



A Trail Plan for Downtown Williamstown's Christmas Brook

by Lauren Goldstein-Kral, Alex Elvin and Andrei Baiu

Williams College – Environmental Planning (ENVI 302)
Prof. Sarah Gardner

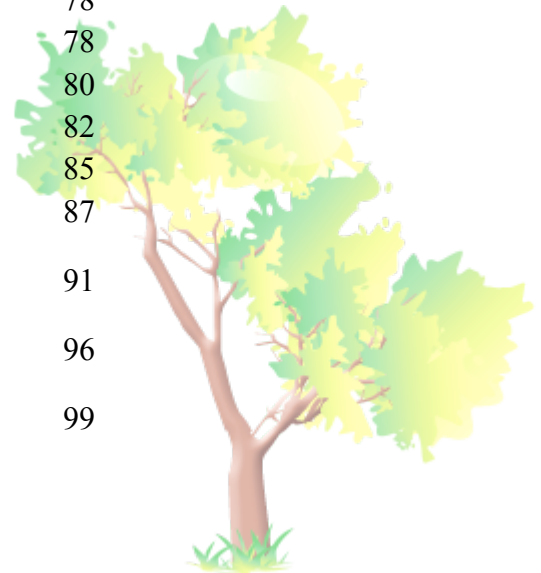
20 December 2010





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INTRODUCTION

Denison Park, owned by Williams College, is a 16-acre area surrounding Christmas Brook and extending from Latham Street to the Taconic Golf Club (Figure 1). Including a woody swamp (as classified by the Massachusetts Department of Environmental Protection¹), it is home to many plant and animal species, and could



Figure 1 – Site Location (for larger map see Appendix

potentially become a valuable asset to Williamstown and surrounding communities. It is adjacent to the Weston Field outdoor athletic facilities at Williams College and immediately south of Williamstown's main shopping district, Spring Street, which makes it an attractive location for casual outdoor recreation.

Currently, the area is densely overgrown with invasive plant species. Our proposal focuses on removing these invasive species and reintroducing native ones. Doing this will create a stronger and healthier natural environment that supports local wildlife, and will also facilitate recreational activities such as walking, skiing, snowshoeing, ice skating and bird watching. Re-establishing and monitoring a native plant community would also offer local schools a valuable educational resource. In addition to our vegetation recommendations we propose adding trails and various amenities to the Christmas Brook area.

¹ "DEP Wetlands (1:12,000) Change." Office of Geographic Information (MassGIS). Massachusetts Department of Environmental Protection Wetlands Conservancy Program, 2005.

Our clients for this project are David F. Fitzgerald, Horticulturalist for Williams College, and Henry W Art, Professor of Biology and Environmental Science also at Williams College. The two major goals they indicated for this project are for us to inventory the invasive species in the area and create and present a proposal for land use.

In approaching this project, we identified several major stakeholder groups in the Williams College and town communities. The stakeholders associated with Williams College are College Facilities, the Outing Club, the Chaplain's Office, Campus Safety and Security, the Oakley Center, and the Athletic Department. Those groups associated with the town are the Williamstown Public Works and Spring Street businesses. The Taconic Golf Club is associated with both the town and college, since it is owned by the college, but governed by a board of directors.

Our final proposal was developed within the context of: stakeholder interest; consideration of ecological impact and benefits; community interest, which was determined based on statewide data and the results of surveys that we conducted; various regulations, including those of the Massachusetts Wetland Protection Act and Rivers Protection Act; technical considerations involving the terrain, hydrology and soil properties of the project area; projected educational value; and cost (although our clients indicated that cost was not a major concern). Ideas and perspectives were gathered by interviewing representatives from each stakeholder group, experts from the local community, and Williams College faculty and students.

SITE TOUR

To the south of our site, the stream flows through the Taconic Golf Club and empties into a man-made pond (Figure 2). The southern edge of the pond is lined with artificial wetland, and provides habitat for many animal species. On just one visit to this area, within ten minutes we sighted a great blue heron, a muskrat carrying a small fish, and three species of duck. At its northern edge, the pond empties through a flood valve and the stream continues. The pond marks the southernmost boundary of our site. Just to the northwest of the pond is a small area of dense forest (Figure 3).

In the southern half of the site, the area around the stream is densely overgrown with invasive honeysuckle (Figure 4). The eastern side of the stream here branches into many small tributaries.

To the west of this part of the stream the terrain slopes steeply upward and meets a large, sloping



Figure 2 – Pond



Figure 3 – Forest



Figure 4 – Honeysuckle

meadow (Figure 5). This meadow is owned by Williams College and occupies about 4 acres. On the eastern edge of the meadow is the Oakley Center (also owned by the college) and on the western edge are several private residences. Water runoff from the meadow flows through two small ravines that connect and join Christmas Brook.



Figure 5 – Meadow

In the northern half of our site the undergrowth is less dense, but still difficult to walk through (Figure 6). In November, a few areas on either side of the stream were heavily saturated, including several pools of standing water ranging from about 8 to 20 feet across at the widest point. Closer to Latham Street, the stream again branches several times and is joined by a smaller stream flowing from the west.



Figure 6 – Woodland

The site also includes Williams College maintenance facilities (Figure 7). These are located in a relatively large and visible clearing in the north part of the site,



Figure 7 – Agway Lot

which is elevated above and to the west of the stream. There are three large barns in the

clearing, which were built in 1977, 1979 and 1984, and referred to collectively as the “Agway” barns. They are currently used for the storage of road sand and salt, building materials, and other maintenance supplies. There are two dumpsters on the site that are used for recycling (Figure 8). There is also a gate on the property that was built in 1984, and a chain link fence runs along Denison Park Drive. The fence is covered with an opaque green material that conceals the area from Denison Park Drive, but one of the barns and some other structures are still visible from Spring Street. The college invested in a cleanup of the site in 1991 and made improvements to the sand and salt storage structures in 2004.²



Figure 8 – Dumpsters



Figure 9 – Meditation House

Near the middle of the site, on the eastern side of the stream, is a small stone building that is used by Williams College as a meditation house (Figure 9). This building was originally a spring house, and is sometimes called Denison Spring House. It appears in the earliest maps we have seen of the area,



Figure 10 – Art

² Williams College Facilities

and may have been built as early as the 1700s.³ In the late 1990s it was renovated by a student at Williams for the purpose of

meditation. A piece of public art hangs on a tree in front of the meditation house (Figure 10). Next to the meditation house is a wide path that leads from Weston Field to the Agway lot (Figure 11). This path crosses an old stone bridge over the stream (Figure 12).

Located between the meditation house and Latham Street are the poured concrete remains of a larger structure (Figure 13), which may have been associated with an earlier pond along Christmas Brook. In addition to various concrete remains, garbage ranging from cigarette packs to bicycles and tables can be found throughout the site, as well as old, rusty fences that no longer serve any purpose (Figure 14).



Figure 11 – Existing Path



Figure 12 – Existing Bridge



Figure 13 – Concrete Remains

³ See appendix

The stream enters a culvert under Latham Street (Figure 15), and travels underground through a pipe until it emerges again at the Green River below Water Street. Along Latham Street a chain link fence limits public access to the stream.

On Denison Park Drive, just west of the American Legion building a dirt path provides access to the project site (Figure 16). It crosses over a narrow tributary that collects runoff from a meadow and the area around the college Health Center to the west.



Figure 14 – Rusted Fencing



Figure 15 – Culvert



Figure 16 – Site Access

SITE HISTORY

Before the 1700s, Christmas Brook probably supported healthy vegetative wetlands and various forms of wildlife. Originally it was called Phebe's Brook, after Phebe Holmes,⁴ who in the 1700s lived in a cabin near where the brook began, on land owned by John Denison II.⁵ Phebe's Brook probably included a pond just south of Latham Street, and was joined farther north by water flowing from Walden Cold Spring on Spring Street (Appendix 11). The pond south of Latham Street was likely man-made, and the remnants of dams along the brook may indicate exactly where it was. The brook has changed its course over time, most likely due to human and natural causes.

In the early 1850s, the land east of Spring Street, which included Phebe's Brook, was purchased by Williams College under the direction of Professor A. Hopkins. A wooden gymnasium was built in the north part of the land, and a baseball field in the south (now Weston Field). A park was created on the hillside below where Driscoll Dining Hall now stands, which incorporated Christmas Brook (Figure 17).⁶ This project is recounted in *Williamstown: The First Two Hundred Years* by R.R. Brooks:

To carry out the park effect a stone dam was built, and the water of the brook allowed to flood the lower part, forming a small lake about 200 by 80 feet with a little island in the middle. Overhanging elms shaded one side and pine trees were planted on the shores, a few of which still survive. The name Christmas Lake was given to it by Professor Hopkins in 1875. It was a very pretty spot in summer and attractive in winter as a skating pond. (Brooks)

⁴ Perry, 1894

⁵ Danforth, 1895

⁶ Brooks, 1953

Although it was a popular place on campus, by 1889 the lake had become neglected and lost much of its charm. A sewer line had been laid across the bottom of the lake, which made winter skating unsafe, since the water below the ice flowed out through the pipe. Construction of the sewer line also created a depression on the northern shore of the lake, which was filled in unattractively. By 1953, the lake had finally been drained and filled in completely.⁷ In the early 1960s, when the college hockey rink was built, Christmas Brook was redirected into an underground pipe, leaving only the section of the stream south of Latham Street exposed. Over the years, what remains of Christmas Brook, obscured by undergrowth and recently fenced off from Latham Street altogether, has become a somewhat forgotten part of the Williamstown landscape.



Figure 17 – Christmas Lake in late 1800s

⁷ Brooks, 1953

PROJECT BACKGROUND RESEARCH

Weston Field Restoration Plan

Despite its long history with the college, the Christmas Brook site has fallen largely into disrepair. This has not gone unnoted by Williams College Facilities, but the sensitive nature of wetlands areas has pushed development away from the site. Indeed, despite encompassing the entirety of the Christmas Brook channel, the recently green-lighted Weston Field renovation plans do not propose any changes to the vegetated area our clients are concerned with. Quick staff turnover and relatively short institutional memory has contributed to the lack of interest in any kind of redesign project.

In some ways, however, the Weston Field project indirectly serves the Christmas Brook restoration. As part of the renovations, a parking lot adjacent to the river will now be relocated, and replaced instead with a grassy area, a potential location for field events like shotput. This will remove some of the imperviousness inside the Brook's riverfront area. The plan currently includes some replanting as well, though not to the extent or scale intended in this project. In terms of flood control, the current renovation plans will not affect watershed in any way, with planners choosing not to add water – thus increasing flood problems – nor remove water – potentially affecting downstream habitat.

According to Jason Moran, Project Manager for the Weston Field restoration, the Agway Lot located on the west side of the stream has been considered as a potential expansion site for athletic facilities. The decision, he said, rested on whether the architects in charge of the plan had enough space to provide all of the facilities required by the coaches at Williams. Moreover, if the Agway Lot were relocated, crossing the stream to reach it from Weston Field would

present a challenge due to the sudden changes in elevation encountered when moving east-west across the waterway. Mr. Moran mentioned that one possible connection to the Agway Lot sought by Facilities would have been to add a suspended bridge that would link the stream's high east bank to the even higher Agway Lot without affecting the stream borders in any way.

Williamstown Public Works

As of February 2010, the Williamstown Department of Public Works has filed a notice of intent to the Williamstown Conservation Commission for a "Proposed Culvert & Related Work" (Department of Public Works, 2010). The plans would replace the current culvert – which has a capacity of 140 cubic feet per second – with one capable of handling a 100-year-storm – approximately 640 cubic feet per second in this case, assuming the proper functioning of the Taconic Crest Golf Course collection pond dam. This project does include some tree cutting, and the reconstruction of the entire flood wall associated with the present culvert. The current guardrail and fencing will be temporarily removed, and replaced once the culvert and roadway are repaired. None of these changes will affect our proposal; however, the construction of an enlarged culvert will ensure that the stream will not continue to flood and cause damage further down Latham St.

RESEARCH RESULTS

Statewide and Local Demographics

An overview of local demographics and broader statewide trends provides a general context for this project. According to the 2000 US Census, Williamstown has 8,424 residents, which include about 2,000 Williams College students.⁸ It is the fourth largest town in Berkshire County.⁹ The median age is 36, with 28 percent of the population between the ages of 18 and 24. Fifteen percent of the population is disabled, compared a national average of 19 percent (disabled access is something we considered in developing our trail proposal, but finally had to abandon due to the limitations of the terrain). Williamstown residents have higher than average education levels, with 89 percent having graduated high school and 54 percent of residents 25 and older having a bachelor's degree or higher. This suggests that an educational component of the restoration of Christmas Brook would be welcomed and appreciated by the community. 26 percent of people in Williamstown above the age of 16 walk to work, compared to a national average of 2.9 percent, suggesting that the walking itself is a popular activity in Williamstown, and that the use of a centrally located recreation area in Williamstown would be higher than in many other parts of the country.

The 2006 Massachusetts Statewide Comprehensive Outdoor Recreation Plan (SCORP) indicates statewide trends in the use of public recreation areas. Data from this report, in addition to the surveys we conducted locally, helped us determine which amenities would be most

⁸ Town of Williamstown

⁹ Wikipedia

appropriate to include in our proposal. According to the report, in recreation areas associated with rivers and streams, the most popular activities were sightseeing, tours and events; picnicking; watching wildlife and conducting nature studies; and walking (Appendix 2). The report also indicated which amenities were most needed in which areas of the state. In the Berkshires, new facilities for picnicking, biking, skiing and walking were the most needed (Appendix 3). With the exception of biking, which often has a negative ecological impact on natural areas, our proposal incorporates all of the activities in the SCORP report that more than 4 percent of respondents said they used or would like to use but are unable to because of the lack of adequate facilities. The SCORP report also found that “Proximity appears to determine the frequency of visits,” which further supports the possibility of having outdoor recreation facilities in downtown Williamstown.

Research Tools

Much of the early part of the planning stage involved assessing the needs, concerns and suggestions of the public, stakeholders and experts. For individuals, this information was gathered using a series of semi-guided and guided interviews (depending on the importance we placed on specific, detailed information from a particular source) of staff, faculty, students and outside sources. Many of the interviews were in-person, and usually involved sending questions ahead of time via email along with a brief project description for convenience. Where an personal interview was not possible or practical, phone and email interviews were used instead. With few exceptions, the interviews have revealed a lot of support and interest in the project.

Initial stakeholder interviews were designed to gather information that may restrain or expand our planning. Whether this involved specific concerns of safety, cost or legislation, or

merely suggestions for potential use, we used these interviews to directly inform our plans. As our research identified more specific areas of concern, we began interviewing experts in relevant fields, as well as seeking out case studies that might compare to our site considerations. Many of the interviews provided us with specific information and are therefore referenced throughout the paper. For two sets of sample interview questions, see Appendix 4.

In contrast to the interviews, public opinion was gathered using brief surveys which assessed the use and needs of outdoor recreational spaces in Williamstown. For a sample survey, see Appendix 7. The surveys were administered over a period of three weeks at a variety of locations around Williamstown and Williams College. All surveys were filled out on the spot, with facilitators standing close by. This ensured a higher response rate and gave the surveyed public a chance to ask questions regarding the survey or the site. Facilitators presented the project briefly, along with the survey and a map of the area in question. In the attempt to avoid selection bias, surveyors approached participants randomly. In order to approximate the makeup of Williamstown, the locations were chosen to include areas at which Williams College students do not make up the majority of the public.

Interview Results

Information obtained from our interviews has been referenced freely throughout this study. A full list of all persons interviewed can be found in Appendix 5, while a summary of selected stakeholder interviews are located in Appendix 6.

Survey Results

Surveys were collected at a number of locations including Tunnel City Coffee Shop, Paresky Student Center, the Spirit Shop on Cole Ave., the Williamstown Public Library as well

as a number of Spring St. businesses. A total of 77 surveys were collected. For full, detailed results, see Appendixes 8 and 9. Our survey did not perfectly match the town's demographics, but it should provide useful information regarding the population that commonly utilizes the downtown Williamstown area.

Some notable aspects of our demographics are that 34% of those surveyed were Williams College students – in this case an overrepresentation of the population of the town. Another important fact is that 62% live within a 15 minute walk of downtown. Thus, this sample may have a bias towards using a resource located in the downtown area (although it is uncertain what proportion of the Williamstown population at large would be included in this percentage). Our survey oversampled the age group of 44-64-year-olds, skewing the distribution away from the 65+ group. The sample was also weighted towards women, as 66% of the participants reported their sex as female.

Our survey asked participants to check amenities that they hoped to see added or improved to the downtown Williamstown area from a list. Moreover, participants could enter in original responses under an "Other" category. Our results indicate that a strong interest (>50% of respondents) in seating areas, picnic areas, nature walks, as well as a community garden. Along with the other suggestions listed in this question, this information was used to motivate the amenities included in our plan.

The next questions regarded predictions of future use. The first such question asked participants to estimate how often they would utilize a nature walk located a few minutes away from downtown Williamstown. The average response on our 1-5 scale was a 3.5, indicating an intention to use the site once every 3 months or so. If we assume that our survey was perfectly

representative of the total town population of 8424, 4 trips a year would amount to just over 90 trips a day. The following question asked participants to predict frequency of use of an outdoor skating rink. The average response on this 1-5 scale was a 2.6, somewhere in between once per season and once per month. According to an outdoor skating rink in Cambridge, MA, outdoor skating seasons last anywhere between 15-50 days. Even assuming an average 30-ice-day season, and use of the rink only once during the whole season, this would indicate over 100 visitors a day. While issues with representativeness have been delineated clearly above, we feel that these numbers are still a good indication of a large proportion of the town and point to a desire for centrally-located outdoor recreation.

While conducting the surveys, we spoke to employees at several shops on Spring Street, all of whom were enthusiastic about the possibility of there being outdoor recreation space in the downtown area. Several of those employees were concerned that handicapped-accessible areas in Williamstown are too few and that teenagers have too few opportunities for local recreation in general. The owner of “Where’d You Get That,” Michelle Gietz, was especially supportive of offering visitors to Spring Street more options than just shopping and eating. She mentioned the town’s previous efforts to construct an artwalk connecting Spring Street to the Clark Art Institute via Agard House, (a Williams College dormitory). The artwalk had been proposed a few years ago by members of the public, but did not have the support of Williams College, and was never built. Mrs. Gietz liked the possibility of incorporating public art into the downtown area, since Williamstown already draws many visitors to its museums and local art galleries.

Hydrology

The Christmas Brook watershed encompasses about 600-800 acres¹⁰ between Stone Hill and the Green River. It includes various non-perennial streams that collect runoff from nearby hills and meadows. Although most maps indicate that Christmas Brook is a simple, unbroken stream, the actual picture is much more complex (Figure 18). The stream branches into many tributaries, and within Denison Park is joined by two smaller streams from the west. We observed the stream in late November; however, the presence of small ravines and crevasses throughout the site indicate that in the spring, when water flow is heavier, the stream becomes even more complex and occupies more

Elvin, 2010

Figure 18 – Christmas Brook's Complex Hydrology – For larger version, see Appendix 14

space.



An important consequence of having such a large watershed is the flooding that takes place at the northern-most end of the site, at the Latham St. culvert. Classified as statistical 2-year floods, the events occur more frequently; heavy rains and snow melt can inflate the stream from just a few inches to several feet in depth. The current culvert, which can only handle 140 cubic feet per second when clear of debris, often backs up, sending flood water over the floodwall and onto Latham St. and residences east of our site. Due to various regulations, alterations to the flood plain or watershed are not possible and will not be attempted by this project or the Weston Field Project.

