

Geological Resources

THE PATH WE SHARE

A Natural Resources Strategy
for Nova Scotia 2011-2020
Five-year Progress Report

APPENDIX 4

GOAL 14: SUSTAINABLE RESOURCE DEVELOPMENT

Support the sustainable development of the province's geological resources in order to attract investment, create high-value jobs, and grow the economy.

54 Continue to lead research on the province's geology, mineral resources, and opportunities related to the full mining life cycle.

WHAT WE ARE DOING

- In 2014, the Geoscience and Mines Branch launched a new website, novascotia.ca/natr/meb, that significantly improved access to the results of the department's geoscience research. All research undertaken by government geoscientists is now made available online, at novascotia.ca/natr/meb/maps, through reports, maps, and databases. Clients can also use the new website to more easily access information on the department's geoscience programs and projects, and to directly access staff expertise.
- DNR geologists are assessing the mineral resource potential of the Antigonish and Cobequid Highlands, and the Cheticamp area of Western Cape Breton. This work includes detailed geological mapping, identification of new mineral occurrences, and geochemical and geophysical analysis. To date, the results of these assessments have led to increased exploration by industry for gold, rare earth metals, copper, lead, zinc, and cobalt.
- The department has completed a major update to our online drill core and drill hole database. The update includes the addition of 10,000 new drill holes, bringing the total 27,000. The database includes drill hole location, depth, availability of drill core, and who drilled the hole.
- The department is nearing completion of an assessment of the aggregate, stone, and clay resources of Hants, Kings, Annapolis, Digby, and Yarmouth Counties.
- We are promoting exploration opportunities that we identified through our geoscience research at leading industry events, such as the Prospectors and Developers Association of Canada's International Convention.

55 Identify and promote innovative uses and secondary processing of Nova Scotia's mineral resources.

WHAT WE ARE DOING

- In 2014, the Minerals Development and Policy Section of the Geoscience and Mines Branch of the Nova Scotia Department of Natural Resources, working in cooperation with Nova Scotia Business Inc. (NSBI), encouraged gypsum value-added businesses by designing and executing a small-scale marketing exercise. The objective was to inform an audience of global decision makers of the opportunities to invest in gypsum value-added businesses in Nova Scotia. The goal was to measure (gauge) the interest of decision makers and to help determine what actions government could undertake next to fully realize the potential for the value-added business opportunities to create jobs in Nova Scotia.
- The department is working on the Annapolis Valley Stone Resource Project. This project identifies and evaluates the bedrock aggregate and glacial sand and gravel potential and identifies other glacial deposit and stone potential, such as clay-rich deposits, rip-rap, armour stone, and specialty stone products, which may have economic or environmental value in the future.

56 Identify and promote new ways to gain social and economic benefits from our cultural and physical geoheritage.

WHAT WE ARE DOING

- The province has published a book entitled *The Joggins Fossil Cliffs: Coal Age Galapagos*. This book tells the story of one of the world's most outstanding examples of the coal age, some 300 million years ago. It is written for the general public and highlights the unique geological heritage, history, and people who have made Joggins worthy of world attention. Revenue from the book sales will help generate funds for the Joggins Fossil Centre. It is also a very important tool for promoting the site for tourism.
- The department was part of the steering committee for *Gold: A Nova Scotia Treasure*, a travelling exhibition and virtual exhibit. The exhibition draws heavily on art works, artifacts, mineral specimens, and historic photography contained within provincial government and private collections that relate to gold and gold mining. Nova Scotia's past gold mining heritage forms the centerpiece of the exhibit, but the exhibition also examines how gold mining, and gold in general, has affected various aspects of Nova Scotia's culture.
- The department has completed an inventory of geoheritage sites across Nova Scotia, documented in an Open File Map and online interactive StoryMap, both pending release. Input was sought on developing the list of geoheritage sites at all available opportunities, including professional meetings, such as the Atlantic Geoscience Society Annual Meeting and Colloquium; meetings of focus groups, such as the Education Committee of the Atlantic Geoscience Society; public meetings; workshops with teachers; and consultation with individual geoscientists, prospectors and members of the public. Consultation with staff of Tourism Nova Scotia has directed the geoheritage program to meet broader roles of economic development in rural areas.
- Fundy Geopark—The department has taken the lead role in engaging the community in identifying the economic development opportunity of a UNESCO Global Geopark along the Parrsboro shore. The Cumberland Geological Society, comprising community leaders and entrepreneurs, has embraced the opportunity and has informed the national committee for Global Geoparks of their intentions as an aspiring geopark.

