Mount Watatic Reservation – Resource Management Plan

References

Ashburnham, Massachusetts. *Open Space and Recreation Plan*, 2004-2009.

Ashby, Massachusetts. *Open Space and Recreation Plan*, 1999-2004.

Clark, Frances (Carex Associates), 1999. *Biological Survey of Mt. Watatic Wildlife Management Area and Vicinity*. Prepared for Mass. Division of Fisheries and Wildlife.

Executive Office of Environmental Affairs, Division of Conservation Services. 2000. *Statewide Comprehensive Outdoor Recreation Plan*.

Executive Office of Environmental Affairs, Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program. 2001. *Biomap: Guiding Land Conservation for Biodiversity in Massachusetts.*

Executive Office of Environmental Affairs, Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program. 2003. *Living Waters: Guiding the Protection of Freshwater Biodiversity in Massachusetts.*

Executive Office of Environmental Affairs, Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program. 2004. Species Data and Community Stewardship Information.

Grifith, G.E., J.M. Omernik, S.M. Pierson, and C.W. Kiilsgaard. 1994. *The Massachusetts Ecological Regions Project*. U.S. Environmental Protection Agency. Publication No.17587-74-6/94-DEP.

Johnson, Stephen F. 1995. Ninnuock (The People), *The Algonquin People of New England.* Bliss Publishing, Marlborough, Mass.

Massachusetts Invasive Plant Advisory Group. 2005. *Strategic Recommendations for Managing Invasive Plants in Massachusetts.*

Scanlon, J.J. 1992. *Managing Forests to Enhance Wildlife Diversity in Massachusetts. Northeast Wildlife*, Volume 49, pages 1-9.

Mount Watatic Reservation Resource Management Plan

Acknowledgements

Land Protection Efforts:
- Campaign for Watatic
- Ashby Land Trust
- Ashburnham Conservation Trust
- Towns of Ashby and Ashburnham
- Commonwealth of Massachusetts DCR & DFW Land Protection Staff

Watatic Management Committee, Representatives and Alternates
- Ashby Land Trust – Bob Leary and Tom Mikes
- Ashburnham Conservation Trust – Diane Wright and Cec Snow
- Town of Ashby – Roberta Flashman and Tim Bauman
- Town of Ashburnham – Lorraine DeSouza and Tim Driskell
- MA Department of Fish & Game – Dennis McNamara and Pat Huckery
- MA Department of Conservation & Recreation – Eddie Torcoletti & Andy Backman

Participants / Contributors during the management planning process
Kevin Ahearn, Ashburnham Police Dept.
Chuck Bell, DFW
Dolores Boogdanian, DCR Counsel
Peter Capone, Ashburnham Eagle Scout
Lucille and Bill Carignan, Neighbor
Paul Cavanagh, DCR Resource Management Planner
Maureen Cavel, Neighbor
Bruce Colburn, DCR Willard Brook SF
Eugene Dionne, Neighbor
Betsy Dilbeck, Community Journal
Dwayne Ericson, DCR Wachusett Mountain SR
Chris Gagnon, Ashburnham Resident
Kathryn Garcia, DCR Great Brook District Manager
Chris Haas, Ashby Resident
Susan Hamilton, DCR Northeast Regional Director
Dwight Horan, Neighbor
Gary Howland, Campaign for Watatic & Ashburnham Conservation Trust
Craig Irish, Neighbor
David Joseph, Snowmobile Advocate
Amanda Krchak, DCR Forestry Assistant
Michael Labenski, Ashburnham Police Department
Chandreyee Lahiri, DCR GIS Specialist
Richard Lampula, Ashburnham Selectman
Jack Lash, DCR Ecologist
Jeanie Lindquist, Campaign for Watatic & Ashby Land Trust
Nathanael Lloyd, DCR GIS Program Director

Leslie Luchonok, DCR Resource Management Planning Director
Andrea Lukens, DCR Director of Environmental Planning
Thomas Mahlstedt, DCR Archaeologist
Steve McAndrew, Environmental Police Officer
Mike McCallum, Campaign for Watatic, Ashby Selectman
Steve McLatchy, Ashby Police Chief
Jane & Oliver Mutch, Neighbor and Friends of the Wapack Trail
Ollie Peirce, DCR Central Regional Director
Chuck Pernaa, DCR Management Forester
Loni Plocinski, DCR GIS Specialist
Mike Pryzbyla, Friends of the Wapack Trail
William Seymour, Jr., Ashby Fire Chief
Frank Shea, Naturalist & Old Growth Advocate
Paul Somers, DFW Natural Heritage Program State Botanist
Wayne & Linda Lee Stacy, Neighbor
Doug Williams, DCR Wachusett Mountain SR Ecologist
James Wrightson, New England Mountain Bike Association
Paul Zbikowski, Ashburnham Fire Department

APPENDIX A - PUBLIC PARTICIPATION SUMMARY

1. Summary of public participation process and revisions to the final Resource Management Plan

In accordance with M.G.L. Chapter 21: Section 2F, the Resource Management Plan (RMP) for Mount Watatic Reservation was developed in conjunction with a public participation process to ensure that interested parties had an opportunity to provide input in the formulation of the plan.

The Watatic Management Committee was formed in May 2004 with one representative and one alternate from each of the six managing partners. During the summer and fall of 2004 the Management Committee held a series of open public meetings in the Ashby and Ashburnham Town Halls to discuss visitor use and resource management issues and opportunities for the reservation, and to formulate related goals and objectives. A Law Enforcement Subcommittee met with local and state law enforcement officials in 2005. The Management Committee held two additional public planning meetings in 2006.

The first draft RMP was reviewed by all partners, then revised accordingly. A public notice regarding the public review process for the draft plan was circulated to town boards and commissions and was included in the *Environmental Monitor*, published by the Executive Office of Energy and Environmental Affairs on March 21, 2007. The notice indicated that a public meeting was scheduled for April 25, 2007 in the Ashburnham Town Hall. The draft plan was posted on the DCR Resource Management Planning website, available for public review as of March 21, 2007. A press release with information about the public meeting was distributed to local newspapers in advance of the meeting.

The draft RMP distributed for public review included two possible alternatives regarding snowmobiling use. One alternative prohibited snowmobiling use, the other alternative allowed snowmobiling use. The draft RMP stated, “These two alternative recommendations regarding snowmobile access and use are included in the draft RMP to solicit public comment on either alternative. The final version of the RMP is expected to resolve this question.” Based upon public comment and further Management Committee deliberations, the final RMP provides for snowmobiling access and use at the Reservation, contingent upon the establishment of a written agreement between a responsible snowmobiling group and the Management Committee Partners. This agreement must include Partner-approved performance standards, including the identification of designated snowmobile trails.

Revisions to the draft RMP regarding the organization of contents and formatting are also incorporated in the final RMP.

2. April 25, 2007 public meeting summary

Approximately 40 attendees attended the public meeting held in the Ashburnham Town Hall.

The majority of public comments were related to snowmobile use:

- Ashburnham Conservation Trust provided background of management planning process and July 04 consensus related to snowmobile use, mentioned the last minute change of course for this issue, and stated that the partners should stick with what was presented to the public during the Campaign for Watatic, i.e. snowmobiling should be a permitted use.
- Snowmobile enthusiasts / contributors were misled, this will detract from land trust's local fundraising capacity.
- Snowmobiling is not a damaging use related to ground cover.
- One person mentioned that the Reservation is a connector for snowmobiles, between Townsend and NH
- Good sport for all ages.
- Snowmobilers are a good volunteer work force.
- Lack of state financial support for snowmobiles compared with other trail uses. Fees, insurance costs cited.

3. Additional public comments received

In addition to the comments presented at the April 25, 2007 public meeting, five written comments were received via e-mail, and the Town of Ashby Management Committee representative set up a blog site, hosted by the Ashby Conservation Commission website, intended to solicit additional public comment.

Ashburnham Conservation Trust comments, presented at the 4/25/07 public meeting and provided via e-mail.

The Watatic Management Committee has been working since March, 2004 to create a Resource Management Plan for the Mt. Watatic Reservation. This has been quite a challenge as this property is owned by two State entities, two Towns (different Counties) and two Land Trusts, all of which had their own opinions on how this property will be cared for and used by the public. There is only one item that could not be agreed upon by the partners and the management team is looking for input from the public on whether or not to allow snowmobiles to use the property. While ACT is not promoting or discouraging the use of snowmobiles, we are taking a stand on a promise that was made when this property was protected. The Campaign for Watatic raised approximately One Million Dollars to protect this land and during the fundraising assurances were made that snowmobiles would be an allowed use on the mountain. The Campaign for Watatic included this use within its fundraising brochures, during fundraising events, in obtaining grants, and it is ACT's position that we should honor this promise.

I have the utmost respect for my fellow management team members. I do, however, question why this issues is before the public and my question stems from the following facts:

1. We started meeting in March of 2004 and set some guidelines on how we would attempt to create a management plan with so many owners and differences of opinions on this property. Each owner designated a representative and an alternate.

2. Our next meeting, May of 2004, it was agreed "to create the management plan through consensus" and "should the need for a vote arise, each owner entity shall have one vote". Also within our minutes it was stated "The public is welcome to attend, but creation of the management plan is the work of the 6 representatives".

3. Our next meeting, June 15, 2004, again it was written in the minutes to create this plan through consensus and the committee discussed how the voting rules would work.

4. Our next meeting, July 20, 2004, there were several discussions on allowing snowmobiles and the minutes specifically states "Consensus Issue: Will snowmobiling be a permitted use? Consensus: Yes.

   .Some mention/promise of this use was included in fundraising materials

   .MADFG do not permit motorized vehicles in wildlife areas – however, this property was not purchased as exclusively a wildlife area.

   State Parks do allow snowmobiles on designated trails with at least 4" of snow on the trails.

5. Our next meeting was August 17, 2004, a representative from the Friends of Wapack attended the meeting and presented a meeting and the minutes states "that Ed's graphic staff could use as the base for presenting data on the area. It could eventually be developed into a multi-use map – biking trails, hiking trails, snowmobile trails, and hunting areas."

6. We met in September and no discussions on snowmobiles.

7. Our meeting on November 16, 2004 pertained to safety issues on the property and MA Environmental Police Officer Steve McAndrew attended the meeting. "McAndrew stated that he felt the usual 4" of snow base required in State Parks for snowmobiling didn't seem to be sufficient to protect the steeper environment of Mt Watatic" and he "Would want to see a base of 6" at least. The minutes again state, which has been stated several times in previous minutes, that "The Campaign for Watatic made a commitment that snowmobiles would be allowed – need to designate trails and/or depth of snow."

Friends of the Wapack Comments on
Draft Resource Management Plan for Mount Watatic Reservation
Approved during 5/3/07 Board meeting

The Friends of the Wapack is a 700 member strong volunteer organization dedicated to the preservation and maintenance of the 21-mile Wapack Trail, one of the oldest interstate trails in the country which runs from Mount Watatic in Ashburnham, Massachusetts to North Pack Monadnock Mountain in Greenfield, New Hampshire.

Slightly less than three and a quarter miles of the Wapack and associated side trails lie within the Mount Watatic Reservation and abutting conservation properties. This includes 2.26 miles of the Wapack main trail.

The Friends have reviewed the Draft Management Plan and support the overall management goals outlined with a few key comments.

The Friends support the exclusion of wheeled-motorized vehicles on the Reservation. There has been significant damage to the Wapack Trail due to ATV motorcycles, and four-wheel drive vehicles over the years. However, the Friends do not support the exclusion of snowmobiles on the Reservation. Snowmobiles, when traveling on a sufficient base of snow, have minimal impacts on trails. In addition, the original fund raising for the purchase of the land promised that snowmobiles would be allowed. Going back on this would be a dangerous precedent that could impact future land conservation efforts in the area. If snowmobiles were to be prohibited from specific areas of the reservation, we would suggest that this be limited to the section of the Wapack trail from where it leaves the cart path near the Route 119 lot up to the summit and from the summit north to the Nutting Ledges. The former section is quite steep and has numerous ledges, and the latter section travels through the Watatic Wildlife Sanctuary.