Soil Properties

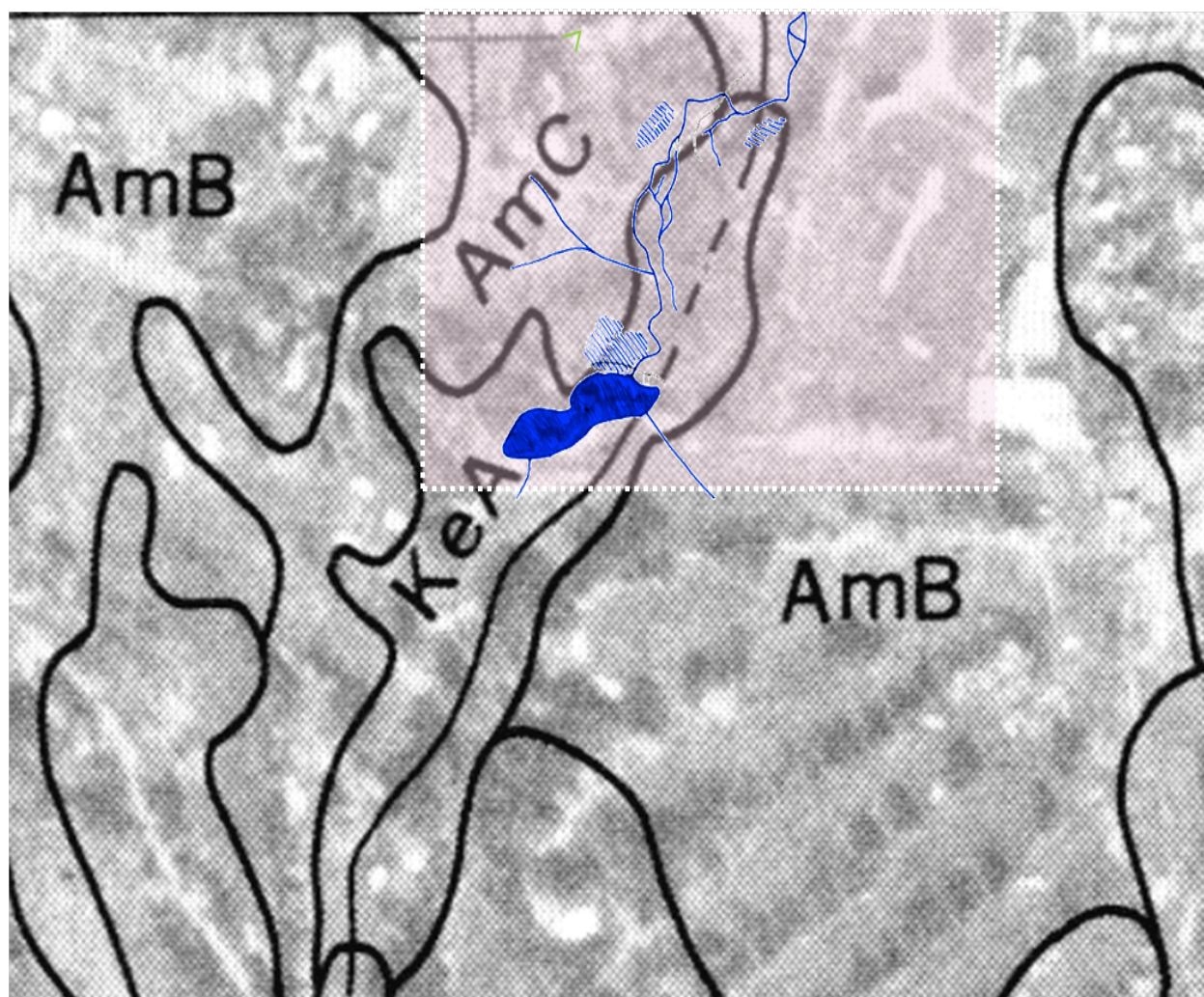
The United States Department of Agriculture conducted a comprehensive soil survey of Berkshire County in 1988. According to the survey (which remains relevant, since soils change very slowly) our project site is composed of two soil types (Figure 19). The soil along the banks of the stream is considered Kendaia silt loam, or KeA. According to the survey, “This is a nearly level, very deep, poorly drained soil in small depressions and in areas around drainageways” (45). In winter and early spring, the water table below KeA soils can rise to the same level as the soil surface, making the surface difficult to walk on. The properties of KeA soil can help determine which plants should be added to the project area:

The root zone is restricted by the seasonal high water table in early spring and by the firm substratum below a depth of about 26 inches . . . This soil is well suited to grasses and legumes for hay and pasture. Drainage is needed, and water-tolerant plants produce the highest yields. (USDA, 1988)

The soil around the Agway Buildings, which is located at a higher elevation, is classified as Amenia Silt Loam, or AmC. According to the NRCS, “This is a sloping, very deep, moderately well drained soil on the sides of drumlin-like glacial ridges.” Also, “This soil is fairly well suited to cultivated crops.” The depth and chemistry of AmC soil and its suitability for cultivated crops make the Agway Lot attractive as a potential site for a community garden. However, since development has occurred on the lot, and many different materials have been stored there, more current soil samples would be needed to determine the agricultural suitability of the area. AmC soil is also well suited to trail building. A trail built in AmC soil would provide a firm, dry walking surface and could be made to efficiently shed water.

USDA Soil Conservation Service, 1988

Figure 19 – Christmas Brook's Soils with Superimposed Waterway



Trail Construction

If a trail is built in the right location and with the right methods, it can last indefinitely with minimal maintenance.¹¹ American Trails, an online trail building resource, offers detailed procedures for building trails in various types of terrain. The location of a trail along Christmas Brook would be limited by the hydrological features of the stream and by the local soil properties. It would most sustainably be built into the hillside west of the stream, where the ground is drier and more stable. Hillside trails can be built entirely by removing material from the hillside. This is called “all in cut” and requires the addition of no new material. Trails not built into a hillside should include grade reversals every 100 feet so that water can run off the trail. Casual walking trails should remain relatively flat (American Trails recommends an average trail grade of 10 percent) while including natural curves that make the trail more interesting. Hillside trails that follow the natural contour of the terrain will remain flat while also including curves. Destinations also make trails more interesting.

Where trails cross bodies of water, additional structures are needed. Bridges allow the trail to remain flat over water crossings, and so are more desirable. When the body of water is narrow, a single unit timber bridge may be all that is needed. These bridges can be built quickly and for a relatively low cost. We recommend including handrails to increase safety. According to American Trails, “the lowest part of the bridge should be 5 -10 feet above the highest flood level.” Stepping stones are another option for crossing small bodies of water. This is a low-cost solution and would provide extra recreational enjoyment. Since the tributary we envision a trail crossing is very narrow, more than one stepping stone may not be necessary. However, since the

¹¹ American Trails, 2010

ground immediately on either side of the tributary is very steep, wooden or stone steps would be required to prevent erosion and mitigate the sudden grade increase.

We recommend that trail building be overseen by the Williams Outing Club (WOC), which has previous experience with building trails in the Williamstown area. Benjamin Keulthau, Student Assistant Trail Manager at Williams College, suggested that trails around Christmas Brook could be built by Williams students, and that a trail of the size we envision could be completed in a couple of weeks. He feels confident that students will be enthusiastic about volunteering their time and labor to build a new trail. Scott Lewis, Director of WOC, cited past examples of student projects involving bridge and trail building in the area.

All of the options mentioned above will require the approval of the Williamstown Conservation Commission, which would determine whether the tributary lies within the wetland area, or is considered non-jurisdictional. The Conservation Commission would also determine the ecological impact of other structures we propose adding to the area. ¹²

Law and Policy

Jason Moran, Project Manager for the Weston Field restoration project, stated that their project would involve "staying as far away from [Christmas Brook] as possible," due to the restrictive legislation surrounding wetland and riparian land regulation. Indeed, these laws will be the most restrictive factor of the Christmas Brook restoration plan as well. According to the Massachusetts Department of Environmental Protection (Mass DEP), the area commonly referred to as Christmas Brook is considered a mix of hydrologic connections and wooded swamps. As this connection is perennial, it is designated a stream under the Wetlands Protection

¹² Jeff Kennedy

Act (WPA), part of the General Laws of Massachusetts. According to the Rivers Protection Act (RPA), a 1996 amendment to the WPA, for a town of the size and population density of Williamstown, a Riverfront Area extending 200 feet in either direction from a stream's high water mark will be protected from damaging modification and encroachment (Figure 20). Furthermore, the WPA ensures a 100-foot buffer zone extending from the edge of wetland vegetation. Within these buffer zones, any development must not interfere with the "protection of private and public water supply, protection of groundwater, flood control, prevention of storm damage, prevention of pollution, protection of land containing shellfish, protection of wildlife habitat, and protection of fisheries"¹³

Given Christmas Brook's wide flood valley, its buffer area is fairly large. While the Mass. DEP currently considers the stream to be dispersed in the areas of wooded swamp, simple



Figure 20 – Christmas Brook's with 200-foot RPA Riverfront Area in Pink

observation will indicate that the stream continues to run in a fairly channelized form even in these swampier areas. As the bordering wetland vegetation does not extend more than 100 feet away from the high water mark, the 200-foot buffer will overlap the 100-foot wetland buffer in all cases, varying only with the width of the stream's flood plain. As the stream approaches the

¹³ Mass. General Law, 1996.

flood wall at Latham St, this flood plain becomes increasingly large, encompassing part of the parking lot to the east and over half of the river-side Agway Lot.

In the present case, WPA and RPA regulations imply that our plan cannot include dredging of the current streambed, modification of banks, removal or addition of watershed, addition of impervious surface or interference with flood plains. This will mean that on one hand, trails and benches, if properly located, will be exempt from the legislation as they will not add to the imperviousness of the ground. Removing large swaths of invasive plants will necessitate an Impact Statement as well as notification of intent and approval of the Williamstown Conservation Commission. Given the positive impacts of replacing invasive species with native ones, this will likely not be problematic.

On the other hand, building bridges to cross the brook will be quite difficult as most bridges involve some bank modification. The existing bridge – a remnant of the Brook's more manicured past – as well as the Meditation House – likely one of the oldest buildings in the Williamstown downtown area – are both exempt from WPA and RPA regulations as they have been in existence long before the laws were written. The same is true of the concrete foundations and barbed wire fence located in the north of the site. According to the WPA, current work may involve "maintaining, repairing or replacing, but not substantially changing or enlarging" these structures. While this would mean that the small bridge next to the Meditation House will be repairable, it also implies that removing the concrete foundations may require special consideration, as its close location next to the stream might make removal difficult.

By contrast, the Agway Lot is a legal uncertainty. While the lot was established after the WPA came into effect, its buildings are not covered by the 100-foot wetland buffer. The 200-

foot river buffer does, however, include the eastern-most building, and part of the large central building. This also includes a number of large industrial dumpsters containing college refuse ranging from electronics and furniture to old mattresses and trash. While the RPA does have several exemptions regarding storage and dumping, it is uncertain whether the current conditions are entirely legal. At best, the location of dumpsters within the buffer zone is not ideal for a wetland area and should be investigated regardless of the outcome of the present proposal.

The numerous, unmapped tributaries of Christmas Brook at our site present further legal uncertainty, as in the absence of a site tour by the Conservation Commission, it would be impossible to determine whether they fall under regulatory standards. It is possible that the currently identified tributaries are seasonal; similarly, further investigation could identify other ephemeral tributaries which were not apparent during our study period. Regardless of their designation, it would be in the interest of our plan to interfere with flow as little as possible.

Legislation has also informed our conception of the stream as an important habitat. In 2001 and 2003, studies run by the Natural Heritage & Endangered Species Program (NHESP) and Nature Conservancy identified hundreds of locations throughout Massachusetts to be considered Core Habitats as part of their BioMap and Living Waters conservation plans. According to the 2003 study, Christmas Brook qualifies as a Core Habitat for Living Waters, defined as critical habitat for the continued existence of rare and endangered aquatic species. Our team was unable to identify the species selected by the NHESP – such information is generally kept hidden to avoid the perverse incentive of removing the species to allow development. While encouraging, these studies were designed to act as a reference for lawmakers and do not represent any form of real regulation, such as the "Priority Habitat" designation of NHESP, which was created to enforce the Massachusetts Endangered Species Act

(MESA). Elena Traister mentioned that she is unaware of invasive plant species having a negative impact on fish. However, studies of woodland streams run by Williams College Ecology classes may indicate otherwise. According to data collected by students in November 2010 at Hopkins Forest, the microhabitats formed in streams by buildups of fallen leaves support fewer and less diverse species of aquatic insects when the leaves belong to invasive trees, like Norway maple – an invasive tree present in our site as well. While not the main subject of the study, this finding suggests that invasive plants may affect the health of stream habitats. This underscores the importance of this site's rehabilitation in the face of invasive species threats.

Case Study: Vassar College

Vassar College has restored and expanded a campus-wide trail system, which can serve as a model for our project. Although the trail system there is much larger and more complex (5 to 7 miles on campus and another 7 miles around the Vassar Farm), it addresses many of the ecological and public issues that our project would be likely to encounter. Present along the trails are wetlands, ponds and streams, whose native and non-native vegetation is similar to our own. Also, since the trails are used mostly by a college community, they are probably used in a way similar to the way that trails would be used in Williamstown. We spoke with Jeff Horst, Buildings and Grounds Director of Special Operations, and Keri VanCamp, Biology Lab Technician and Preserve Manager, who maintain the Vassar trail system and its surrounding vegetation.

Ms. Van Camp offered some suggestions for removing invasive species and reintroducing native ones. First of all, removing invasives raises the problems of soil exposure and erosion, which need to be addressed quickly, especially when a body of water is nearby; it is

important to be sensitive to the function of plants in a wetland buffer zone, where they filter and treat runoff before it enters the body of water. Something that Mr. Horst discovered when restoring the trails at Vassar in the 1970s and later was that once invasive species were removed, native species showed up very quickly on their own. For instance, where honeysuckle was removed, cattails showed up. The cattails had been present, but were repressed by the honeysuckle.

Another issue regarding re-vegetating a natural area is that after removing lots of invasive plants, the landscape can look ragged and unattractive. But as soon as the growing season begins, Mr. Horst said, other plants will quickly show up. At Vassar, natives were added in clumps, rather than individually. Reintroduced plants included cardinal flower and turtlehead, and tree species that Ms. Van Camp mentioned as possibly suiting our area are American chestnut, hemlock, alder, hackamore, silver maple (a floodplain tree) and white oak. Regardless of the approach, this type of project requires a period of recovery, during which public relations can be especially fragile. It also requires constant maintenance so that invasive species will not reestablish themselves, as they have in some areas at Vassar.

Any project that involves trails being built through a natural area requires regular maintenance. At Vassar, Buildings and Grounds staff members go through once a year to remove large fallen trees from the trails. Other than that, the trails are maintained mostly by students. Some of the boardwalks at Vassar were created by a local Eagle Scout group, and a similar arrangement could probably work in Williamstown.

Public relations during such a project can become problematic if the public is not aware of the long-term goals. At Vassar, when the trail restoration project began, the school newspaper

labeled Mr. Horst “The Landscape Destroyer,” because of the initial appearance of the trails. “If people don’t understand that you’re restoring ecology, reclaiming the landscape, they can become quite angry thinking you’re destroying the edges of the stream,” Mr. Horst said. Eventually, the Vassar community understood that the ugliness of the trails was a necessary stage in their restoration, and became more supportive of the project. In order to inform the public of the long-term goals of such a plan, we suggest having a sign near the site explaining the project, and also an article in the *North Adams Transcript* or *Berkshire Eagle*. Indeed, on December 15th, the *Transcript* reported on our group's final project presentation in front of members of the public, students, staff and the Conservation Commission (Appendix 10).

Trails that go through fields generally grow back especially quickly and need more frequent maintenance. Heavily used trails are easier to maintain, although where trails exist, people tend to make their own trails that go where want them to go. Keri said it is important to build trails in the first place that go to interesting places.

One of the most popular trail destinations at Vassar is an English cob bench (made from straw and clay) that was built as a senior project a few years ago. The bench is covered by a simple open-sided structure, and sits at the edge of a golf course, overlooking the campus. The view there makes the bench a popular destination, but it is also a place where students can go to study. At our site, a similar destination (strangely also overlooking a golf course), which can be used for relaxing or studying, is included.

Lighting was not required along the trails at Vassar. There are signs on the Vassar trails, indicating what plants and animals might be encountered, and others that designate the different trails. There is also a kiosk at the entrance to the trail system with free maps. A trail through

Denison Park probably wouldn't need anything that elaborate, but a trash receptacle would be useful. Dogs are allowed on the Vassar trails, but cleaning up after them has been a problem. Some people leave their dog's waste in plastic bags along the trail, or throw it away in the on-site receptacles, which makes a mess that then has to be cleaned up by Buildings and Grounds.

We asked about the misuse of trails, and were told that graffiti, drinking and trash have been a moderate concern, but that the only way to address those problems is to remove graffiti and trash as soon as they appear. Otherwise, you send a signal that doing that sort of thing is OK. Mr. Horst said, "When you take care of a place people tend to respect it more." He thought that the same would be true of the meditation house at Weston Field. If the area were maintained and had a sign indicating what the building is used for, he believed that misuse would not be a problem. "I think generally you would get through to most people that this area is to be respected and taken care of," he said. Keri added that there will always be one or two vandals, but all you can do is stay on top of the situation by keeping the area well maintained.

In the nineties, there was a demand for exercise stations along one section of the trails at Vassar, and stations were actually installed. They were very popular for a while, and then people just stopped using them. Mr. Horst perceived it as having been a passing trend, and that at some point the exercise stations might again become popular. Although there is not much room along Christmas Brook for exercise stations, this aspect of the history of Vassar's trails shows how public interest can change over time.

According to Mr. Horst, the major stakeholders regarding the Vassar trail project were the plants and animals themselves who benefitted from a healthier environment, but also the many students, faculty and community members who use the trails. The trails are used for

academic research as well as for recreational walking and biking. There are birdwatchers, who tend to be older and prefer more open, manicured trails, and runners who use the trails for training and personal exercise. Running trails at Vassar need to be 4 feet wide and covered in wood chips, which would be difficult along Christmas Brook. One small but important detail is that grass along trails has to be kept low to prevent contact with ticks. Overall, Horst and Van Camp stressed that a project such as ours is inherently ongoing and will require regular maintenance, as well as adaptation to changing uses.

Case Study: Housatonic River Walk

On November 29th, 2010, we interviewed Rachel Fletcher by phone about the Housatonic River Walk located in downtown Great Barrington, Massachusetts, and on December 2nd, we visited the site. The Housatonic River Walk is approximately ½ mile long (similar to the trails proposed for Christmas Brook) and can be used as a model for removal of invasive species, planting of native species, and creation of a public path. This river walk was formed in 1988 and is now a well-established public location in Great Barrington with approximately 30 to 100 visitors daily from April to December.

The area that is now the Housatonic River Walk used to contain many of the same invasive species as the Christmas Brook site such as Norway maple, multiflora rose, and ground elder. Rachel Fletcher looked favorably on this project, but she did emphasize that initially, removal of invasive species is extremely time-consuming and labor-intensive. She explained:

“eradication can be hundreds of hours in the first year. It gets less every year.”¹⁴ However, a good core of volunteers makes the task less daunting.