57 Continue to provide technical and financial assistance to prospectors to help them attract investment for mineral exploration and development.

WHAT WE ARE DOING

- The Nova Scotia Mineral Incentive Program (NSMIP) was created in 2012, with the goal of increasing and promoting mineral exploration, leading to mineral discoveries and new producing mines in Nova Scotia. The NSMIP funds several initiatives to promote mineral exploration in the province. The program is made up of four components: Prospector Grants, Advanced Project Grants, Marketing Grants, and a Prospector Education Program.
 - Prospector Grants, of up to \$15,000, are intended to fund activities by prospectors on grass-roots exploration activities to find economically viable mineral resources in Nova Scotia. A total of \$184,250 was awarded in 2016.
 - Advanced Project Grants of up to \$100,000 provide up to 50 per cent of eligible costs and are an industry-government cost-sharing initiative designed to fund exploration and evaluation activities beyond the grass-roots level. A total of \$140,000 was awarded in 2016.
 - Marketing Grants provide funds for prospectors to attend the Prospectors and Developers Association of Canada convention in Toronto and the Mineral Exploration Roundup in Vancouver in order to market their mineral properties for option or sale. Over \$60,000 in Marketing Grants were provided up to January 2015.
 - The Prospector Education Program has funded GIS workshops for prospectors and supported the development of a series of online modules of a prospectors course. Approximately \$17,000 was spent in 2014.

Year	Total Prospector Grants	Total Advanced Project Grants
2012	\$164,805	\$440,000
2013	\$180,200	\$412,000
2014	\$89,600	\$455,000
2015	\$136,075	\$185,000
2016	\$184,250	\$140,000

- The Nova Scotia Prospectors Association has been provided with funding to purchase an X-ray fluorescence analyzer. This unit will be available to Nova Scotia prospectors to undertake geochemical testing of rock samples.
- The department is providing professional development opportunities for geologists.

GOAL 15: LIFE-CYCLE PLANNING

Align mineral exploration, mining, and land reclamation practices with leading government and industry standards.

58 Review, monitor, and promote the use of best practices for mineral exploration and mining.

WHAT WE ARE DOING

- In November 2013, the department published *Community Consultation: A Guide for Prospectors and Mineral Exploration Companies Working in Nova Scotia*. This document provides guidance and resources to help prospectors and exploration companies with community consultation.
- A guidebook designed to assist communities in their engagement of mineral exploration companies is being developed. The key components of the guidebook are a questionnaire for use by communities to capture relevant information on proposed mineral exploration surveys and tables that outline some potential benefits, risks, and mediation options for mineral exploration surveys. The guidebook also contains educational materials and a question and answer section. It will be ready for publication in 2016.
- During February 2014, DNR co-sponsored and participated in a two-day workshop (Exploring Common Ground) that brought together representatives from the mineral industry, environmental NGOs, provincial and municipal governments, and the public to identify new pathways for positive engagement around mineral exploration and mining.

59 Address biodiversity in reclamation plans for new mineral-related development.

WHAT WE ARE DOING

- The Surface Coal Mine Reclamation Enhancement Initiative study has evaluated a number of past surface coal mine sites to determine the state of the lands following reclamation and has developed recommendations for future re-integration of lands through the use of leading reclamation practices. The final report has not been released.
- The updated Mineral Resources Act requires that reclamation plans be filed and updated every three years by licensees and lessees. This helps to ensure up-to-date reclamation plans and appropriate levels of security and monitoring throughout the process.

60 Work with interested groups to find better ways to manage mine tailings and reclaim land.

WHAT WE ARE DOING

- Staff from DNR's Hydrogeology Program provided support to projects related to the management of historical gold-mine tailings. Specific activities included a review and summary of existing environmental studies on gold-mine tailings in Nova Scotia, consultations on proposed research regarding tailings revegetation methods, and advice to DNR Regional Services Branch on specific gold-mine tailings sites.

