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Overview of Current Maine Geological Survey Activities and Programs

Robert G. Marvinney, Maine State Geologist

Introduction

The Maine Geological Survey is the primary source of information on the geologic framework of the State, its groundwater resources, and geologic hazards.

Geologic information is fundamental to social, economic, and environmental applications in Maine. Water and mineral resource distribution, their qualities, and consequences of their use and misuse can be better understood with geological information. The programs of the Maine Geological Survey (MGS) provide significant benefits to the citizens of Maine. These benefits can be defined as promoting a sound understanding of the state’s geological resources and their appropriate use while safeguarding the environment.

Programs of the Maine Geological Survey reflect the broad application of geology to societal issues:

- The Bedrock and Surficial Geology program provides basic geologic mapping and interpretation of bedrock (ledge) and unconsolidated surficial materials. This basic geologic mapping is the foundation for the evaluation and inventory of specific physical resources, mineral occurrences, and geologic hazards in the state.
- The Hydrogeology program assesses ground and surface water conditions, emphasizing groundwater quality and quantity, and the protection and sustainable use of the State’s groundwater resources.
- The Marine Geology program conducts research on the geological setting of the coast and nearshore submarine environment and provides technical services to other state agencies involved in the coastal zone. Research and mapping are conducted for shoreline stability, sea-level rise, beach nourishment sources, and dredge spoil disposal sites.
- The Publications and Outreach program ensures that the geological information generated by the other programs is made available to a variety of users.
Bedrock Mapping

Henry Berry, Physical Geologist
Amber Whittaker, Senior Geologist
Robert Marvinney, State Geologist

Purpose

The bedrock mapping program at the Maine Geological Survey (MGS) strives to produce accurate, high-quality, easily accessible maps of Maine's bedrock. Maine has old, complicated bedrock (also known as ledge) that varies from place to place. Bedrock maps show the various types of bedrock and their structural relationships. These maps and supporting information have a wide range of uses. The most direct and common practical use is in subsurface investigation or planning by geologists or geotechnical engineers. Over 60% of Maine's water supply comes from bedrock wells. Bedrock wells are less likely than surficial water supplies to show bacterial contamination but have the disadvantage of possibly encountering natural inorganic contaminants from the bedrock such as radon or arsenic. Our understanding of groundwater quality and movement requires detailed bedrock mapping. Bedrock maps are also used in bridge and road construction, locating potential stone resources or mineral deposits, predicting soil chemistry, and in reconstructing the geologic history of the Earth.

Goals

We set annual mapping priorities with an external Mapping Advisory Committee comprised of people who use bedrock information for different purposes. The focus is on the more heavily populated areas of the State, and especially areas which lack detailed bedrock maps. Users have emphasized the need for easily searchable and downloadable digital maps and data, which means that we must upgrade many of our older maps to integrate them into our digital system and stay current with demand.

Our bedrock mapping program relies in part on external grant funding from the U.S. Geological Survey through the National Cooperative Geologic Mapping Program. This program provides matching funds to state geological surveys for geologic mapping because even though the federal government has identified geologic mapping as a national infrastructure priority, the USGS does not have the personnel and local expertise to perform the mapping. This funding allows us to contract with geologists to do summer field mapping that multiplies our output capacity.

Status

MGS produces standard bedrock maps at three levels of detail. The whole state is covered at only the least detailed level, a 1:500,000-scale wall map. At the intermediate level of detail, a mixture of regional and reconnaissance maps produced over the past 50 years, about 70% of the state is covered. At the most detailed level of mapping (1:24,000 scale), which most modern site work now requires, we have covered about 10% of the State. We are continually trying to balance the need to cover such a large State with the time required to produce maps at the detailed level.
Outcomes

As bedrock maps are completed, they are published through the MGS web site for viewing and free download through a collaborative agreement with the Maine State Library. For ease of access, MGS has created a custom web mapping application to show all available geologic maps for the State.

Here are a few specific examples of how MGS bedrock maps have been used recently:

- A research group at Columbia University funded by the National Institutes of Health studied the relationship of arsenic concentrations in groundwater to bedrock in the Augusta area.
- A private geotechnical firm in Portland designed a bridge in Naples using an innovative foundation by taking into account bedrock structure shown on the bedrock map.
- A private consulting company in Portland classified bedrock core samples drilled along a highway alignment in Hampden for the Maine DOT.
- A geologist from Yarmouth used a bedrock map to update a numerical groundwater flow model to evaluate water resources for a community in Freeport.
Surficial Geology Mapping
Lindsay Spigel, Senior Geologist

Purpose

Surficial geology comprises all the loose earth materials, such as glacial till (also known as “hardpan”), sand, gravel, silt, and clay, that overlie bedrock (ledge). Most of these materials were deposited by glacial processes during the end of the last Ice Age (which occurred from about 2.5 million to 10,000 years ago). Glacial ice scoured and sculpted the landscape, picking up and moving rock debris for miles. Some surficial deposits were derived directly from glacial ice (till), while others (sand, gravel, silt, and clay) were washed, sorted, and transported by glacial meltwater and modern streams. Mapping Maine’s surficial geology is critical to safe and sustainable development and catalogs a portion of the state’s natural history.

