Geologic Resource Evaluation Scoping Summary

Marsh-Billings-Rockefeller National Historical Park &
Saint-Gaudens National Historic Site

Geologic Resources Division
National Park Service

The Geologic Resource Evaluation (GRE) Program provides each of 270 identified natural area National Park Service (NPS) units with a geologic scoping meeting, a digital geologic map, and a geologic resource evaluation report. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity for discussion of park-specific geologic management issues and, if possible, include a site visit with local geologic experts. The purpose of these meetings is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and potential monitoring and research needs. Outcomes of this scoping process are a scoping summary (this report), a digital geologic map, and a geologic resource evaluation report.

The National Park Service held a GRE scoping meeting for Marsh-Billings-Rockefeller National Historical Park (MABI) and Saint-Gaudens National Historic Site (SAGA) on July 10, 2007 at the University of Massachusetts, Amherst. Tim Connors (NPS-GRD) facilitated the discussion of map coverage and Bruce Heise (NPS-GRD) led the discussion regarding geologic processes and features at the two units. Participants at the meeting included NPS staff from the parks, Northeast Temperate Network, and Geologic Resources Division, geologists from the University of Massachusetts, the Vermont Geological Survey (VGS), New Hampshire Geological Survey (NHGS), and Andover Geologic Consulting as well as cooperators from Colorado State University (see table 1). This scoping summary highlights the GRE scoping meeting for Marsh-Billings-Rockefeller National Historical Park and Saint-Gaudens National Historic Site including the geologic setting, the plan for providing digital geologic maps, prioritized lists of geologic resource management issues, descriptions of significant geologic features and processes, lists of recommendations and action items, and a record of meeting participants.

Park and Geologic Setting

Both Marsh-Billings-Rockefeller National Historic Site and Saint-Gaudens National Historic Site lie within the Connecticut River watershed encompassing some 643 and 148 acres, respectively. Marsh-Billings-Rockefeller National Historic Site, established on August 26, 1992 and open to the public since 1998, preserves the home and agrarian landscape of pioneer conservationist George Perkinds Marsh just west of the town of Woodstock, Vermont. This site is the headquarters for the Conservation Study Institute and contains the oldest managed forest in the United States. Marsh-Billings-Rockefeller National Historic Site is devoted to demonstrating conservation stewardship and forest management practices. Saint-Gaudens National Historic Site, authorized August 31, 1964, is the only NPS unit in New Hampshire, located just east of the Connecticut River. This site contains the home of sculptor Augustus Saint-Gaudens whose late 1800s to early 1900s works include the Shaw Memorial in Boston, Massachusetts.

Lower Paleozoic metasedimentary and metavolcanic units dominate the bedrock geology of eastern Vermont and western New Hampshire. In the immediate vicinity of the two national historic sites, old Precambrian age rocks (exposed in the Green Mountains and Chester Dome) were thrust upward, deforming the overlying rocks creating folds with interference patterns during Paleozoic

mountain building events. Bedrock composition, geologic structures such as faults and upturned folds, glacial scouring, and differential erosion controlled the formation of the current topography in the area. Notable hills in the area include Mount Ascutney, Dingleton Hill, Mount Tom, Tinkham Hill, Mount Peg, and Hurricane Hill. A large regional fault, the Monroe thrust, separates these Lower Paleozoic rocks from the New Hampshire sequence to the east. The Connecticut River's course appears to follow this geologic boundary. Further downstream, the river flows through Triassic extensional basins. During the last glacial advance of the Pleistocene Epoch, the Hudson-Champlain ice lobe scoured the area creating rounded hilltops. Upon glacial retreat, thick units of silt- and clay-rich till blanketed the landscape at Marsh-Billings-Rockefeller National Historic Site. In the Saint-Gaudens National Historic Site area, Glacial Lake Hitchcock inundated the re-excavated Connecticut River Valley leaving near shore deltaic and lacustrine deposits on the landscape.