61 Share knowledge about, and participate in research and reclamation of, orphaned and abandoned mine sites.

WHAT WE ARE DOING

- Since 2001, the Abandoned Mine Opening Remediation Program, managed jointly by the Geoscience and Mines and Regional Services branches of the Department of Natural Resources, has invested about \$760,000 to remediate the most hazardous of these openings on Crown land. Approximately \$50,000 of remediation work is completed each year.
- The Geoscience and Mines Branch maintains a database of the known Abandoned Mine Openings (AMO) in the province (on both private and Crown lands). This database is available online at novascotia.ca/natr/meb/geoscience-online/aboutdatabase-amo.asp. Field inspection reports are used to update both the AMO database and an AMO remediation priority list.
- In November 2013, Version 5 of the Nova Scotia Abandoned Mine Openings Database was released. This update to the 2009 Version 4 contains an additional 329 mine openings not previously documented. Users will also note updates to mine opening locations, facilitated by GPS and GIS technology over the past number of years.
- In 2016, an online interactive map showing the location of thousands of orphaned and abandoned mines in Canada will be launched by the National Orphaned/Abandoned Mines Initiative (NOAMI). Nova Scotia is contributing to this map by providing data on 825 such sites—mainly historical gold, coal, gypsum, and iron ore mines. The Geoscience and Mines Branch compiled the data from its existing Abandoned Mine Openings database and various Open File and Economic Geology Series reports.

GOAL 16: RESEARCH AND KNOWLEDGE SHARING

Provide leadership in the collection and use of earth-science research and knowledge to benefit and protect Nova Scotians.

62 Continue to provide information and knowledge about the geology of Nova Scotia

WHAT WE ARE DOING

- In 2014, the Geoscience and Mines Branch launched a new website, novascotia.ca/natr/meb, that significantly improved access to the results of the department's geoscience research. All research undertaken by government geoscientists is now made available online, at novascotia.ca/natr/meb/maps, through reports, maps, and databases. Clients can also use the new website to more easily access information on the department's geoscience programs and projects, and to directly access staff expertise.
- The Geoscience and Mines Branch has over 200 GIS geoscience data sets (open data) that clients may download directly for their own use. Between 2010 and 2014 there were more than 227,000 data set downloads and over 2.6 million hits on the interactive map applications. Since 2015, the branch has been in the process of rebuilding server infrastructure, updating software, and modernizing all online database and interactive map applications.
- In fall 2015, five of six Geoscience and Mines Branch interactive map applications were upgraded to a new platform: the Geoscience Atlas, Groundwater Atlas, Radon Risk, Acid Rock Drainage Risk, and the Southwest Nova Bedrock Map. A new version of the Mineral Resource Land-Use Atlas will be available soon. The look and feel of the applications have been improved, and their behaviour is more like Google Earth. Panning now just involves a mouse click and drag, and the mouse scroll wheel will allow zooming in and out. Mashing-up (combining) layers is easier because the transparency of each layer can be controlled with its own slider bar. Coordinates are now available in lat/long and UTM. Customizing maps with notes and drawings is now possible, along with improved and added functionality to search, print, export, and share maps via Facebook, Twitter, and email.
- In fall 2014, the Mineral Resources Branch was renamed the Geoscience and Mines Branch. The change was made to better reflect the range of services that the branch provides.
- In winter 2014, the Geoscience and Mines Branch renamed the newsletter *Nova Scotia Minerals Update* to *The Geological Record*. Over the past ten years, government has expanded the responsibility of the branch to include evaluating Nova Scotia's groundwater resources and understanding the risks associated with geohazards, coastal flooding, and erosion. In recognition of these changes, the name and content of the newsletter have been revised to better reflect the wide range of work that constitutes today's operations of the Geoscience and Mines Branch.
- All geoscientists in the branch are required to publish yearly accounts of their work. These accounts may be published as scientific reports, memoirs, or maps, or they may be more effectively summarized in less-technical publications, such as information circulars or newsletters. All forms of publication play an important role in delivering geoscience information for the branch to enhance public awareness and

promote the mineral resources of Nova Scotia. The Annual Report of Activities for the Geoscience and Mines Branch can be found at novascotia.ca/natr/meb/geoscience-online/report-of-activities-recent.asp.