The expansion of the Route 119 parking is needed to minimize parking on Route 119. The Friends currently has a map kiosk located up the trail from the lot and would be willing to relocate it to the expanded lot in order to supplement any other posted information there.

The Friends are currently working on the Memorandum of Understanding with the U.S. Fish & Wildlife Service for the section of trail through the Wapack National Wildlife Refuge located at the northern end of the trail. We hope to use this document as a model for the Watatic Reservation.

In 2006, the Friends provided DCR with our GPS trail data and we hope to work with DCR in the future on identifying and prioritizing any trail maintenance work. We would also hope to be involved in any trail expansion.

Finally, the Friends strongly recommends that the various access points to the reservation where vehicles can currently enter the Reservation be gated and signed. This includes the old ski area road, Watatic Mountain Road, and the Wapack Trail coming in from New Hampshire. These gates could be opened during winter to allow snowmobiles where appropriate.

Maureen & John R. Cauvel received via e-mail 5/3/2007

We completely support snowmobiling on Mount Watatic. My family has a snowmobile, and we love to take our children out for rides on the mountain. Our house directly abuts Mount Watatic (along the access road). Snow permitting, there are lots of snowmobilers out on the mountain enjoying it as well. And we have friends that come from all over - Ashburnham, New Ipswich (NH), Bedford (MA), Billerica and Dracut that like to snowmobile too.

Representative Robert L. Rice, Jr. received via e-mail 8/29/07

August 29, 2007

Commissioner Rick Sullivan
Department of Conservation and Recreation
251 Causeway Street, Suite 600
Boston, MA 02114-2104

RE: Mount Watatic Reservation Draft RMP, March 2007

Dear Commissioner Sullivan:

As you may know, the original management partners who preserved Mount Watatic from development envisioned and accepted snow mobile access to the summit. This agreement was crucial to the successful preservation of this wonderful natural resource, used by so many of our residents.

As a frequent user of Watatic- I hike there regularly and used to ski there often- I know the value of a plan that preserves and protects Watatic. Snowmobile access will not impair this mission. Snowmobile access will honor the original agreement and understanding.

Therefore, I urge you to adopt the alternative recommendation permitting snowmobile access.

Respectfully yours,

ROBERT L. RICE, JR.
State Representative
Second Worcester District

COMMONWEALTH OF MASSACHUSETTS

DIVISION OF FISHERIES & WILDLIFE

Patricia Huckery, *District Manager*

TO: Andy Backman, Susan Hamilton, Kathryn Garcia, Ed Torcoletti, Chuck Pernaa,
FROM: Pat Huckery and Dennis McNamara, DFW

DATE: 6/4/07

RE: 5/14/07 DFW-DCR meeting
Mt. Watatic Reservation Management Plan

On 14 May 2007, our agencies met to discuss snow vehicle hearing comments received on the Mt. Watatic Reservation Management Plan. In this memo we provide additional information regarding DFW's updated position on snow vehicle use at Mt. Watatic Reservation, and supporting documentation.

As is the nature of committee work, members may disagree on certain aspects of planning and management, opinions may change based on new information or review of literature, regulations and management plans. For example, DFW supported closure of Summit Road, a road recently carved up the side of Mt. Watatic. It is our opinion that Summit Road serves as a direct conduit to fragile summit plant communities, as well as communities at every elevation, for off highway vehicles (OHV)(including snow vehicles) and 4-wheel drive highway vehicles. However, we know that DCR, and the towns of Ashby and Ashburnham, feel very strongly that it should remain open for emergency and management use. Therefore, we decided not to argue this point publicly. Also, DFW has not taken issue with trail management on the mountain. Our trail management style is simple - we do not actively maintain trail systems through our properties, unless to protect natural resources. The result is fewer disturbances to wildlife and wildlife habitats. Generally, we find that there are enough existing woods roads in good condition for public enjoyment.

Our opinion on snow vehicle use has evolved based on closer examination of our Wildlife Manage Area regulations (c.131 3.01(h)), which govern use and management of lands fully or partially under DFW control, and our 2006 review of special use permits at multiple District Manager meetings. We brought this new information up as soon as possible to the committee, prior to hearing and a final management plan. DFW

questioned how we could legally permit snow vehicle use, unless for a research or management purpose, based on the wording of our regulations:

321 CMR 3.01(h) *"No person, except under permit from the Director or his authorized agent, and except governmental employees in the performance of their duties, shall drive, operate, or possess within the bounds of any wildlife management area ("WMA") any motor vehicle,* ***snow vehicle*** *(emphasis added) or recreational vehicle, except on roads or trails maintained by a governmental agency and designed for the express purpose of permitting vehicular traffic."*

Also, in 2006, District Manager's were reporting habitat damage from snow vehicle riders cutting new trails, building unauthorized bridges over streams, and damaging vegetation. We found that the additional use of snow vehicle trails by OHVs in the warmer months created extensive erosion and sedimentation of habitats, access to sensitive habitats, vegetation damage, spread of invasive plant species, and creation of more trails. This was the case on properties across the state. A snow vehicle trail accommodates OHVs. Some individuals use both snow vehicles and OHVs. Over the short and long-term, a snow vehicle prohibition protects wildlife and their habitats, as well as the tranquility many users desire.

There is a body of literature that speaks to the short and long-term negative aspects of snow vehicle use, including damage to sensitive habitats, impacts to wildlife, and pollution of aquatic habitats. There are reports on the affect of snow vehicle use on other users seeking outdoor recreation which pertain to noise, fumes, user incompatibility. Attached are some of the references for your information.

The Ashby and Ashburnham Land Trusts have supported snow vehicle use throughout the management process. They feel obligated to support snow vehicle use because they included it in promotional materials, and received money and votes as a result. It is our opinion that they, or any committee member, should be free to change their opinion based on new information (see references). For example, about the time DFW raised the snow vehicle issue, the Ashby Land Trust proposed working with Sweetwater Trust towards a monetary reimbursement in exchange for designating all or part of Mt. Watatic Reservation as Forest Reserve. A Forest Reserve designation may exclude snow vehicle use, thus raising a conflict for the Ashby Land Trust.

In the last 15 years the development of towns along the Rt. 495 corridor has been robust, as supported by the number and location of filings with our Natural Heritage & Endangered Species Program, and other indicators. It is expected that development will continue to expand towards Rt. 190 and Mt. Watatic Reservation. Also, Mt. Watatic Reservation is now a public property, a map of which will be available at our website for anyone to access. Recreational pressures at Mt. Watatic would be expected to increase, including snow vehicle use. Snow vehicle use at Mt. Watatic Reservation appears to be currently limited to a few local residents, per committee members and those at the hearing. There are no well-established cross county snow vehicle trails on this property. A few short miles away, there is a snow vehicle trail system at Mt. Wachusett, for public use. Recently DCR staff mapped the Mt. Watatic trail system and found it in fair-poor

condition. Based on this information, it seems an ideal time to establish Mt. Watatic Reservation as a no motorized vehicle property. This move would adhere to the Mt. Watatic Management Plan mission statement and overall management goals:

"The mission guiding the long-term stewardship of the Mount Watatic Reservation is to conserve and manage important natural, cultural and recreational resources." and "…maintain and enhance native biodiversity, provide for sustainable public access for hiking and other low-impact forms of outdoor recreation, including opportunities for panoramic views from the summit, and preserve a place to relish the peace and beauty of nature in the heart of an exceptional protected landscape."

Abbreviated REFERENCES (partial list) - Snow Vehicle Impacts

1. Snowmobiles can stress wildlife. Robin Meadows. Conservation Biology and Montana State University News Service, June 2002.
2. Snowmobile Impact on Three Alpine Tundra Plant Communities, Environmental Conservation, 1974
3. Snowmobile impact on old field and marsh vegetation in Nova Scotia, Canada: An Experimental Study, Environmental Management, 1979.
4. A Continuing Study of the Ecological Impact of Snowmobiling in Northern Minnesota, Bemidji State College, 1972.
5. Ecological Effects of Snowmobiles, The Canadian Field Naturalist, 1972.
6. Snowmobile Noise Effects on Wildlife, University of Wisconsin, Madison, 1972.
7. Winter Recreation and Hibernating Black Bears (*Ursus americanus*), Biological Conservation, 1994.
8. Effects of lead and hydrocarbons from Snowmobile Exhaust on Brook Trout (*Salvelinus fontinalis*), Trans American Fisheries Society, 1975.
9. Snowmobile Use and Winter Mortality of Small Mammals, University of Minnesota, 1971.
10. Effects of snowmobiles on White-tailed Deer, Journal of Wildlife Management, 1985. Record of the Snowmobile Effects on Wildlife: Monitoring Protocols Workshop, National Park Service, 2001.
11. Effects of Winter Recreation on Wildlife of the Greater Yellowstone Area: A Literature Review and Assessment, Greater Yellowstone Coordinating Committee, 1999.

ASHBY CONSERVATION COMMISSION WEBPAGE BLOG SITE

Following the public meeting, the Town of Ashby's representative to the Watatic Management Committee set up a blog site on the Conservation Commission webpage intended to solicit additional comments on the snowmobile issue. Eight comments were posted, and although some of the responders were not snowmobile users, all of the comments recommended that snowmobile use should be allowed in the Reservation.The address of the blog site is http://AshbyCC.wordpress.com.

APPENDIX B. GIS SUPPLEMENTAL INFORMATION

The following is a summary of the GIS methodology used by the Department of Conservation and Recreation (DCR) GIS Program to generate and present data within the Mount Watatic Reservation Resource Management Plan (RMP).

1. Boundaries

The Mount Watatic Reservation boundaries were digitized by a GIS Specialist from the Department of Fish and Game. A survey was used as the primary source of information. The eastern side of the property abuts the Department of Fish and Game's Ashby Wildlife Management Area. The western side of the property abuts the Ashburnham town line and the Department of Fish and Game's Watatic Mountain Sanctuary.

Viewing the digitized boundaries as an overlay on the MassGIS 2005 color orthophotography with near infrared display settings (http://www.mass.gov/mgis/colororthos2005.htm) reveals a discrepancy between the northern digitized boundaries and a fence or wall on or just outside of the property.

While collecting infrastructure data with GPS, DCR's Management Forester and a GIS Specialist also collected boundary points. It is important to note that eight of the nineteen boundary points were unmarked stone walls.

The digitized boundaries will be corrected in December, 2007 using GPS points and other information, such as orthophotography and deed research.

2. Demographics

The Massachusetts Census Blocks (2000) and population data were obtained from MassGIS. Additional information about the data can be found on the MassGIS website (http://www.mass.gov/mgis/cen2000_blocks.htm). The New Hampshire Census Blocks (2000) geographic data were obtained from the New Hampshire Department of Resources and Economic Development. The New Hampshire tabular population data were obtained from the Environmental Systems Research Institute, Inc. (ESRI). The geographic and tabular data were joined by the DCR GIS Program using the FIPS ID field, which is a concatenation of the state FIPS code, Census Tract number and Census Block number).

For each state's Census data, the following methodology was used. The area of each Census Block, calculated by ArcGIS and measured in square meters, was divided by 4046.856 or the number of square meters in an acre. The quotient was divided into the population of each Census Block to obtain the number of people per acre of each Census Block.