Goals

• Describe the nature and extent of surficial deposits in Maine at a detailed scale (1:24,000 scale maps).
• Use surficial deposit characteristics and landforms to interpret a portion of Maine’s natural history, primarily how Maine’s landscape evolved during and since the last Ice Age.

Status

As of September 2018, 938 detailed surficial materials and surficial geology maps have been published by the Survey. The majority of these maps were produced in part with competitive grant awards to MGS from the USGS STATEMAP program. Mapping has been focused in the most populated area of the state where needs and impact are greatest, with work progressing to the north from the Portland and coastal areas over time. Map quality has been bolstered by state lidar topographic data acquisition, which provides geologists with detailed “bare-earth” topography, revealing previously unknown landforms and glacial geology features.

Outcomes

Surficial geology maps and their associated data are used by many different stakeholders throughout the state:

• Developers and engineering consultants: Maps are a starting point for siting projects based on the challenges of working with certain surficial materials, and for locating potential aggregate resources within or near a work site.
• Transportation: Maine DOT uses surficial geology maps to help guide road and bridge projects, and for locating potential aggregate resources within or near a work site.
• Environmental consultants: Knowledge of surficial geology is critical to tracking and remediating subsurface contamination (chemical spills, etc.).
• Public works: Surficial geology maps are essential for locating waste disposal sites and water resources.
• Landowners: Individuals can use surficial geology maps to locate aggregate resources on their property and to guide construction project or septic system placement.
• Tourism: Surficial geology maps detail a part of Maine’s natural history. Maps and publications aimed at the public that result from mapping work are popular with Mainers and visitors who want to know more as they explore the landscape.

Left photo: Sand and gravel deposited by glacial meltwater streams being mined for use as aggregate.

Right photo: An exposure of glacial till, which is a mix of sediments and the most common glacial deposit in Maine.
Landslides
Lindsay Spigel, Senior Geologist

Purpose

Landslides are a known hazard in Maine, especially in southern Maine, where events have occurred from early post-glacial (about 13,500 years ago) to modern times. Recent noteworthy landslides occurred at Bunganuc Bluff, Brunswick (2016), Rockland Harbor (1996), and along the Stroudwater River, Gorham (1983). Landslides may occur statewide but are most common in areas underlain by the Presumpscot Formation, which is a mud that was deposited in the sea that covered much of southern Maine at the end of the last Ice Age. The Presumpscot Formation is significant because it is a type of “sensitive clay” meaning that it can deform and flow when disturbed or left unsupported, creating the risk of landslides. A new type of topographic data called lidar recently revealed over two hundred previously unknown large landslides (average size 28 acres) – the vast majority of these are located in the most populated areas of the state and are related to the Presumpscot Formation. The Survey has undertaken many landslide-related projects over the years, most recently in cooperation with MEMA (and funded with FEMA grants) to investigate the newly identified landslides.

Goals

- Identify landslide locations and characteristics from lidar topographic data as it becomes available for new areas of the state and catalog this information in a GIS database.
- Identify a sub-set of landslides for field investigation and determine their ages through radiocarbon dating of vegetation that was swept up or buried by the landslides.

Status

- Lidar data collected and released prior to 2018 has been analyzed and a database of landslide locations and characteristics has been created. Lidar data released in 2018 is currently under review.
- As of October 2018, 26 landslides have been studied in the field and over 60 samples have been sent for radiocarbon analysis.

Outcomes

Prior to the most recent research, a reasonable explanation for the newly discovered landslides is that they must be thousands of years old and occurred in a landscape much different from today as Maine transitioned out of the Ice Age. The new radiocarbon ages have shown that this is not true – landslides have occurred throughout post-glacial times and are thousands to hundreds of years old. Many of the landslides included in the study occurred randomly over time, but some occurred in clusters, indicating possible regional triggers such as earthquakes or a period of very wet climate conditions. This study shows that large landslides are not just a thing of the past and as growth continues in southern Maine, the landslide risk should be recognized. New information from the GIS and field analyses have been shared with MEMA and the public at conferences and field days.
Left photo: Lidar hillshade image of a landslide (outlined in red) along the Saco River near Steep Falls. Tree cover obscured the slide in air photos and traditional topographic maps were not detailed enough to reveal it.