Marsh-Billings-Rockefeller National Historic Site sits on a ridgeline anchored on the east by Mount Tom, which rises more than 400 m (1,300 ft) above sea level. The site contains a large 14-acre pond (The Pogue) sitting in a gently sloping saddle. Large streams such as Barnard Brook, Gulf Stream, and Bridgewater Brook, in addition to local unnamed streams are part of the larger Ottauquechee River watershed. Steep slopes flank these waterways as they cut through the metamorphic bedrock. At Saint-Gaudens National Historic Site, Blow-Me-Down Brook and Blow-Me-Up Brook border the park on two sides flowing through the rolling hills of the forested uplands before merging on a broad floodplain just before the confluence with the Connecticut River. From its west-facing slope vantage point, Mount Ascutney dominates the view.

Geologic Mapping for Marsh-Billings-Rockefeller National Historical Park and Saint-Gaudens National Historic Site

During the scoping meeting Tim Connors (NPS-GRD) showed some of the main features of the GRE Program's digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of GIS compatibility. The NPS GRE Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation set for the GRE Program. Staff members digitize maps or convert digital data to the GRE digital geologic map model using ESRI ArcMap software. Final digital geologic map products include data in geodatabase, shapefile, and coverage format, layer files, FGDC-compliant metadata, and a Windows HelpFile that captures ancillary map data. Completed digital maps are available from the NPS Data Store at http://science.nature.nps.gov/nrdata/.

When possible, the GRE program provides large scale (1:24,000) digital geologic map coverage for each park's area of interest, usually composed of the 7.5-minute quadrangles that contain park lands (figure 1). Maps of this scale (and larger) are useful to resource management because they capture most geologic features of interest and are positionally accurate within 40 feet. The process of selecting maps for management use begins with the identification of existing geologic maps and mapping needs in vicinity of the park. Scoping session participants then select appropriate source maps for the digital geologic data to be derived by GRE staff as well as determine areas in need of further mapping or refinement. Tables 2 and 3 (at the end of this document) list the source maps chosen for Marsh-Billings-Rockefeller National Historical Park and Saint-Gaudens National Historic Site as well as any further action required to make these maps appropriate for inclusion.

Park resource management identified surficial and bedrock geologic maps as needed data sets. At present, large scale, digital geologic mapping exists for bedrock and surficial geology of the town of Woodstock, Vermont including the park area. This is an adequate extent for resource management at Marsh-Billings-Rockefeller National Historic Site. For Saint-Gaudens National Historic Site, 1:24,000-scale mapping needs persist for both bedrock and surficial geology. Park resource management determined coverage of the towns of Cornish, New Hampshire and Windsor, Vermont is adequate for their needs and entire 7.5-minute quadrangles are not necessary. The New Hampshire state map has coverage at 1:250,000 scale (contact: Lee Wilder), but this is likely too coarse for resource management. Unpublished surficial coverage may also exist for some parts of the area (contacts: Fred Larson at Norwich University and Jac Ridge at Tufts University). Tables 2 and 3 list the source maps chosen for Marsh-Billings-Rockefeller National Historic Site and Saint-Gaudens National Historic Site and mapping needs in certain quadrangles, in addition to a unique "GMAP ID" number assigned to each map by GRE staff for data management purposes, map scale, and action items.

For the **Marsh-Billings-Rockefeller National Historic Site**, GRE staff used the following maps:

- (74748) Thompson, Peter J., 2006, Bedrock Geologic Map of Woodstock, Vermont, Vermont Geological Survey, Open-File Report VG06-4, Plate 1 of 2, 1:24000 scale

- (74749) DeSimone, David, 2006, Surficial Geologic Map of Woodstock, Vermont, Vermont Geological Survey, Open-File Report VG06-5, 1:24000 scale

The completed MABI digital geologic map is now available from the NPS Data Store at the following address:
http://science.nature.nps.gov/nrdata/quickoutput.cfm?type=ds&cat=geology&key=GRE&parkcode=MABI

