groups including: academic institutions; the Mining Society of Nova Scotia; Prospectors and Developers Association of Canada; Canadian Institute of Mining, Metallurgy and Petroleum; Mining Association of Nova Scotia; Association of Professional Geoscientists of Nova Scotia; Canadian Land Reclamation Association; industry; and the Department of Education. The continued participation of the Department of Natural Resources in current outreach activities (e.g., Mining Matters) must be balanced with new outreach and awareness initiatives delivered to the target publics through workshops, the creation of Memorandums of Understanding (MOUs), and at unconventional engagements (e.g., annual conference of the Atlantic Planners Institute).

3. Create new and dedicated positions for outreach and community awareness liaisons and planning services personnel.

4. Create an external scientific advisory panel to the minister that will include geoscientists.

5. Increase geosciences in school curricula, by working with universities and the Department of Education to include geosciences as part of regular (not optional) elementary and high school curriculum.

6. Track and improve geoscience information usage by monitoring precisely what stakeholders are using the geoscience information, and how this information is being used. This must include regular assessment of client satisfaction through the creation and implementation of online surveys and face-to-face engagements with clients at all levels (government including other departments, planners and RDAs, communities, prospectors, industry). Identify stakeholders that are not using the information but should be, and determine opportunities to disseminate digital data to them. Use this information to improve Geographic Information Systems (GIS) products.

7. Improve GIS products by creating resources to develop new web-based applications for students and laypersons to use geoscience information effectively, to train clients to use the applications effectively (e.g., GIS orientation workshops with communities and planners, online tutorials), and to decrease the amount of time for GIS products to become available through increased staffing.

8. Build capacity for research by creating and sustaining resources to enable special research projects between the Department of Natural Resources, universities, and other government departments. Research initiatives should encompass both the review and interpretation of historical data, and new endeavours. Areas of focus should be planned through interaction with communities and planners in order to identify their specific needs.

9. Enhance resources for existing areas of strength in geoscience information (e.g., mineral deposit mapping, surface and coastal mapping, geochemistry). Additional funding is needed for basic geological mapping at a more detailed level than is currently available.

10. Review and update the Mineral Resources Act (MRA) through the establishment of a working group with industry, nongovernmental organizations, exploration companies, prospectors and public members. Dialogue and consultation with other departments (Nova Scotia Environment, Economic and Rural Development) should ensure that policies and regulations are not contradictory.

11. Declare new minerals under the Mineral Resources Act through the establishment of a working group with Nova Scotia Environment, Mining Association of Nova Scotia, and the Department of Transportation and Infrastructure Renewal representatives to evaluate the need, benefits, or desire to declare aggregate resources, non-Crown limestone, gypsum, quarry stone, and groundwater as minerals under the revised Mineral Resources Act (consistent with the aims of the *Drinking Water Strategy* 2002).

12. Provide regulatory education through workshops for all affected stakeholders to educate them on new regulations and guidelines for pit and quarry operations.

13. Form a working group to evaluate the effectiveness of the "One Window" Process for Mine Development Approvals and to update the approach where necessary. The working group should include all interested stakeholders, such as Nova Scotia Environment, and a variety of mineral and non-mineral industry representatives.

14. Update the provincial groundwater database. More field work is required to update and complete higher-quality mapping of both quaternary-age sand and gravel deposits, and bedrock areas where major groundwater supply systems have been developed, with an understanding of potential risks for contamination of these aquifers. The water-well records database should be complemented with diamond drilling records, geotechnical-borehole data, and other mineral, natural gas, and petroleum drilling data on relevant geologic information.

15. Develop more detailed mapping of both the quaternary and bedrock geology of urban centres that currently depend on groundwater for municipal water supplies.

16. Conduct risk assessments to evaluate all projects that impinge on groundwater resources (quantity and quality) including potential interaction of groundwater with: industrial, mine, and domestic wastes, or geothermal energy and carbon dioxide, liquefied natural gas, natural gas storage, or sequestration systems. Buffer zones should be expanded as necessary, and long-term monitoring of effectiveness of controls should be evaluated as part of the Environmental Assessment Process. This must be a collaborative effort between Nova Scotia Environment and the Department of Natural Resources.

17. Strengthen relationships between the Department of Natural Resources and Nova Scotia Environment to develop human resources capacity and a more coordinated plan for better management and safeguarding of precious groundwater resources. A Memorandum of Understanding that exists between both organizations to this effect is a good example of what can be done.