Right photo: Soil core from a landslide in Arundel. The dark area at the bottom is a soil that was buried by a landslide. The blue-grey clay above the soil is Presumpscot Formation that failed and flowed, becoming the landslide. Plant fragments from the soil were used for radiocarbon dating.
Water Use Information Collection and Modeling

Ryan Gordon, Hydrogeologist
Amber Whittaker, Senior Geologist

Purpose

Information about human uses of water in Maine are vital for the State’s long-term development, natural resource planning, and ecological conservation, as well as for shorter-term studies of water resources in select basins. MGS is the State’s most comprehensive source of reliable information on water resources, including water use. Our Water Use Program collects data about human uses of water on an annual basis, including total gallons extracted from surface water and groundwater in a variety of major categories, such as domestic use, agriculture, industry, snowmaking, and bottled water. We collaborate with the US Geological Survey’s National Water Use Information Program, and our data and efforts assist them with their regular reports on water use across the nation. The water use information we collect also helps us with basin studies of water availability, which focus on areas of concern where the magnitude of human water use is close to the total amount of water that is naturally available.

Goals

- Improve the quality and coverage of the information we collect by improving estimates of total water use in key categories such as public water supply, crop irrigation, and industrial uses.
- Develop computer models that can predict and estimate water use based on related factors, such as weather.
- Collect additional information about water use, such as the locations of use, the aquifer or water body being used, and how much of the water is consumed or returned to nature.

Status

MGS has been compiling and reporting on major water uses in Maine since 2003, as required by Maine’s Water Withdrawal Reporting Program. In 2016, we received funding from the USGS Water Use Data and Research Program to improve the quality of our data, the plan for which was published in a five-year workplan document. Since then, we have executed a major effort to survey agricultural water users and develop a computer program to estimate irrigation water demand. We are also beginning a second USGS-funded effort to improve the collection of public water use information from water utilities around the State.

Outcomes

- Results of the successful survey of agricultural water users were published as an MGS report in May 2018.
- A computer model of irrigation water demand has been built and used to estimate agricultural water use.
- We have recently restarted direct collection of data from golf courses and snowmaking businesses.
• Our database of water use information will continue to improve in coverage and quality in the coming year.

Water used for irrigation on an Aroostook County potato field.
National Groundwater Monitoring Network
Ryan Gordon, Hydrogeologist

Purpose

The National Groundwater Monitoring Network (NGWMN) is a federal program that brings together monitoring wells from federal, state, and local agencies across the United States into a single data network. The purpose of this network is to provide access to groundwater data needed for planning, management, and development of groundwater supplies to meet the water needs of humans and ecosystems.

Maine became a contributor to the network in 2017 through a grant from the US Geological Survey. Before this time, most available information about long-term groundwater levels in Maine was from a network of just 19 wells maintained by the U.S. Geological Survey. Maine’s contribution to the NGWMN adds long-term water level measurements from an additional 32 wells distributed around the State in a variety of different aquifer types. The wells are all at sites permitted by the Maine Department of Environmental Protection. Water level information from the network is used by scientists and the public to monitor the effects of drought, climate change, and human activities on groundwater resources.

Goals

- Continue to operate the Maine portion of the network by maintaining our database and ensuring proper connections between our database and databases of the NGWMN and the Department of Environmental Protection.
- Deliver timely and accurate data to the national NGWMN network so that water level information is available to the public.
- Improve our knowledge about the wells in our network by accurately surveying and measuring well elevations and depths and by increasing the frequency of water level measurements. We also plan to use a well-bore camera to record information about the well casings, screens, and lithology.

Status

MGS is now operating our groundwater level monitoring network under an “ongoing maintenance” grant with the US Geological Survey. The network currently consists of 32 wells at 22 unique site locations that are measured annually, semi-annually, or quarterly. We are also beginning a new USGS-funded project to visit all the well sites, in order to survey their locations, take additional measurements, and gather pertinent well information.

Outcomes

- Maine has been a full data-provider member of the NGWMN since 2017.
- Groundwater levels at Maine wells are available through the online mapping portal at https://cida.usgs.gov/ngwmn/.
Screenshot from the NGWMN online mapping portal, showing MGS wells.
Kennebunk, Kennebunkport, and Wells Water District Ground Water Monitoring

Daniel B. Locke, Hydrogeologist
Ryan P. Gordon, Hydrogeologist

Purpose

Starting in late 2016, the Maine Geological Survey in cooperation with the Kennebunk, Kennebunkport and Wells Water District (KKWD) began monitoring water levels and specific conductance in monitoring wells associated with the KKWD Merriland River gravel-pack well in Wells, Maine. For a number of years, there has been some concern that long-term pumping of this well at elevated withdrawal rates in combination with sea level rise and coastal storm surge events could result in intrusion of salt water from the ocean. The issue was again brought up in the findings of a ground water modeling study of the Branch Brook watershed conducted in collaboration between the U.S. Geological Survey and the Maine Geological Survey. In preparation for the construction of a ground water model to evaluate potential for salt water intrusion at the site, pressure transducers have been deployed at nine monitoring wells located near this public water supply well.