For the **Saint-Gaudens National Historic Site**, GRE staff remain undecided on which geologic maps best cover the SAGA area adequately, but the following maps may prove to be the currently best available:

- (2344) Lyons, J.B., Bothner, W.A., Moench, R.H., and Thompson, J.B., 1997, Bedrock geologic map of New Hampshire, U.S. Geological Survey, , 1:250000 scale

- (74827) Derek S. Bennett, Chad A. Wittkop, an Connie L. Dicken, 2006, Bedrock geologic map of New Hampshire-a digital representation of the Lyons and others 1997 map and ancillary files, , Data Series 215, 1:250000 scale

- (74826) Suzanne W. Nicholson1, Connie L. Dicken1, John D. Horton1, Michael P. Foose1, Julia A.L. Mueller1, and Rudi Hon2, 2006, Preliminary integrated geologic map databases for the United States-Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, Rhode Island, and Vermont, , Open-File Report OF-2006-1272, 1:500000 scale

During scoping it was mentioned that the bedrock geology has never been published for the four 7.5' quadrangles of interest (North Hartland, Hartland, Claremont North and Windsor quadrangles). It was mentioned that there may be surficial mapping of the Claremont North quadrangle by Jack Ridge, a varve specialist at Tufts University. This needs follow-up by GRE staff. It was also

suggested to contact Fred Larson (Norwich University) and Greg Walsh (USGS) to ask about their knowledge of large-scale geologic mapping in the area.

Lastly, it was mentioned that there may be mapping for the towns of Cornish, Windsor and Hampshire that should be tracked down.

Because of workload and prior commitments, GRE staff will likely work on tracking down this information beginning in FY 2009.