18. Promote and safeguard all provincial coastal resources through guidelines to protect against the adverse effects of development. Coastal management policies enforced by the Department of Natural Resources must be consistent province wide and based on scientific principles so that they can be justified and better explained to the public.

19. Map coastal zones using a systematic and comprehensive geological mapping plan for the coastal zone, in close communication with federal, provincial, and municipal planning organizations, and industrial and community groups affected by coastal processes. The mapping should be conducted at a scale appropriate to identifying site-specific coastal hazards and be linked to a GIS database with integrated coastal geoscience including ranked geohazards risk.

20. Conduct a geohazard assessment that gauges and prioritizes potential geohazards (such as flooding, storm surges, saltwater contamination of aquifers, tsunamis, and slope failure) and provide guidance to municipal and regional planners. Addressing issues of coastal stability, geohazards, and safety and security before they reach crisis stage is very important in gaining public trust.

21. Coordinate coastal studies by drawing on vast geoscience and oceanographic expertise existing in the scientific and academic communities (professionals and students). The Department of Natural Resources should lead and coordinate efforts to synergistically exploit this human resource.

22. Promote our mineral diversity through a comprehensive communications strategy. An industry-oriented component should be aimed at the promotion of the geology, mineral deposit types, and opportunities in Nova Scotia.

23. Preserve strategic mineral resources by ensuring that protected-areas planning utilizes mineral-potential maps so that areas containing strategic mineral resources that may be vital to the province's economy and environmental sustainability are preserved for future use.

24. Reinstate the Prospector's Assistance Program to encourage mineral resource development, assist prospectors in the promotion of their mineral properties, and attract investment to Nova Scotia. The total value of this program should be restored to at least 1997-2002 levels ($600,000) with a goal to match New Brunswick levels.

25. Make mineral exploration in Nova Scotia nationally and globally competitive by developing a mineral resources strategy modelled after those in provinces that have had hallmark success on all fronts related to mineral resource development (e.g., British Columbia, Ontario, Newfoundland and Labrador; see Fraser Institute scores) and other countries (e.g., Sweden, Australia).

26. Promote remediation and reclamation success by developing and promoting a best practices database that is accessible on the department's website and that celebrates remediation and reclamation successes (e.g., East Kemptville, Goldenville, Cape Breton, Springhill).

27. Develop a reclamation working group to design a multi-stakeholder program (relevant government departments and agencies, industry and communities) to systematically assess the environmental and economic state of old mine sites and develop a reclamation implementation plan where opportunities exist. This must include evaluation of mine tailings for recoverable resources, and consideration of the long-term risks of leaving existing tailings undisturbed relative to short-term disturbance to dispose of contaminated tailings permanently.

28. Develop a database on abandoned quarries and degraded mined areas to delineate areas with highest acid rock drainage potential and contamination potential of groundwater and surface waters.

29. Investigate a levy system (including costs and benefits) to fund the reclamation of abandoned pits and quarries.

30. Consider mineral recovery under reclaimed lands and the protection of reclaimed lands in the review of the Mineral Resources Act and other relevant legislation.

31. Identify special projects budgets and equalization of funding relative to other branches of the Department of Natural Resources. A special projects fund will enable new geoscience initiatives to be undertaken and eliminate financial dependence on other departments while maintaining those highly productive collaborations.

32. Develop a biennial review process led by an external management consultancy to evaluate the performance of the Mineral Resources branch in implementing the recommendations of the new Natural Resources Strategy, identify gaps in performance, and establish new goals and funding needs in deficient areas. This process must include the evaluation of client satisfaction.

33. Improve knowledge transfer for retirements/replacements through improved documentation and information sharing, and overlap of staff whenever possible.

34. Encourage external consultation between Mineral Resources branch experts and other departments. The Department of Natural Resources should work with other departments to revise existing Memorandums of Understanding to enable more expert consultation where geological expertise is required in the Environmental Assessment Process (e.g., pit and quarry development; groundwater and coastal resources; geothermal; mineral deposits).

12.0 GLOSSARY

Acid rock drainage

This refers to the outflow of acidic water.

Acquifer

This is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.

Aggregate resources (aggregates)

These are (a) a mass or body of rock particles, mineral grains, or a mixture of both; (b) any of several hard, inert materials, such as sand, gravel, slag, or crushed stone, used for mixing with a cementing or bituminous material to form concrete, mortar, or plaster, or used alone, as in railroad ballast or graded fill.