Goals

The pressure transducers are programmed to collect water level data every 15 minutes (water level and specific conductance is also monitored near Merriland River supply well). The goal is to collect data over an extended period under normal pumping conditions throughout the seasons as input for a computer model of ground water flow.

Status

Currently, we are collecting data with these instruments and downloading the information every six months.

Outcomes

The ultimate product of this effort will be the construction of a computer model, based on the Branch Brook watershed model, which will be used to evaluate the long-term likelihood of salt water being drawn into this public water supply well.

Project area in Wells showing the Merriland River water supply well and associated monitoring wells.
Soil Water Balance Models
Ryan Gordon, Hydrogeologist

Purpose

The Soil Water Balance (SWB) model is a computer model that divides the area of Maine into square grid cells and tracks the inputs and outputs of water to the soil layer in each cell through time, based on measurements of actual weather patterns and soil properties. MGS is using the SWB model for two distinct projects: (1) estimating the recharge of groundwater to aquifers at every point in Maine; and (2) estimating the demand for irrigation water in crop fields.

Groundwater recharge is the amount of water from precipitation that soaks through the soil layer and enters saturated groundwater aquifers. Currently, very limited information exists about recharge rates in Maine. Recharge is a very important part of the water cycle because it is the source of all the State’s groundwater resources available for human use and natural systems, including most of the public water systems supplying Maine households. MGS is working with the US Geological Survey on a project to estimate annual recharge across the state using the SWB model.

The agricultural sector is a growing part of Maine’s economy, and farmers are increasingly turning to irrigation to withstand dry spells and improve the quality of their products. As part of our efforts to collect better data about human uses of water in Maine, MGS is trying to improve the way we estimate the amount of water used to irrigate crops. We are using the SWB model to calculate the water demand that crops place on the soil as they grow and use water, and the likely response of a farmer who might use irrigation to meet that demand.

Goals

• Estimate mean annual recharge over the past 20 years in grid cells across Maine.
• Predict irrigation demand on crop fields and estimate the Statewide use of water for irrigation in recent years.
• Forecast irrigation water demand for future years based on weather patterns.
• Make recharge and irrigation water use data available to the public.

Status

The recharge project is nearing completion after three years of work at the US Geological Survey. The model is being calibrated to known natural conditions and will produce estimates of mean annual recharge values for the period 1994-2014, along with other important statistics for understanding the results. The irrigation demand model was built and calibrated during 2018, and detailed results are available now.

Outcomes

• Results and statistics from the recharge project will be reported in an upcoming publication by the US Geological Survey and made available to users of the Maine StreamStats application.
Estimates of irrigation water use derived from the SWB model will be published in a Maine Geological Survey report in the near future.

Output of the irrigation model for a portion of Penobscot County. Colored squares indicate annual water demand in crop fields.
The Maine Cooperative Snow Survey

Daniel Locke, Hydrogeologist
Amber Whittaker, Senior Geologist

Purpose

To assist with flood forecasting, the Maine Cooperative Snow Survey collects, interprets, and distributes information on the depth and water content of Maine’s snowpack in the throughout Winter and early Spring, when the danger of flooding in Maine’s rivers and streams is greatest. This effort involves dozens of cooperators from state and federal agencies, private sector water managers, and educational institutions.

Goals

- Collect systematic data on Maine snowpack conditions throughout the winter season until snowmelt is complete.
- Deliver timely and accurate data on snow conditions to meteorologists, emergency managers, dam operators, and the public to aid in flood forecasting.
- Maintain long-term statistics on snowpack statewide to better understand the impact of climate change on Maine’s water resources.

Status

For the past 30 years, this program has begun each winter on or around January 1. The field data, which typically are collected 11 to 12 times during the season, are analyzed by staff from the Maine Geological Survey and U.S. Geological Survey, and maps are prepared showing the water content in the snowpack for the State. Data are collected monthly until March, when the data collection and the associated map preparation occurs weekly until May 1.

Outcomes:

- Data provided to the National Weather Service for use in preparing flood potential statements and running flood forecast models and refine estimates of flood crests.
- Data distributed to the Maine Emergency Management Agency (MEMA) and, through MEMA, to county emergency management officials.
- Long-term data maintained for statistical analysis of trends.

https://www.maine.gov/dacf/mgs/hazards/snow_survey/
Maine Beach Mapping Program

Peter Slovinsky, Marine Geologist
Stephen Dickson, Marine Geologist

Purpose:

The Maine Beach Mapping Program (MBMAP) was established in 2007 to monitor shoreline change along most of southern Maine’s larger beach systems. MGS scientists use a Real Time Kinematic Global Position System (RTKGPS) to annually monitor several different beach features.