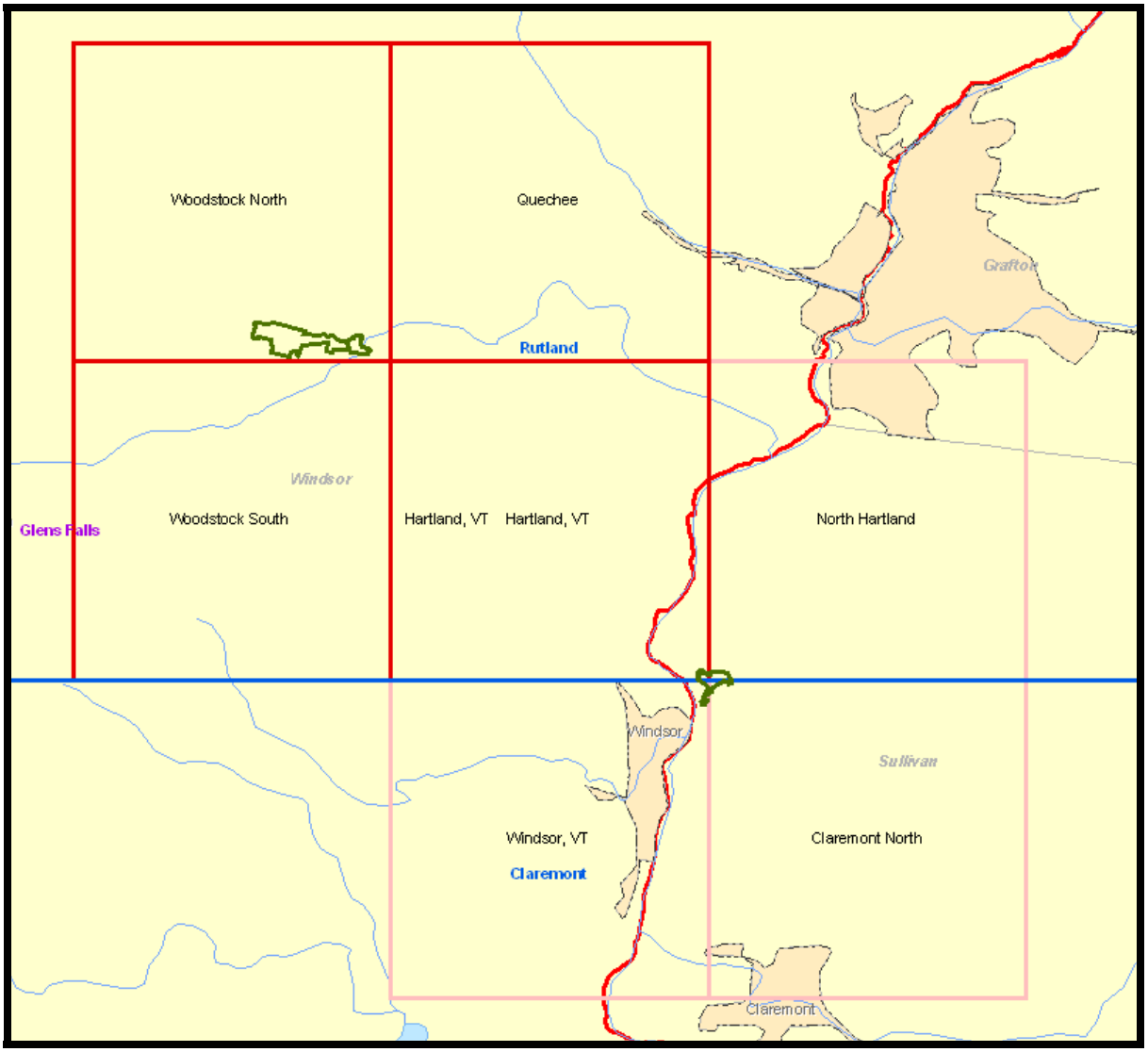

Figure 1. Quadrangles of interest for Marsh-Billings-Rockefeller National Historic Site and Saint-Gaudens National Historic Site. The figure shows USGS 7.5' quadrangles (red outline), 30' × 60' sheet (blue outline, blue font labels), and 1° × 2° sheets (purple outline, purple font labels).

During the July 2007 GRE scoping session a document entitled "Overview of Known Geologic Mapping for Northeast Temperate Network (excluding Acadia NP)" was circulated to meeting attendees. To request an electronic copy of this document, please contact Tim Connors at tim_connors@nps.gov.

Additional items of interest pertaining to geologic mapping from the scoping
The parks have some interest in groundwater flow maps, landscape evolution maps, and soils mapping.

Geologic Resource Management Issues

The scoping session for Marsh-Billings-Rockefeller National Historical Park and Saint-Gaudens National Historic Site provided the opportunity to develop a list of geologic features and processes, which will be further discussed in the final GRE report. During the meeting, participants prioritized the most significant geologic issues as follows:
(1) Fluvial issues
(2) Pond maintenance
(4) Disturbed lands
(3) Mass wasting
(5) Ecological relationships
(6) Seismicity
(7) Paleontological resources

Fluvial Issues

The Connecticut River and its tributaries, including the Ottauqhechee River and Blow-Me-Up and Blow-Me-Down brooks are significant factors contributing to the evolution of the landscape at both national historic sites. Fluvial issues include riverbank and head-cutting erosion. Increased sedimentation can occur in some streams near high use areas such as trails. Clearing of vegetation can result in accelerated runoff and erosion, locally increasing sediment load and changing channel morphology.

At Marsh-Billings-Rockefeller National Historic Site, there is nearly 2 km (1 mile) of streams within park boundaries. These streams erode steep notches into the slopes of the landscape at the site. The Pogue Stream ravine has active slope creep and slumping. Ottauquechee River is within the authorized boundary and seasonal flooding occurs along this river. Flooding threatens buildings, roads, trails, and other infrastructure constructed along its floodplain.