- NovaScan is the provincial database of geoscience maps and publications for Nova Scotia. It is produced and maintained by the Geosciences and Mines Branch of the Nova Scotia Department of Natural Resources. Containing over 15,000 records, it is updated monthly as new geoscience maps, publications, open files, theses, mineral exploration assessment reports, and mining property reports become available. NovaScan can be found at <https://gesner.novascotia.ca/novascan/DocumentQuery.faces>.
- DNR staff provide classroom presentations on various geological topics, and the department has provided rock and mineral kits to a number of schools throughout the province. The presentations to grade 4 classes are designed to meet curriculum outcomes.
- DNR geologists continue to help the Atlantic Geoscience Society with public education initiatives, such as the Geological Highway Map of Nova Scotia and *A Pebble Identification Guide for Nova Scotia*.
- DNR geologists participate in the annual Gem and Mineral Show in Parrsboro, providing a display on Nova Scotia geology and leading geological field trips for attendees. Between two and three thousand people attend the show annually.
- DNR continues to have a significant presence at the annual Prospectors and Developers Association of Canada (PDAC) conference in Toronto, and the Mineral Exploration Roundup in Vancouver. These events provide international audiences with information and knowledge about the geology of Nova Scotia and its mineral resources.
- Research and Information Services (RIS, formerly the DNR Library) provides a public interface between the researcher and DNR's information resources. Staff collect, preserve, and make accessible both new and legacy information generated by DNR staff. RIS staff provide expert research support for DNR staff and members of the public.

63 Expand groundwater mapping: (a) to identify water resource potential and associated risks; and (b) to provide advice and direction for future development and land use decisions.

WHAT WE ARE DOING

- The department is continuing work on the organization and maintenance of provincial groundwater information in a centralized spatial database, including routine updating of groundwater databases such as the Nova Scotia Well Logs Database, the Nova Scotia Pumping Test Database, the Nova Scotia Groundwater Chemistry Database, and the Nova Scotia Test Holes Database.
- To update our baseline understanding of the groundwater resources of Sable Island, which was designated a National Park Reserve in 2013, a compilation report summarizing available hydrogeological information was produced. The report and accompanying mapping was released as Open File Report ME 2014-001 and is available at novascotia.ca/natr/meb/pdf/14ofr01.asp.
- A spatial inventory and a preliminary characterization of surficial aquifers across the province were conducted in 2013 through the analysis of existing stratigraphic information, such as water well and government test hole logs, and relevant historical groundwater assessment reporting. The identification and characterization of surficial aquifers may help alleviate groundwater quantity and quality issues in some areas of the province by providing alternative water supply targets for various water users.
- The DNR hydrogeology program is contributing hydrogeological expertise to a multi-disciplinary wetland collaborative research effort at the Big Meadow Bog on Brier Island, Digby County, where a peatland has been affected by historical drainage activities. The wetland complex hosts *Geum peckii* (Eastern mountain avens), a globally rare plant. Hydrologic baseline information is being collected to better understand the impacts and to inform potential restoration activities.
- The Nova Scotia Groundwater Observation Well Network, operated by Nova Scotia Environment, is a key source of information on background groundwater chemistry and groundwater levels in the province. In 2013, DNR supported the conversion of two unused picnic park wells in Lunenburg County to provincial observation wells.
- In 2013, the department collaborated with Natural Resources Canada to carry out a survey of methane levels in water wells located in the Carboniferous basins of Nova Scotia. Approximately 100 water wells were tested for methane: follow-up testing for higher-chain hydrocarbons, as well as hydrogen and carbon isotopes of methane, was completed for wells where elevated methane concentrations were identified.
- In 2014, preliminary work was conducted on the development of a spatial database for arsenic-risk mapping. Datasets assembled include arsenic concentrations measured in stream sediment, lake sediment, biological media, till, bedrock, and groundwater.
- A project was initiated in 2014 to develop background concentrations for selected substances, using existing data, to be supplemented by additional soil sampling in the Halifax Regional Municipality. The development of quantitative information on background concentrations of various substances in soils is important to enhance science- and evidence-based decision making in dealing with contaminated sites.
- The department worked with Nova Scotia Environment (NSE) and Dalhousie University to advance research and policy on the management of naturally occurring uranium in groundwater. This work builds on existing DNR research that identified the potential for uranium to be mobilized in groundwater by certain land use activities (see novascotia.ca/natr/meb/data/pubs/cs/cs_me_2013-001.pdf). The intent of

the research is to develop new methods for identifying potential uranium-mobilization situations so that mitigation measures can be implemented.