Goals

- Develop a long-term shoreline position monitoring dataset;
- Quantify shoreline changes along southern Maine’s beaches;
- Understand shoreline changes to help aid beach management at local, regional, and state levels; and
- Provide shoreline change data to the public and various stakeholders.

Status

Since 2007, MGS scientists collected positions of the seaward edge of dune vegetation. In 2017, this was supplemented with the position of the mean high water line, the approximate average high tide. Analysis of how these two features change over time allows for understanding of beach and dune changes. Data are collected annually at: Crescent and Seapoint Beaches, Kittery; Long Sands Beach, York; Ogunquit Beach, Ogunquit; Wells, Drakes Island, and Laudholm Beaches, Wells; Parsons, Crescent Surf, and Goochs Beaches, Kennebunk; Goose Rocks Beach, Kennebunkport; Fortunes Rocks and Hills Beaches, Biddeford; Camp Ellis, Ferry, Bayview, and Kinney Shores Beaches, Saco; Ocean Park, West Grand, and East Grand Beaches, Old Orchard Beach; Pine Point, Ferry, Western, Scarborough, and Higgins Beaches, Scarborough; Crescent and Kettle Cove Beaches, Cape Elizabeth; Willard Beach, South Portland; Small Point Beach and Popham Beaches, Phippsburg; Reid State Park Beach, Georgetown; and Pemaquid Beach, South Bristol.
Outcomes

Collected data is used to calculate averaged beach and dune change rates (in feet per year). This information allows us to understand how beaches and dunes are responding to seasonal changes, storms, and sea level rise. In 2017, MGS began calculating the “dry beach width”, the distance from the mean high water line and dune or seawall. This indicates the buffering capacity of the beach to storms, available recreational beach space, or space for migratory bird species such as piping plovers. Annual data is released to the public via the Maine Beach Mapping website: https://www.maine.gov/dacf/mgs/hazards/beach_mapping/index.shtml.
Assessing Sediment Budgets in Support of Beach Nourishment and Coastal Community Resiliency

Peter Slovinsky, Marine Geologist  
Stephen Dickson, Marine Geologist  
Claire Enterline and Ben Kraun, Maine Coastal Program

Purpose

This NOAA-funded Project of Special Merit (POSM) focuses on understanding sand movement at Maine’s major sand beaches near federal beach nourishment projects. This includes understanding how nourished beaches respond to storms, how nourishment designs might be optimized, and to determine where dredged materials might be placed in the nearshore as part of future efforts in order to benefit to nearby beaches.

Goals

• Develop terrestrial, nearshore, and bathymetric data near federal dredge/nourishment projects;  
• Quantify volumetric changes along Maine’s monitored beaches;  
• Develop locations for nearshore sediment placement in the vicinity of federal dredge projects;  
• Optimize beach nourishment designs for effectiveness and longevity; and  
• Understand beach changes to help aid beach management at local, regional, and state levels.

Status

Project partners developed a data collection protocol at Wells, Saco, and Scarborough – beaches which have or would be receiving either beach nourishment or nearshore sand placement. An UAV was used to capture terrestrial imagery and elevations down to approximately low water. The MGS Nearshore Survey System (NSS) was used to capture nearshore bathymetry at survey sites. NSS data was collected near times of high tide in order to overlap with UAV data as much as practicable. Multibeam bathymetric data was then collected by the Maine Coast Mapping Initiative (MCMI). In areas where weather conditions or scheduling inhibited data collection, available fall 2018 USACE topo-bathy LIDAR and orthoimagery will be used to supplement datasets. The project proposes additional data captures in spring (typically March - April, when the beach profile is at its leanest due to winter storms) and early fall (September, when the beach profile is at its richest) 2019 and 2020.

Outcomes

Terrestrial, nearshore and bathymetric elevation data in the vicinity of Wells, Saco, and Scarborough federal dredge and nourishment projects. Data will be used to create a seamless digital elevation model. Findings will be used by Maine, the USACE, and municipal partners for informing beach nourishment and nearshore placement locations and designs and beach habitat management. Preliminary project results from Scarborough are in a Maine Geological Survey Facts and Localities. Nearshore bathymetry from Saco, ME is shown below.
Coastal Processes and Hazards

Stephen Dickson, Marine Geologist
Peter Slovinsky, Marine Geologist

Purpose

The Marine Geology division has expertise and experience with natural hazards along the Maine coast. Geologists provide outreach and education related to commercial and residential development that includes land loss from erosion and flooding as well as insight into shoreline stabilization. MGS scientists provide an independent scientific analysis to the DEP and Board of Environmental Protection. Public works projects in or adjacent to coastal dunes and beaches are reviewed by MGS for both federal Coastal Barrier Resource System boundaries (16 U.S.C. 3502; 38 M.R.S. Ch. 21). The division works with the U.S. Army Corps of Engineers on maintenance dredging and harbor improvements. Seafloor mapping is done in collaboration with the Maine Coastal Program at DMR. As needed, MGS staff provide information for a scientific basis for public policies related to coastal hazards.