Saint-Gaudens National Historic Site controls more than 2 km (1.5 miles) of stream channels within park boundaries. Additionally, 40 acres of the site sit on the floodplain of the Connecticut River. This is frequently inundated during high flows. Flood stages cause river water to back up into the park pond and may cause damage there. Local seasonal springs and seeps occur throughout the site where groundwater, percolating through unconsolidated surficial (glacial) deposits, encounters the underlying impermeable bedrock horizon forcing it to concentrate and flow along the hard surface. When this flow intersects the land surface, a seep spring emerges. Other fluvial concerns include beaver dams, which create wetlands at the site. Park resource management is concerned as to the effects of flooding if these dams break.

Pond Maintenance

Marsh-Billings-Rockefeller National Historic Site has a large man made pond called the Pogue. This 2 m (6 ft) deep pond is considered a cultural resource, but is prone to sedimentation and needs to be maintained as a historic feature. This pond was originally a natural wetland area. Geologic structures and processes control its location. It sits within a west-southwest plunging hinge zone along a local fold structure. While clearly not of glacial (kettle pond) origin, the actual genesis of the wetland remains unclear.

The man made pond at Saint-Gaudens is historical with a preserved gristmill on site. A concrete dam (ca. 1939-40) impounds the 15-acre pond and wetland area after the original 1890 dam was destroyed during a hurricane in 1938. For interpretive efforts, the resource management staff at the site is concerned about maintaining its historic appearance. Maintenance of this cultural landscape requires resisting natural geologic processes such as erosion, mass wasting, sedimentation, and flooding. If the site considers dredging the pond to maintain its current depth and morphology, an environmental assessment (EA) or an environmental impact statement (EIS) would be required.

Disturbed Lands

Historical land use practices factor strongly into the creation of both national hsitroic sites. Many areas that may be considered to be disturbed are preserved as cultural resources. At Marsh-Billings-Rockefeller National Historic Site, there was cut-and-fill activity around the mansion and other structures. Carriage roads carried guests and visitors along the slopes of Mount Tom. There are 19 km (12 miles) of carriage roads at Mount Tom. The national historic site considers these to be historic and will not restore them to natural conditions. One purpose of the site is to demonstrate forest conservation in part to commemorate Mr. Marsh's extensive role in historical logging in the area. Forest maintenance includes logging access roads (skid roads). These may be decommissioned and recreated elsewhere. Grazing was also traditionally associated with the agrarian history of the area and may resume at Marsh-Billings-Rockefeller National Historic Site.

Saint-Gaudens National Historic Site has old right-of-way roads which are now active. Hunters, horseback riders, loggers, and hikers use these paths through the site to access adjacent natural areas and logging tracts. Adjacent to the park are 900 acres with an active logging operation. This is creating an access issue at the site. What impacts local logging may have on natural resources at the historic site remains unknown.

As local populations and related development increase, the parks are concerned about negative impacts on their natural resources. Stabilizing forests will be logged and impermeable surfaces such as roads, parking lots, and driveways will increase. Potential negative effects range from overuse of the parks' facilities, increased erosion and sediment load, water contamination from septic systems and sewers as well as increased surface runoff.

Mass Wasting

The local streams in both park areas cut through steep slopes and terraces. Gravity, frost and plant root wedging, differential erosion, and minor karst dissolution are primary natural causes of slope instability. As such, hillslope processes such as landslides, slumping, and minor rockfall are a prevalent issue at both parks. Anthropogenic changes to the hill slopes such as road and trail construction, mining, undercutting, and deforestation are the most common triggers of active sliding. Engineering structures designed to redirect water and stabilize riverbanks often lead to instability and reactivation of old landslides.

At Marsh-Billings-Rockefeller National Historic Site, slope creep occurs along the Pogue Stream ravine that runs through the site. After high precipitation events, higher flow can erode banks, undercutting the overlying geologic units. This setting can be prone to mass wasting and the stream corridors should be regularly monitored for slope creep. In this area, mass wasting may also expose

almandine garnets and attractive amphibole sprays in bedrock geologic units that could be targets for mineral collectors.