Four different buffers were drawn around Mount Watatic Reservation at ½, 1, 5 and 10 miles, using the buffer tool in ArcGIS. The Census Blocks were then clipped to the area of the buffers. The area of the clipped Census Blocks was recalculated in acres, using the calculate geometry feature in ArcGIS. This value was then multiplied by the number of people per acre of each Census Block to obtain the population estimate.

It is important to note that the population estimates within smaller distances are likely less accurate than those within greater distances. This occurs because the Census Blocks were clipped. Clipping eliminates the actual count of the Census and makes the data an estimation of population in the remaining portion of the Census Block. To account for this, the reported number of residents per acre (below and on the report and wall sized maps) was rounded to the nearest 10 residents.

Table 1. The Number of Residents within ½, 1, 5 and 10 Miles of Mount Watatic Reservation (Rounded to the Nearest 10 Residents)

	MA Residents	NH Residents
½ Mile	90	50
1 Mile	300	190
5 Mile	6,620	4,960
10 Mile	73,770	19,510

It is also important to note that the buffer distances were chosen to describe the density of residents living close to the property. There is some qualitative and anecdotal information showing that most visitors of DCR properties live nearby. Therefore, knowing how many people live in close proximity to a particular property can provide some insight as to the user demand for the recreation resources at that property. This is a general description of visitation patterns and does not hold for all properties within the DCR system.

The Census data were further analyzed with ArcGIS to determine the characteristics of the Massachusetts population surrounding Mount Watatic Reservation. The New Hampshire data was excluded from this analysis in order to gain a better understanding of the Department's target audience – the residents of Massachusetts. The Census Block Groups (2000) and data from the Summary File 3 (SF3) Tables were used. This information was provided by MassGIS (http://www.mass.gov/mgis/cen2000_blockgroups.htm).

Each Block Group that intersected with the Massachusetts version of the clipped 10 mile buffer described above was selected using the select by location tool in ArcGIS. The data for the selected Block Groups are summarized below.

Table 2. Summary of Massachusetts Block Groups within 10 Miles of Mount Watatic Reservation

Sample Population 92,779
Number of Households 35,048

Age and Gender

	Males	Females
Total	45,645	47,134
Children (<18)	12,387	11,832
Adults (18-64)	28,439	27,925
Seniors (65+)	4,819	7,377

Race

White	83,369
Black or African American	1,691
American Indian or Alaskan Native	217
Asian	2,061
Native Hawaiian or Other Pacific Islander	54
Some Other Race (alone)	3,043
Persons of Two or More Races	2,344

Income

Low (<$10,000 - $24,999)	10,001
Medium ($25,000 - $74,999)	17,848
High ($75,000 - >$200,000)	7,199

Language

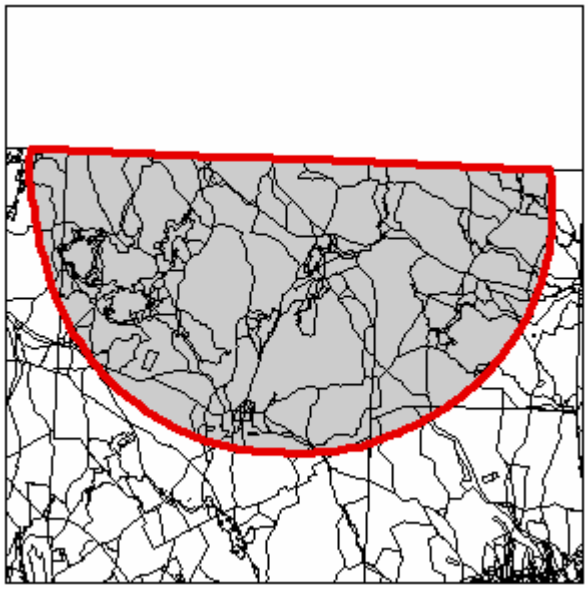
English	28,433
Not English	6,615
"Not English" includes:	
Spanish	2,517
European	3,059
Asian	520
Other	519

Education

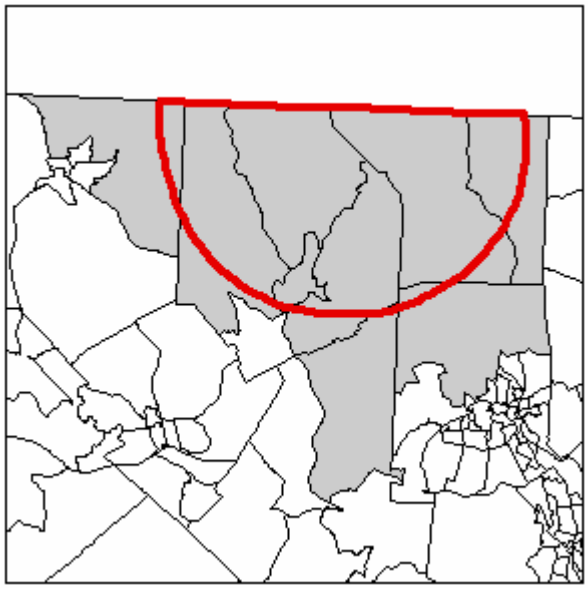
	Males	Females
Population >25	29,352	31,361
< High School[1]	5,860	5,761
High School Diploma	10,048	10,646
< Bachelor's Degree[2]	7,859	9,073
Bachelor's Degree	3,538	3,809
> Bachelor's Degree[3]	2,047	2,072

[1] No School, < 11th Grade, 12th Grade No Diploma
[2] College < 1 Year, College > 1 Year No Degree, Associate's Degree
[3] Master's Degree, Professional School Degree, Doctorate Degree

It is important to emphasize the differences between the numbers presented in Table 1 and Table 2. First, there is a difference in Census geography. Table 1 reflects Census Block geography and Table 2 reflects the larger, Census Block Group geography. Next, there is a difference in geoprocessing. The Census Blocks were clipped, meaning that they were cut to the shape of the buffer. In turn, both whole and partial Blocks were included. The Census Block Groups were selected via intersection, meaning that if any part of a Block Group overlapped with the buffer, it was selected. Only whole Block Groups were selected.



Census Blocks clipped to the Massachusetts buffer.



Census Block Groups selected via intersection.

These differences introduce an acceptable amount of error into the Tables. In the case of Table 1, the Census data are evenly redistributed across the partial Census Blocks, which may not reflect the actual distribution of people within those partial Blocks. In Table 2, the data include people who live more than 10 miles from the Reservation, since only whole Census Block Groups were included and several of those Block Groups extent beyond the 10 mile buffer.

3. Forest Types

The MassGIS 2005 color orthophotography was used to digitize the forest type information. Modifications were made based on the work of the DCR Management Forester (see page 33 of the RMP). The display of the imagery was not altered during the digitizing process. Additional information about the MassGIS orthophotography, including the various display options, can be found on the MassGIS website (http://www.mass.gov/mgis/colororthos2005.htm).

4. Infrastructure

The trails data were collected by DCR's Management Forester and a GIS Specialist over the course of several weeks in August and September, 2006. A GPS trails application was developed by the DCR GIS Program in an attempt to standardize the data. However, it is important to note that several of the trails attributes are qualitative, e.g. trail width and condition. It is assumed that the individual collecting the data used their best judgment when populating these attributes.

The trails data were clipped to the boundaries of Mount Watatic Reservation within ArcGIS in order to estimate the total length of trails on the property. There are approximately 4 miles (rounded to the nearest mile) of trails on the property. This estimate increases to 7 miles (rounded to the nearest mile) when the former ski slopes are included. The former ski slopes are considered illegal trails on the property.

5. Land Stewardship Zoning

The Natural Heritage and Endangered Species Program (NHESP) Natural Community datalayer, provided by MassGIS, was clipped to the Mount Watatic Reservation boundary using ArcGIS in order to create the Significance Overlay. Additional information about the Natural Community datalayer can be found on MassGIS' website (http://www.mass.gov/mgis/natcomm.htm).

The area defined as Zone 3 was digitized using MassGIS' 2005 color orthophotography. Additional information about this imagery can be found on the MassGIS website (http://www.mass.gov/mgis/colororthos2005.htm). The display of the imagery was not altered during the digitizing process.

6. Orthophotography

Additional information about the MassGIS 2001 and 2005 color orthophotography can be found on their website (http://www.mass.gov/mgis/colororthos2001.htm) and (http://www.mass.gov/mgis/colororthos2005.htm). The 2005 color orthophotography was not altered for this map.

7. Priority Natural Resources

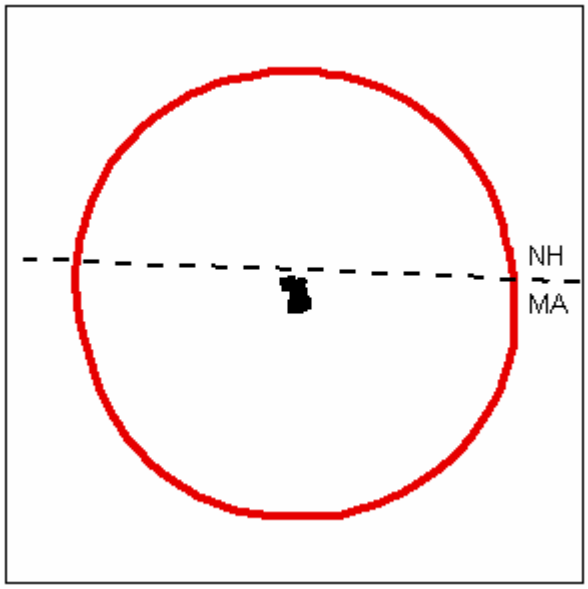
The Natural Heritage and Endangered Species Program (NHESP) datalayer was obtained from MassGIS. The data correspond to the 12th Edition of the Natural Heritage Atlas, effective October 1, 2006. Additional information about the data can be found on the MassGIS website (http://www.mass.gov/mgis/laylist.htm) under the Conservation/Recreation heading and on the NHESP website (http://www.mass.gov/dfwele/dfw/nhesp/nhesp.htm).

8. Regional Land Use

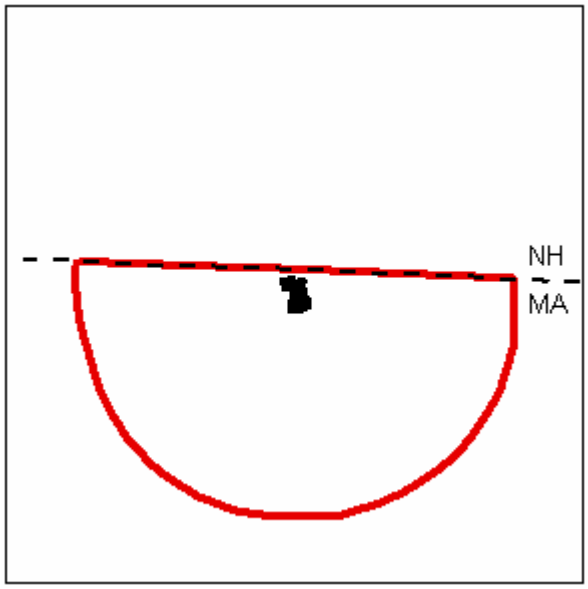
The Massachusetts land use data (1999) were obtained from MassGIS. Additional information about the data can be found on the MassGIS website (http://www.mass.gov/mgis/lus.htm). For the purpose of this RMP, the 21 land use classifications were aggregated into 9 classifications:

1. Forest
2. Agriculture (a. Crop Land, b. Pasture, c. Woody Perennial)
3. Open Land (a. Open Land, b. Urban Open)
4. Wetland (a. Non-forested Wetland, b. Salt Water Wetland)
5. Water
6. Recreation (a. Water Based, b. Participation, c. Spectator)
7. Low Density Residential (a. Low Density, b. Medium Density)
8. High Density Residential (a. High Density, b. Multi-family Density)
9. Intensive Use (a. Industrial, b. Commercial, c. Transportation, d. Mining, e. Waste Disposal)

The Massachusetts land use statistics listed below were generated using ArcGIS. The 5 and 10 mile buffers around Mount Watatic Reservation were clipped to a 1:25,000 scale version of the Massachusetts state outline (provided by MassGIS). Additional information about these data can be found on the MassGIS website (http://www.mass.gov/mgis/outline.htm). The total number of acres within each clipped buffer was then calculated, using the calculate geometry feature, and rounded to the nearest 10 acres. Next, the land use data were clipped to the area of the clipped buffers. The land use acres were summed by classification, rounded to the nearest 10 acres and then divided by the rounded acres in each clipped buffer to obtain the percentage. It is important to note that the values reported below were rounded to the nearest 10 acres to account for error.