Goals

• Provide independent reviews of Natural Resources Protection Act permit applications for DEP.
• Classify erosion hazards along coastal bluffs for Municipal Shoreland Zoning.
• Calculate and distribute elevations of tidal datums along the coast for property surveys.
• Educate homeowners and businesses about coastal processes such as erosion and flooding.
• Update the MEMA State Hazard Mitigation Plan on natural hazards.
• Investigate impacts of storms and sea-level rise on erosion, washover, and infrastructure.

Status

Publications, mapping, and data collection is ongoing with constant revisions and improvements to the MGS catalog and web resources. MGS provides timely reviews of DEP requests for permit applications. Developers and consultants apply geospatial data, including tidal elevations, in products prepared for homeowners and businesses. MGS responds after coastal storms to document and distribute impacts for municipal and state officials during post-storm recovery and long-range infrastructure planning.

Outcomes

Coastal development along beaches has been safely constructed for three decades. In that time, no new structures were damaged by coastal storms or floods. MGS has become a trusted source of information relevant to hazard mitigation and reduction as well as infrastructure planning. Collaboration with state, federal, and municipal officials has resulted in sound decisions with awareness of coastal processes, hazards and public safety.
Goochs Beach, Kennebunk, 3/2/2018, B. Smith

Popham Beach State Park, 11/11/2009, S. M. Dickson
Increasing Resilience and Reducing Risk through Successful Application of Nature Based Coastal Infrastructure Practices in New England

Peter Slovinsky, Marine Geologist
Kathleen Leyden, Maine Coastal Program
Casco Bay Estuary Partnership; The Nature Conservancy; Maine Coast Heritage Trust; Town of Brunswick; Northeast Regional Ocean Council Partner States (NH, MA, RI, CT)

Purpose

This 3-year NOAA-funded Regional Resilience Grant builds on previous work completed in New England on understanding regulatory and physical challenges to implementing living shorelines; an identified challenge was a lack of on-the-ground projects. The purpose is to implement living shoreline demonstration treatments in New England and develop a regionally-acceptable monitoring protocol to gain information on living shoreline siting and efficacy – this information is vital to the regulatory community to understand how to review and permit living shorelines throughout New England.

Goals

- Develop living shoreline demonstration sites in Casco Bay Maine and treatments which beneficially reuse naturally occurring materials (fallen trees, shell material, etc.)
- Design, permit, and construct living shoreline demonstration sites in Casco Bay, Maine
- Develop a regionally acceptable monitoring protocol to be implemented at all demonstration sites
- Conduct education and outreach to a variety of stakeholders on living shorelines in Maine
- Use collected monitoring information to inform regulatory review of living shoreline applications

Status

Numerous meetings have occurred with New England states and state and federal regulatory and commenting agencies to develop an accepted monitoring protocol. In Maine, several workshops were held for the general public and practitioners (engineers, architects, etc.). Maine project partners selected three sites for living shoreline applications in Casco Bay: Wharton Point and Maquoit Bay Conservation Lands (Brunswick) and Lanes Island (Yarmouth). Preliminary data collection has been initiated. RFQ for contract engineering services has been released and is being reviewed. It is expected that design and permitting will be

An eroding bluff from Lanes Island, Yarmouth is shown below (image by P. Slovinsky, MGS).
completed over winter 2018/2019 months, with construction in spring 2019. Monitoring of living shoreline treatments will continue in spring, summer, and fall 2019 and 2020.

Outcomes

Increased knowledge on efficacy of living shoreline techniques that beneficially reuse naturally occurring on-site materials. A standardized monitoring protocol that is acceptable to state and federal regulatory and commenting agencies. Demonstration projects which can be shared throughout Maine and New England. Education and outreach to a variety of stakeholders. Development of a regulatory path for permitting of living shorelines in Maine. Preliminary project information: https://www.maine.gov/dacf/mgs/explore/marine/living-shorelines/.
Maine Well Driller's Commission
Daniel B. Locke, Hydrogeologist

About

The Maine Well Drillers Commission was created by an act of the Legislature in 1994 to protect drinking water and ground water quality by establishing standards for well location and construction and minimum requirements for licensure as a well driller or pump installer. The Commission also investigates complaints regarding potential violations of the Well Drillers and Pump Installers Rules, 144 CMR 232 (doc format). The Commission meets on the second Wednesday of every month at the Maine Geological Survey in conference room W213 of the Williams Pavilion. Members are appointed by the Governor and include three licensed well drillers, three hydrogeologists employed by the State (Maine Geological Survey, Maine Department of Health and Human Services, Drinking Water Program, and the Maine Department of Transportation), and one layperson. The Commission is administered by the Maine Department of Health and Human Services.