The stream channels at Saint-Gaudens National Historic Site cut steep ravines into the local slopes. Slope creep, slumping, and minor slides are the primary forms of mass wasting at the site. Runoff from these slopes is causing increased sedimentation into the pond and local streams. Park trails are at some risk to damage from surficial runoff and erosion.

Ecological Relationships

Important correlations exist between flora, fauna, and geologic features and processes at Marsh-Billings-Rockefeller and Saint-Gaudens National Historic Sites. Detailed geologic maps of both parks could help focus ecological research. Geologic structures such as plunging folds and natural basins impact the formation of wetland areas such as the precursor to the Pogue. Forest management and conservational stewardship, which are the goals of Marsh-Billings-Rockefeller National Historic Site, require an understanding of the interrelationships between geology, soil science, biology, climatology, and hydrology. Park resource management expressed a desire to understand how geologic information can help determine the conditions of the site for forest management. There are many examples of geology influencing vegetation patterns. In as much as the underlying geology influences soil development and composition, the limey soils west of the Pogue support specific forest assemblages at Marsh-Billings-Rockefeller National Historic Site. Dredged material including peat and limey marl from the formation of the pond provided fertilizer for local fields. Deep, clay rich glacial till substrates generally have poor drainage and inhibit some species from thriving there.

Seismicity

Neither national historic site is located near an active seismic zone. Small earthquakes do happen locally, but most of these events are too minor to be felt at the surface and range between magnitude 2.5 and 4. They may correlate to tectonic stresses caused by the Ascutney intrusive event. Large seismic events may trigger landslides, rockfall and damage park infrastructure. The nearest seismic station is at the Weston Observatory. The U.S. Geological Survey monitors seismic activity throughout the region. Recent activity is available at the following earthquake-monitoring website: http://earthquake.usgs.gov/eqcenter/recenteqsus/.

Paleontological Resources

Most of the bedrock at both Marsh-Billings-Rockefeller and Saint-Gaudens national historic sites is metamorphosed and too old to contain significant fossils. However, at Saint-Gaudens National Historic Site, some fish and plant remains in addition to trace fossils such as fish fin marks are potentially present in lake varve deposits. Varves may be present in steep ravines throughout the site.

Features and Processes

Karst Dissolution

Karst processes are active to a minor degree on the landscape at Marsh-Billings-Rockefeller National Historic Site. Karstification involves the processes of chemical erosion and weathering of limestone or dolomite (carbonate rocks) (Palmer, 1981). Dissolution occurs when acidic water

reacts with carbonate rock surfaces along cracks and fractures. Karst features have not developed to any appreciable extent, but include local solution pits.

The Pogue and Glaciation

During the Pleistocene Epoch, more than 10,000 years ago, glacial ice sheets descended from the north over the Connecticut River Valley, covering the landscape. Glaciers are effective agents of erosion, beveling hills and other topographic highs while transporting vast amounts of sediments picked up en route. When the glacial ice melts and retreats, these sediments remain and may cover the underlying landscape. If glacial retreat is rapid, the sediments once entrained in the glacial ice are relatively unsorted and contain fragments of various sizes ranging from the smallest clay to boulders. Outwash streams typically accompany glacial melting by draining downslope away from the melting ice front. These sediment choked streams leave sorted channel, delta, and floodplain deposits. A series of glacial lakes (Glacial Lake Hitchcock) formed in front of the retreating glacial ice edge. Associated with these lakes are clay, sand, beach, and shoreline features throughout the Saint-Gaudens National Historic Site area. Thin glacial deltaic and outwash deposits mantle the bedrock there. Deltaic deposits formed by water flowing from melting glaciers and outwash streams into glacial lakes whose impoundments were located south of the national historic sites.