Five mile buffer around Mount Watatic Reservation.



Five mile buffer clipped to Massachusetts state outline.

Table 3. Massachusetts Land Use (1999) within 5 and 10 Miles of Mount Watatic Reservation

	5 Mile	10 Mile
Forest	75% (25,570 ac)	72% (84,890 ac)
Agriculture	5% (1,640 ac)	5% (5,510 ac)
Open Land	2% (670 ac)	3% (3,680 ac)
Wetland	3% (990 ac)	2% (2,540 ac)
Water	5% (1,670 ac)	3% (3,250 ac)
Recreation	0.5% (160 ac)	1% (1,150 ac)
Low Density Residential	2% (800 ac)	5% (5,360 ac)
High Density Residential	7% (2,270 ac)	7% (8,480 ac)
Intensive Use	0.3% (90 ac)	2% (2,780 ac)

The New Hampshire land cover data (2001) was obtained from the Multi-Resolution Land Characteristics Consortium (MRLC). Additional information about the MLRC and the data can be found on the MLRC website (http://www.mrlc.gov/index.asp). For the purpose of this map, the 21 land cover classifications were aggregated into 7 classifications:

1. Water
2. Low Intensity (a. Developed Open Space, b. Low Intensity)
3. Medium Intensity
4. High Intensity
5. Forest (a. Barren Land, b. Deciduous, c. Evergreen, d. Mixed, e. Shrub/Scrub)
6. Agriculture (a. Grassland/Herbaceous, b. Pasture/Hay, c. Cultivated Crops)
7. Wetland (a. Woody, b. Emergent Herbaceous)

The New Hampshire land cover statistics listed below were generated using Spatial Analyst, an extension in ArcGIS. The New Hampshire versions of the clipped 5 and 10 mile buffers were created by tracing segments of the Massachusetts versions of the clipped buffers and the original buffers. The total number of acres within each New Hampshire clipped buffer was then calculated, using the calculate geometry feature, and rounded to the nearest 10 acres. Next, the land use data were clipped to the area of the clipped buffers. The land use acres were summed by classification, rounded to the nearest 10 acres

and then divided by the rounded acres in each clipped buffer to obtain the percentage. It is important to note that the values reported below were rounded to the nearest 10 acres to account for error.

Table 4. New Hampshire Land Cover within 5 and 10 Miles of Mount Watatic Reservation

	5 Mile	10 Mile
Water	3% (660 ac)	3% (2,540 ac)
Low Intensity	6% (1,540 ac)	6% (6,510 ac)
Medium Intensity	0.3% (70 ac)	0.5% (490 ac)
High Intensity	0% (10 ac)	0.1% (70 ac)
Forest	79% (20,380 ac)	78% (79,610 ac)
Agriculture	7% (1,840 ac)	6% (6,420 ac)
Wetland	4% (970 ac)	5% (4,990 ac)

The Massachusetts land cover statistics listed below were generated for comparison using the same methodology as described above with the only exception being the use of the Massachusetts versions of the clipped buffers.

Table 5. Massachusetts Land Cover within 5 and 10 Miles of Mount Watatic Reservation

	5 Mile	10 Mile
Water	5% (1,790 ac)	3% (3,190 ac)
Low Intensity	7% (2,330 ac)	10% (11,290 ac)
Medium Intensity	0.3% (110 ac)	3% (3,300 ac)
High Intensity	0% (10 ac)	1% (1,060 ac)
Forest	73% (24,860 ac)	70% (81,910 ac)
Agriculture	6% (2,010 ac)	6% (7,220 ac)
Wetland	7% (2,400 ac)	7% (8,400 ac)

9. Regional Open Space

The Massachusetts open space datalayer was obtained from MassGIS. Additional information about the data can be found on the MassGIS website (http://www.mass.gov/mgis/osp.htm). For the purpose of this RMP, the privately owned parcels were removed.

The Massachusetts open space statistics listed below were generated using ArcGIS. The total statewide land area was calculated by summing the "AREA_ACRES" field within the shaded 1:25,000 scale version of the Massachusetts state outline (provided by MassGIS). Additional information about this data can be found on the MassGIS website (http://www.mass.gov/mgis/outline.htm). The reported statewide land area was rounded to the nearest 10 acres to account for error.

The statewide open space acres were calculated by summing the area of each polygon, which was calculated by ArcGIS (measured in square meters). The total was then divided by 4046.856, or the number of square meters in an acre, and rounded to the nearest 10 acres to account for error. The rounded number of statewide open space acres was divided by the rounded statewide land area to obtain the percentage.

The Massachusetts versions of the clipped 5 and 10 mile buffers described above were used to clip the open space data. The open space acres were summed, rounded to the nearest 10 acres and then divided by the rounded acres in each clipped buffer to obtain the percentage. It is important to note that the values listed below were rounded to the nearest 10 acres to account for error.

Table 6. Massachusetts Open Space within 5 and 10 Miles of Mount Watatic Reservation Compared to Statewide Open Space

Land Area	Open Space (In Fee)	Open Space (Deed Restriction)
5 Miles (33,880 ac)	15% (4,940 ac)	4% (1,350 ac)
10 Miles (117,630 ac)	18% (21,290 ac)	2% (2,310 ac)
Statewide (5,172,620 ac)	22% (1,114,680 ac)	3% (166,250 ac)

The New Hampshire conservation/public lands data was obtained from New Hampshire GRANIT. Additional information about the data can be found on the GRANIT website (http://www.granit.sr.unh.edu).

The New Hampshire open space statistics listed below were generated using ArcGIS. The total statewide land area was pulled from the "ACRES" field within the shaded version of the New England States datalayer (provided by MassGIS). Additional information about this data can be found on the MassGIS website (http://www.mass.gov/mgis/newnglnd.htm). The reported number of statewide land area was rounded to the nearest 10 acres to account for error.

The statewide open space acres were generated using the same methodology as was used in Massachusetts with the only exception being the use of the New Hampshire versions of the clipped 5 and 10 mile buffers and the New Hampshire conservation/public lands data.

Table 6. New Hampshire Conservation/Public Lands within 5 and 10 Miles of Mount Watatic Reservation Compared to Statewide Conservation/Public Lands

Land Area	Conservation/Public Lands
5 Miles (25,740 ac)	9% (2,410 ac)
10 Miles (101,730 ac)	15% (15,370 ac)
Statewide (5,935,590 ac)	25% (1,490,510 ac)

10. USGS Topographic Quadrangles (and 3-D Relief)

The USGS Topographic Quadrangles and 3-D relief were provided by MassGIS. Additional information about this data can be found on their website (http://www.mass.gov/mgis/img_shdrel5k.htm) and (http://www.mass.gov/mgis/im_quad.htm).

11. Water Resources

The dams datalayer was created by the DCR GIS Program by digitizing their locations in ArcGIS based on the Department's Office of Dam Safety paper maps. The attributes were obtained from the Department's Dam Safety Database. The data are currently undergoing major revisions and are not available for distribution.

The location of Nutting Hill and Mount Watatic were estimated based on MassGIS' USGS Topographic Quadrangles. Additional information about the maps can be found on the MassGIS website (http://www.mass.gov/mgis/im_quad.htm). The elevation of Mount Watatic was pulled from the RMP.

MT WATATIC VISITOR SURVEY – FALL 2004

Surveyor's notes:
Name of surveyor: _____
Date: _____
Time of day: _____
Weather conditions: _____
Approx number of cars in parking lot and alongside Rt 119: _____

Have they answered this survey already (face-to-face or post card)?

Questions for visitors:

Where do you live? _____

Are you here today with family ___ friends ____ members of _____ organization?

Why did you come here today? hike___ other trail use ___ hawk watch ____
other (please explain) _____

How many years have you been coming to Mt Watatic? _____

Approx. how many times per year do you visit Mt Watatic? _____

Do you also visit in the - winter __ spring __ summer__?

Compared with your past visits is it becoming - less crowded ___ about the same ___
more crowded___?

Do you have concerns with trail conditions ___ number of visitors ___ conflicting uses ___
other (please explain) _____

Do you have any suggestions for improving your experience when you visit Mt Watatic?

Would you be interested in volunteering for trail improvement work or other projects? Y __ N __
If Yes, Contact Info:

LAND STEWARDSHIP ZONING GUIDELINES
DEPARTMENT OF CONSERVATION AND RECREATION
February, 2006

Background

In July, 2003 state legislation established the Department of Conservation and Recreation (DCR), consisting of a Division of Urban Parks and Recreation, a Division of State Parks and Recreation, and a Division of Water Supply Protection. This legislation essentially merged the former Department of Environmental Management (DEM) and the Metropolitan District Commission (MDC). In addition, the legislation required the preparation of management plans for state parks, forests and reservations under the management of DCR (Chapter 21, Section 2F). This legislation states that management plans shall include guidelines for operation and land stewardship, provide for the protection and stewardship of natural and cultural resources, and shall ensure consistency between recreation, resource protection, and sustainable forest management.

As part of addressing this legislative requirement, land stewardship zoning guidelines will be incorporated into the development and implementation of DCR Resource Management Plans. These Land Stewardship Zoning Guidelines (Guidelines) represent a revision of the previous Land Stewardship Zoning system developed by Executive Office of Environmental Affairs (EOEA) agencies in the early 1990s, and which had been applied to the preparation of management plans for state parks, forests and reservations under the management of the former DEM.

The purpose of these revised Guidelines is to provide a general land stewardship zoning framework for the development of Resource Management Plans for all state reservations, parks and forests under the management of the DCR Divisions of Urban Parks and Recreation and State Parks and Recreation. The Guidelines do not apply to Division of Water Supply Protection (DWSP) properties because DWSP watershed planning has a separate legislative mandate and established planning procedures.

Overview of Guidelines

The Guidelines define three types of zones to address the legislative requirement to provide for the protection and stewardship of natural and cultural resources and to ensure consistency between recreation, resource protection, and sustainable forest management. The Guidelines are intended to provide a general land stewardship zoning framework that is flexible and that can guide the long-term management of a given DCR property or facility. The three zones may be supplemented with significant feature overlays that identify specific designated/recognized resource features (such as Forest Reserves, Areas of Critical Environmental Concern, or areas subject to historic preservation restrictions). DCR parks, forests and reservations are also subject to specific policy guidelines and/or performance standards (such as Executive Order No. 181 for Barrier Beaches) and applicable environmental laws and regulations of the Commonwealth.

Application of the three-zone system to a particular DCR park, forest or reservation is facilitated by the development and application of Geographic Information Systems (GIS) technology. GIS resource overlays provide a general screen whereby lands of special resource significance and sensitivity can be mapped and identified. General landscape features such as forested areas, wetlands, streams and ponds can also be mapped as part of this overlay approach. Further, additional data regarding recreational uses and developed facilities and sites can be added. This type of mapping and data collection, based on the best information currently available, provides the basis for subsequent analysis and ultimately the development and application of appropriate land stewardship zoning guidelines to a specific state park, forest or reservation.