Commission Duties

Complaints

Complaints must be received by the Commission within 2 years of the date the work in question was performed. Evidence should include pictures, water quality test results, the location of the well, the name(s) of the individuals and companies that performed the work, the date the work was performed, and a written description of the problem and issues that initiated the complaint. The Commission will review the complaint at its next regular meeting. Complaints determined to have the potential for a violation of the rules will be investigated by the Commission’s independent inspector. Complaints that do not appear to include a violation of the rules will not be accepted for investigation.

Exam Application and Company Licensure

All applications for professional licensure exams are reviewed by the commission for completeness and required experience.

Specialty Well Applications

In some cases, it is necessary to deviate from the rules regarding well placement (144 CMR 232) because of site conditions and lot size. Many specialty wells involve a reduced setback from subsurface wastewater disposal systems because of small lot size or salt water intrusion issues. There may also be cases where a well must be installed under a driveway because of space limitations. Such specialty well information must ultimately be detailed within the county registry of deeds in association with the applicable lot or parcel.
Water Well Database
Amber T. H. Whittaker, Senior Geologist
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Purpose

The Maine Geological Survey (MGS) collects information for all domestic water wells drilled in Maine. The 1987 Water Well Information Law requires a well drilling company to submit a report on each well to MGS on forms designed and distributed by MGS. Well information, including well location, date drilled, well type, well depth, and yield, is stored in a database managed by MGS. This information is essential to any effort aimed at understanding Maine's ground water resources. In addition, the information is useful to communities considering new water supplies or in their planning efforts, to developers and businesses, to consultants investigating water supply or quality issues, to drillers siting new wells, and to agricultural irrigators. MGS also reports information to the Maine Well Driller’s Commission upon request, a body that oversees well driller licensure requirements and investigates complaints.

Goals

- Maintain a database of all reported Maine wells, both current and historical.
- Provide public access to well information via the MGS website, or by phone or email request.
- Strive to spatially locate as many wells as possible, as accurately as possible, to facilitate information searches.

Status

As well information forms are received by MGS, they are entered by hand into the database. This is an ongoing, time-consuming process, and several additional MGS staff volunteer to enter data as their workload allows. In 2017, MGS entered information for 2,833 wells, with 2,048 spatially located; in 2016, 2,603 wells were reported, 1,815 located. MGS staff have entered 1,129 wells so far in 2018. Wells are spatially located either by coordinates (latitude and longitude) provided by the well driller (which automatically provides a well location), geocoding the address of the property (an automated process to generate an approximate well location), or by tax map and lot number (a manual process). Well location information is critical for the well database to be useful; well characteristics are highly site-specific, and well information disconnected from location is of limited use.

MGS staff and other Department of Agriculture, Conservation and Forestry staff also enter data from historical wells drilled prior to 1987 as time allows. These data were obtained from various State agencies over the past 50 years, such as the Water Resources Division of the State Planning Office, and voluntary reporting to the Maine Geological Survey, and are contained in old binders and folders that are deteriorating with age. An optimistic assessment is that a quarter of these old reports have been verified and entered.

Outcomes

The Maine Water Well database currently hosts 129,248 well records, with 65,183 spatially located. Located wells may be viewed on an interactive map. Information for each located well,
including depth and yield, may be viewed by clicking on the colored dot. Records without location information are available for download in csv format.

MGS continues to strive to improve the reporting process and has been researching ways for drillers to report well information online. Current technologies do not allow an easy and affordable way for well drillers to enter information into an online form. MGS will monitor and evaluate new online mapping tools as they are developed with the intention of providing an easy-to-use and free service to well drillers to submit and edit their own data in digital format, hopefully resulting in more accurate well locations and a higher level of compliance with the law.

Screen capture of the MGS Well Database interactive map.
Educational Outreach
All Maine Geological Survey Staff

Purpose

The Maine Geological Survey (MGS) is committed to providing the people of Maine with essential geologic information. Part of that mission is educational outreach to inform the general population about their geologic surroundings. An informed populace is better equipped to appreciate and make decisions about how we use our natural resources and to understand and mitigate the potential impacts of these uses on our natural environment.

Goals

- Develop and publish materials aimed at informing the general public about Maine’s geologic history and resources.
- Participate in outreach activities that are open to the public.
- Help cultivate the next generation of Maine earth scientists.