Rachel Fletcher sees community involvement as one of the most important factors contributing to the success of the Housatonic River Walk. There have been approximately 2100 volunteers, and twenty volunteers have logged over 100 hours of work.¹⁵ Chemicals are not used in the removal of invasive species and in the maintenance of the site, so it is labor intensive. To facilitate community involvement, there are workdays that are advertised to the public, and Rachel Fletcher works with local schools to provide information about the area and look for volunteers. The suggestions that Rachel Fletcher provided about recruiting volunteers will be important for us to employ in the removal of invasive species at the Christmas Brook site.

In addition to being a site of wetland revival, the Housatonic River Walk provides educational opportunities for the community. Volunteers are educated about invasive species in the area and how to remove them. Another educational opportunity is involvement in research at the site. From 2006 to 2009, an experiment was conducted to look at the effect of compost tea on plant growth.¹⁶ In addition to providing educational opportunities to volunteers, the Housatonic River Walk also educates visitors. At the William Stanley Overlook, there is an informational sign that describes the early industrial history of the region (Figure 21). The sign and the view at Williams Stanley Overlook make it one of the destination locations on the river walk. However, it is important to note that the sign was an expensive addition to the site. Rachel Fletcher commented that the cost of an informational sign of that size is approximately

¹⁴ "Rachel Fletcher." Telephone interview. 29 Nov. 2010.

¹⁵ "Welcome to Great Barrington Housatonic River Trail." Great Barrington Land Conservancy. Web. 6 Dec. 2010. <<http://www.gbriverwalk.org/>>.

¹⁶ "Welcome to Great Barrington Housatonic River Trail."

\$800, and installation costs approximately an extra \$250. The costs and benefits of signs such as this one will be important to consider when looking at the options for trails at the Christmas Brook site.



Figure 21 – A destination and informational sign (left edge of the picture) at the Williams Stanely Overlook on the Housatonic River Walk

VEGETATION PROPOSALS

Overview

The proposal for this project will be presented in three parts: vegetation proposals, trail and amenity proposals, and final proposal. The vegetation proposals are presented first because it is possible to remove invasive species and plant native species without employing any of the other proposals. The trail and amenity proposals are presented next and are divided into three levels based on difficulty to implement and number and types of amenities. We recommend that all of the trail and amenity proposals be implemented, but that they are implemented in stages. The first proposal is a basic proposal, the second proposal is slightly more involved, and the third proposal is the most involved. The second and third proposals involve the creation of a trail. We recommend that this happens in conjunction with the removal of invasive species. A large portion of the trail goes through a patch of invasive honeysuckle. Once the honeysuckle is removed from that area, work on the trail can begin.

Evaluation

This section examines the background, distribution, and recommendations for twenty different plants that are common at the site. The vegetation proposal is divided into two sections: native plants and invasive species. For native plants there are three possible recommendations: do nothing, plant more, and increase diversity. The option of “increase diversity” is only possible when the plants studied are from the same genus and the genus includes a variety of native species. If the plant is a specific species or if the genus does not include other native species, then the “increase diversity” option is not explored. For invasive species, there are two possible recommendations: do nothing, and remove it. The proposals are

evaluated quantitatively by the equation: $S = v_1B_1 + v_2B_2 + v_3B_3 + \dots + v_nB_n$ where “S” is total score, “ v_n ” is weight of a specific effect such as “environmental impact”, and “ B_n ” is the corresponding magnitude of the effect for a specific species. “v” can be either positive (indicating a benefit) or negative (indicating a cost), and the possible values of “v” range from -5 to +5. A weight of -5 indicates a large cost while a weight of 5 indicates a large benefit. The weights given by “v” are based on the goals of this project and conversations with our clients. For example, environmental impact is given a weight of “5” because the main focus of this project is scope and what is best for the environment and the community. The magnitude of the effect (“B”) is on a scale from 0 to 5 with 0 being no effect and 5 being a large effect. The values for “B” are based on research and case studies. Once the proposals are quantitatively evaluated, a proposal for each species is recommended. The “do nothing” option refers to a score of zero and is an implied option for all species. If all proposals for a given species receive negative scores, then the “do nothing” option is recommended. In the next two sections, “Native Plants” and “Invasive Species”, plants are introduced in order starting with the highest priority recommendation as judged by the score of the recommended proposal. At the end of the “Invasive Species” section, there is a comprehensive chart showing all of the plants, their recommended proposals, and their scores.

NOTE: For the format of the vegetation recommendations, illustrations will not be annotated – all maps and photographs courtesy of Lauren Goldstein-Kral, 2010. Footnotes, however, will provide more detailed reference information to allow easy cross-referencing. A list of full references can be found at the end of this paper.

Native Plants



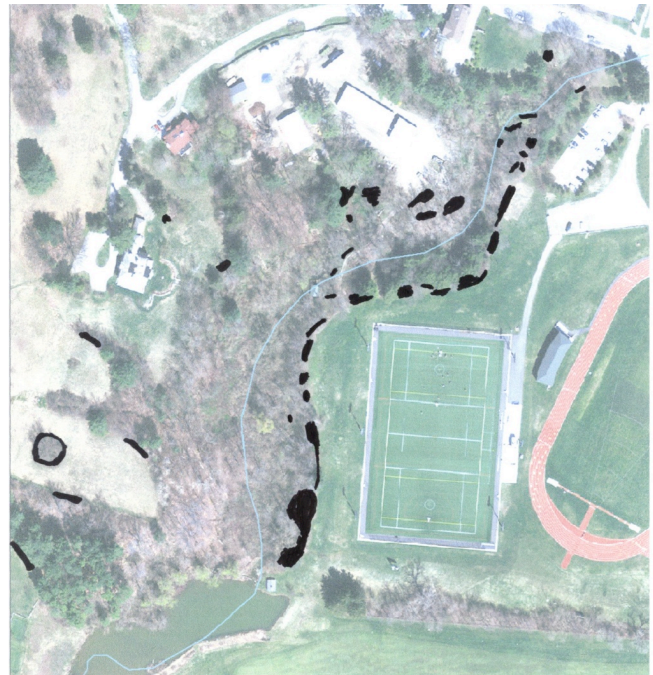
Goldenrod:

Goldenrod is from the genus *Solidago*. They are generally flowering perennially herbaceous plants that grow from rhizomes or seeds spread by the wind. They grow in patches of plants that are genetically the same. Although there is not much diversity in the species of goldenrod at this site, there are more than 130 species of goldenrod in the United States.¹⁷ In ecosystems where it

is present, goldenrod is important for soil nitrogen levels.¹⁸ It also provides shelter and food for insects such as grasshoppers. Goldenrod flowers in late summer and is insect pollinated. Its honey is used as food by larvae of many species of Lepidoptera.

Distribution of Goldenrod:

Goldenrod is found in clumps on the outside boarder of vegetation. It is generally not found in shady areas. Goldenrod is most



¹⁷ "Goldenrod." University of Maryland Medical Center. Web. 6 Dec. 2010. <<http://www.umm.edu/altmed/articles/goldenrod-000251.htm>>.

¹⁸ "Yale Study Offers New Paradigm on Ecosystem Ecology." Yale School of Forestry & Environmental Studies - Masters of Environmental Management. Web. 4 Dec. 2010. <<http://environment.yale.edu/news/5591>>.

common in the eastern portion of the site. It is not found in regions of standing water by the brook, but it is found in damp soils in the southeastern portion of the site and in drier soils in the northeastern portion of the site. Its distribution is similar to that of aster, and it is mainly threatened by ground elder, ground ivy, burdock, and black locust.

Recommendations for Goldenrod:

The recommendation that received the highest score is to increase diversity in goldenrod species. To minimize costs in increasing the diversity of goldenrod, we recommend that goldenrod be planted from materials collected locally. The Housatonic River Walk

		Plant More		Increase Diversity in Goldenrod Species	
	v	B	v*B	B	v*B
Environmental Impact	5	2	10	3	15
Long-term benefits	5	3	15	4	20
Aesthetic Impact	3	2	6	4	12
Labor cost	-3	1	-3	2	-6
Financial cost	-1	1	-1	2	-2
Score			27		39

employed this strategy. Some species of goldenrod that can be planted from locally collected materials are: Wreath Goldenrod, Canada Goldenrod, Early Goldenrod, Zig-Zag Goldenrod, and Rough Goldenrod.¹⁹

¹⁹ "Native Plants on the Great Barrington River Walk." Great Barrington Land Conservancy. Web. 6 Dec. 2010. <<http://www.gbriverwalk.org/Native%20Plants.html>>.



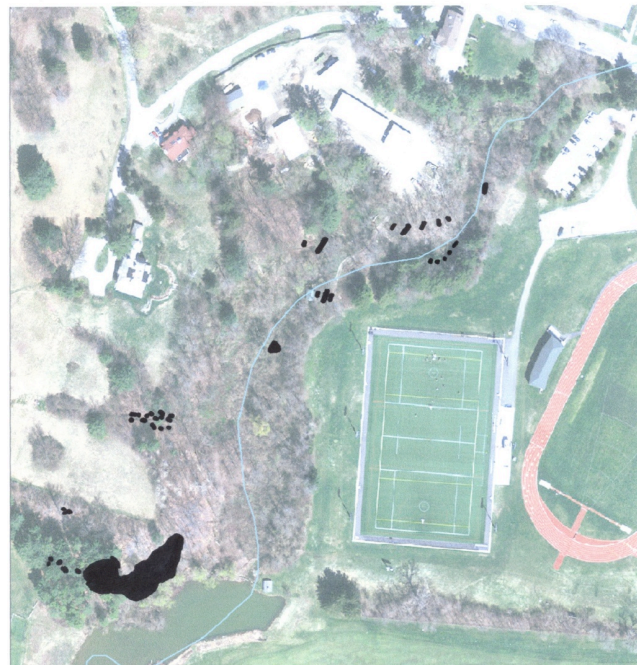
Spinulose Woodfern:

Spinulose Woodfern (*Dryopteris spinulos*) is a deciduous fern that is green with light brown spots. Ferns are vascular plants—they have xylem and phloem which are tissues that transport water and nutrients. Ferns are a particularly

interesting and unique species to learn about because of their growth pattern. They can be found in two forms: diploid sporophytes (the form in the picture above) and haploid gametophytes. In the sporophyte form, the fern has two sets of genetic information, and it produces spores on the bottoms of its leaves through a process called meiosis. These spores only have one set of genetic information, and they grow into haploid gametophytes. The haploid gametophyte form is much smaller than the diploid sporophyte form. The gametophyte form produces gametes that then fuse to and grow into a sporophyte. The growth pattern of ferns is referred to as “alternation of generations.”

Distribution of Spinulose Woodfern:

Spinulose Woodfern is found in damp but well-drained soils in shaded regions of the site. It is found mainly in regions that also contain pine or Eastern Hemlock and is found in the greatest density in the southeastern



edge of the pine forest just north of the pond. Spinulose Woodfern in the dense patch on the edge of the pine forest is not threatened by invasive species, but it is threatened by honeysuckle in the central regions of the plot.

Recommendations for Spinulose Woodfern:

Increasing diversity in fern species received the highest score. Increasing diversity in fern species is good for both ecological and educational reasons. Because ferns are very sensitive to environmental conditions, it is important to examine the environmental

		Plant More		Increase Diversity in Fern Species	
	v	B	v*B	B	v*B
Environmental Impact	5	2	10	3	15
Long-term benefits	5	2	10	3	15
Aesthetic Impact	3	3	9	3	12
Labor cost	-3	1	-3	3	-3
Financial cost	-1	1	-1	2	-2
Score			25		37

conditions in an area before planting ferns. Specific conditions that should be considered are light levels, temperatures, soil types, pH levels, and nutrient levels. Many of these conditions will also depend on the other types of native species introduced to the area. Planting of native fern species should occur after other native species are planted. Special attention should be given to the planting of native trees because these trees will greatly affect the amount of shade. A variety of fern species should be considered and environmental conditions should be used to decide which ferns should be planted. Some ferns that can be planted from local materials are: Maidenhair fern, Lady fern, Hay scented fern, Toothed wood fern, Marginal weed fern, Ostrich fern, Bracken fern, Wood Fern, Sensitive Fern, Cinnamon Fern, Interrupted Fern, Royal Fern,

Christmas Fern, and Braun's holly fern.²⁰

²⁰ "Native Plants on the Great Barrington River Walk."



Aster:

Aster is a genus of the family Asteraceae.

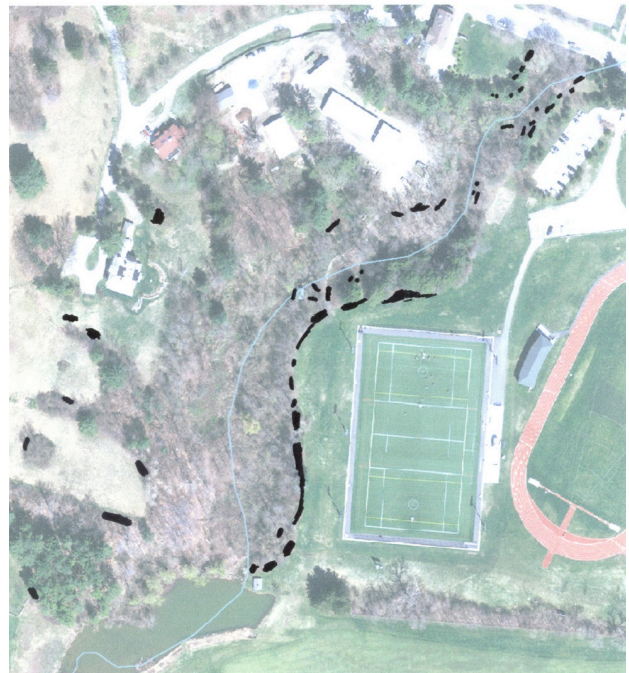
There are approximately 180 species of aster in the United States.²¹ Because there are so many

different species of aster, they can be found in a variety of locations and soil conditions.

However, most species of aster prefer regions of direct sunlight and well-drained soils. Asters generally bloom in the late summer to early fall and are an important component of the ecosystem because they are a food source for many species of Lepidoptera.

Distribution of Aster:

The distribution of aster is similar to that of goldenrod, but patches of growth are smaller and less dense. Aster is generally found along borders of vegetation. At this site, the most dense aster growth is along the eastern border from the region above the athletic field to the pond. There is also dense growth in a few isolated patches along the meadows and scattered growth in the northern portion of the plot. Aster, like



²¹ "Ontario Wildflowers - Panicle Aster (*Symphyotrichum lanceolatum*)."
Ontario Wildflowers Home Page. Web. 6 Dec. 2010. <<http://ontariowildflowers.com/main/species.php?id=14>>.

goldenrod, is most threatened by ground elder, ground ivy, burdock, and black locust.

Recommendations for Aster:

Increasing diversity of aster species received the highest score. Species of aster that are native are: Whorled Wood Aster, Blue Heart-Leaved Aster, White Wood Aster, White Wreath Aster, Calico Aster, Large-leaf Aster, Schreber's Aster, Smooth Aster, New England Aster, Purple-stemmed Aster, and Flat-topped Aster.²² Most of these species can be grown from local materials. Locations suitable for the planting of aster are regions along the border of vegetation from which burdock and black locust is removed. Aster can also be planted along the edges of vegetation in the meadows region. There is not currently much aster in this region, so planting aster in this region would have significant aesthetic and ecological benefits.

		Plant More		Increase Diversity	
	v	B	v*B	B	v*B
Environmental Impact	5	2	10	3	15
Long-term benefits	5	2	10	3	15
Aesthetic Impact	3	2	6	4	12
Labor cost	-3	1	-3	2	-6
Financial cost	-1	1	-3	2	-2
Score			20		34

²² "Native Plants on the Great Barrington River Walk."



Eastern Hemlock:

Eastern Hemlock (*Tsuga Canadensis*) is a species of tall coniferous trees. The largest Eastern Hemlock was approximately 154 feet tall.²³ Eastern Hemlock is also extremely long-lived and has been known to live over 500 years.²⁴ Because of their beauty and long life, Eastern Hemlock has historically been an important component to many nature areas. Furthermore, Eastern Hemlock is integrated into the ecosystem as food for white-tailed deer, snowshoe hare, mice, voles, squirrels, and other rodents. However, recently Eastern Hemlock has been threatened by the hemlock wooly adelgid, an insect that feeds on the tree ultimately killing it.

Distribution of Eastern Hemlock:

The greatest density of Eastern Hemlock is in the wooded region in the eastern central portion of the site. The Eastern Hemlock in this region is generally old trees that cast dense shade on the ground. Within the site, this region is unique in its appearance and species distribution, so it is an important



²³ "Tsuga Canadensis Description." *The Gymnosperm Database: Home Page*. Web. 18 Dec. 2010. <<http://www.conifers.org/pi/ts/canadensis.htm>>.

²⁴ Ibid.

contributor to diversity. There is also a small patch of young Eastern Hemlock by the Agway lot, but this stand is less well established and the environment is less unique.

Recommendations for Eastern Hemlock:

Because Eastern Hemlock is a species, there is not the option to increase diversity. However, there is an advantage to planting more Eastern Hemlock. One possible complication to this proposal is that Eastern Hemlock generally grows on moist soils that are rich in nutrients from decayed organisms and vegetation, but the invasive species at this site may have depleted soil nutrient levels. It is

		Plant More	
	v	B	v*B
Environmental Impact	5	3	15
Long-term benefits	5	3	15
Aesthetic Impact	3	4	12
Labor cost	-3	3	-9
Financial cost	-1	2	-2
Score			31

important to test nutrient levels before deciding where to plant Eastern Hemlock. It also might be necessary to plant other species first and wait to plant Eastern Hemlock until there is a patch of moist, nutrient-rich soil. Even if Eastern Hemlock is not immediately planted, it is important to monitor the Eastern Hemlock currently at the site to make sure that it is not being subjected to parasitism by the woolly adelgid.



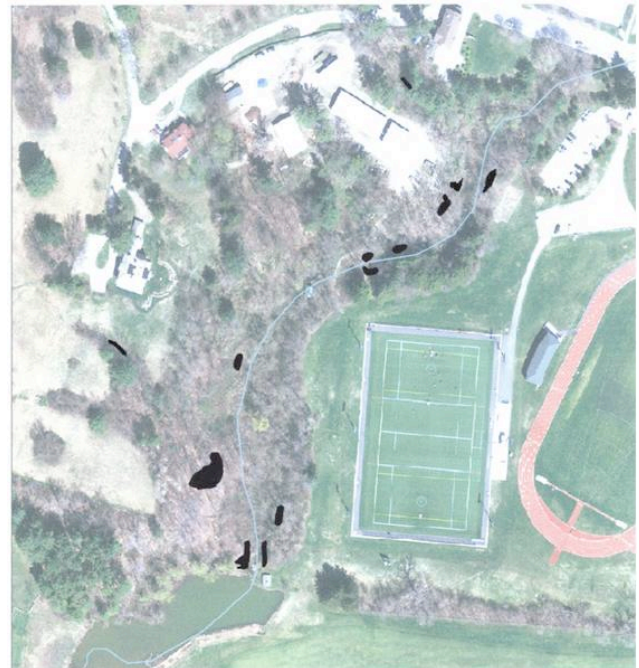
Northern Swamp Dogwood:

Northern Swamp Dogwood (*Cornus racemosa*) is a large shrub (or small tree depending on the classification system) that grows in swampy wetlands. It is frequently used in

wetlands revival projects because it can easily be grown from seeds cut from mature plants and it requires little maintenance. Furthermore, Swamp Dogwood is rarely affected by disease. In recreation, swamp dogwood is prized because of its dense, white flowers.²⁵ It is also an important contributor to the ecosystem. Its fruit attracts birds such as quail, catbirds, mockingbirds, and brown thrashers.²⁶

Distribution of Northern Swamp Dogwood:

Northern Swamp Dogwood at this site is found in wet, poorly drained soils by the brook. Although there are many patches of



²⁵ "Wetland Indicator Status." United States Department of Agriculture. Web. 4 Dec. 2010.
<http://plants.usda.gov/java/wetland?familycategory=all&growthhabit=all&nat_wet_ind=any&nativestatus=all&nreg_wet_status=FACW-&stateSelect=all&wet_region=nwi_r1>.