Land Stewardship Zoning Guidelines provide a foundation for recommendations that will address resource stewardship and facility management objectives, and are intended to cover both existing DCR property or facility conditions and desired future conditions for that property or facility. Proposals for changing the Guidelines in a previously approved Resource Management Plan should be submitted to the DCR Stewardship Council for review and adoption.

Land Stewardship Zones

Zone 1

General Description

This zone includes unique, exemplary and highly sensitive resources and landscapes that require special management approaches and practices to protect and preserve the special features and values identified in the specific Resource Management Plan. Examples of these resources include rare species habitat identified by the Natural Heritage & Endangered Species Program as being highly sensitive to human activities, fragile archaeological or cultural sites, and unique or exemplary natural communities. Management objectives emphasize protecting these areas from potentially adverse disturbances and impacts.

General Management Guidelines

- Only dispersed, low-impact, non-motorized, sustainable recreation will be allowed provided that the activities do not threaten or impact unique and highly sensitive resources.
- Existing trails and roads will be evaluated to ensure compatibility with identified resource features and landscape, and will be discontinued if there are suitable sustainable alternatives. New trails may be constructed only after a strict evaluation of need and avoidance of any potential adverse impacts on identified resources. New roads may only be constructed to meet public health and safety needs or requirements; however, the project design and siting process must avoid any potential adverse impacts on identified resources and demonstrate that there are no other suitable alternatives.
- Vegetation or forest management will be utilized only to preserve and enhance identified resource features and landscapes.

Zone 2

General Description

This Zone includes areas containing typical yet important natural and cultural resources on which common forestry practices and dispersed recreational activities can be practiced at sustainable levels that do not degrade these resources and that hold potential for improving their ecological health, productivity and/or protection through active management. Examples include terrestrial and aquatic ecosystems characterized by a diversity of wildlife and plant habitats, rare species habitat that is compatible with sustainable forestry and dispersed recreation, agricultural resources, and resilient cultural sites and landscapes. Zone 2 areas may be actively managed provided that the management activities are consistent with the approved Resource Management Plan for the property.

General Management Guidelines

- Management approaches and actions may include a wide range of potential recreational opportunities and settings that are consistent and compatible with natural resource conservation and management goals.
- Utilize Best Management Practices for forestry and other resource management activities to encourage native biodiversity, protect rare species habitats and landforms.
- Protect and maintain water quality by providing for healthy functioning terrestrial and aquatic ecosystems.
- Provide a safe, efficient transportation network with minimal impact on natural and cultural resources while serving public safety needs and allowing visitors to experience a variety of outdoor activities.
- New trails may be allowed dependent upon existing area trail densities, purpose and need, physical suitability of the site, and specific guidelines for protection of rare species habitat and archaeological resources.
- Sustainable forest management activities may be undertaken following guidelines established through ecoregion-based assessments, district level forestry plans, current best forestry management practices, and providing for consistency with resource protection goals.
- Roads may be constructed if access for resource management or public access is needed and construction can be accomplished in an environmentally protective manner. Existing roads will be maintained in accordance with the DCR road classification system and maintenance policy.
- Additional site-specific inventory and analysis may be needed prior to any of the management activities described above to ensure that no adverse impacts occur to previously un-documented unique and sensitive resources and landscape features.

Zone 3

General Description

This zone includes constructed or developed administrative, maintenance and recreation sites, structures and resilient landscapes which accommodate concentrated use by recreational visitors and require intensive maintenance by DCR staff. Examples include areas developed and deemed appropriate for park headquarters and maintenance areas, parking lots, swimming pools and skating rinks, paved bikeways, swimming beaches, campgrounds, playgrounds and athletic fields, parkways, golf courses, picnic areas and pavilions, concessions, and areas assessed to be suitable for those uses.

General Management Guidelines

- The management approach and actions will emphasize public safety conditions and provide for an overall network of accessible facilities that meets the needs of DCR visitors and staff.
- Maintenance of these facilities and associated natural and cultural resources, and new construction or development, will meet state public health code, and state building code and environmental regulations.
- Shorelines and surface waters may be used for recreation within constraints of maintaining public safety and water quality.
- Historic restoration, rehabilitation or reconstruction for interpretation or adaptive reuse of historic structures will be undertaken only in conjunction with a historic restoration plan.
- To the greatest extent possible, construction will include the use of "green design" for structures, such as use of low-flow water fixtures and other water conservation systems or techniques, solar and other renewable energy sources, and the implementation of Best Management Practices to protect the soil and water resources at all facilities.

Significant Feature Overlays

General Description

The three land stewardship zones may be supplemented with significant feature overlays that identify specific designated/recognized resource features. These significant features are generally identified through an inventory process or research, and are formally designated. The purpose of these overlays is to provide more precise management guidance for identified resources and to recognize, maintain, protect, or preserve unique and significant values, regardless of the zone in which they occur. Examples of significant feature overlays include Forest Reserves, areas subject to public drinking water regulations, or areas subject to historic preservation restrictions.

Management Guidelines

Specific management guidelines for significant features overlays are provided by resource specialists or by the federal/state/regional/local agency that has recognized and listed the resource or site.

MOUNT WATATIC - CULTURAL RESOURCES

Prehistoric Archaeological Resources

The portion of Massachusetts in which Mt. Watatic is located is among the least well know archaeologically in the state. Few prehistoric sites have been identified in an area of several hundred, if not several thousand contiguous square miles; none have been professionally excavated or reported on. However, the existing State of Knowledge is undoubtedly more a function of sample error than of actual prehistoric settlement in the area. This region has historically been rather sparsely settled, and it has not yet experienced many of the development pressures that often expose archaeological sites to the careful inspection of the "artifact hunter". Indeed, most of the sites in the archaeological record have been found by amateur archaeologists who scour recently plowed fields and inspect the disturbed soils of construction sites. Thus, we must consider the existing site inventory artificially low.

In evaluating the archaeological sensitivity of the Mt. Watatic area, its natural resources and environmental setting must first be evaluated. The composition of the bedrock, together with glacial and post-glacial deposition, and erosion has created a mosaic of landforms, sediments and soils. These topographical and geological characteristics featured a network of streams and wetlands, lakes and ponds, and supported a biota that included pine and hardwood forests, pioneer hardwood and herbaceous forests, and open floral communities. This environment attracts, or did attract, virtually every form of wildlife known in the northeastern part of the United States. Together these factors provided Native American hunters and gatherers a rich and diverse subsistence base that would have contributed to the many forms of land use practiced throughout the 12,000 years that humans probably would have occupied the region.

To the east of Mt. Watatic, Paleo Indian hunters and gatherers may have reached the Nashua River Drainage sometime between 12,000 to 9,500 years ago**,** and they are well documented on the Connecticut River to the west. One therefore would speculate that they roamed and likely lived, even if only in small brief camps, in the intervening area, such as around Mt. Watatic. By Late Woodland and Early Historic times the Nashaway, a band of a broader group of Algonquin speaking peoples**,** inhabited the area prior to colonial settlement. The Nipmuc, Massachusetts and Pennacook tribes may have all hunted or inhabited portions of the area.

Given the complex environmental characteristics and favorable site location criteria of much of the Mt. Watatic region, the area must be considered to contain exceptionally high archaeological potential, both for the numbers of sites yet to be discovered, as well as for sites that retain high archaeological integrity and research value. The lack of development and low population densities have likely allowed for the survival rate of archaeological sites to be higher here than in most other parts of the state, therefore, the Mt. Watatic region " is a veritable archaeological museum."

The potential archaeological resources within Mt. Watatic region are unique records of past human behavior, sometimes resulting from a single activity or event, and sometimes

from hundreds and even thousands of years of repeated and recurrent use. The potential survival of many intact and well preserved archaeological sites here makes it one of the most important areas for research about our cultural heritage within the Commonwealth.

Historic Archaeological Resources

Historically, the Mt. Watatic region featured a low density dispersed settlement pattern based almost solely on agrarian activities. It never really developed the core communities that trading centers like Lancaster and Worcester did. It largely retains its rural character today. A frontier community in colonial times, the first land grants date to 1733, and the archaeological remains of some of the farmsteads associated with those grants exist today. An early primary highway, the Northfield Road, was laid out from Lunenburg west to the Connecticut River Valley in 1733 as a military road: it passed through the southern portion of Ashburnham. By 1765 Ashurnham was incorporated as a town and a meeting house was established on the Northfield Road.

The archaeological remains of Colonial and Federal Period farmsteads dot the landscape, often hidden and protected by a shroud of vegetation. The remains of farm complexes featuring a main house, barns of varying sizes, a multitude of out buildings, wells, and stone walls that set aside pastures from tilled land, and orchards, attest to the agrarian base of the region.

While the Mt. Watatic region never achieved the industrial success of other Central Massachusetts towns like Worcester, Mendon and Sutton, its watercourses supplied sufficient head of water for small mill operators. The remains of grist and saw mills can be found throughout the region, often in seemingly isolated locations.

One of the more interesting historic archaeological remains in the Mt. Watatic region is that of a Shaker compound. Although the Shaker religious movement is reasonably well documented in the literature, we do not know how the Ashburnham property, labeled as ***Harvard Shakers*** on the Beers' 1870 ***Atlas of Worcester County, Massachusetts,*** was related to the nearby Shaker communities at Harvard and Shirley. Reputedly, the Ashburham Shaker lot was used for cattle breeding during the summer, and the cattle were driven to the nearby rail depot in the fall and returned to Harvard for the winter.

The site contains visible structural remains of building foundations and stone walled enclosures (probable animal pens and gardens). The site apparently was a satellite, or out parcel, of the larger Harvard Shaker Village in nearby Harvard, MA.; it therefore would also have been related to the Shirley Shaker community since the two apparently shared ministries at one time.

The Shaker settlement at Harvard was founded in 1781-1782 by followers of Mother Ann Lee, who was thought to be the female, second incarnation of Christ. Harvard was the second Shaker community in the United States and the first in Massachusetts, and it was considered the ***heart*** of the movement at one point. In the 1850s its resident population peaked at about 200 members with landholdings of over 2,000 acres. The presence of the

Ashburnham lot is somewhat unusual since typically the physical layout of a Shaker community was highly centralized and nucleated with all meeting houses, workshops, dwellings, gardens, barns and pasturage clustered together thereby forming a well defined ***village.***

Since the property is related to the Harvard community it derives a high degree of historic significance. However, it is not entirely clear whether the Ashburnham lot was opened as off site pasturage some time around the Harvard community's peak in the 1850s, or whether it represented an earlier holding that had been donated to the cause by a Shaker adherent. The number and types of structures are not known, nor has the configuration of the site been determined.

Historic and Scenic Landscapes

Presently, Historic and Scenic Landscape Inventories have not been prepared for Ashburham as they have for many other communities throughout the state. As with the archaeological record, this region is virtually unknown, but because of its continued rural character, which has largely spared it from strip malls, nucleated malls, business and industrial centers, and large residential developments, it is expected that reasonably good representations of Historic and Scenic landscapes exist. Working farms can still be found, and former farms retain much of the integrity of setting as they still can be associated with outbuildings, stone walls, orchards, and field systems etc.

Visual intrusions caused by modern accretions to the landscape are relatively modest in the Mt. Watatic Region, and except in isolated cases do not distract from the peace, quiet and reasonable pace of the broader rural landscape. These are all qualities that are worthy of preservation.