Biometallurgy

This refers to the development and uses of bacteria and other biological agents in hydrometallurgy, flotation, solid-liquid separation, remediation etc.

Bioremediation

This can be defined as any process that uses microorganisms, fungi, green plants or their enzymes to return the natural environment altered by contaminants to its original condition.

CO2 sequestration mapping

This is mapping underground geology for carbon capture and storage.

DGPS

This acronym refers to the Differential Global Positioning System - an enhancement to the global positioning system (GPS), which results in greater accuracy.

Estuary

This is a partly enclosed coastal body of water with one or more rivers or streams flowing into it.

Geological processes

These are processes related to geology.

Georectified

This refers to the process of matching image data to a set of geographical coordinates.

Geosphere

This refers to the lithosphere, hydrosphere, and atmosphere combined.

Geothermal

This term refers to the heat of the interior of the earth.

Green technologies

These are any application of science, knowledge, or technology directed towards improving the relationship between human technology involvement and the impact this has on the environment and natural resources.

Gypsum

A widely distributed mineral consisting of aquated calcium sulfate: CaSO4•2H2O. It is the most common sulfate mineral, and is frequently associated with halite and anhydrite in evaporites, forming thick, extensive beds interstratified with limestone, shale, and clay.

Hydrogeology

The study of water flow in aquifers and the characterization of aquifers.

Hydrology

This is the study of the movement, distribution, and quality of water throughout earth, and thus addresses both the hydrologic cycle and water resources.

LiDaR

Light Detection and Ranging (LiDaR) is an optical remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target. The most common method to determine distance to an object or surface is to use laser pulses.

Bathy-LiDaR

This is similar to LiDaR but measures range to distance of submerged objects.

Liming

This usually refers to any process is traditionally accomplished with lime or calcium hydroxide.

Limestone

This is a sedimentary rock consisting chiefly (more than 50 per cent by weight or by areal percentages under the microscope) of calcium carbonate, primarily in the form of the mineral calcite, and with or without magnesium carbonate; specifically a carbonate sedimentary rock containing more than 95 per cent calcite and less than 5 per cent dolomite.

Non-Crown limestone

Limestone located on private land is refered to as non-Crown limestone.

Mercury contamination

This is related to the historic use of mercury in the extraction of gold from ore.

Mineral

This is a naturally occurring solid formed through geological processes that has a characteristic chemical composition, a highly ordered atomic structure, and specific physical properties.

One Window Process for Mine Development Approval

This refers to the process of having proponents meet with representatives of each regulatory body to review proposed projects and receive advice and recommendations to allow for timely and accurate application of the project.

Pit

This is a shallow excavation, up to several metres deep, dug to expose a soil or geologic section of relative soft sediments.

Platinum group elements

This term refers specifically to ruthenium, rhenium, palladium, osmium, iridium, and platinum. Abbrev: PGE

Quarries

This term refers to the extraction of building stone or other valuable non-metallic constituent from a surficial mine, or quarry.

Rare earth elements (metals)

This refers to oxides of a series of fifteen metallic elements, from lanthanum (atomic number 57) to lutetium (71), and of three other elements: yttrium, thorium, and scandium.

Reclamation

This is the process of creating useful landscapes that meet a variety of goals, typically creating productive ecosystems (or sometimes industrial or municipal land) from mined land. It includes all aspects of this work, including material placement, stabilizing, capping, regrading, placing cover soils, revegetation, and maintenance.

Saltwater intrusion

This refers to the movement of saline water into freshwater aquifers.

Seawater inundation

This is also referred to as seawater flooding.

Shore types

This is the fringe of land at edge of large body of water and the various type of shore/shoreline that occur.

Sterilized (mineral resources)

This refers to the removal of areas of known or potential mineral endowment from future development.

Subsidence

This is the motion of a surface (usually, the earth's surface) as it shifts downward.

Sustainable development

This refers to a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations.

Synthetic liner

This is a kind of geomembrane and geosynthetic that incorporates a bentonite or other clay, which has a very low hydraulic conductivity. The resulting lower permeability slows the rate of seepage.

Tsunami

This is a gravitational sea wave produced by any large-scale, short-duration disturbance of the ocean floor, principally by a shallow submarine earthquake, but also by submarine slumps, subsidence, or volcanic eruption.

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