²⁶ Ibid.

swamp dogwood throughout the plot, there are two patches that are of much greater density than the other patches—the patch in the eastern corner and the patch in the southwestern portion.

Throughout the site, swamp dogwood is threatened by privet and honeysuckle, but the patch in the southwestern portion is especially vulnerable. It is currently surrounded by honeysuckle.

Recommendations for Northern Swamp Dogwood:

Northern Swamp Dogwood, like Eastern Hemlock, is the name of a specific species, so there is no option to increase diversity. However, there is a benefit to planting more. Because Northern Swamp Dogwood can easily be grown and requires little maintenance, it is a good species to use for immediate revegetation of areas from which invasive species have been removed. It will be especially

		Plant More	
	v	B	v*B
Environmental Impact	5	2	10
Long-term benefits	5	3	15
Aesthetic Impact	3	4	12
Labor cost	-3	2	-6
Financial cost	-1	1	-1
Score			30

useful along the western portion of the brook after honeysuckle is removed. In some regions, Northern Swamp Dogwood will probably spread its distribution naturally. For example, if the honeysuckle surrounding the Northern Swamp Dogwood in the southwestern portion is removed, it is likely that Northern Swamp Dogwood will grow in its place.



Norway Spruce:

Norway Spruce (*Picea abies*) is not native, but it is included in this section because it is not invasive. It is native to Europe and has been planted in the United States for ornamental

reasons. Norway Spruce generally grows best in slightly moist acidic soil, but it can also grow in harsh conditions. It is not nearly as tall as Eastern Hemlock and generally only grows to about 80 feet.²⁷ One concern with Norway Spruce is that it is subject to parasitism by spider mites.

Distribution of Norway Spruce:

The largest patch of Norway Spruce is at the southeastern side of the site. These trees are slightly in front of the other vegetation and look as if they were planted intentionally for ornamental reasons. There are also five other Norway Spruce trees at the site. These trees are located by the Oakley Center and by the Agway lot and were likely also planted for ornamental reasons.



²⁷ "Ohio Trees - Norway Spruce." *Ohio Department of Natural Resources - Camping, Boating, Fishing, Hunting, Biking, Hiking in Ohio*. Division of Forestry. Web. 2 Dec. 2010. <http://www.dnr.state.oh.us/Home/trees/spruce_norway/tabid/5421/Default.aspx>.

Recommendations for Norway Spruce:

Because Norway Spruce is not native, there does not seem to be an advantage to planting more, especially in a project that encourages growth of native species. However, Red Spruce is native to the Berkshires. Red Spruce is shade tolerant and

		Plant More		Increase Diversity	
	v	B	v*B	B	v*B
Environmental Impact	5	0	0	2	10
Long-term benefits	5	0	0	2	10
Aesthetic Impact	3	0	0	4	12
Labor cost	-3	3	-9	3	-9
Financial cost	-1	3	-3	3	-3
Score			-12		20

grows well in moist soils. This suggests that it would grow well at the Christmas Brook Site.

Planting Red Spruce at the Christmas Brook Site would have a significant aesthetic impact (it is known as a beautiful tree that grows to about 130 feet tall²⁸), and it would increase the diversity of the site. One region where Red Spruce could be planted is the shaded region southeast of the Agway Lot which is currently overgrown with invasive honeysuckle.

²⁸ "Picea Rubens Description." *The Gymnosperm Database: Home Page*. Web. 18 Dec. 2010. <<http://www.conifers.org/pi/pic/rubens.htm>>.



Paper Birch:

Paper Birch (*Betula papyrifera*) is known for its bright white trunks which provide contrast and are visually appealing in recreational areas. In the Berkshires, Paper Birch is at the southern end of its range, and there is fear that it will disappear from this region due to global warming.

Paper Birch grows in a variety of soils, but it prefers soils

with a slightly acidic pH. Paper Birch is an important

contributor to the ecosystem as it is used for food by snowshoe hare, moose, deer, and mice. It is also subject to predation by ants.

Distribution of Paper Birch:

At this site, there is a patch of Paper Birch in the southeastern portion of the southern meadow. This patch of paper birch is visually attractive and provides a contrast to the dark trunks of pine trees in the forest nearby.

Our recommended trail (explained later) passes by this region. There are two other isolated

Paper Birch trees. These trees are outside of the Oakley Center and seem to have been planted for ornamental reasons.



Recommendations for Paper Birch:

There is an advantage to planting more Paper Birch, but because of global warming, the future of Paper Birch is uncertain. The recommendation “plant more” received a positive score indicating that it would be beneficial, but the score was not very large. We recommend that if

		Plant More		Increase Diversity	
	v	B	v*B	B	v*B
Environmental Impact	5	1	5	2	10
Long-term benefits	5	1	5	2	10
Aesthetic Impact	3	3	9	5	15
Labor cost	-3	3	-9	4	-12
Financial cost	-1	3	-3	3	-3
Score			7		20

Paper Birch starts growing naturally when invasive species are removed, its growth be encouraged. However, there seems to be a greater benefit to increasing the diversity of the birch species at the site than to planting more Paper Birch. Other native species of birch that could be planted are Sweet Birch and River Birch. Sweet Birch grows in moist, well-drained, acidic soils. Soil pH levels at the site should be measured. Some regions that might be appropriate for planting Sweet Birch are the regions directly north and south of the Agway Lot that currently contain a large amount of invasive honeysuckle. River Birch grows in wet soils and has even been found in floodplains and swamps, so it should also be able to grow well at this site. It has a substantial aesthetic and educational impact because of its unique peeling bark and fruit with winged seeds. River Birch could be planted in the wet soils along the western side of the brook once honeysuckle is removed.



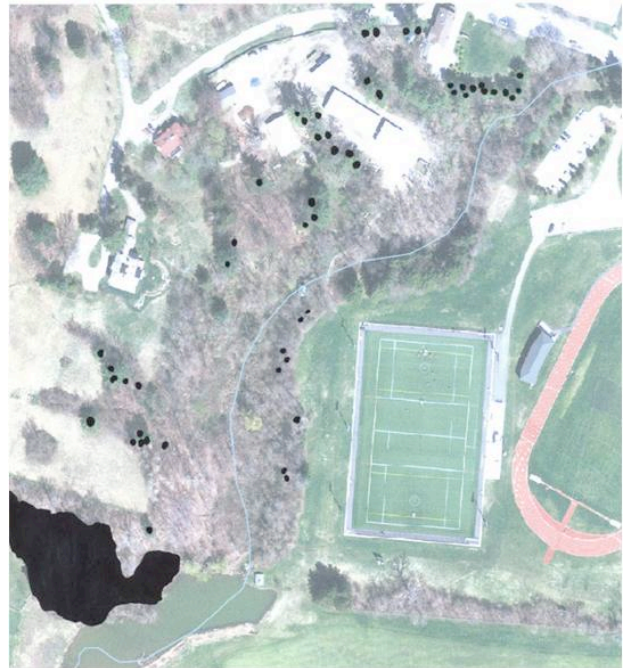
Pine:

There are 114 different species of pine and they are native to every continent. Pines add to the aesthetic beauty of a location because of their tall trunks and beautiful pine cones. Pines also

add a historical component to the region in which they are found. Pine trees regularly live hundreds of years. Some species of pine live over 1000 years, and *Pinus longaeva* has many individuals over 4000 years old.²⁹ Pine trees are generally drought resistant, shade-tolerant, and can live in soils of low nutrient levels.

Distribution of Pine:

There is a large number of pine trees at this site. Pine trees are scattered throughout the site in regions that have moist but well-drained soils and generally are not found near the brook. There is a large stand of pines in the southwestern corner of the site. This stand would be a good location for an educational sign about pine trees, their growth patterns, and their history in the area. To link the sign to the



²⁹ "Pinus Description." *The Gymnosperm Database: Home Page*. Web. 19 Dec. 2010. <<http://www.conifers.org/pi/pin/index.htm>>.

site, the ages of the pines could be approximated by an expert and that information could be included on the sign. This area is also aesthetically pleasing and is the proposed site for a destination location on the trail plan (explained later).

Recommendations for Pine:

The Christmas Brook site contains a variety of smaller environments ranging from the Eastern Hemlock forest, to the meadows, to the wetlands areas, to the pine tree forest. All of these environments are important and contribute to the beauty and diversity of the site. It is important to preserve this diversity. There does not seem to be a feasible location in which a pine tree stand could be

		Plant More	
	v	B	v*B
Environmental Impact	5	0	0
Long-term benefits	5	0	0
Aesthetic Impact	3	1	3
Labor cost	-3	2	-6
Financial cost	-1	2	-2
Score			-8

created without compromising the diversity of the site. Pine trees create dense shade, so the creation of a pine tree stand would limit the other species that could live there. Because of this, we do not recommend planting more pine trees even though they are an important, beautiful, and historic component of the site. Instead, we recommend monitoring and preserving the pine forest that is already there.



Box Elder:

Box Elder (*Acer negundo*) is a small, fast-growing species of maple. It is also an important source of food for some insects and squirrels.

Box Elder can grow in a variety of soil types, can grow close together, and can form thickets of saplings. Because of its close dense growth and ability to grow on uneven ground, it can be used for stabilization of soils and for erosion control. Box Elder can colonize new areas quickly, but it is also short-lived and is subject to a variety of diseases and fungi. Because Box Elder can colonize areas quickly, it is sometimes considered an invasive species.

Distribution of Box Elder:

Although research suggests that Box Elder can grow on the edges of rivers and is important for bank stabilization, Box Elder at this site does not seem to have that role.



Rather, Box Elder is found closer to the edge of vegetation in areas where it can get a large amount of sunlight. Its distribution is similar to that of goldenrod and aster, but less dense.

Although it is found in many areas throughout the site, it does not currently seem to be experiencing uncontrolled growth.

Recommendations for Box Elder:

One of the main positive contributions of Box Elder in an ecosystem is its ability to stabilize river banks. However, because Box Elder does not generally grow along the river banks at the Christmas Brook site, it does not take on this important role. It is important for ecosystem diversity as food for some insects and squirrels, but there does not seem to be a significant ecological benefit to planting more. Also,

		Plant More	
	v	B	v*B
Environmental Impact	5	0	0
Long-term benefits	5	0	0
Aesthetic Impact	3	2	6
Labor cost	-3	3	-9
Financial cost	-1	2	-2
Score			-5

because Box Elder can grow like an invasive species, planting more Box Elder could have a negative impact on the ecosystem. We recommend not to plant more Box Elder and to monitor the Box Elder that is currently present at the site. Once invasive species are removed, it will become especially important to monitor the Box Elder. Because Box Elder can colonize new areas quickly, there is a risk that Box Elder will colonize empty spaces created by the removal of invasive species.



Grapevine:

Grapevine is from the genus *vitis*.

Grapevine are woody vines that can be found in a variety of locations ranging from streambeds to

roadsides. The vines make both positive and negative contributions to the ecosystem.

They provide a nesting place for birds and are a source of food for a variety of organisms such as fox, rabbit, opossum, raccoon, and deer. However, they also threaten trees and other species of plants. Their weight can cause tree branches to snap. Furthermore, in regions where there is a lot of grapevine growth, grapevine can block sunlight from reaching the lower leaves on trees and from reaching the understory layer of the forest.

Distribution of Grapevine:

In this site, grapevine is primarily found in regions with tall deciduous trees. It is not found near the brook, in the meadows, in the pine or hemlock forests, or on the edge of vegetation. There are two areas which have dense grapevine growth: the area north of the Agway Lot and the area south of the Oakley Center.



Recommendations for Grapevine:

Because it is unknown whether grapevine will have a positive or negative impact on the ecosystem, planting more grapevine is not recommended.

Furthermore, grapevine is not known for aesthetic beauty, so planting more grapevine would not add to the quality of a recreational facility. We recommend not to plant grapevine and to monitor the grapevine that is present to make sure that it is not causing damage to the trees or blocking sunlight from native understory shrubs and herbs.

		Plant More	
	v	B	v*B
Environmental Impact	5	0	0
Long-term benefits	5	0	0
Aesthetic Impact	3	0	0
Labor cost	-3	3	-9
Financial cost	-1	3	-3
Score			-12

Invasive Species

Honeysuckle:

Honeysuckle which includes plants from the genus *Lonicera* was introduced into the United States from Asia in the early 1800s for aesthetic reasons, erosion control, and wildlife habitat.



Honeysuckle was used for erosion control because it grows in dense thickets. However, this characteristic of honeysuckle growth also made it a powerful invasive species. When honeysuckle grows, it entwines other plants in its path. These plants are generally cut off from sunlight, compete with honeysuckle for nutrients, and ultimately die.

Distribution of Honeysuckle:

At this site, honeysuckle is the most powerful invasive species. It is found in dense clumps throughout the site. These clumps threaten the growth of other native species in the area. The most concerning region is in the southwestern portion of the plot where a patch of native swamp dogwood is completely surrounded by honeysuckle. It is important to remove this honeysuckle to make sure that it does not encroach on the swamp dogwood. Furthermore, there



is a long, dense patch of honeysuckle along the western side of the brook. Growth is so thick in this region that it is nearly impossible to walk through. There is also a low level of biodiversity in this area with few other plant species. Our trail proposal (explained later) involves cutting through this patch of honeysuckle. This would be a good location to form a trail because the trail would help in the removal of invasive species and would not disrupt native species.

Recommendations for Honeysuckle:

Removal of honeysuckle is extremely important to the biodiversity and beauty of the site. The removal of honeysuckle would create space for the planting of native species. Also, there are locations where honeysuckle currently threatens native species. Removing honeysuckle would eliminate that threat. In order to remove

		Remove It	
	v	B	v*B
Environmental Impact	5	5	20
Long-term benefits	5	5	20
Aesthetic Impact	3	5	15
Labor cost	-3	5	-15
Financial cost	-1	5	-5
Score			35

honeysuckle, pull out young plants after a rain when the ground is wet and soft. Make sure not to leave portions of the plant behind because honeysuckle can re-root.³⁰ For larger plants, in the spring, cut the honeysuckle three feet above the ground and cover it with a thick construction grade garbage bag. Cover the entire crown and wrap it with rope. Stake the bag to the ground with nails or earth staples. Leave the bag in place for several months until the plant dies. Then the honeysuckle can be removed by hand.³¹

³⁰ "Twenty-five Ways to Remove Amur Honeysuckle." Greater Cincinnati Wild Ones Chapter. Web. 2 Dec. 2010. <<http://www.cincinnatiwildones.com/wildones/HoneysuckleRemoval.pdf>>.

³¹ Ibid.



Norway Maple:

Norway Mapler (*Acer platanoides*) was introduced into the United States in 1756 from Europe and became common in the 1900s.³² It is a rapidly spreading invasive species because it

produces many seeds, grows quickly, and has

shade tolerance. As it grows, it competes with native vegetation because it has shallow roots.

Distribution of Norway Maple:

Much of the Norway Maple at this site is immature saplings. Even though these saplings are not mature trees, they are included in the map because they still take up space that could be occupied by native species. The most common location of these saplings is at the northernmost end of the site. There is also a patch of Norway Maple at the southern end of the site just east of the pine forest. Because this project was undertaken in late fall to winter, many Norway Maple had lost their leaves before the site was completely mapped. Once Norway Maple lost their leaves they were difficult to identify. Thus, the actual number of Norway



³² "Invasive Exotic Plant Tutorial - Norway Maple." DCNR. Web. 4 Dec. 2010.
<http://www.dcnr.state.pa.us/forestry/invasivetutorial/norway_maple.htm>.

Maples present in the plot is likely greater than that shown on the map. We recommend that the Norway Maple distribution is re-mapped in the spring.

Recommendations for Norway Maple:

Removing Norway Maple would help facilitate the growth of native species in the northern and southern portions of the plot because they would not have to compete with Norway Maple for space. It also would provide an opportunity for the introduction of new native species. Some native maples that could be planted as alternatives to Norway Maple are Striped Maple, Red Maple, Sugar Maple, or Silver Maple.

		Remove It	
	v	B	v*B
Environmental Impact	5	4	20
Long-term benefits	5	4	20
Aesthetic Impact	3	4	12
Labor cost	-3	5	-15
Financial cost	-1	5	-15
Score			32

In order to remove Norway Maple, hand-remove seedlings and saplings by the roots.³³ Cut and dig up larger saplings.³⁴ Most of the Norway Maple in the northern portion of the plot should be able to be hand removed or removed by basic mechanical means. Contractors should be hired to remove large trees.

³³ "Rachel Fletcher."

³⁴ Ibid.



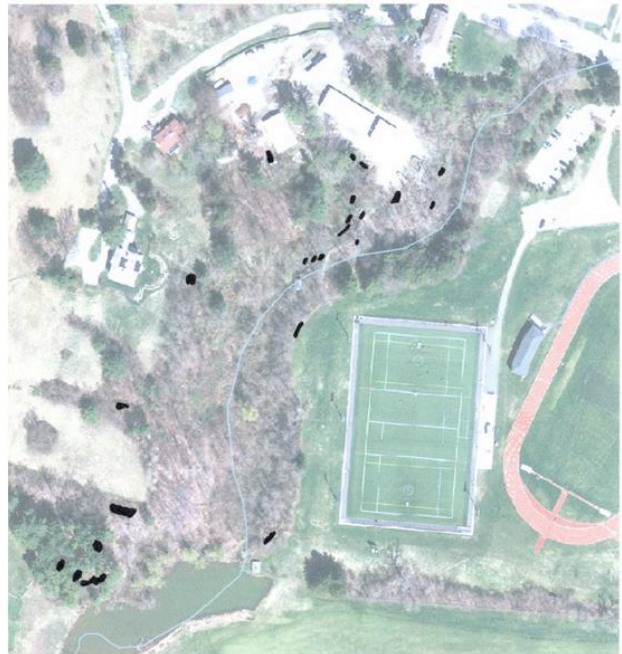
Privet:

Privet (*Ligustrum vulgare*) forms dense, thickets in the understory of forests. Privet growth has been known to become so dense that it is nearly impossible to walk through.³⁵ Non-

native privet starts forming leaves in the spring before many native plants. These leaves minimize the amount of sunlight that reaches the forest floor. Without enough sunlight, many plants that grow close to the forest floor beneath the privet die.

Distribution of Privet:

Privet is found in many small clumps throughout the site that have not yet formed dense thickets. Privet is not found in shady areas and is not found in wet soil. However, privet still has an extensive distribution and can be found in a variety of environmental conditions at this site. For example, it is found in damp soils and well drained soils, on the edge of the vegetation and in the center of vegetation, and in direct sunlight and in areas of moderate sunlight.