Threats to Cultural Resources

Cultural resources are commonly defined as sites, buildings, structures, objects, landscapes, and districts evaluated as having significance in history or prehistory. There are a number of threats that can diminish or destroy cultural resources. These include:

Collecting – collecting or otherwise removing artifacts or other resources for personal use or sale can irreversibly impact fragile archaeological resources, and it is an illegal activity on state owned land. Not publicizing locations of sensitive cultural resources may reduce stealing and pilfering artifacts. Alternatively, informing the public about the adverse affects that such behavior has, and the fact that it is against the law to remove or alter historic artifacts may also have the desired effect.

Erosion/trampling – erosion created by foot, bicycle or vehicular traffic can seriously damage archaeological sites, particularly prehistoric sites where artifacts can become exposed and trampled. Locating high and medium impact uses away from cultural resource areas can minimize the potential for damaging erosion. Climbing on and over

the stone walls of domestic cellarholes and mill sites can cause the walls to deteriorate and crumble.

Disturbance – any digging or construction can inadvertently disturb or destroy cultural resources and historic and archeological sites. Undertaking renovation on historic structures can inadvertently change or destroy historic resources by altering their integrity. Proper planning and consulting with state experts is key to avoiding impacts.

Vandalism – destruction or defacement of structures or sites is an ongoing concern for easily identifiable structures or sites. Ensuring sufficient surveillance and enforcement, as well as publicizing penalties for those caught vandalizing resources are necessary to minimize the risk of vandalism.

Neglect – time and weather can gradually destroy historical structures as well as archaeological sites. Structures should be evaluated to determine the appropriate treatment, if any, to improve their longevity. A regular cyclical maintenance system is recommended for historic buildings. Monitoring the condition of the ground and walls in and around prehistoric and historic archaeological sites should also be performed regularly.

Management Guidelines for Cultural Resources

The following guidelines are intended to support management goals for cultural resources that have been established by the Mt. Watatic partners.

Goals

- Permanently protect cultural sites of historical importance including prehistoric and historic archaeological sites, historic buildings and structures, historic landscapes, historic roads, cemeteries and objects
- Permanently protect viewsheds, and protect and enhance scenic vistas

Guidelines for Historical and Archeological Resources

Management guidelines to protect cultural resources are based on the DCR Division of Parks & Recreation's (DPR) management guidelines. They include general guidelines that outline a process to ensure work activities are conducted in a manner that is protective of known and unknown resources. The guidelines also include more specific management and operation guidelines to protect these resources. Finally, this section includes general recommendations for education and interpretation of cultural resources.

State agencies are required by law to undertake certain notification and protection efforts with regard to cultural resources. The guidelines for protecting cultural and historic resources are institutionalized to some extent by the existence of a number of Federal and State laws as overseen and implemented by the Massachusetts Historical Commission (MHC).

MHC is the State Historic Preservation Office and is responsible for administering State Register properties and other historic and archaeological assets. The MHC is also the office of the State Archaeologist, whose duties are to compile and maintain an inventory of archaeological sites, to issue permits for archaeological investigations on lands in which the Commonwealth has an interest, and, in accordance with Massachusetts General Laws, Chapter 38, Section 6, notify the Commission on Indian Affairs if a possible Native American burial site has been identified.

Programmatic Memorandum of Agreement (PMOA)

In order to expedite and streamline the process for regulatory compliance, DPR has executed a Programmatic Memorandum of Agreement (PMOA) with the Massachusetts Historical Commission (MHC). Under the PMOA, certain activities are exempted from the MHC review process or can be approved by staff within the Office of Historic Resources (OHR). The PMOA also outlines a streamlined process through which the MHC can review projects based on preliminary review by internal DCR Office of Historical Resources staff.

Whenever the Watatic partners undertake a project, the Office of Historic Resources should be contacted early on the planning process. OHR staff will first determine whether the work qualifies as a categorical exemption from MHC review as defined in the PMOA. If the project is categorically exempt, OHR staff will provide internal review and approval of the work. The staff Archaeologist and Preservation Planners are authorized to comment on projects and make recommendations that are consistent with the MHC review process. Although this will expedite the review of projects, the same standard for the protection of cultural resources will apply during both MHC review and this internal process. If a project does not qualify as an exemption, staff of the Office of Historic Resources will evaluate the impacts of the project on cultural resources and prepare a Project Notification Form (PNF) for the submission to the MHC. Through the PNF, the OHR will request that the MHC concur with DPR's findings and approve the project in a timely manner.

General Permit for Archaeological Investigation

The General Archaeological Permit (GAP) provides an important part of the in-house process that the PMOA establishes. Specifically, it provides DPR with the capacity to perform its own limited archaeological investigations with its own staff, as part of OHR's evaluation of impacts of proposed projects within the Commonwealth's Forest and Parks. The GAP supplements the PMOA by providing for limited field evaluations of those projects not included in the Activities Exempt from MHC Review. Under the auspices of the GAP, the DPR Archaeologist is authorized to perform in-house sub-surface investigations for small projects (i.e., five days maximum in the field) in order to evaluate the impact, or potential impact, of a proposed project to archaeological resources. This evaluation process may pertain to small capital improvement projects (i.e., parking areas, leach fields, utility improvement and upgrades), but will generally be related to

maintenance and operations activities that are performed by park staff such as trail work, vegetation plantings, installation of boat ramps, composting toilets, and signage.

Issues and Recommendations

Management of the resources at Mt. Watatic should incorporate the appropriate protection procedures to insure that the cultural resource base is not adversely affected by daily operations and visitor use. The cultural resources including archaeological remains and historic buildings and remnants are finite resources. They represent unique records of past events and behavior that are part of our communal heritage. Typically, prehistoric sites resulted from short-term sporadic occupation. There is seldom much material left, and under the best of circumstances sites are difficult to excavate and interpret properly. They are extremely fragile and easily damaged. Archaeological sites cannot be repaired or fixed, and their loss is analogous to the extinction of a plant or animal species. Once these resources are gone, they are gone forever.

The preservation of cultural resources at Mt. Watatic can easily be accomplished through continued cooperation and teamwork. Good planning and early communication about proposed projects will insure smooth project implementation. Beyond the dictates of legal compliance and resource protection, the cultural history of Mt. Watatic should be explored, developed and offered to the public.

In general, good management of the cultural resources will include:

- Planning of projects, both capital and normal operations, that takes into account the potential effects on historic and archaeological resources
- Partners must notify the MHC of any project that has the potential for impacting the historical, architectural, archaeological or cultural qualities of a property. Should partners undertake a project under federal funding or requiring federal oversight and/or permits, Section 106 of the National Historic Preservation Act of 1966 as amended (16 USC 470 et seq.) also requires consultation with the MHC.
- For projects planned at Mt Watatic, staff should consult with DPR's Archaeologist and Preservation Planners.
- For most projects, the DCR Project Planning, Design and Development staff will require a project description, a site plan and photographs for review. No physical work can occur until one of the following outcomes has been achieved:
    - Determination by DCR Project Planning, Design and Development staff that the project constitutes a categorical exemption and is consistent with DEM preservation standards
    - Determination of "no effect" or "no adverse effect" from the MHC
    - Successful completion of any mitigation outlined in the Memorandum of Agreement (MOA) between DCR and MHC (in cases of determination of

"adverse effect"). If Project Planning, Design and Development or the MHC determines that the project will result in an "adverse impact" to cultural and/or archaeological properties, the project proponent will work with OHR and the MHC to avoid, minimize or mitigate the impact. The Office of Project Planning, Design and Development will initiate and manage those activities that will minimize or mitigate adverse impacts to cultural and archaeological resources on the state properties.

- Maintenance of confidentiality regarding the specific locations of prehistoric sites (the Freedom of Information Act does not apply)
- Improvements to National Register listed or eligible properties in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties
- Continued recognition of significant historic buildings, objects and landscapes through their nomination to the National Register of Historic Properties

Operations and Management Guidelines

- Site Protection is the best strategy for the management of the known cultural resources.
- Planning of projects, both capital and normal operations, that takes into account the potential effects on historic and archaeological resources
- In the case of sensitive archaeological sites, avoidance of the area and monitoring of erosion are recommended for the protection of the site.
- Undertake regular and periodic vegetation management on, in and around historic sites.
- Do not locate trails or sections of trails in areas of high archaeological sensitivity
- Use existing trail system wherever possible and add new trails to complement the existing trail system where necessary and appropriate
- Employ gentlest means possible for treatment of a trail's surface by avoiding cutting, racking back, and regrading as much as possible
- Monitor erosion gullies as they can harm archaeological resources, and stabilize erosion prone areas of the trail system with water bars
- Identify areas where visitor use is causing soil disturbing conditions
- Place brush and deadfall barriers to block off problematic areas in order to lessen impacts from trail use and maintenance
- Monitor for illegal digging, collecting and other disruptive landscape modifications
- Breaks or reconfigurations of stonewalls should be avoided
- Special attention should be given to Contact or Colonial trails

- Unexpected Discoveries During Project Implementation or Construction – contact DCR Office of Historic Resources
- Discovery of Bones – secure area, contact DCR Office of Historic Resources, State Police and State Medical Examiner
- Discovery of Artifacts – Contact DCR Office of Historic Resources, protect site intact
- Illegal Digging/Looting – Contact DCR Office of Historic Resources
- Reporting of discoveries of artifacts or soil anomalies, observing the effects of active recreation to sensitive areas, and monitoring for looting of known archaeological sites (as identified by appropriate staff)
- The use of metal detectors is prohibited

Education and Interpretation of Cultural Resources

- Development of interpretive programming that reflects the range and quality of the cultural resources at Mt. Watatic: prehistory, colonial and post-colonial era settlement.
- Contingent on availability of staff and funding, install interpretative signage and prepare brochures on the various historic and prehistoric themes that are appropriate for Mt. Watatic.
- Introduce informative/educational signage that addresses the stewardship of sensitive cultural resources.

Thomas F. Mahlstedt
Archaeologist
Department of Conservation & Recreation
Division of Planning and Engineering
6/3/04

METHOD TO ASSESS TRAIL CONDITIONS & IMPACTS FROM TRAIL USE

INTRODUCTION

Wachusett Mountain State Reservation is a 2,025-acre reservation in central Massachusetts run by the Massachusetts Department of Environmental Management (DEM). There are 15 miles of hiking trails and a 450- acre ski area at the reservation (Epsilon Assoc., 1999). The mountain is a popular birding spot, one of the best places in the area to watch the annual hawk migration. This reservation also contains acres of old growth forest and many vernal pools where breeding amphibians congregate, including a population of salamanders larger in size than any other in the state.

This mountain is the closest recreational area of its kind for many Massachusetts residents. Various groups use this reservation including hikers, horseback riders, birdwatchers, skiers, and educational groups. Given the fact that all of these uses are occurring in such a small reservation, impacts to the hiking trails have been great. Trail degradation has been identified as one of the most important use-related impacts on the mountain (Epsilon Assoc., 1999). The Resource Management Protection Plan (RMPP) in effect at the mountain requires an annual trail assessment of all hiking trails. While this plan provides information on which indicators to assess, it provides no guidelines on how to conduct the assessment. The only method currently employed by DEM is the establishment of permanent points along a trail and measuring the depth of the tread. While this method is accurate, it does not encompass all of the indicators required by the plan.

It became apparent that there was a need for a management tool that would assess the overall "health" of a trail by measuring multiple forms of degradation. In response to this need, a trail assessment survey was created. This survey is rapid, qualitative and requires little training. Its purpose is to assess the condition of hiking trails by ranking characteristics that contribute to tread stability. Managers at the mountain will be able to use the results to identify unstable and actively degrading trail segments and prioritize them for remediation. It will also provide information on common problems being experienced on the Mountain.