- In recent years, several subdivision developments in the Halifax Regional Municipality that rely on private wells have experienced water shortages because of declining aquifer levels. To help address this problem, DNR had previously worked with NSE and HRM planners to develop a groundwater assessment guide and toolkit as planning tools to ensure aquifer sustainability in subdivision developments. DNR is building on this work by supporting research at Dalhousie University to model the effects of low-impact-design stormwater management methods on aquifer sustainability.
- The department continues to help various clients with requests for data and for technical advice. In 2013, the department developed a web page to assist municipalities requesting information on seawater intrusion vulnerability to coastal aquifers during the preparation of Municipal Climate Change Action Plans.

64 Conduct and share results of earth-science research that helps us to understand and protect Nova Scotia's biodiversity.

WHAT WE ARE DOING

- The DNR hydrogeology program is contributing hydrogeological expertise to a multi-disciplinary wetland collaborative research effort at the Big Meadow Bog on Brier Island, Digby County, where a peatland has been affected by historical drainage activities. The wetland complex hosts *Geum peckii* (eastern mountain avens), a globally rare plant. Hydrologic baseline information is being collected to better understand the impacts and to inform potential restoration activities.
- Every year, DNR's Abandoned Mine Openings program remediates historical mine openings on Crown land that could pose a safety hazard to the public. As of the end of 2015, four abandoned mine openings have been gated off to prevent people from entering, while still providing access for other animals, such as bats, to enter. In this way, the program serves two purposes: enhancing public safety and preserving habitat for threatened or endangered species.
- Since the release of the Natural Resources Strategy, the Wildlife Division has prioritized its inventory and classification efforts on higher-conservation-value ecosystem types falling into natural ecological groups with similar environmental drivers. Higher priority ecosystem groups currently being addressed include the following:
 - Coastal beaches and dunes—The Wildlife Division partnered with the Atlantic Canada Conservation Data Centre (AC CDC) and Parks Canada to survey beach and dune ecosystems of Nova Scotia. Surveys were completed in 2015 with a Wildlife Division expedition to Sable Island. The classification and a scientific report on this important component of provincial ecosystem diversity will be completed in 2016–17.
 - Karst—Karst is a rugged type of topography formed by processes in which rock dissolves. In Nova Scotia, karst ecosystems include sinkholes, cliffs, caves, and rock pinnacles formed in areas underlain by gypsum or limestone. The kinds of karst ecosystems in Nova Scotia are nationally rare and support significant biodiversity features. The Wildlife Division has spent part of two summers surveying karst, but additional surveys are needed to complete this classification.

65 Assess and report the potential for geohazards, such as radon, arsenic in drinking water, abandoned mine openings, sinkholes, landslides, and coastal flooding, to help protect the health and safety of the public.

WHAT WE ARE DOING

- Radon—In November 2013, the department released a map showing the potential for radon in indoor air in Nova Scotia. The map is available as a pdf digital download and as an online interactive map.
- Arsenic—The department is currently in the early stages of a project to develop an understanding of the hydrogeologic controls of arsenic in well water. The project will also include the development of a risk communication tool that will allow well users, planners, water treatment specialists, etc. to predict risk and to promote water testing and appropriate treatment.
- Abandoned mine openings—Since 2001, the Abandoned Mine Opening Remediation Program, managed jointly by the Geoscience and Mines and Regional Services branches of the Department of Natural Resources, has invested about \$760,000 to remediate the most hazardous of these openings on Crown land. Approximately \$50,000 of remediation work is completed each year.
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- Sinkholes—The department is developing a work plan for producing a karst risk map for the province and is in the process of gathering the required data sets.
- Landslides—The department is characterizing how the coastline is eroding in different areas of the province. The results of this research will help property owners and municipalities to better understand the risks to existing coastal infrastructure, and how to plan more effectively new construction along the coast.
- Coastal flooding—We are working with the Nova Scotia Community College to develop an Internet mapping website where officials from the emergency management community and other interested parties can obtain information about the possible extent of coastal flooding inundation as a result of a predicted high-water event (storm surge or tsunami), access whatever critical infrastructure may be at risk, access transportation closures and alternative routes, access possible mass evacuation of people at risk, and enhance situational awareness of the pending event.
- Coastal flooding—Through a series of workshops and presentations, the department has helped municipalities understand the methodologies required to conduct high-level coastal flood-risk assessments. This has helped support the development of Municipal Climate Change Action Plans.
- Acid rock drainage—The department produced a set of 26 1:50 000-scale maps showing the bedrock acid rock drainage potential of southwestern Nova Scotia. It can be accessed at novascotia.ca/natr/meb/download/mg/ofm/htm/ofm_2013-002.asp.