³⁵ "Identifying Invasive Plants." Web. 19 Dec. 2010. <[http://www.cas.vanderbilt.edu/bioimages/pages/invasive-plants.htm#ligustrum vulgare](http://www.cas.vanderbilt.edu/bioimages/pages/invasive-plants.htm#ligustrum%20vulgare)>.

Recommendations for Privet:

It is important that privet is removed soon before it forms dense thickets and becomes more challenging to remove. Removal of invasive vegetation should start in portions of the plot that contain privet because of its potential to undergo uncontrolled growth and form dense thickets. The southwestern corner of the plot which contains multiple privet clumps would be a good starting location.

	v	B	v*B
Environmental Impact	5	3	15
Long-term benefits	5	4	20
Aesthetic Impact	3	3	9
Labor cost	-3	3	-9
Financial cost	-1	3	-3
Score			32

Privet can re-grow from an underground system, so it is important to dig up privet and remove the roots. Other than digging up privet, there does not seem to be a well-accepted method for mechanically removing privet. In a study in Tennessee in 2000, it was reported that goats can be effective at removing privet.³⁶ However, this method does not seem feasible on the Williams campus. Privet seeds are spread by birds which means that they can travel far distances. Because of this, even after privet is removed, other sections of the site should be examined to ensure that privet has not spread.

³⁶ "New York Non-Native Plant Invasiveness Ranking Form." Cornell University Cooperative Extension. Web. 6 Dec. 2010. <<http://nyis.info/PlantAssessments/Ligustrum.vulgare.NYS.pdf>>.



Willowherb:

Willowherb (*Epilobium hirsutum*) is native to Eurasia and North Africa. It arrived in the United States in ship ballast in the mid-1800's and became an invasive species.³⁷

Willowherb grows in moist soils and requires a large amount of sunlight. In wetlands, it has been known to undergo aggressive growth.

Willowherb spreads by rhizomes and by seeds that are spread by the wind. Rhizomes enable willowherb to spread rapidly once it becomes established in an area.

Distribution of Willowherb:

There are only six clumps of willowherb at this site, and four of the clumps are not well-established. The two well-established clumps are the clump on the edge of the meadows and the clump at the entrance to the trail by the athletic fields. The clump by the meadows is the largest and is of particular



³⁷ "Invasive Exotic Plant Tutorial - Hairy Willow-herb." DCNR. Web. 19 Dec. 2010. <http://www.dcnr.state.pa.us/forestry/invasivetutorial/hairy_willow_herb.htm>.

concern because the soils in that area are moist and there is a large amount of sunlight. Thus, that position seems best suited to willowherb growth.

Recommendations for Willowherb:

Currently willowherb is not well-established at the site, so it is important to remove it before it has a chance to spread further. Compared to the other invasive species mentioned, willowherb should be relatively easy to remove. The three clumps by the Agway Lot and the clump in the southern region are small and appear to be young, so they can be easily removed by digging up the plant, roots, and rhizomes

		Remove It	
	v	B	v*B
Environmental Impact	5	2	10
Long-term benefits	5	4	20
Aesthetic Impact	3	2	6
Labor cost	-3	2	-6
Financial cost	-1	2	-2
Score			28

(which are probably not yet widespread).³⁸ The seeds of willowherb spread easily by the wind, so it is important to bag willowherb during and after removal.³⁹ In the other two regions, willowherb should be removed as previously described, but it is important to monitor the two regions closely for regrowth. Because there is denser growth of willowherb in those regions, rhizomes will likely be better established and harder to remove. In addition, those two locations are on hills. Willowherb seeds are spread by the wind, and the presence of a hill enables seeds to spread farther than normal. In the four small clumps, once willowherb is removed, native species should naturally grow in its place. In the two larger clumps, native willows or aster should be planted in regions from which invasive willowherb is removed.

³⁸ "Hairy Willow-herb Identification and Information - Epilobium Hirsutum." King County, Washington. Web. 6 Dec. 2010.<<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/hairy-willowherb.aspx>>.

³⁹ Ibid.



Japanese Barberry:

Japanese Barberry (*Berberis thunbergii*) is from Asia and was brought to the United States in the late 1800s as an ornamental plant.⁴⁰ It prefers well-drained or wet soils but can be found in a

variety of soil types. Furthermore, Japanese

Barberry is shade-tolerant and drought resistant. In addition to its ability to adapt to survive in a variety of environments and under different conditions, Japanese Barberry is successful as an invasive species because of its ability to raise soil pH. This increase in pH can cause the death of plants that are sensitive to pH. Also, deer generally prefer to eat native species of plants instead of Japanese Barberry. This enables Japanese Barberry to spread at the expense of native species. Once a colony of Japanese Barberry is established, it can spread rapidly.

Distribution of Japanese Barberry:

⁴⁰ "Maine Invasive Plants." *The University of Maine*. Web. 8 Dec. 2010. <<http://umaine.edu/publications/2504e/>>.

Japanese Barberry is widely distributed throughout the site. It is one of the few species that is found in the meadows, on the edges of vegetation, in forested regions, and close to the brook. However, most of the patches of Japanese Barberry growth are not yet dense. The patches of Japanese Barberry that are most concerning are the large patch just south of the Oakley Center (because it is the largest patch at the site), the patches by the pine forest (because they threaten native ferns), and the patches on the southeastern side of the brook just north of the pond (because they are in a region that has dense goldenrod and aster growth).

Recommendations for Japanese Barberry:

		Remove It	
	v	B	v*B
Environmental Impact	5	2	10
Long-term benefits	5	4	20
Aesthetic Impact	3	2	6
Labor cost	-3	3	-9
Financial cost	-1	2	-2
Score			25

With the exception of the patch just



south of the Oakley Center, Japanese Barberry has not formed dense colonies. However, it is a significant concern because it is widely distributed throughout the site. The best time to remove Japanese Barberry is in the spring because it leafs out before most other plants.⁴¹ Thus, it can be identified easily and can be removed before its leaf cover can block understory

⁴¹ Ibid.

plants from receiving sunlight. In order to remove Japanese Barberry, dig up the plants and roots.⁴² Japanese Barberry can re-sprout from the roots, so it is important to remove the roots as completely as possible. It may take several attempts to remove all Japanese Barberry, but repeated cutting or mowing has been known to be successful.⁴³

⁴² Ibid.

⁴³ Ibid.



Multiflora Rose:

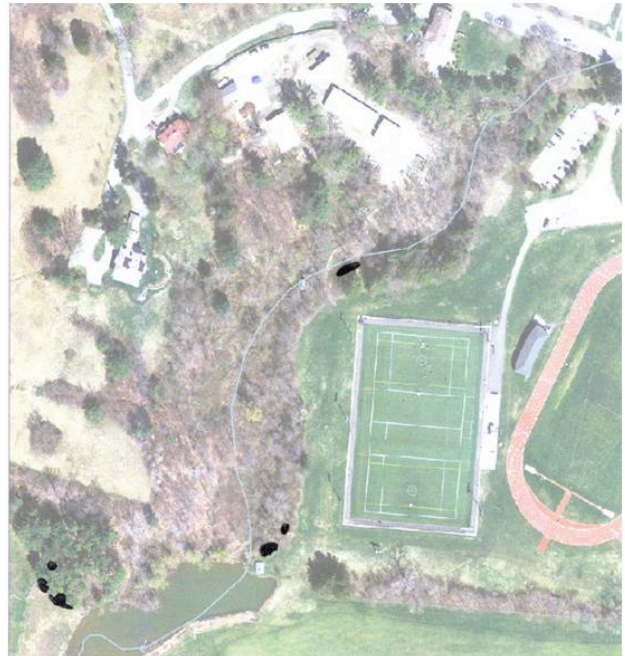
Multiflora Rose (*Rosa multiflora*) was introduced into the United States in 1866 from Japan. It (like honeysuckle) was used for erosion control because of its thick growth. It was also

used to make environments more suitable to the

growth of pheasants, bobwhite quail, and cottontail rabbit.⁴⁴ Multiflora Rose requires a lot of sunlight and is most common in open areas or at the edges of vegetation.

Distribution of Multiflora Rose:

Multiflora Rose at this site follows its expected distribution: it is found on the edges of vegetation in regions of much sunlight. However, Multiflora Rose has not yet invaded the meadows even though the meadows have a lot of sunlight. The patch of Multiflora Rose in the southwestern corner is the least concerning of the patches of Multiflora Rose because it is bordered by Pine which creates dense shade.



⁴⁴ "PCA Alien Plant Working Group - Multiflora Rose (Rosa Multiflora)." *U.S. National Park Service - Experience Your America*. Plant Conservation Alliance. Web. 4 Dec. 2010. <<http://www.nps.gov/plants/ALIEN/fact/romu1.htm>>.

Because Multiflora Rose does not survive well in shade, it seems unlikely that it will spread from that location. However, the patch in the southeastern corner is concerning. It threatens native goldenrod and aster and it is in a location with a lot of sunlight that seems favorable for the spread of Multiflora Rose. The patch in the center of the site is of moderate concern. The path is to the west of it, Eastern Hemlock is to its south and east, and the brook is to its north. Thus, it cannot spread to a location immediately next to it. However, if its seeds cross the brook, it could potentially spread.

Recommendations for Multiflora Rose:

The southeastern patch of Multiflora Rose should be removed first since it is the most threatening. To remove Multiflora Rose, cut down the plant and dig up the roots. All portions of the roots must be removed to prevent re-sprouting. The removal process normally takes several attempts.⁴⁵ Repeated cutting of Multiflora Rose (normally three to six times) ultimately results in fatality even if some roots remain.⁴⁶

		Remove It	
	v	B	v*B
Environmental Impact	5	2	10
Long-term benefits	5	4	20
Aesthetic Impact	3	2	6
Labor cost	-3	3	-9
Financial cost	-1	2	-2
Score			25

⁴⁵ "Multiflora Rose Control." Ohio State University. Web. 5 Dec. 2010.
<<http://ohioline.osu.edu/b857/pdf/b857.pdf>>.

⁴⁶ Ibid.



Ground Elder:

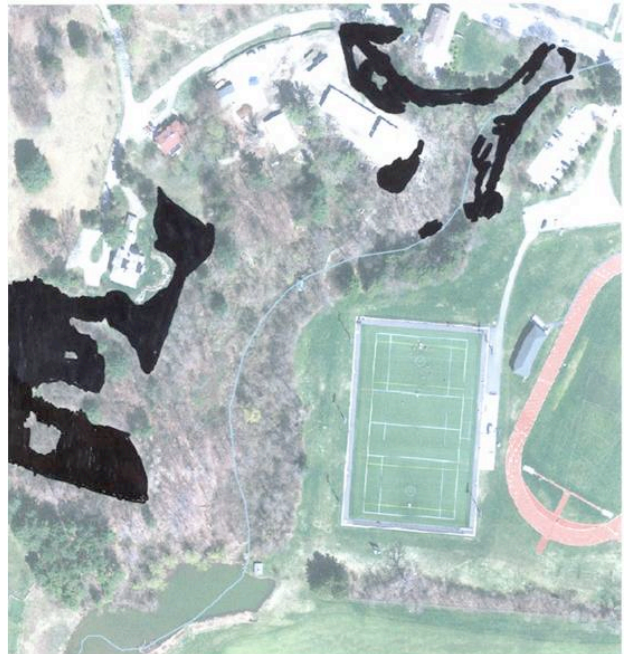
Ground elder (*Aegopodium podagraria*) is a perennial herb. The origin of ground elder can be traced back to Roman times.⁴⁷ It was brought to the United States by settlers for ornamental

reasons. Ground elder is versatile and can be

found in a variety of habitats provided there is a period of cold weather during which time the seeds germinate, but it survives best in moist soil.⁴⁸ It spreads by a rhizome system. This rhizome system facilitates the formation of a dense patch which forces out other vegetation in the area. This dense patch also prevents the growth of seeds from plants and trees.

Distribution of Ground Elder:

Ground elder is found in the northern portion of the site and in the meadows portion of the site. In places where it is found, it covers a large area. In the meadows, tall grasses can still grow above the ground elder. However, in



⁴⁷ "BBC - Gardening - Design - Roman." *BBC - Homepage*. Web. 19 Dec. 2010.

<http://www.bbc.co.uk/gardening/design/nonflash_roman2.shtml>.

⁴⁸ "Invasive Exotic Plant Tutorial - Goutweed." *DCNR. Plant Conservation Alliance*. Web. 2 Dec. 2010.

<<http://www.dcnr.state.pa.us/forestry/invasivetutorial/Goutweed.htm>>.

the northern part of the site, areas with ground elder generally have low biodiversity and not many native species.

Recommendations for Ground Elder:

It is important to remove ground elder in the northern portion of the site because it is preventing the growth of native species. In order to remove ground elder, dig it up by the roots.⁴⁹ The roots of ground elder are easy to find because they are white, bulky, and shallow in depth. It is likely that ground elder will have to be removed several times from the same location because it is difficult to locate all

		Remove It	
	v	B	v*B
Environmental Impact	5	4	20
Long-term benefits	5	2	10
Aesthetic Impact	3	4	12
Labor cost	-3	5	-15
Financial cost	-1	3	-3
Score			24

ground elder. Also, ground elder can entwine itself around the roots of other plants. If the entwined ground elder is not removed, it will re-grow. In cases where ground elder has entwined itself around other plants, remove the affected plant when it is dormant (normally late autumn), plunge the roots in a bucket of water to clean the roots to make the ground elder roots more visible, remove the ground elder, and return the plant to the soil.⁵⁰ If possible, ground elder in the meadows portion should be removed. However, it does not seem to affect the growth of native meadow grasses, so if the removal of ground elder seems to disturb native meadow grasses, then it might not be worthwhile to remove it.

⁴⁹ "Ground-elder - Recognition and Treatment." *Down Garden Services - for Co Down, Northern Ireland. Garden Work, Maintenance, Landscaping, Planting*. Web. 2 Dec. 2010. <<http://www.dgsgardening.btinternet.co.uk/ground-elder.htm>>.

⁵⁰ Ibid.



Black Locust:

Black Locust (*Robinia pseudoacacia*) is a small tree that originated in Southern Appalachia and the Ozarks. It was introduced into Wisconsin

in the early 1900s for protection against soil erosion. The distribution of Black Locust spread

because it was used for wood and to burn as fuel. Black Locust contributes positively to ecosystems through attracting bees and hummingbirds which pollinate its flowers, and its seeds are eaten by white-tailed deer, rabbits, squirrels, and a variety of birds. However, Black Locust is invasive. It reproduces both through seeds and through root suckering. In root suckering, new shoots of Black Locust arise from roots of another tree. This process of reproduction causes Black Locust to spread quickly and form dense growth in some environments.



Distribution of Black Locust:

Black Locust is found mainly in five clumps in our plot. These clumps are located near the edge of vegetation. All of these clumps are concerning because they are all near native

vegetation. The two southern clumps threaten goldenrod and aster, and the northern clumps threaten swamp dogwood and fern and are located near Eastern Hemlock.

Recommendations for Black Locust:

Because it has shallow roots, removal of Black Locust is not extremely difficult compared to the removal of other invasive trees. Furthermore, it is a relatively small tree that only grows from approximately 30 feet to 80 feet tall.⁵¹ Cutting Black

		Plant More		Increase Diversity	
	V	B	v*B	B	v*B
Environmental Impact	5	4	20	2	10
Long-term benefits	5	2	10	2	10
Aesthetic Impact	3	4	12	3	9
Labor cost	-3	3	-15	3	-9
Financial cost	-1	3	-3	3	-3
Score			24		17

Locust causes sprouting of new trees from the roots. Thus, in order to remove Black Locust it must be dug up, and the roots must be completely removed.⁵² Hay should be placed in the area to minimize re-sprouting, and it might take several attempts to completely remove the Black Locust.⁵³ Small trees can be removed by hand while larger trees require contractors. However, in this site, most of the trees seem to be small enough to remove by hand. Black Locust in the central portions can be replaced with Black Cherry, Choke Cherry, and Tilia. Black Locust in the southeastern portion can be replaced with aster and native willows such as pussy-willow or black willow.

⁵¹ "Invasive Species - Black Locust (Robinia Pseudoacacia) - WDNR." *Wisconsin Department of Natural Resources*. Web. 4 Dec. 2010. <http://dnr.wi.gov/invasives/fact/black_locust.htm>.

⁵² "Black Locust | MDC." *MDC* /. Web. 19 Dec. 2010. <<http://mdc.mo.gov/landwater-care/plant-management/nuisance-plant-management/black-locust>>.

⁵³ Ibid.



Burdock:

Burdock is a biennial thistle in the genus *Arctium*. It is native to Europe and Asia and was introduced into the United States in the 1700s for

medicinal reasons.⁵⁴ It was also used in paper-making and for coffee.⁵⁵ Burdock will grow in a

variety of soils, but it shows a strong preference for areas with a lot of sunlight. Within the ecosystem, burdock has positive and negative roles. It provides food for *Lepidoptera*, but it also produces burs that cause irritation to animals and can cause intestinal hairballs. Furthermore, burs can cause allergic reactions in humans. This is especially important for us to consider as we propose to make Christmas Brook into a recreational area.

Distribution of Burdock:

Burdock is found mainly in the eastern central region of the site and on the edge of



⁵⁴ "Common Burdock." Natural Biodiversity. Web. 2 Dec. 2010.

<<http://www.naturalbiodiversity.org/biobullies/downloads/Common%20Burdock.pdf>>.

⁵⁵ Ibid.

vegetation. It is generally found in clumps, and its distribution is similar to that of goldenrod and aster. Thus, goldenrod and aster are the native species that are most threatened by burdock.

Recommendations for Burdock:

The removal of burdock is recommended. However, burdock is not as aggressively invasive as many of the other invasive species at this site, so its removal is not a high priority. Burdock has a large taproot, and in order to remove it, the taproot must be dug up.⁵⁶ The best time to remove it is immediately after it flowers.⁵⁷ Burdock can also be dug up when it is a rosette, but rosettes are more difficult to locate than mature plants. Because burdock, aster, and

		Remove It	
	v	B	v*B
Environmental Impact	5	2	10
Long-term benefits	5	2	10
Aesthetic Impact	3	3	9
Labor cost	-3	3	-9
Financial cost	-1	1	-1
Score			19

goldenrod grow under similar environmental conditions, aster and goldenrod can be planted in regions from which burdock is removed. Furthermore, the recommendation for aster and goldenrod is to increase diversity of species. The removal of burdock would provide space that could be filled with a variety of aster and goldenrod species. (For specific aster and goldenrod species that could be planted, refer to the aster and goldenrod recommendation sections.)

⁵⁶ "Common Burdock." USDA Forest Service. Web. 19 Dec. 2010.
<http://na.fs.fed.us/fhp/invasive_plants/weeds/common-burdock.pdf>.

⁵⁷ Ibid.