BACKGROUND

Types of Impact

Trail impacts may either be classified as use-related or environmental. Use-related impacts are related to the type and amount of use as well as user behavior. Increased erosion, excessive muddiness, trampling of vegetation, trail widening, and proliferation of informal (social) trails are all use-related impacts (Marion and Leung, 2001). Environmental impacts my influence the severity of use-related impacts. Soil, vegetation type, topography, climate, and slope are all environmental conditions that are acting on the trail. These may work with use-related impacts to make trail conditions worse. For example, uneven and deeply eroded treads or excessive muddiness may cause visitors to try and avoid these problems by moving off the main tread. This leads to unnecessary trail widening and the creation of secondary treads (Leung & Marion, 1996). Rochefort and Swinney found a negative correlation between both slope and condition

class and elevation/condition class in their study of use-related impacts in Mount Rainier National Park (Rochefort & Swinney, 2000). In their study, a low condition class indicated a "healthier" or less impacted trail. This means that as slope or elevation rose, the trails became less impacted. In this case environmental conditions such as steep slope and high elevation were influencing user behavior by discouraging people from using those trails.

Assessment Techniques

In a survey of 93 backcountry managers, trail impacts were listed as the "most pervasive problem" on their land (Marion, 1994). Of these, 31% said trail widening was a problem, and 25% listed excessive muddiness as a problem on their trails. Despite this, only 8 locations had any type of official trail impact monitoring program. Twelve sites did have trail surveys intended to identify maintenance problems and were conducted by maintenance personnel. Another 18 noted informal evaluations done by park rangers during routine field patrols (Marion, 1994).

Perhaps the reason for this lack of assessment is due to the complex, expensive and time-consuming methods available. Jewell and Hammitt conducted an analysis of published research on soil erosion assessment methods for trails (Jewell & Hammitt, 2000). In their paper, they provide an overview of the most widely used assessment techniques. Many of these, including maximum tread incision, maximum tread incision post-construction, and cross-sectional area involve taking measurements of tread depth and the establishment of permanent points (Yoda & Watanabe, 2000). These may be effective at measuring amounts of erosion in the tread, but require a lot of time and training of personnel. These methods may not be suitable in large areas with many miles of trail. There is also room for error between people taking the measurements and in correctly identifying the pre or post-construction height of the tread.

Stereo photography is a method where pictures of a treadway are taken and compared with future photographs of the same site. This is a good record of change, but provides no immediate benefit. Aerial photo appraisal is similar in that it provides a photographic record, but can only show location and extent of trails without providing specific information about type and extent of impact on the ground.

Condition class is a method that is relatively inexpensive, fast, and requires little training. Descriptive classes are assigned to trail segments based on predefined criteria (Marion & Leung, 2000). In Jewell and Hammit's analysis of different assessment types, condition class was ranked the highest overall method (Jewell & Hammit, 2000). One of the methods used to study human impacts in Mt. Rainier National Park was a condition class survey (Rochefort & Swinney, 2000). Researchers used systematic sampling with 0.1- acre circular plots. In each plot vegetation type, slope, aspect, bare ground cover, vegetative cover and elevation were identified. They also noted the presence of informal trails, litter, or campsites. Plots were ranked in classes from 0-Pristine to 4-Habitat Destroyed (Rochefort & Swinney, 2000). A negative correlation between slope/condition class and elevation/condition class was found. The researchers concluded that this method "described the broadest spectrum of impacts" and was useful in monitoring and assessing the condition of a large area (Rochefort & Swinney, 2000). The condition class method is rapid and does not require a lot of personnel training (Marion, 1991).

A similar approach, the census-based, is a point sampling method. A transect is run along a length of trail that has been impacted and the treadway is assessed at regular intervals. In one example, researchers used maximum tread incision post-construction to measure erosion, and ranked vegetative cover, rock, exposed soil, exposed roots, muddiness, and organic litter in 10% categories. They also noted the number of informal trails and secondary treads (Marion & Leung, 2001).

Arches National Park in Utah used the census-based method with $0.25m^2$ quadrats placed along a transect. They measured vegetative ground cover and composition as well as plant litter, mosses, lichens, bare ground, rock, gravel, animal pellets, soil, and water infiltration. They reported that this method was easy, efficient and generally represented the actual conditions of the trail relative to use levels (Belnap, 1998).

The final assessment type reviewed was the problem assessment. Before going out into the field a list of problems are drawn up. All of the trails are walked, and every occurrence of the predefined problems are recorded and measured. This gives information on the number and location of the occurrences and the percent of trail length affected by them (Leung & Marion, 2000). It is a good method for recording impacts that occur infrequently, and although results may not always be accurate they are very useful to managers who are seeking problem areas in their parks (Leung & Marion, 2000). This method has been recommended as a good way to provide information on how to "direct maintenance efforts to the most pressing impact problems" (Marion & Leung, 2001).

Based on the review of all the above assessment methods, a unique combination of condition class and census-based point sampling was chosen for use at Wachusett Mountain. The primary goal in designing this survey was for it to fulfill the requirements under the RMPP while remaining qualitative, rapid, require little specialized training and be highly useful for prioritizing trails for maintenance efforts.

METHODS: Choosing Indicators

An indicator is a feature or impact to a trail or treadway that can be measured as a reflection of the health or stability of a trail. Indicators included in the Resource Management Protection Plan include; trail width, presence of rock, abundance of litter and visible roots, soil erosion, presence of bike/vehicle tracks, soil resistance, plant cover and overall level of degradation for trail segments (Epsilon Assoc., 1999). During the development of this survey an extensive review of current trail assessment techniques was conducted. Each indicator included on the Trail Assessment Survey was researched and field-tested to determine its usefulness as an indicator of trail condition. The indicators laid out in the RMPP were researched and tested along with many others to create a comprehensive survey for trail assessment.

Herbaceous Cover. The amount of herbaceous cover in a treadway influences erosional rates. Vegetative cover acts to protect the soil from erosion by holding it in place and buffering the impact of wind and water in the treadway. When vegetation is trampled or stripped away the soil is exposed to increased wind and water erosion (Belnap, 1998).

Leaf Litter. Leaf litter may add stability to the treadway by protecting exposed soil from erosion. However, it also prevents light from reaching the treadway, inhibiting the growth of new herbaceous vegetation.

Exposed Soil. One of the most studied indicators is soil erosion. A survey of 106 National Park Service managers found that half of them identified trail erosion as a problem in their park (Jewell & Hammitt, 2000). Erosion on hiking trails leads to excessive muddiness, root exposure, uneven tread, loss of tread stability and makes passage more difficult (Jewell & Hammitt, 2000). While a certain amount of erosion is expected along a treadway, excessive amounts lead to increased sedimentation in nearby water bodies (Marion & Leung, 2001). Erosion is so important because it is essentially permanent compared with other impacts; and once soil is lost, it cannot be replaced (Jewell & Hammitt, 2000). Many trail assessment methods such as maximum tread incision and cross-sectional area measure soil erosion as the sole indicator of tread stability. Erosion is particularly important on a mountain because trails at high elevations have been shown to experience greater rates of soil loss than those at low elevations. Mountain trails also loose more soil on steep slopes and from extreme freeze/thaw events (Marion and Leung, 1996).

Erosion can either be measured using permanent points or estimated using percent exposed soil. Exposed soil may either be organic or mineral. Organic soil is the first layer revealed after the herbaceous cover has been worn away. The organic layer is composed of partially decomposed organic debris. Depending on the area, this layer may be very narrow or quite thick. If organic soil is visible it is a sign that the trail is becoming more susceptible to erosion by wind, water and human activities. Mineral soils are the layers found beneath the organic layer. When a lot of mineral soil has been exposed it indicates that erosion has been occurring on the treadway over a sufficient period of time to remove the herbaceous and organic layers.

Exposed Rock. Large boulders and bedrock provide stability to the treadway due to their resistance to erosion. If bedrock is at or near the surface, soil erosion will be minimized. Rocks also help slow the downward movement of water and trap organic matter and soil on the treadway. Areas of fully exposed rock, where there is no soil or herbaceous layer remaining, hold little potential for further change and therefore are not a priority for maintenance.

Root Exposure. Exposed roots are an indicator of active erosion. When many fibrous roots are visible along the treadway it indicates loss of herbaceous layer, recent ongoing erosion and possibly trail widening. With extensive and continued trampling exposed tree roots will eventually die, making the tree less drought tolerant. This may lead to the death of the tree, further decreasing tread stability and increasing the potential for erosion. In addition to environmental impacts, exposed roots are aesthetically unpleasing and make passage more difficult, possibly detracting from the visitors' experience at the mountain (Marion and Leung, 2001).

Presence of Wet Areas. The presence of standing or flowing water along a hiking trail during snowmelt or periods of heavy rain is not uncommon on a mountain system. However if this water remains in the treadway it will have long lasting impacts on the trail. Flowing water will increase the rate of soil erosion and wet or muddy soil will increase water runoff, lead to widening and the creation of secondary treads (Marion and Leung, 2001).

Average Tread Width. The standard tread width for the hiking trails at Wachusett Mountain is 4 ft. While tread width will vary depending on the trail, excessively wide treads will increase the impact that the trail is having on the ecosystem (Marion and

Leung, 2001). When a trail begins to widen, it is a sign that there is a problem in the treadway that is causing users to move out to the sides to avoid it. Most often this problem is a wet or muddy section of tread.

Secondary Treads. Secondary treads are treads formed by visitors that deviate from the main tread to circumvent a problem area, usually the presence of water. The impact of a secondary tread is similar to that of tread widening. It increases the area being compacted and decreases water infiltration and vegetative cover (Belnap, 1998). When secondary treads are present, it is a sign that there is a problem occurring in the treadway that needs management attention.

Slope. The slope of the trail will influence the extent of soil erosion and will also influence user behavior. Erosion is greater on steep slopes and steeper trails experience less use that more flat ones (Marion and Leung, 2001).

Cover Type. The dominant type of vegetation along the treadway is an important influence on soil quality and resistance to erosion. Conifer forests allow less sunlight to penetrate, suppressing the growth of an herbaceous layer and making the trail more vulnerable to erosion. Hardwood stands allow more sunlight to penetrate and potentially have vigorous herbaceous layers that act to slow erosion.

Type of Trailside Vegetation. The type of vegetation growing on the sides of the trail will influence user behavior and tread width. Dense vegetation helps prevent widening by making it more difficult to move off the designated tread (Marion and Leung, 1996). In an open forest it is much easier for users to venture off the trails, increasing the impact on the ecosystem.

Condition of Trailside Vegetation. The condition of the vegetation along the trail may be an indicator of the extent that users are impacting the trail. If there are many dead trees along the trail, it is a sign that use-related activities are impacting the system. Loss of vegetation will increase the potential for erosion. Markings on trees or other signs of human disturbance are not only detrimental to the plant, but may reduce the visitors experience at the Reservation.

Presence of Tire/Horse Tracks. Bicycles are prohibited from the hiking trails at Wachusett Mountain. Horse use has been linked to increased compaction, trail widening and the creation of informal trails (Marion and Leung, 1996). Noting their presence will help identify areas where these types of trail use are occurring.

Number of Informal Trails. Informal or social trails are those created by users off of a designated trail into a new area. These trails increase the amount of disturbance and habitat fragmentation in the ecosystem (Belnap, 1998). Any informal trails found will need to be brought to the attention of maintenance personnel so they may be closed.

Each of these indicators was tested in the field using a form of the final survey. The results were compiled and the utility of each indicator was discussed. A literature review of similar surveys in wilderness areas and campgrounds was used to help make the final decisions (Marion, 1991 and Mount Rogers National Recreation Area, 2000). Indicators that did not accurately and reliably measure trail condition were not included in the final survey.