66 Continue to map Nova Scotia's coastal geology and advise communities about adapting to and mitigating the effects of sea-level rise, coastal erosion, and flooding.

WHAT WE ARE DOING

- The Geological Services Division works closely with the Parks Division by providing geological expertise in assessing park properties and infrastructure located along Nova Scotia's shoreline. Assessments of the general geology and coastal processes that affect the parks are provided to assist in developing long-term park management plans. A wide range of information on topics—such as past, present, and future sea-level rise; beach and cliff stability; storm impacts; and natural coastline evolution—affect provincial park management and infrastructure development plans.
- Coastal flooding—We are working with the Nova Scotia Community College to develop an Internet mapping website where officials from the emergency management community and other interested parties can obtain information about the possible extent of coastal flooding inundation as a result of a predicted high-water event (storm surge or tsunami) , access whatever critical infrastructure may be at risk, access transportation closures and alternative routes, access possible mass evacuation of people at risk, and enhance situational awareness of the pending event.
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- The department is characterizing how the coastline is eroding in different areas of the province. The results of this research will help property owners and municipalities better understand the risks to existing coastal infrastructure and how to more effectively plan new construction along the coast.

GOAL 17: EDUCATION AND SHARED STEWARDSHIP

Help interested groups become better stewards by strengthening their understanding of Nova Scotia's geology.

67 Engage Nova Scotians in planning projects and making decisions about mineral resource development that affects their communities

WHAT WE ARE DOING

- In November 2013, the department published *Community Consultation: A Guide for Prospectors and Mineral Exploration Companies Working in Nova Scotia*. This document provides guidance and resources to help prospectors and exploration companies with community consultation.
- During February 2014, DNR co-sponsored and participated in a two-day workshop (Exploring Common Ground) that brought together representatives from the mineral industry, environmental NGOs, provincial and municipal governments, and the public to identify new pathways for positive engagement around mineral exploration and mining.
- In 2015, the department sponsored workshops for professional geoscientists to receive training in community consultation.
- A guidebook designed to assist communities in their engagement of mineral exploration companies is being developed. The key components of the guidebook are a questionnaire for use by communities to capture relevant information on proposed mineral exploration surveys and tables that outline some potential benefits, risks, and mediation options for mineral exploration surveys. The guidebook also contains educational materials and a question and answer section. It will be ready for publication in 2016.
- In 2015–16, a collaborative approach was used during a review of the provincial Mineral Resources Act. Industry representatives, associations, and environmental non-governmental organizations were invited to submit position papers to an interdepartmental panel and present their recommendations for change. Follow-up meetings were held for feedback as work progressed. Meetings were also held with the Mi'kmaq, and public input was solicited via online surveys and through written submissions.

68 Provide information about the geology of the province to help in provincial and municipal land use planning and decision making.