Ground Ivy:

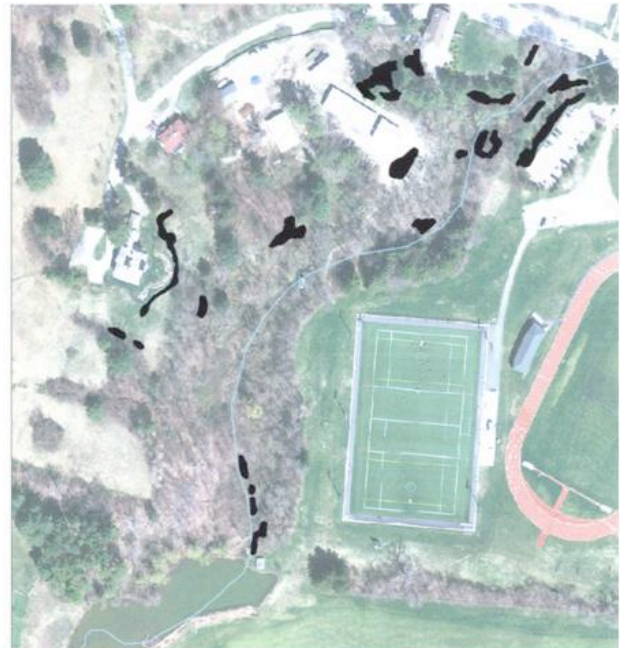
Ground Ivy (*Glechoma hederacea*)

originated in Europe and was brought to the United States by early settlers. It grows best in damp, shady locations, but it can also be found in

sunny locations. It has a stem that spreads over the ground and creates a thick mat which crowds out other vegetation. Because of its ability to slowly spread but ultimately invade large areas of land, ground ivy is nicknamed “Creeping Charlie.”

Distribution of Ground Ivy:

Ground Ivy is found throughout the northern portion of the site in wet soils, in front of the Oakley Center, and in wet soils east of the brook in the southern portion of the site. The region that is of most concern is the northern portion of the site. In the northern portion of the site, ground ivy is generally found in areas that contain a large amount of invasive species and few native species.



Recommendations for Ground Ivy:

It is recommended that ground ivy be removed. The highest priorities of ground ivy removal are the northern portion of the site and the southern portion of the site. Outside of the Oakley Center, other grasses are able to grow above the ground ivy, so if removal of ground ivy seems to disturb the meadow grasses, then it can be allowed to remain. Removal of ground ivy depends on the

		Remove It	
	v	B	v*B
Environmental Impact	5	3	15
Long-term benefits	5	2	10
Aesthetic Impact	3	3	9
Labor cost	-3	4	-12
Financial cost	-1	3	-3
Score			19

density of its growth and the plants around it. If there is not dense growth, gently pull on the ivy in the direction opposite of its growth in order to pull up the roots.⁵⁸ Make sure to remove all ivy from an area or else remaining pieces will spread and a mat of ivy will return. If ivy growth is dense, use the “Log Roll Method.”⁵⁹ For the “Log Roll Method”, mark the plot of ivy that you want to remove by placing rope along its borders. Identify plants in the area that are not ground ivy and mark them with a stick. Place a log at one edge of the designated area. Pull a mat of ivy around the log and roll the log across the area. This task may require several logs as the logs become heavy and hard to roll because of the ivy. Once the area is no longer covered in a mat of ivy, remove stray vines. Cut all vines (including vines from the logs) into three to five foot fragments. Move to a different area of the forest that is not invaded by ground ivy and pile the ivy. Cover the pile and allow it to dry and decompose. Follow-up is an important component of

⁵⁸ "Overview of Control Methods, 2010.

⁵⁹ Ibid.

ground ivy removal. Check the site for vines that may be missed or vines hiding under other vegetation in the area. Return to the site at least once every six months to insure that ground ivy has not returned.

Recommendations

We recommend that the proposal with the highest score for each plant is employed. A summary of these proposals is shown in the table below:

Type of Vegetation	Invasive or Native	Plan	Score for Plan
Goldenrod	Native	Increase diversity	39
Spinulose Woodfern	Native	Increase diversity	37
Honeysuckle	Invasive	Removal	35
Aster	Native	Increase diversity	34
Norway Maple	Invasive	Removal	32
Privet	Invasive	Removal	32
Eastern Hemlock	Native	Plant more	31
Northern Swamp Dogwood	Native	Plant more	30
Willowherb	Invasive	Removal	28
Japanese Barberry	Invasive	Removal	25
Multiflora Rose	Invasive	Removal	25
Ground Elder	Invasive	Removal	24
Black Locust	Invasive	Removal	21
Burdock	Invasive	Removal	19
Ground Ivy	Invasive	Removal	19
Norway Spruce	Not native or invasive	Increase diversity	17
Paper Birch	Native	Increase diversity	14
Pine	Native	No change	0
Box Elder	Native	No change	0
Grapevine	Native	No change	0

In general, this chart accurately describes the priority level of each plan. However, there is one notable exception. Based on this chart, removal of honeysuckle is third. Removal of honeysuckle received a score of five (the maximum score) for all sections: “environmental impact”, “long-term impact”, “aesthetic impact”, “labor cost”, and “financial cost.” Because of its labor and financial costs, it was not the highest ranked proposal. However, its “environmental impact”, “long-term impact”, and “aesthetic impact” are all so great that it does not seem logical to judge them on the same scale used for the other species. This is supported by the observation that the distribution of honeysuckle is far more extensive than that of any other species. In

addition, the removal of honeysuckle will create much needed space for the planting of native species. Thus, we recommend making removal of honeysuckle the highest priority plan and using the chart to judge the priority levels of the other plans.

It is important to note that in many regions of the site, there is extensive growth of invasive species. If all invasive species are removed at once, the land in the area could be significantly altered and the banks of the brook could be affected. In order to minimize the environmental impact of the removal of invasive species, the site should be divided into smaller sections. Removal of invasive species should occur gradually based upon these sections. Once invasive species are removed, native plants should be planted as soon as possible to minimize effects such as erosion. Because the site is protected by the Rivers Protection Act and Wetlands Protection Act, a proposal should be taken to the Conservation Commission.

TRAIL AND AMENITY PROPOSALS

Overview

The amenities we propose for the area around Christmas Brook were chosen based on their relevance to public interest, their potential to offer long term benefits to the community and their low ecological impact. Our proposal is broken down into three levels, based on cost and difficulty of implementation. Each level can be implemented individually, or all three can be implemented in stages. Since re-vegetating the area along Christmas Brook would greatly enhance the value of each amenity, we suggest that the top-ranked vegetation proposal be the foundation for all trail and amenities proposals. The cleanup of garbage and the removal of old fences and concrete remains also should be included in each proposal. Each stage includes use of the golf course pond for winter skating, which would be a relatively low cost amenity and one that our survey indicates would be used frequently.

In considering handicapped accessibility, we consulted the Americans with Disabilities Act guidelines for buildings and facilities. To meet ADA guidelines, a trail must be at least 36" wide, stable, non-slip, and relatively level; if the trail is narrower than 60" there must be wider areas every 200' for passing; gradient changes of more than 1/2" must be moderated by a ramp, and the maximum slope for any ramp in a new construction is 1:12 (which means that for every one foot rise or fall there must be a 12 foot ramp); and the maximum rise for any run is 30". These guidelines would limit a handicapped-accessible trail to the edges of the site, outside of the vegetated area. Unfortunately this option would not offer the kind of outdoor experience that we believe most people in Williamstown would desire. If a handicapped-accessible trail were to

go through the vegetated area, it would require a significant alteration of the landscape, which would have a negative ecological impact and most likely not get Conservation Commission approval. For these reasons, we have chosen not to incorporate handicapped-accessibility into our trail proposals. However, the picnic areas near Weston Field and Latham Street could easily be made handicapped-accessible.

The fence on along Latham Street, which inhibits public access to Denison Park, would most likely need to stay in place. Jim Kaiser, Williamstown's director of Public Works, explained that the fence, which is owned by the town, protects people from falling into the stream during periods of flooding. Since the culvert below Latham Street does not adequately handle the volume of water that periodically accumulates, the water level of the stream can actually rise above the level of the street. This happens as frequently as once per year. The fence also prevents garbage on Spring Street from ending up in the stream and possibly clogging the pipe. Although the fence increases Denison Park's isolation from downtown, it does not impede access to the proposed trailhead location.

Trail and Amenity Proposal: Stage 1

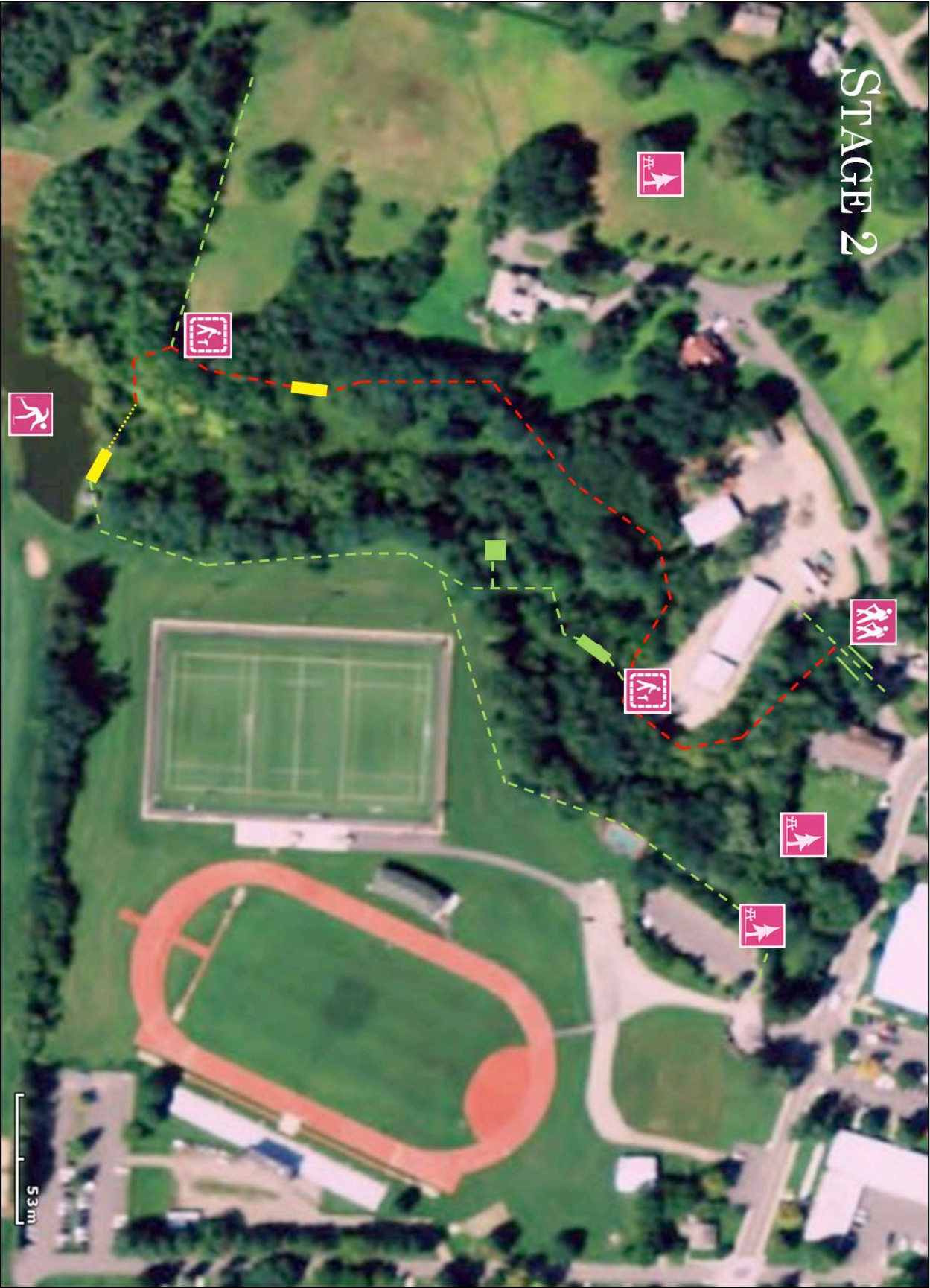
The "Stage 1" trail and amenity proposal is the simplest and cheapest version. This plan begins with invasive plant mitigation and cleanup of trash and debris, concrete remains, and barbed wire fence remains. As the proposal with fewest amenities, this plan does not include the construction of any new trails. Instead, it utilizes existing mowed grass as a guide towards existing features. Starting at the north end of the stream, we propose the addition of picnic tables on the west side of the Weston Field parking lot as well as in the back corner of the American Legion lawn. On the east side of the stream, walking along the tree line will lead towards the Meditation House where an interpretational sign will discuss the ecology of the site as well as the function and history of the building. The sign could point out invasive and native plants and discuss their interaction within this environment. Furthermore, our hope is that by describing the building as having historic and religious importance, we will help reduce the misuse currently attributed to local teenagers. Walking further south leads to the collection pond, which, even in this low-level proposal, we recommend utilizing as an ice rink during the winter time. In our scouting of the site, we also identified a location west of the Oakley Center as a great lookout over the campus, and a great location for another picnic table. While this proposal is modest, it will turn the site into a more attractive feature of the campus and downtown area, rather than one that should be hidden from view.



Trail and Amenity Proposal: Stage 2

The second proposal recommends several additions to Stage 1. The main difference is the inclusion of a full trail on the west side of the stream, forming a loop with the existing mowed grass on the east. This path would begin at the north end of the Agway Lot, at our proposed trailhead, where an interpretational sign and a map will direct users. The trail proceeds southeast, circling around the eastern side of the Agway Lot, carved into the hillside. This all-in trail will bring users just inside the tree line and provide a nice view of the stream below while avoiding the existing Facilities storage area. As it proceeds, it will follow the hill's contour lines, keeping the path level, but providing variety and turns. At the intersection with the existing path, an interpretational sign – relocated northward from the Stage 1 plan – will describe the ecology of the site and history of the building. The new path would then continue west and south, just inside the western edge of the forest. A small mowed path could indirectly connect the Oakley center's existing path, allowing easier access to the picnic bench located on the lookout hill to the west. Heading south, the trail will have to cross a tributary of Christmas Brook. We selected a spot a few yards away from where two small tributaries combine so that we would only require one crossing. The steep banks on either side would easily allow for the construction of a single-unit bridge with handrails that keeps well clear of the waterway and does not affect its banks. A long enough bridge would ensure that this crossing would not involve a dramatic change in elevation – a positive for Nordic skiers. Jeff Kennedy believed that the tributary would be exempt from regulations; however, in the event that building a bridge is not possible, wooden steps could be used to climb down to the small stream which can be stepped over with minimal effort – though at a disadvantage for skiers. Once the trail reaches the southern edge of the

meadow, another interpretational sign will inform users about their location as well as provide more information on the process of invasive species removal as it pertains to the particular location. This location would mark a crossroad, as an existing mowed path exists to the west. To the south east, wooden steps can be used to climb down into the marshy area just north of the pond. This area is considered a wooded swamp or wetland, and regulations as well as the wet, deep soil would make a path here difficult, if not impossible, to create and maintain. Instead, we propose creating an elevated walkway with a handrail, using minimal ground support in order to minimize the impact on the environment. This will likely be the most legally and technically challenging aspect of the trail as its construction will largely depend on clever planning and approval from the Conservation Commission. This walkway leads east to the dam allowing flow into Christmas Brook over which a bridge will take users to the eastern bank. Mr. Kennedy assured us that building a bridge over the existing structure of the dam would likely not cause a problem as it would not add to imperviousness or alter the banks. Connecting back to the east is crucial to this plan as it would create a loop with the mowed grass on the eastern side of the stream.

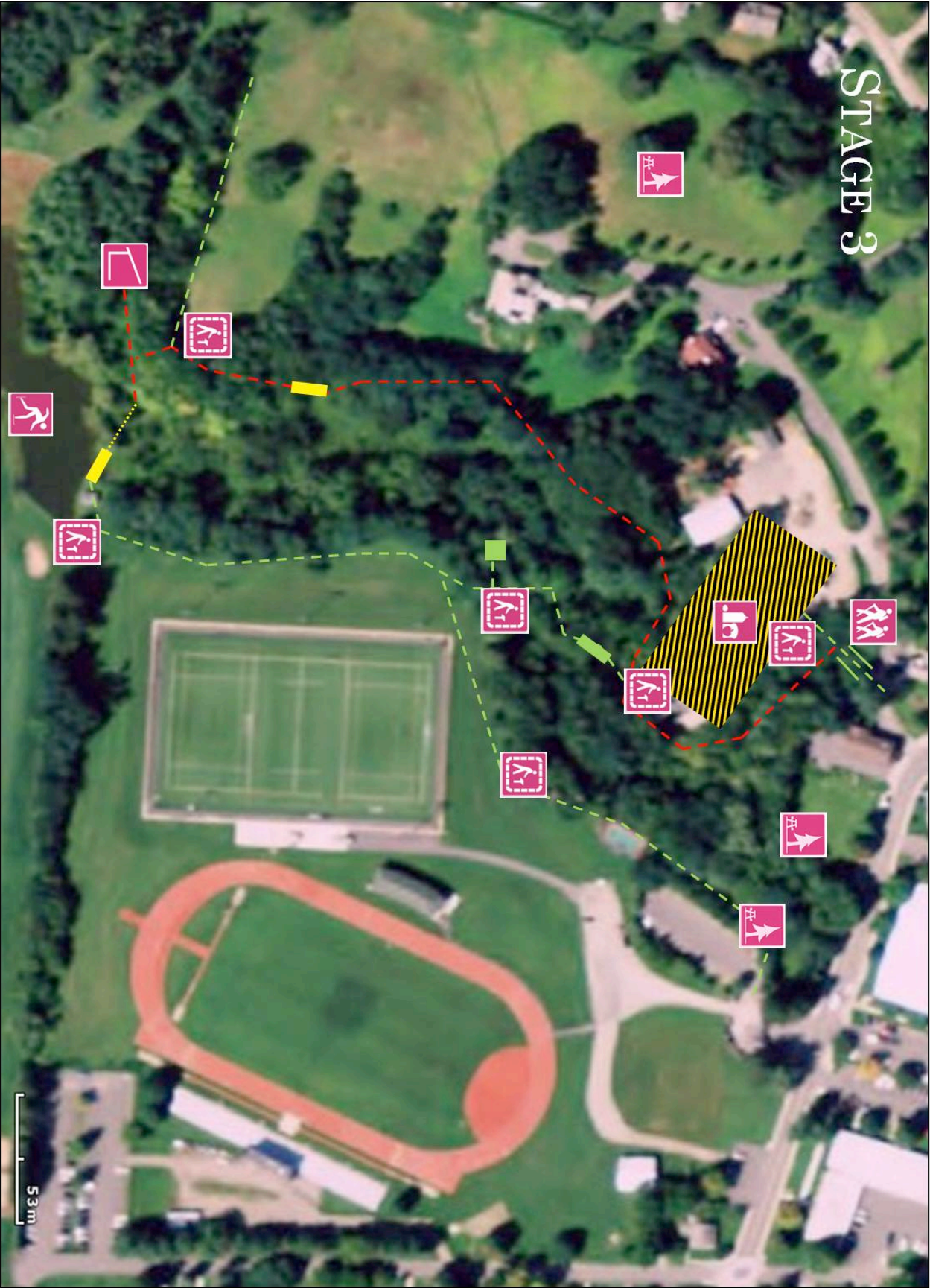


Trail and Amenity Proposal: Stage 3

The third and final proposal only makes small changes to the Stage 2 plan; however, the added amenities would require the relocation of the Agway Lot as well as permitting to allow the construction of a gazebo. The primary addition is a community garden and native plant nursery which would occupy the entire extent of the Agway Lot. Our proposal for the relocation of functions currently filled by the lot are included below. The plan includes the addition of four interpretational signs to the Stage 2 plan. The signs will be located respectively on the eastern bank of the pond, on the path to the Meditation House, on the mowed path north of Lamb Field and on the northern edge of the community garden. Having more signs will create a better educational experience as well as allow more specificity for each area. Finally, the Stage 3 proposal includes a wooden shelter/gazebo built into the hillside of the southern pine forest, just north of the collection pond (see Figure 22 for an example). This building can be made accessible using a branch off the trail headed to the east on the northern edge of the pond.