Status

Educational outreach is an ongoing project, especially with changes in the way that people access information. MGS has responded well with a balance of user-friendly digital resources and personal interaction. A few examples are listed below.

- Geologic Facts and Localities: An online publication series started in 1997 and aimed at the general public (formerly known as Site of the Month). Focused on highlighting Maine geology basics and features on publicly accessible lands. Freely available on the MGS website.
- Maine Earth Science Day: An annual educational event started in 2000 by MGS and now managed by the Maine State Museum.
- Countless presentations at schools, land trust trail days, and other outdoor-minded organizations.
- College student internships and involvement with organizations that encourage student involvement, such as the New England Intercollegiate Geology Conference (NEIGC), Geological Society of Maine (GSM), and the Geological Society of America (GSA).

Outcomes

MGS has published 236 Geologic Facts and Localities (GFL) since its first issue on Mount Katahdin in 1997. The most recent issue was early November 2018, on the geology of Mount Kineo State Park. MGS staff often try to highlight the State Parks; 27 of the 236 publications discuss the geology of State Parks. Since upgrading to our new Digital Maine Repository system in early 2017, GFL publications have been downloaded 28,481 times.

Since 2001, 23,019 students, teachers, and homeschoolers have attended the annual Maine Earth Science Day at the Maine State Museum. MGS staff are always busy with students looking down microscopes, learning about glacial deposits, and viewing a model of ground and surface
water interactions. The event often results in lasting connections with local teachers or homeschoolers interested in more information.

Community groups such as the Belfast Bay Watershed Coalition, organizations such as the Girl Scouts, and Maine K-12 schools frequently contact MGS with requests for geologic talks. All MGS staff present topics related to their area of expertise, and often document these talks with a Geologic Fact and Locality publication.

MGS can hire college student interns through grants from the USGS and a partnership with the University of Maine. Recent student projects have included rescuing exploration core in northern Maine, scanning geologic project progress files, digitizing analog geologic maps, and bedrock geologic mapping in the field with experienced geologists. MGS staff have led numerous field trips for NEIGC, a student-focused annual conference that recently met in Maine in 2016 and 2017. MGS staff regularly interact with college and high school students through annual student conferences with GSM and GSA and continue to mentor students after these events.

2016 Earth Science Day
Digital Data Management and Preservation
Christian Halsted, Director, Earth Resources Information

Purpose

The Maine Geological Survey (MGS) has always been an authoritative source of geologic data for the State of Maine. The essence of what all staff geologists do is collect field observation data and interpret it for publication in maps and reports. This data is expensive to collect and therefore should not be lost to time. Additionally, all MGS scientific data needs to be shared with the academic, geologic, and engineering communities and the public to further research and make sound design, regulatory, and building decisions about our natural world.

Goals

- Inventory and catalog all MGS collections (publications, maps, rock core, field samples, library, geochemistry, aerial photographs, field photos, field notebooks, unpublished maps and reports).
- Maintain a digital repository for all MGS publications that is open and accessible.
- Centralize the storage of all MGS digital datasets.
- Rescue and preserve all MGS digital and physical collections.

Status

In 2013, MGS started a data modernization project by moving its spatial data to a central SQL Server database and upgrading its Geographic Information System (GIS) software to current vendor versions. Shortly thereafter, the Publication Inventory and Sales system data were migrated into the same SQL Server database. Subsequently, the Maine Well Database, Maine Cooperative Snow Survey, Aerial Photograph Collection and National Groundwater Monitoring Network datasets have also been loaded to the database. This centralization of data, along with an integrated user interface developed at MGS, now allows for easy access to all MGS’ major datasets. The integration of spatial and non-spatial data also allows for seamless interaction between systems, live, real-time updating, and the elimination of data duplication between systems.

In 2007, 2010, 2016, 2017, and 2018, MGS applied for and received competitive grants from the USGS National Geologic and Geophysical Data Preservation Program. This program exists to assist state geologic surveys in rescuing important physical collections and making them
available. MGS has used the program to inventory and consolidate the rock core collections, scan and georeferenced over 350 maps, develop a field photo inventory system, scan 8,500 field slide photographs and migrate all digital collection information and products to the Maine State Library’s Digital Maine repository.

Outcomes

The partnership between MGS and Digital Maine at the State Library has provided a stable, easy to use platform for all MGS reports, maps, core, and photo collections – currently 3,056 items. The platform is always available and is a great example of making state information available in a self-service fashion. It also provides MGS with vital statistics for tracking usage.

The centralization and management of over 13 million records in the MGS database is making MGS staff more efficient in map production and data analysis while also providing a high level of data quality and security. It is also enabling data sharing efficiencies that promote MGS’ work and reputation as a respected source of geologic knowledge across the state and the country.