RESULTS

All of the indicators discussed in the previous section were field-tested and their values as impact indicators were assessed. The result of this effort is the Wachusett Mountain Trail Assessment Survey (Figure 1). Of the potential indicators, seven were chosen based on their combined ability to signify trail condition; herbaceous cover, exposed soil, exposed rock, root exposure, presence of wet areas, average tread width and the presence of secondary treads. This survey is intended to be rapid, qualitative, and useful for identifying the most impacted segments at the mountain.

The survey was designed to allow managers to target and assess potential problem sections of trail. For this reason sampling is not random. Instead segments undergoing active change are targeted. These segments are chosen based on the presence of one or more "triggers" along the treadway. These triggers have been chosen because their presence is an indication that the treadway is being impacted in a way that might require attention. An assessment is required if any of the following are occurring: one or more secondary treads, newly exposed rootlets from herbaceous vegetation along the trailside, the presence of standing/flowing water or excessive mud, a sudden increase in tread width, or the presence of alluvium or organic debris along the trailside as a result of erosion or flowing water.

Once a problem area has been identified, the length of the impacted segment must be measured. The length should be measured as a straight line from the beginning of the impact to the approximate point where it is no longer occurring. To ensure that the segment will be able to be found for future surveys, GPS the beginning and end points and reference them on the survey sheet. The average width of the tread is calculated using width measurements every 5 ft. The actual sampling should also be done every 5 ft using a 1x1m grid divided into decimeter squares. The entire width of the treadway, including any secondary treads, should be evaluated.

Within the 1m grid, record the percent cover or presence of each indicator as shown on the survey form (Figure 2). In addition to measuring indicators, there are six observations that provide useful information about the impacted segment. Slope, cover type, type and condition of trailside vegetation, presence of horse/tire tracks and the number of informal trails are all recorded on the survey.

Evaluators should familiarize themselves with the procedure and indicators before going into the field. This will help save time and ensure that all surveys are being conducted as similar as possible. It is recommended that trails not be assessed during times of snowmelt or within 48 hours after rainfall, as water may accumulate in the treadway, leading to inaccurate results. Photographs of each trail segment should be taken as a record of the types and extent of impacts.

DISCUSSION

The process of choosing indicators and observations for the survey involved an extensive literature review of past assessment techniques as well as many hours of field tests using multiple staff members. Input from these sources was taken and used to select the final indicators. Each indicator included on the survey was chosen for its ability to provide information about the level of degradation or stability of the treadway. In addition, the way in which each indicator is measured was tested multiple times to come

up with a simple but accurate way to reflect the state of a segment when compared to others at the Reservation.

Herbaceous Cover. Live herbaceous cover on a trail helps prevent erosion by anchoring soil in place and slowing the downward movement of water. While herbaceous cover is usually worn away during trail construction or shortly thereafter, it was found frequently on trails at Wachusett Mountain. It is an important indicator of trail health because its presence inhibits erosion and degradation of the treadway.

Exposed Soil. Exposed soil, including both organic and mineral soils, was included on the survey as a measure of erosion. Erosion is one of the most serious impacts to a hiking trail because it is essentially irreversible. It leads to exposed roots and rocks, increased runoff, and creates an uneven and more difficult tread. The more soil that is exposed on a trail, the higher the risk of erosion due to wind, water and use.

Exposed Rock. Large boulders and bedrock, once exposed, add stability to the treadway. Rock provides a very erosion resistant surface for hikers. It may also slow the downward movement of water and trap organic debris on the treadway. A rock treadway has little potential for short-term change and therefore may not be a priority for maintenance attention. The types of rock considered for this survey are only bedrock and large boulders that cannot be easily moved from the treadway. Loose stones and pebbles are not included in the percent cover of exposed rock as they do not add stability and are easily removed by users.

Root Exposure. Exposed roots in the treadway were included as an indicator because they are a sign of active erosion. Once the roots are fully exposed they will be able to withstand a certain amount of trampling before becoming permanently damaged. This may lead to the death of the plant, increasing the potential for erosion. Fibrous roots of herbaceous vegetation are also a good indicator of widening when found along the sides of the trail.

Presence of Wet Areas. A trail that is excessively muddy or flooded is a problem that influences user behavior. Users will widen trails or create secondary treads to circumvent flooded or muddy sections of trail. This increases the area impacted by the trail and also makes passage more difficult. Including this indicator on the survey pinpoints wet and flooded segments so they may be corrected before any secondary effects occur.

Average Width. The standard tread width for trails at Wachusett Mountain State Reservation is 4ft. Trails in excess of this might be experiencing use-related problems. Widening usually occurs when there is an obstacle in the treadway that causes users to move out to the sides of the trail. By monitoring the average width over time, managers will be able to recognize if the tread is becoming wider, indicating a problem that might require attention.

Presence of Secondary Treads. Like widening, the presence of a secondary tread indicates a problem in the treadway. Secondary treads are formed when users attempt to avoid a problem in the main treadway. Frequently this is a wet or muddy tread, but may also be a tree or other object preventing proper movement along the marked trail. Secondary treads may also be formed near confusing trail markers or in difficult sections that have an easier alternative route for people to hike through. By noting secondary treads, managers at the Reservation will be able to identify potential problem areas.

In addition to the seven indicators, six observations have been included in the survey. Observations are factors that may influence the extent or type of the impacts discussed above, but are not indicators or measures of the impact itself. These categories were considered and tested as potential indicators but are not included in the final segment rank. Although they are not measures of trail health or stability, they are important to include as influences on the extent of trail related impacts. These observations help give a clear picture of the area that is being considered for remediation.

Slope. Slope was included as an observation because it influences erosional rates. Steep trails have higher rates of runoff than those with a more gradual slope (Marion and Leung, 2001). If a segment on a steep slope is found to have a high amount of exposed soil, this may take priority over a similar segment on flat ground.

Cover Type. The dominant type of canopy vegetation along the trail will have an effect on the extent of an impact. Trees and other vegetation help anchor the soil, preventing erosion and slowing water runoff. It also influences the type of vegetation found in the understory and herbaceous layers due to amount of available sunlight and nutrient content of soil. Erosional rates differ between coniferous and hardwood forest types, making cover type an important observation.

Type of Trailside Vegetation. Trailside vegetation influences user behavior by restricting the creation of secondary treads, informal trails and widening. Dense vegetation will prevent users from moving off the designated tread, reducing impacts to the surrounding area (Marion and Leung, 1996). Some types of vegetation are more resistant to trampling than others. Noting the type of vegetation found along the trail gives managers an idea of how resistant the treadway is to trampling and widening.

Condition of Trailside Vegetation. The condition of vegetation along the trail will influence tread stability as well as the aesthetic properties of the trail. Many dead or dying trees will increase the potential for erosion. Carvings or other signs of human disturbance to vegetation will take away from the aesthetic value of the hiking experience.

Presence of Tire/Horse Tracks. Bicycles are prohibited from the hiking trails at the Reservation. Horses, while allowed on some trails, have a greater impact than either hikers or bikes. They cause increased compaction and erosion, making passage more difficult. Noting where these types of uses are occurring may help explain the severity of indicators listed on the survey.

Number of Informal Trails. Informal, user-created trails unnecessarily increase the area disturbed by the network of hiking trails. They fragment habitat and allow users easy access to fragile areas. The presence and location of an informal trail is important to note so that it may be closed to prevent unnecessary habitat fragmentation and loss.

Leaf Litter. Leaf litter was considered as an indicator, but was not included in the final survey. While litter may play a role in preventing some soil erosion, it is usually only temporary. Litter is easily and quickly worn away and therefore cannot be relied on as an indicator of trail degradation.

Measuring Indicators

All of the above indicators are ranked using a class system that ranges from 0-4. The classes vary by indicator and the lower classes indicate more stable or less degraded trail segments. Segments that have a low score will be considered “healthier” and will

probably not be a high priority for maintenance efforts. Herbaceous cover, exposed soil and exposed rock are all measured in percent classes with 20% increments. These increments are easy to estimate without the grid and still provide accurate and useful results (Marion, 1991). Herbaceous cover and exposed rock have the same class system that ranges from 0=80-100% cover to 4=0-19%. These classes were chosen because the more herbaceous cover or rock present in the treadway the more erosion resistant it is. If the segment is resistant to erosion than it is unlikely to require immediate attention. Exposed soil is ranked in similar classes but ranges from 0=0-19 to 4=80-100%. This is because as more soil is exposed in the treadway erosional rates may rise, making the segment more impacted.

The remaining indicators are all ranked in three classes with values of 0, 2, and 4. Root exposure is difficult to measure and classify by percent class so it is estimated as either none/slight, moderate or severe (Marion, 1991) (Figures 3,4,5). Root exposure is considered severe when most of the treadway is covered with large woody and/or small fibrous roots. Fibrous roots of herbaceous vegetation are especially sensitive to trampling and so would be classified as severe at lower coverages.

The presence of wet areas can be classified as not present, excessively muddy or flooded. A segment has no wet areas present when the soil is dry or simply moist. Excessively muddy is when the treadway is definitely wet and unstable to walk on but contains no standing or flowing water. Flooded is the presence of standing or flowing water in the treadway (Figure 6).

The standard maximum tread width for trail at Wachusett Mountain State Reservation is 4 ft. For this reason any trail with an average width up to and including 4 ft is considered an acceptable width and is classified as a zero. Trails slightly in excess of this (4-6 ft.) may be showing signs of a potential problem and are classified as a two. Trails over 6 ft wide are considered highly impacted and are classified as a four. The reason for measuring the length and width of the treadway in feet is that all DEM divisions use feet as their standard unit of measurement. The Resource Management Protection Plan uses feet to denote the maximum tread width, and so feet were retained as the unit of measurement for length and width. To conduct the actual sampling a meter grid is used so that the data may be more comparable with other scientific studies.

While the presence of even one secondary tread indicates a problem in the treadway, more have a greater impact. Segments with multiple secondary treads may have a more pervasive problem than segments with only one. For this reason a segment will receive a zero for no secondary treads, a two for only one secondary tread and a four if there are two or more. This helps account for the severity of the problem occurring in the treadway as well as the impact of the treads themselves.

Data Processing

Once all samples have been taken for a single segment, average the percent cover of each indicator by sample if necessary. Average these samples to get the total average percent cover for the indicator. Assign a raw score to the indicator based on the percent coverage class (0-4) listed on the survey form. Sum all the individual raw scores to yield the overall raw score for the segment (range 4-28). This raw score will be used to rank the segment relative to all the others assessed.

Using Microsoft Excel enter the segment name, length (ft.), average width (ft.), area ft^2 (length x width), and overall raw score for all assessed segments. Perform a data sort by raw score (descending) then by area (descending). This yields a list of segments from most impacted to least. By numbering these consecutively from 1 (highest raw score) through the lowest score, a list is formed of all the assessed segments (appendix I samples 1&2). This list shows how the segments ranked relative to one another. This list will be used to identify potential problem areas where maintenance time and money should be placed. By examining the assessments, managers can compare problem areas and make recommendations as to the appropriate actions to take for each segment.

CONCLUSION

Impacts to hiking trails are important to study for a variety of reasons. Severely impacted trails affect the quality of the ecosystem and may decrease the visitor's experience. As the popularity of Wachusett Mountain State Reservation increases, the trails will be subjected to more use-related impacts such as erosion, root exposure, trail widening, and trampling of vegetation. As the trails receive more use, it will become increasingly important to protect their integrity through regular maintenance and monitoring. The Resource Management Protection Plan for the Reservation calls for annual assessments of all hiking trails. By measuring herbaceous cover, exposed soil, exposed rock, root exposure, presence of wet areas, average tread width and the presence of secondary treads this survey not only provides that assessment, but a ranking of how each segment compares with others. This trail assessment survey gives managers at Wachusett a tool for prioritizing trail segments in order from most impacted to least. This will help concentrate time and money into areas where it is needed the most, as well as monitor and record the state of the trails over time.