Figure 22 – Example of hillside gazebo



Discussion of Proposed Trails and Amenities

Splitting our proposal into three stages depended largely on clusters of costs and difficulty of implementation of amenities. While all the costs were ambiguous, certain amenities were bound to involve a higher labor or material cost and were therefore moved into the highest stage. The proposed western trail is identical in both Stage 2 and Stage 3 as based on our site scouting, there are no other alternatives for a woodland trail in this area. Still, ranking amenities allows a more incremental approach to development that can gauge public interest and involvement as it progresses. Several stakeholder and expert interviews directly informed our trail choices as enumerated below.

Oakley Center

Although access to the Oakley Center from both the golf course and Latham Street was one consideration in designing trails along the brook, the Oakley Center is seldom used for anything but research and writing. Most students and faculty members have little reason for going there. Michael Brown, who chairs the center, would not object to a trail passing near the property, but indicated it would be better if it did not lead right up to the center itself. The trail we propose passes by the Oakley Center, along the edge of the meadow, far enough away so that traffic along the trail would not be intrusive. However, walkers may be attracted to the patio behind the Oakley Center, which offers a view of the stream in winter.

Pond and Golf Course

The pond at the golf course was created in the 1980s as an irrigation reservoir. Wetland areas that existed at the site were relocated to the northern edge of the pond where they quickly

re-established themselves. The pond is shaped roughly like an hour glass and is approximately 100 meters across at the widest point (Appendix 1).

Ponds along Christmas Brook have historically been used for winter skating. Christmas Lake, as mentioned above, was a popular outdoor skating destination in the 1800s. A second pond, which existed south of Latham Street, may also have been used for winter skating (Appendix 11). In 1964 the Christmas Brook Figure Skating Club was founded in Williamstown and in 1969 it became a member of the United States Figure Skating Association.⁶⁰ (This was shortly after the Lansing Chapman Rink was built and the northern part of Christmas Brook disappeared.) The club still exists today and offers skating lessons to children in the northern Berkshires.

After shutting down for the winter, Taconic Golf Club becomes open to the public. Its winter uses currently include cross country skiing, snowshoeing and sledding.⁶¹ Trails along Christmas Brook would offer additional terrain for skiers and snowshoers and create a connection between the golf course and the downtown area. A simple wooden rack where skiers and snowshoers could rest their gear would be useful at the downtown end of the trail.

Skating on the pond would require the approval of the Board of Directors, and the regular testing of ice stability by hired town employees (the Williamstown Fire Department typically provides this service, but Williams College buildings and Grounds could do so as well).⁶² A major concern with the Taconic pond is that water continues to flow through the pond all winter. This can melt the ice from underneath.⁶³ Regular testing of the ice and a highly visible sign

⁶⁰ Christmas Brook Figure Skating Club

⁶¹ Kent Lemme

⁶² Kent Lemme

⁶³ Kent Lemme

(which could perhaps be hung on the side of the existing shed at the edge of the pond) indicating whether or not the ice is safe would be necessary.

The pond is already somewhat accessible from Latham Street by walking through Weston Field. However, if the pond were opened to public skating, a trail would offer a more scenic and perhaps more practical approach from the downtown area. Use of the trail by skiers and snowshoers would pack down the snow and provide easier access for people walking to the pond.

The Agway Lot

Although the Agway lot lies outside of the 100 foot WPA buffer zone around Christmas Brook, one and a half of Agway barns lie within the 200 foot buffer zone delineated by the Rivers Protection Act of 1996 (Appendix 11). The RPA was an amendment to WPA and provides the area around rivers the same protection as the area around wetlands.⁶⁴ Since the Agway buildings were built after the RPA went into effect in 1997, they were allowed to remain. According to Jeff Kennedy, a Williamstown Conservation Commissioner, the two dumpsters on the site (which are not within any buffer zone) may be subject to section 310 CMR 16 under the Massachusetts Department of Environmental Protection. The volume of material handled by the dumpsters, how long materials there are stored for, in addition to other factors, would determine whether the dumpsters are exempt from DEP regulation.⁶⁵

Mr. Kennedy said that the removal of structures within WPA and RPA buffer zones does not require Conservation Commission approval, since doing so increase the permeability of the ground, which would benefit the wetland/river area. Development that increases ground

⁶⁴ MassDEP, "Massachusetts Rivers Protection Act"

⁶⁵ MassDEP, "310 CMR 16.00"

permeability generally does not require Conservation Commission approval, provided adequate erosion and sediment control measures are taken. Following the removal of vegetation, these measures would include the placement of hay bales and silt fencing in order to prevent erosion until new vegetation takes hold and re-stabilizes the soil.⁶⁶

Although removing buildings does not require Conservation Commission approval, non-native species are not allowed to be planted within the RPA buffer zone.⁶⁷ We recommend using the part of the garden that would be within the buffer zone as a nursery for starting native plant seedlings that would then be transplanted throughout the site. The part of the garden outside of the buffer zone would be used as a regular community garden.

We feel that a community garden in place of the Agway lot would be a better use of this downtown area. The long term benefits of a community garden would include decreasing the community's consumption of imported food (which means cutting down on the use of fossil fuels used for transport) and providing opportunities for greater community interaction. The Williamstown Farmers Market, which takes place in the parking lot on the corner of Denison Park Drive and Spring Street, would increase public awareness of the garden, and offer a convenient venue for the sale of community-grown produce.

One potential relocation site for the Agway buildings is next to the Williams College book depository off of Simonds Road in Williamstown.⁶⁸ This parcel of land, which is owned by Williams College, is large enough and far enough away from the nearest RPA buffer zone to allow for further development (Appendix 12). The existing Agway buildings could perhaps be transported to the new location, which would decrease the need for new construction materials.

⁶⁶ Jeff Kennedy

⁶⁷ Jeff Kennedy

⁶⁸ Jeff Kennedy

One downside to the Simonds Road location is that maintenance vehicles would need to travel farther between the campus and facilities. However, relocating the Agway buildings, in addition to providing space for a community garden, would benefit the Christmas Brook ecosystem by increasing ground permeability, and would make downtown Williamstown more attractive.

Meditation House

Rev. Spalding indicated an interest in preserving the spring house as a historical and spiritual resource. There are currently no other structures on campus devoted specifically to meditation. Also, the fact that the renovation of the meditation house was the project of a Williams College student makes it more of an asset to the college community. Our trail proposal avoids the meditation house, while the cleanup of garbage around it and the placement of an educational sign nearby would provide it a level of dignity that would discourage misuse and increase public awareness of its role in the community.

The rustic stone and concrete walls containing the brook around the meditation house, and the old stone bridge, should remain undisturbed, unless repairing them would be necessary for safety. An assessment of the bridges and walls that currently exist will be necessary to determine if they can handle pedestrian traffic. This could potentially be done by the contractors of the Weston Field project.

Recommendations for Research and Education

Altering natural areas, even those that have been neglected and overgrown with invasive species, requires special sensitivity. Riparian ecosystems are delicate, complex and not completely understood. To get a sense of how altering the vegetation and building trails around Christmas Brook would affect the health of the stream itself, we spoke to Elena Traister at

MCLA, who specializes in stream ecology. We were concerned that removing a large quantity of vegetation around Christmas Brook would have adverse affects on the stream and stream organisms. Although the relationship between riparian and hydrological ecosystems is not well understood, Ms. Traister suggested ways that our project can be more sensitive to the Christmas Brook ecosystem.

Our invasive species inventory will serve as a starting point for further studies of Christmas Brook that would occur during and after the removal of invasive species and reintroduction of natives. According to Ms. Traister, ongoing surveys of the vegetation around Christmas Brook could include measuring percent of ground cover, amount of shade, etc., along with indicators of stream health such as dissolved oxygen levels and microorganism counts. Soil surveys could also help understand the affect of removing certain species and reintroducing others. Monitoring Christmas Brook throughout the restoration project and into the future will provide useful ecological data, which could also benefit other similar restoration projects.

Since Denison Park is only a portion of a much larger stream and watershed, and since water always carries things with it, restoring Denison Park should take into account what goes on upstream. It is possible, for instance, that seeds from invasive plants not in the project area could be carried by the stream and make eradicating certain species more difficult. It would be difficult to determine if this were happening until the invasive species removal could be monitored. Another concern with stream transport is that chemicals upstream (from the golf course, for example) may affect native species differently than the invasive species that currently thrive in the area.

According to Mr. Lemme, the pond at the southern edge of the project area collects runoff from approximately sixty percent of Taconic Golf Club, and fertilizers used by Taconic include Quick Release, Ammonium Sulfate, urea products and nitrogen. Christmas Brook also collects runoff from the area surrounding Buxton School, Stone Hill, and the Clark Art Institute. According to Mr. Lemme, runoff from past construction projects at the Clark Art Institute have turned Christmas Brook blue, leading to public concern. Although the blue runoff did not cause any noticeable harm to the stream, it indicates the extent of Christmas Brook's watershed.

This project could be used as a model for removal of invasive species without chemicals and planting of native species in a wetlands area. The Housatonic River Walk made their revitalization project into a model through the creation of a detailed website outlining their revitalization process.⁶⁹ It would be beneficial if the Christmas Brook project could serve as a local example of how this feat can be accomplished. It could also be used as model on a larger scale through the creation of a website documenting the process. This documentation would be of educational value in the future as Williams College, Williamstown, or other locations with similar invasive species undertake revitalization projects.

This project could also serve as an educational opportunity for students and volunteers. "Revitalization of Christmas Brook" could potentially be offered as a physical education class through the Williams College Outing Club. Furthermore, there could be volunteer days open to students and the community. Successful revitalization projects tend to have a time set aside each week for volunteers to work on the site.⁷⁰ These volunteers would be educated in how to identify and remove common invasive species without chemicals. For volunteers from the community,

⁶⁹ "Welcome to Great Barrington Housatonic River Walk."

⁷⁰ "Rachel Fletcher."

those skills could be useful in their own yards, and for students, those skills could be useful in the future.

The site itself would also have educational value. Informational signs throughout the site would identify places of historical and ecological significance. Furthermore, merely being present at the site would have benefits to both children and adults. Recently “outdoor deprivation disorder” which is associated with physical health problems and mental stress has been identified as a significant problem within the United States.⁷¹ The White House responded by declaring the month of June “Great Outdoors Month.”⁷² According to an article in the New York Times, the National Wildlife Federation “cites scientific findings that outdoor play enhances fitness, raises blood levels of vitamin D (which in turn protects against bone loss, heart disease, diabetes and other health problems), improves distance vision, lowers the risk of nearsightedness, reduces symptoms of stress and attention deficit hyperactivity disorder, raises scores on standardized tests and improves students’ critical-thinking skills.”⁷³ If attractive trails were made through the Christmas Brook Site, it would be an ideal location to fight outdoor deprivation disorder because it is easily accessible both to students and community members because of its proximity to Spring Street.

In addition to having value to the community and to students, the Christmas Brook Site could also be used by science classes at Williams College. At Williams, one of the concepts studied in ecology is ecological succession. The Christmas Brook Site would be a great location for conducting experiments about ecological succession in areas from which invasive species

⁷¹ Brody, Jane E. "Head Out for a Daily Dose of Green Space." The New York Times, 10 Nov. 2010. Web.<http://www.nytimes.com/2010/11/30/health/30brody.html?_r=2&scp=1&sq=outdoor%20deprivation%20disorder&st=cse>.

⁷² Ibid.

⁷³ Ibid.

have been removed. Also, its proximity to campus makes it convenient for labs. In addition, a portion of the community garden could be set aside for experiments by biology or environmental science students.

FINAL RECOMMENDATIONS

Our top-recommended vegetation proposal should serve as the foundation for all trails and amenities in the Christmas Brook area. A careful restoration of Denison Park will benefit the local and regional ecosystem, enhance the aesthetic value of the site and make the proposed amenities more enjoyable. It will also provide long-term educational benefits to local communities, schools, and groups that involve the outdoors. Ongoing research will increase our knowledge of hydrological and riparian ecosystems and of the methodologies of stream restoration. This project can also serve as a model for the restoration of other stream ecosystems. Re-vegetation and research would offer opportunities for volunteer service and community interaction, while supplying much of the labor needed to complete the project.

Although each of the three trails and amenities proposals we offer can stand on its own, we recommend implementing the third level, as a long term goal approached in stages over the course of two or three years. The advantage of a long-term, incremental approach is that it will allow planners to incorporate public opinion on an ongoing basis and also respond more effectively to unanticipated events. An incremental approach will also take place more at the pace of everyday life, and not be too intrusive on downtown activities.

Based on the statewide data and the results of our surveys, we believe the amenities we propose are those that the local community would use most frequently. The third-stage proposal, with its community garden, trail access to skiers and more extensive amenities, best represents the interest of the local community. Depending on the Conservation Commission's views as to its ecological impact, this proposal potentially offers the greatest public and ecological benefits.

Finally, we recommend incorporating this proposal into the current plans for Weston Field, which would potentially benefit both renovation projects. It would gather momentum for the Christmas Brook project – in terms of public awareness, organization, cost and labor – and would add an environmental element to the larger Weston Field project, which in turn may help it generate greater support. The incorporation of these two plans would increase public awareness of the Christmas Brook area, leading perhaps to new insights and considerations, and the greater use of amenities once they are established.

Acknowledgements:

We would like to thank Sarah Gardner, David Fitzgerald and Henry Art for the help and guidance they provided us with throughout the research project. We would also like to thank all the individuals who helped us make this project possible by agreeing to interviews or surveys.



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APPENDIX 1 – SITE MAP - SATELLITE



APPENDIX 2 – MASSACHUSETTS 2006 SCORP DATA

Figure 11. Participation Rates in Activities at Recreational Areas †

		Percent of Respondents ††												
Activity	Recreational Area	Rivers & Streams	Lakes & Ponds	Coastal Beaches	Wetlands	Bikeways	Trails & Greenways	Wildlife Conservation	Mountains	Forests	Agricultural Lands	Historic & Cultural Sites	Parks and Golf Courses	
Passive Recreational Activities														
Photography / painting		2.3	1.4	1.5	3.1	0.0	2.1	3.9	2.3	3.4	2.2	5.1	0.6	
Picnicking		12.7	18.1	8.6	1.3	5.2	6.2	5.8	8.3	9.2	3.9	1.2	7.7	
Sightseeing, tours, events		9.9	3.9	7.4	17.0	2.0	5.5	18.1	19.0	9.2	22.3	81.3	3.4	
Sunbathing		0.2	4.7	26.6	0.3	0.0	0.0	0.0	0.3	0.0	0.3	0.2	0.2	
Watch wildlife, nature study		8.4	4.4	3.6	28.4	1.4	8.4	34.5	9.3	14.7	16.4	3.2	1.7	
Trail-Based Activities														
Biking (mountain)		3.5	2.1	0.5	1.2	38.6	8.7	2.4	2.6	5.9	1.7	0.3	0.8	
Biking (road)		1.9	0.9	0.9	0.0	55.0	3.2	0.6	1.7	1.2	0.3	0.0	2.3	
Horseback riding		0.2	0.1	0.2	0.2	0.1	1.0	0.7	0.8	0.7	2.5	0.0	0.0	
Off-road vehicle driving		0.3	0.1	0.3	0.0	0.0	1.6	0.0	0.4	0.5	0.1	0.0	0.0	
Roller blading / skating		0.7	0.4	0.1	0.0	7.9	0.0	0.0	0.0	0.0	0.0	0.0	1.3	
Running / jogging		1.0	0.2	1.5	0.0	1.4	2.7	0.4	0.2	1.6	0.3	0.0	2.0	
Skiing (cross country)		1.2	1.2	0.0	0.0	0.0	1.2	0.7	5.8	1.4	0.8	0.0	0.7	
Skiing (downhill)		0.8	0.4	0.0	0.3	0.0	0.3	0.0	22.7	0.6	0.0	0.1	0.1	
Snowmobiling		0.0	0.7	0.0	0.0	0.0	1.5	0.0	0.8	0.3	0.4	0.0	0.0	
Walking		30.7	20.0	34.0	44.9	15.4	56.4	46.4	20.6	42.5	22.2	18.5	16.7	

† Based on respondents who indicate that they have visited recreational areas in the last 12 months.

†† Percents may not equal 100 due to multiple responses.

Chadwick, Martin Bailey, Inc. for SCORP

APPENDIX 3 – MASSACHUSETTS 2006 SCORP DATA

Figure 26. Need for New Recreational Facilities by SCORP Region Facilities for:									
	Statewide	Cape Cod and Islands	Southeastern	Metropolitan Boston	Northeastern	Central	Connecticut Valley	Berkshires	
Passive Recreational Activities									
Photography / painting	0.2	0.0	0.0	0.2	0.9	0.0	0.0	0.2	
Picnicking	3.1	2.1	1.4	3.2	0.7	5.3	5.5	7.7	
Sightseeing, tours, events	2.3	0.8	1.6	3.7	0.7	0.8	2.8	2.3	
Sunbathing	1.1	4.5	1.6	1.6	0.0	0.0	0.0	0.0	
Watch wildlife, nature study	2.2	4.1	3.4	1.2	1.4	3.5	3.9	1.1	
Trail-Based Activities									
Biking (mountain)	6.7	3.8	5.3	6.2	6.1	8.5	10.3	9.2	
Biking (road)	12.9	15.5	17.6	10.5	14.1	12.1	14.5	6.8	
Horseback riding	1.2	0.0	1.7	1.1	0.9	1.3	1.7	2.8	
Off-road vehicle driving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Roller blading/skating	3.0	4.4	2.6	3.5	3.2	1.5	2.8	1.5	
Running/jogging	3.0	1.5	4.5	4.2	1.1	0.3	2.4	2.8	
Skiing (cross country)	1.3	0.0	0.6	0.7	0.0	3.4	4.1	4.6	
Skiing (downhill)	1.3	1.7	0.6	0.8	1.6	2.5	1.8	2.7	
Snowmobiling	0.6	0.0	0.0	0.2	1.8	1.4	0.7	1.1	
Walking	13.8	9.0	12.6	14.8	11.8	16.5	13.9	11.3	

APPENDIX 4 – SAMPLE INTERVIEW QUESTIONS

SECURITY QUESTIONS:

- 1) To your knowledge, what security concerns/issues have come up over the years in the Christmas Brook area/Zen House?
- 2) From a safety and security point of view, what are the concerns with a path moving through a lightly wooded area from Latham St. to the Oakley Center?
- 3) What are your recommendations for the management of the Zen House?
- 4) From a security point of view, is there anything you would like to see included in the Christmas Brook restoration?
- 5) From your personal point of view, is there anything you would like to see included in the Christmas Brook restoration?

SITE DEVELOPMENT QUESTIONS:

- 1) What are the goals of the Weston Field restoration?
- 2) Has the Christmas Brook area adjacent to Weston Field been included in any way in the project?
- 3) What are the problems you might foresee with the Christmas Brook project - specifically, how might it affect the Weston Field restoration?
- 4) How is the Agway lot being managed? Is there any plan to relocate the functions of the lot?
- 5) From your professional point of view, is there anything you would like to see included in the Christmas Brook restoration?
- 6) From your personal point of view, is there anything you would like to see included in the Christmas Brook restoration?