WHAT WE ARE DOING

- A project was initiated in 2014 to develop background concentrations for selected substances, using existing data, to be supplemented by additional soil sampling in the Halifax Regional Municipality. The development of quantitative information on background concentrations of various substances in soils is important to enhance science- and evidence-based decision making in dealing with contaminated sites.
- The department worked with Nova Scotia Environment (NSE) and Dalhousie University to advance research and policy on the management of naturally occurring uranium in groundwater. This work builds on existing DNR research that identified the potential for uranium to be mobilized in groundwater by certain land use activities (see novascotia.ca/natr/meb/data/pubs/cs/cs_me_2013-001.pdf). The intent of the research is to develop new methods for identifying potential uranium-mobilization situations so that mitigation measures can be implemented.
- In recent years, several subdivision developments in the Halifax Regional Municipality that rely on private wells have experienced water shortages due to declining aquifer levels. To help address this problem, DNR had previously worked with NSE and HRM planners to develop a groundwater assessment guide and toolkit as planning tools to ensure aquifer sustainability in subdivision developments. DNR is building on this work by supporting research at Dalhousie University to model the effects of low-impact-design stormwater management methods on aquifer sustainability
- The department continues to help various clients with requests for data and for technical advice. In 2013, the department developed a web page to assist municipalities requesting information on seawater intrusion vulnerability to coastal aquifers during the preparation of Municipal Climate Change Action Plans.
- The department provided support to Parks Canada in establishing a groundwater monitoring program on Sable Island for the proposed national park.
- The department is assessing the potential for sea-level rise and coastal erosion to negatively affect provincial parks. These assessments are being used to help develop long-term management plans for parks that are located in coastal areas.
- Coastal flooding—We are working with the Nova Scotia Community College to develop an Internet mapping website where officials from the emergency management community and other interested parties can obtain information about the possible extent of coastal flooding inundation as a result of a predicted high-water event (storm surge or tsunami) , access whatever critical infrastructure may be at risk, access transportation closures and alternative routes, access possible mass evacuation of people at risk, and enhance situational awareness of the pending event.
- Coastal flooding—Through a series of workshops and presentations, the department has helped municipalities understand the methodologies required to conduct high-level coastal flood-risk assessments. This has helped support the development of Municipal Climate Change Action Plans.
- The department is characterizing how the coastline is eroding in different areas of the province. The results of this research will help property owners and municipalities better understand the risks to existing coastal infrastructure and how to more effectively plan new construction along the coast.

- The department has developed a series of acid rock drainage risk assessment maps, and has met with municipal planners to inform them how the maps can be used to support land use planning.
- We have developed a radon risk assessment map that highlights areas of the province at risk of having high levels of radon within dwellings. We are working to educate municipalities and the public and about the importance of evaluating the risks posed by radon in existing and planned buildings.

69 Work with educators to increase awareness—particularly among young people—of the vital importance of earth sciences and geological resources.

WHAT WE ARE DOING

- A third-year planning course at the Dalhousie University School of Planning, entitled Geology and Land-Use Planning, was made available during 2013–14. This is the second year the course was offered at the school. A number of geoscientists from the Nova Scotia Department of Natural Resources and Natural Resources Canada were guest lecturers in the course, which covered topics from coastal erosion to mineral resource development and their relevance to land use planning. These lectures provided opportunities to educate land use planners about geological issues at an early stage in their careers.
- DNR staff give classroom presentations on various geological topics, and have provided rock and mineral kits to a number of schools throughout the province. The presentations to grade 4 classes are designed to meet curriculum outcomes.
- DNR geologists continue to help the Atlantic Geoscience Society with public education initiatives such as the Geological Highway Map of Nova Scotia and *A Pebble Identification Guide for Nova Scotia*.
- DNR geologists participate in the annual Gem and Mineral Show in Parrsboro, providing a display on Nova Scotia Geology and leading geological fieldtrips for attendees. Between two and three thousand people attend the show annually.

GOAL 18: GOOD GOVERNANCE

Provide clear and effective laws and policies that support sustainable geological resource development.

70 Review and update the Mineral Resources Act.

WHAT WE ARE DOING

- In 2015–16, a collaborative approach was used during a review of the provincial Mineral Resources Act. Industry representatives, associations, and environmental non-governmental organizations were invited to submit position papers to an interdepartmental panel and present their recommendations for change. Follow-up meetings were held for feedback as work progressed. Meetings were also held with the Mi'kmaq, and public input was solicited via online surveys and through written submissions.
- The updated Mineral Resources Act received royal assent in the House of Assembly on May 20, 2016. Regulations are in development.

71 Review and improve legislation related to renewable energy that uses the province's geological resources, such as geothermal energy from mine waters.

WHAT WE ARE DOING

- The use of geothermal energy from groundwater resources for heat pumps is under consideration at Nova Scotia Environment for inclusion within amendments to well construction regulations. These amendments are included for consideration as part of NSE's long-term planning, with no set dates at this time.

72 Develop underground coal gasification laws and policies.

WHAT WE ARE DOING

- The Department of Natural Resources and the Department of Energy have a policy-level agreement on how an underground coal gasification project would progress, from DNR issuing authorizations for coal exploration rights to Energy issuing permits or authorizations for a pilot project. There are no current interests in underground coal gasification in Nova Scotia and therefore no plans to develop legislation or additional policy regarding this issue.