Glaciers that covered the area during the Pleistocene Epoch left lasting influences on the landscape at both parks. At Marsh-Billings-Rockefeller National Historic Site, glacial features include drumlins, rock drumlins (west and north of the Pogue), plucked cliffs, a mantle of glacial till, and a roche moutonnée. A roche moutonnée is a sculptured knob of bedrock whose long axis is oriented in the direction of ice movement. The stoss (or upstream side) is gently inclined and rounded whereas the lee (downstream) side is steep and rough. Remnant glacial ice may also have contributed to the early formation of the original Pogue wetland. The Pogue is a large manmade pond sitting at the base of Mount Tom at Marsh-Billings-Rockefeller National Historic Site. The pond was originally a boggy wetland area and sits in a shallow depression in the lee of the roche moutonnée. This feature, scoured by glacial ice, formed when glaciers modified the horseshoe-shaped, structurally controlled ridge north and west of the pond (Pete Thompson, written communication, 2007). In 1890, the Pogue brook was dammed before its confluence with Barnard Brook. This feature provided fertile dredge material, ice, and drinking water.

Saint-Gaudens National Historic Site sits within the basin of Glacial Lake Hitchcock. This lake was impounded at its maximum extent near Holyoke, Connecticut. Sedimentation into this lake left lacustrine sands and clays on the landscape as surficial deposits. Deltaic deposits, which formed where local streams drained into the lake, may exist as part of the surficial geology of the upper portions of the site. Careful mapping is needed to confirm their presence. Shoreline levels along the Connecticut River Valley indicate glacial rebound (the uplift in response to the removal of the depressing mass of glacial ice) in this area is approximately 0.8 m/km (4.2 ft/mile).

Aeolian Features

As described above, glacial ice covered the Connecticut River Valley area during the Pleistocene Epoch. Once the glacial ice melted and retreated northward and the ensuing glacial lake drained down the valley, the stark landscape was devoid of any stabilizing vegetation. The prevailing winds picked up the sand and silt from glacial lake deposits, transporting them on currents to create loess deposits. At Saint-Gaudens National Historic Site, aeolian deposits may have blanketed the entire

area. More large-scale surficial mapping will reveal if these deposits are present in the national historic site.

Geology and History Connections

People settled within the Connecticut River Valley for its abundant natural resources. The landforms of this area had significant impacts on the settlements building up and down the river's corridor. People such as George Perkins Marsh, Frederick Billings, Laurance and Mary Rockefeller, and Augustus Saint-Gaudens were drawn to the scenic nature of the mountainous landscape of eastern Vermont and western New Hampshire.

Vast tracts of heavily forested wilderness once covered the entire area. By the late 1700s, nearly all of this forest was gone due to logging for lumber, potash and pearlash (made by burning hardwood), and land clearing for pasture and fields. George Perkins Marsh noticed that the deforestation of Mount Tom for sheep pasture had resulted in increased erosion and subsequent siltation in local streams. His observations about how interrelated natural factors form an ecosystem would have profound effects on forest management practices for future generations. He started planting Norway spruce, European larch, and Scotch pines. Buildings were set on terraces to take advantage of scenic views. Carriage roads were designed along the original ridges to take advantage of natural topography for drainage. Later owners of the farm in Woodstock, Vermont continued his forest management work and preserved his conservationist legacy.

Views of the Connecticut River Valley and Mount Ascutney from the Saint-Gaudens home no doubt inspired artistic endeavors there. A friend of Saint-Gaudens named Beeman attempted to establish an artists colony in the area because it reminded him of Italy. This landscape now attracts many local residents and visitors to recreate at the national historic site. Lacustrine clays, deposited into Glacial Lake Hitchcock are present in the local substrate in the Saint-Gaudens National Historic Site area. It is unknown at this time whether the artist used these clays for molding sculptures.