APPENDIX 5 – LIST OF ALL INTERVIEWS (alphabetized by last name)

Dave Boyer, Williams College Interim Director of Campus Safety and Security

Michael Brown, Director of the Oakley Center for the Humanities and Social Sciences

Adam Falk, President of Williams College

Michelle Gietz, Owner of Where'd You Get That!?

Gary Guerin, Williams College Associated Director of Operations/Athletics

Jeff Horst and **Keri Van Camp**, Buildings and Grounds Director of Special Projects (Horst) and Preserve Manager (Van Camp) at Vassar College

Timothy Kaiser, Director of Williamstown Public Works

Jeff Kennedy, Williamstown Conservation Agent

Ben Kuelthau, Student Assistant Trail Manager for Williams College

Kent Lemme, Superintendant of Taconic Golf Club

Scott Lewis, Williams Outing Club Director

Jason Moran, Williams College Facilities Project Manager

Richard Spalding, Williams College Chaplain

Laura Staugaitis and **Alexandra Highet**, Director (Staugaitis) and Coordinator (Highet) of the WOOLF (Williams Outdoor Orientation for Living as First-Years) program.

Elena Traister, Coordinator of the Environmental Studies Program at MCLA

APPENDIX 6 – SELECTED STAKEHOLDER INTERVIEW SUMMARIES

Dave Boyer, Interim Director of Williams College Campus Safety and Security

As our project is located in the center of Williams Campus, one of our initial concerns was the security of a wooded path. Mr. Boyer was very excited about the possibilities offered by our plan and offered us a lot of information regarding the site. One detail that emerged early on in the discussion was the repeated misuse of the Meditation House. Despite being relatively unknown to Williams students, the small, isolated building had attracted a lot of attention from local teenagers who used the building for illegal parties. The current management of the building has worked against this; currently it is run by a combination of the Chaplain's Office and Campus Safety and Security (CSS). The college Chaplain provides a list of names to CSS, who can then issue out temporary keys to students looking to utilize the building for meditation. On average, 4-5 students are on the list every year, though the building is not very often used. Despite the building now being locked, the area surrounding it is littered with spent alcohol containers and cigarette butts. Mr. Boyer stated that if the area were to be open to the public, it would be preferable from the point of view of the CSS for its use to surpass a certain threshold. This limit would establish the area as public, as opposed to secluded and sheltered from law enforcement.

In terms of amenities, Mr. Boyer recommended a destination to attract a larger number of users. He also brought up the possibility of requiring lighting and an emergency phone along the path, although he conceded that this might be less necessary given that most students have a mobile form of communication with them. Mr. Boyer did not anticipate any security issues related to football games and the increased accessibility of the Christmas Brook site. Moreover, he was strongly in favor of shifting pet walking from Weston Field to a path, though he stressed the need for trash receptacles and signage.

Jason Moran, Project Manager for Williams College Facilities

Over the past several years, Mr. Moran has been in charge of the Weston Field restoration project. As of fall 2010, the project has once again been green-lighted after being suspended in the face of the school's financial difficulties in 2008-2010. According to Mr. Moran, the progress has been quite frustrating as building codes have changed twice since 2005, requiring redesign of the project on both occasions. While some thought had been given to including Christmas Brook as a feature in the new design; however, WPA regulations make any development difficult. In the end, the choice was to stay as "far away from [Christmas Brook] as possible." In terms of development, he called attention to the non-compliance of the Agway Lot and the difficulty involved in replacing the Facilities storage buildings with athletics buildings – as had been considered in some versions of the plan.

He continued by stressing the importance of cleaning up Christmas Brook of trash, drawing out water features and making it more aesthetically pleasing. He pointed out that the planned relocation of the parking lot currently located in the northeast end of our site would help remove imperviousness. Despite this change, care has been taken to avoid changing the Christmas Brook watershed. Currently, half of Weston Field sheds water eastward towards the Green River, while the other half combines with the already large Christmas Brook watershed in the west (about 600-800 acres according to Mr. Moran). Reducing this watershed would affect downstream habitat, while adding to it would worsen the Latham culvert flooding situation.

Despite all these limitation, Mr. Moran appeared interested in the results of our project and how they might inform the Weston Field restoration.

APPENDIX 7 – SAMPLE SURVEY

As part of a project run by Williams College Facilities looking at revitalizing Christmas Brook (see map) and opening the area to public use, we are analyzing trends in the utilization of outdoor spaces in Williamstown. The following questions are concerned with the use and availability of outdoor recreational spaces in the downtown Williamstown area (Spring St, Latham St., Water St.).

The survey is anonymous – your identity will in no way be connected to your responses. Please direct any questions to Andrei Baiu at ab1@williams.edu or 608-358-1802

1. Which of the following amenities would you want to improve or see more of in the downtown Williamstown area (Spring St, Latham St, Water St.)? Check all that apply.

- ☐ Seating areas (benches)
- ☐ Pet walks/pet areas
- ☐ Picnic areas (grass/tables)
- ☐ Winter sports (skating, cross country skiing)
- ☐ Pedestrian nature walks
- ☐ Public art
- ☐ Secluded/quiet areas for seating
- ☐ Community garden
- ☐ Other: _____

2. If a nature walk were available within 10 minutes or less (relaxed walk) from Spring St., how often would you use it?

- | | | | | |
|-------|------------------|------------------------|-------------------|--------------------------|
| 1 | 2 | 3 | 4 | 5 |
| Never | Once per
year | Once every
6 months | Once per
month | Once or more
per week |

3. If an outdoor winter skating rink were available within 10 minutes or less (relaxed walk) from Spring St., how often would you use it?

- | | | | | |
|-------|---------------------------|-------------------|------------------|--------------------------|
| 1 | 2 | 3 | 4 | 5 |
| Never | Once per
winter season | Once per
month | Once per
week | Daily or
almost daily |

4. Do you live within a 15 minute relaxed walk of Spring St?

YES NO

Williamstown resident? YES NO

Williams College Student? YES NO

Williams College Faculty or Staff? YES NO

Age range (optional) Under 25 26-35 36-45 46-55 56-65 66+
Gender (optional) _____

APPENDIX 8 – SURVEY RESULTS*

*(the next Appendix page contains the same results in a table format for your convenience)

1. Which of the following amenities would you want to improve or see more of in the downtown Williamstown area (Spring St, Latham St, Water St.)? Check all that apply.

53.2% (41/77)	Seating areas (benches)
41.6% (32/77)	Pet walks/pet areas
51.9% (40/77)	Picnic areas (grass/tables)
32.5% (25/77)	Winter sports (skating, cross country skiing)
55.8% (43/77)	Pedestrian nature walks
44.2% (34/77)	Public art
27.3% (21/77)	Secluded/quiet areas for seating
50.9% (39/77)	Community garden

Other: bike path, weekend social events, more trashcans, playground, running trails, concerts, outdoor art

2. If a nature walk were available within 10 minutes or less (relaxed walk) from Spring St., how often would you use it?

1	2	3	4	5
Never	Once per year	Once every 6 months	Once per month	Once or more per week
2.6% (2/77)	15.6% (12/77)	24.7% (19/77)	28.6% (22/77)	28.6% (22/77)

3. If an outdoor winter skating rink were available within 10 minutes or less (relaxed walk) from Spring St., how often would you use it?

1	2	3	4	5
Never	Once per winter season	Once per month	Once per week	Daily or almost daily
13% (10/77)	32.5% (25/77)	20.8% (16/77)	28.6% (22/77)	5.2% (4/77)

4. Do you live within a 15 minute relaxed walk of Spring St?

YES	NO
62.3% (48/77)	37.7% (29/77)

Williamstown resident? YES 44.2% (34/77) NO 55.8% (43/77)

Williams College Student? YES 33.8% (26/77) NO 66.2% (51/77)

Williams College Faculty or Staff? YES 16.9% (13/77) NO 83.1% (64/77)

Age range (optional): Under 25 16.9% (32/77) 26-35 6.5% (5/77) 36-45 6.5% (5/77)

46-55 26% (20/77) 56-65 10.4% (8/77) 66+ 9.1% (7/77)

Gender (optional) Male 31.2% (24/77) Female 66.2% (51/77)

APPENDIX 9 – SURVEY RESULTS

Seating	Pets	Picnics	Winter sports	Nature walk	Art	Quiet	Garden
41	32	40	25	43	34	21	39
53.2%	41.6%	51.9%	32.5%	55.8%	44.2%	27.3%	50.6%

Nature Walk Use	Skating Pond Use
3.526316	2.684211

Do you live close to downtown?	Williamstown Resident	Williams Student	Williams Staff/Faculty
48	34	26	13
0.623377	0.441558	0.337662	0.168831

-25	26-35	36-45	46-55	56-65	66+	M	F
32	5	5	20	8	7	24	51
41.6%	6.5%	6.5%	26.0%	10.4%	9.1%	31.2%	66.2%

APPENDIX 10 – NORTH ADAMS TRANSCRIPT ARTICLE

Williams students propose work at Christmas Brook area

By Meghan Foley

Friday December 17, 2010

WILLIAMSTOWN -- Williams College students propose to enhance the institution's Christmas Brook area with trails, picnic areas and the removal of invasive species.

Seniors Alex Elvin and Andrei Baiu and junior Lauren Goldstein-Kral said Wednesday afternoon that cleaning up the area and building a nature trail would benefit the Spring Street area, Williams students and the entire town. "It would be an educational and ecological benefit to the community," said Elvin, a resident of Williamstown. "It would help bring this sort of forgotten part of town back."

Before merging with the Green River near Water Street, Christmas Brook runs southeast toward Latham Street along the western edge of Weston Field from a pond located on the northwestern edge of the Taconic Golf Course.

Baiu, who is from Madison, Wis., said students would like to remove invasive species, including honeysuckle and about a dozen other plants, first and then plant more native species. Next, they have proposed a three-stage process that would initially add picnic tables and a sign telling people about the area and directing them to existing trails on the outer edge of the property.

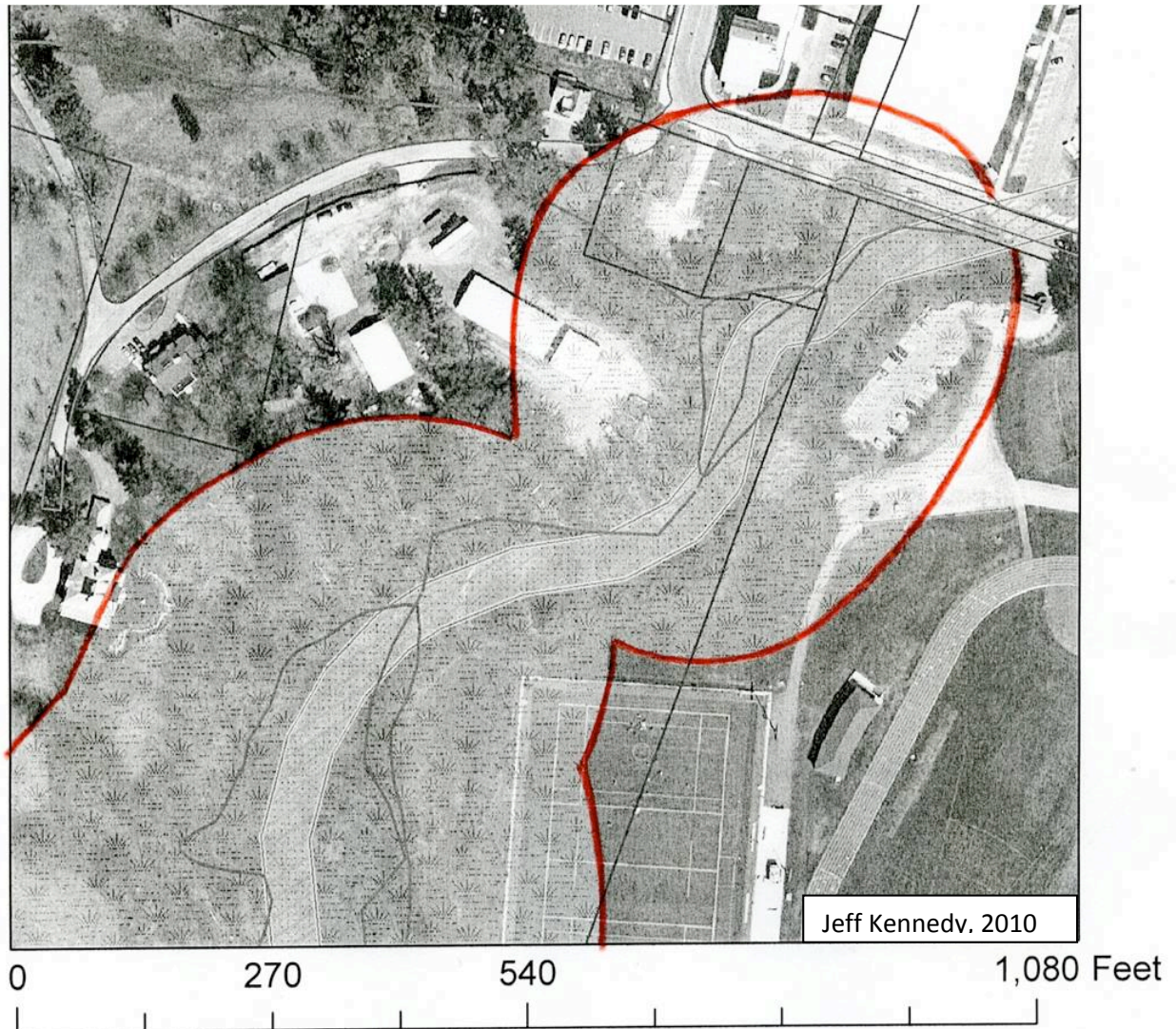
The second stage would involve building a half-mile trail, which would include two bridges and an elevated walkway, from Denison Park Drive to the pond, Baiu said. The third stage would involve relocating a building and grounds storage facility known as the "Agway" building off Denison Park Drive and turning the area into a community garden. It also includes creating an outdoor skating rink on the pond.

The students, who did the project as part of an environmental planning course, presented their proposal and supporting research to Williams College officials, members of the Williamstown Conservation Commission and community members Wednesday afternoon.

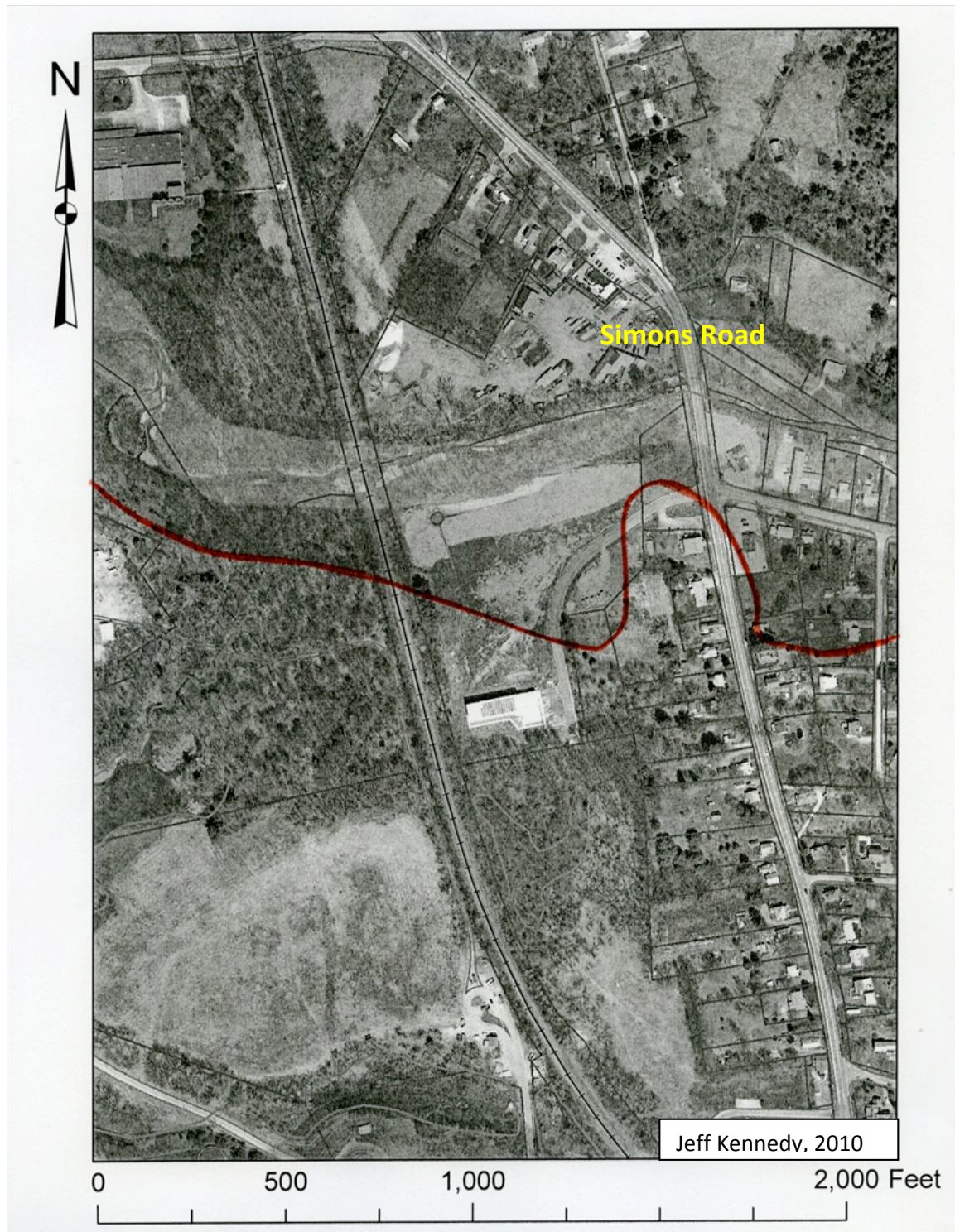
If the project is pursued, Elvin said, they would need approval from the Conservation Commission for some aspects of it, including the construction of bridges at two stream crossings. Baiu said Christmas Brook is classified as a perennial stream and wood swamp and falls under the Wetlands Protection Act and Rivers Protection Act. "Christmas Brook has a large watershed," he said. "It's a 600- to 800-acre watershed." Aside from state and federal laws, the hydrology and soils of the area would make it a challenge to build a trail and to make sure it drains properly, he said.

"One thing we learned very early on is Christmas Brook tends to flood next to the culvert on Latham Street," he said, noting that the town Department of Public Works has proposed to replace it with a larger culvert. Williams' redesign of Weston Field may also complicate the proposal, Baiu said.

While the students would rely on volunteers to help build the trail and amenities, Baiu said the college may want to incorporate it into the Weston Field project. "There is a great educational benefit to this proposal," he said. However, James G. Kolesar, assistant to the president for public affairs, said the Weston Field project is taking place further away from Christmas Brook than the area the students studied. "It's certainly not part of the project at this time," he said.

APPENDIX 12 – SITE MAP WITH WETLAND BUFFER

APPENDIX 13 – POSSIBLE RELOCATION SITE FOR AGWAY BUILDINGS



APPENDIX 14 – HYDROLOGICAL MAP (Hand-mapped by Alex Elvin)



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