Abstract
The goal of this project was to create a comprehensive map of the walking and hiking trails in the greater Waterville area. We mapped 48 miles of trails and off-road Kennebec-Messalonskee Trails using hand-held GPS units. We overlaid these routes on satellite images of the Waterville area. Included in the map are trail head parking areas and major street names to facilitate navigation to trail heads. A table of trail lengths also was compiled.

Introduction
The mission of the Kennebec-Messalonskee Trails organization is to "promote, build, and maintain recreation and fitness trails along our waterways, connecting the communities of Waterville, Winslow, Benton, Fairfield, and Oakland. This is a multi-faceted effort to improve the health of our community, embrace our historic river heritage, provide a model of regional cooperation, and attract attention to the aesthetic and economic values represented by our clean and reborn rivers."

The KM Trails organization requested assistance in revising their current trail brochure of the Waterville area walking and hiking trails. KM Trails currently is expanding their network, and is involved in the planning and construction of several new trails. These trails also were included. Working with KM Trails, the goal of this project was to create an updated and more accurate trail map of the greater Waterville area. This was accomplished by walking, running, or biking each trail while recording the track on a handheld GPS. In the final brochure, each trail also will have an associated description including trail length, estimated walking time, trail difficulty, hazards, and scenery.

Methods
Using the original Kennebec Messalonskee trail map, existing trails were located and mapped with two Garmin GPSMAP 60 hand-held GPS units. Planned trails and trails under construction also were mapped with the GPS units. Data points were taken every ten meters. These data were downloaded from the GPS units into ArcGIS (ESRI, 2010) and overlaid onto a two-meter resolution satellite image of the Waterville, Oakland, Winslow, Benton, and Fairfield areas. Data for Colby Trails (Renwick, 2007) also was overlaid. Trail tracks were then edited in ArcMap. Existing roadway footpaths were digitized as a separate layer based on roads in the satellite images and the original trail map. Major road names and parking areas were added to the map. Trail distances were measured in ArcMap. The entire map was projected using NAD1983, UTM Zone 19N.

The map was put into a GoogleEarth interface and uploaded to the Kennebec Messalonskee Trails website, www.kmtrails.org. This map is interactive, allowing users to attain more detailed information and directions. It also will eventually be made into a brochure for distribution, and can be viewed currently at www.colby.edu/environ/courses/ES212/AOM10/AOM_projects.htm.

Results
The final trails and footpaths map is displayed as Figure 1. Inset maps for the Quarry Road and Messalonskee Stream Trails and the Airport Loop, Thomas College, and Waterville Junior High School Trails are displayed as Figures 2 and 3, respectively. Trail distances, in miles, were measured (Table 1). Numbers on map correspond to trails listed in Table 1.

Discussion
In the processes of developing this map, we confirmed that many of the trails in the existing brochure were inaccurate. Our map increases the accuracy of the trail system and adds new, previously unmapped trails. However, there are limitations inherent to this study. For instance, the GPS units are accurate only to ten meters and frequently lost their signal in densely wooded areas. For example, the two GPS units commonly displayed different tracks in ArcGIS for the same trail (Fig 1). Thus, some interpretations of trail routes were made in ArcGIS.

Additions and revisions to this map may be necessary in the future, pending further trail development by the KMT staff.

Conclusion
We developed a clear, high-resolution map of the Kennebec Messalonskee Trails for public use. Original unclear maps were refined to more accurately display the trails. Trails are now easier to find and use. Happy trails!

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