A nearby feature, Mt. Ascutney, provided the model example of the geologic concept of magmatic stoping by Reginald Daly. The term magmatic stoping refers to the process by which pieces of surrounding country rock become detatched and engulfed by hot, liquid magma rising towards the surface during an igneous intrusive event. The block of country rock presumably sinks downward and is partially or wholly melted and assimilated into the magma. This process results in a compositional mix between the magma and surrounding rocks yielding a unique chemical signature to the cooled, solid rock.

There is a need to interpret the natural features and evolution of the landscape at Marsh-Billings-Rockefeller and Saint-Gaudens National Historic Sites. Visitors wish to understand why the landscape looks the way it does.

Recommendations

(1) Complete road logs and walking tours focusing on the geology and geologic resources of the area as they influence landscape evolution and historical events at both MABI and SAGA.
(2) Create a plan to deal with potential mineral theft as collectors may be interested in garnets within the bedrock geologic units at MABI.

(3) Study sedimentation patterns and distribution along all local stream corridors noting areas of sediment loss and gain.
(4) Contact GRD regarding environmental impact studies for dredging the gristmill pond at SAGA.
(5) Promote research into the overall tectonic history of the region as the local rivers and streams expose rocks that are elsewhere covered and/or overgrown including understanding the relationships between structure, lithology, fluvial geomorphology, and mass wasting in the parks through careful mapping.
(6) Interpret the geologic maps for both parks for visitors focusing on evolution of the landscape, geologic resources, historic conservation efforts, artistic endeavors, and settlement patterns.
(7) Model potential landscape response to flooding caused by dam failure at both sites, especially beaver dams at SAGA.

Action Items

(1) GRE staff obtain spring and seep inventory (in GIS format) from the town of Woodstock, VT.
(2) GRE will produce digital geologic map for Marsh-Billings-Rockefeller National Historic Site and Saint-Gaudens National Historic Site including bedrock and surficial geologic coverage (see above geologic mapping section).
(3) GRE report author will obtain the Rich Northern Harwood Sites reports.

References

www.nps.gov/saga (accessed July 26, 2007)

www.nps.gov/mabi (accessed July 26, 2007)

www.topozone.com (accessed July 27, 2007)

Palmer, A.N. 1981. *A geological guide to Mammoth Cave National Park*. Teaneck, NJ: Zephyrus Press.

Wilke, S., L.Morrissey, J.T. Morrissey, and J.Morrissey. 2002. Cultural Landscape Report for the Forest at Marsh-Billings-Rockefeller National Historical Park: Site History and Existing Conditions. Woodstock, Vermont: National Park Service.

Table 1. Scoping Meeting Participants

Name	Affiliation	Position	Phone	E-Mail
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Table 2. GRE Mapping Plan for Marsh-Billings-Rockefeller National Historical Park

Covered Area	GMAP [1] ID	Reference	GRE appraisal	GRE Action	GRE file location or URL	Scale
Woodstock, VT	74748	Thompson, Peter J., 2006, Bedrock Geologic Map of Woodstock, Vermont, 114, Open-File Report VG06-4, Plate 1 of 2	Covers are of interest for park, GRE should use	Conversion	http://www.anr.state.vt.us/DEC/GEO/images/digitalofrs/WoodstockBedrockMapWeb.pdf	24000
Woodstock, VT	74749	DeSimone, David, 2006, Surficial Geologic Map of Woodstock, Vermont, 114, Open-File Report VG06-5	Covers are of interest for park, GRE should use	Conversion	http://www.anr.state.vt.us/DEC/GEO/images/digitalofrs/WoodstockSurficial%20MapWeb.pdf	24000

[1]GMAP numbers are unique identification codes used in the GRE database.

Table 3. GRE Mapping Plan for Saint-Gaudens National Historic Site

Covered Areas	GMAP [1] ID	Reference	GRE appraisal	GRE Action	GRE file location or URL	Scale
Cornish, NH	gmap					24000
Windsor, VT	gmap					24000

[1]GMAP numbers are unique identification codes used in the GRE database.