Boyne Mountain Environmental Sustainability Plan

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April 2009

Acknowledgements

We would like to express our most sincere gratitude to the following individuals for their efforts and contributions to our project. Their hard work and generosity were greatly appreciated and helped us complete a successful and enlightening report.

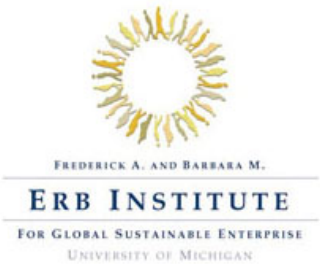
Boyne Mountain personnel:

- Julie Ard, Director of Resort Marketing and Communications
- Kerry Argetsinger, Garage Manager
- Tobie Aytes, Food and Beverage Purchasing Manager
- Brad Bos, Grounds Maintenance Director
- Steven Dean, Facility Manager and CPO of Avalanche Bay
- Niki Dykhouse, Housekeeping Supervisor
- Erin Ernst, Public Relations Manager
- Bernie Friedrich, Retail General Manager
- Jim Gibbons, Grounds Operations
- Ed Grice, General Manager
- Sean Handler, Director of Spas
- Amanda Haworth, HR Manager
- Roy Haworth, Restaurant Manager and Resort Accommodations Manager (2009)
- Sam Hayden, Waste Manager
- Cindy Johnson, Controller, Avalanche Bay
- Phil Jones, Resort Accommodations Manager (through 2008)
- Meagan Krzywosinski, HR Recruitment & Training
- Brian Main, Resort Sales Specialist & Marketing Manager
- Dave Newman, Area Manager
- Patrick Patoka, Avalanche Bay Director
- Casey Powers, Head Golf Professional
- Becky Quakenbush, Dept. Supervisor, Geschenk Laden Gift Shop
- Tom Reed, Tri-Turf Vendor
- Sarah Rocheleau, Boyne Design Group
- Mark Skop, Golf Course Superintendant

University Of Michigan faculty:

- Chris Ellis, Associate Professor and Faculty Advisor
- Greg Keoleian, Associate Professor and Co-Director, Center for Sustainable Systems
- Andrew Hoffman, Professor and Co-Director of the Erb Institute

Furthermore, we would like to thank the following organizations for funding our research:



Executive Summary

Context and Need for Study

Several significant factors led Boyne Mountain's management team to explore the development of a comprehensive sustainability plan, including:

- The ski industry recognizes that climate change affects productive snowfall levels and the length of the skiing season; the golf industry recognizes its reliance upon a healthy environment to create an aesthetically enjoyable golfing experience
- The resort industry is starting to recognize the negative impacts its own activities can have upon the environment, and is becoming interested in more sustainable tourism
- Boyne Mountain has a long history of environmental concern that includes land conservation measures and renewable energy generation from a hydropower dam
- Boyne Mountain team members and management are interested in environmental sustainability both on a personal and professional level, with some employees having already initiated green projects on their own
- Boyne Mountain's management wants to be proactive in preparing for tougher state and federal energy efficiency and environmental impact requirements that will affect its operations.

Project Goals and Scope

The purpose of this report is to provide Boyne Mountain management with an environmental management plan to improve the sustainability of its operations. This plan includes projects and policies built on principles and methods that similar resorts have successfully employed, but that incorporate the specific priorities, needs, and constraints of the Boyne Mountain site. Our comprehensive recommendations include ten specific and detailed project components, including implementation advice that will help Boyne Mountain move forward with putting the plan into action.

This report spans a broad spectrum of topics including energy and water usage, waste reduction through recycling and composting, designs for sustainable landscaping that preserves ecosystem function and biodiversity, responsible sourcing, green marketing, employee communication and incentive schemes, and forward thinking decision-making protocols. Project recommendations focus primarily on the ski mountain, base lodge area, restaurants, and golf course, but the concepts can be extrapolated onto adjacent properties such as the private condominiums whose owners enjoy Boyne's amenities.

Approach

The team reviewed publicly available data including online case studies of resorts already employing effective environmental initiatives and U.S. Geological Survey (USGS) data to understand the latest trends in environmental management within companies similar to Boyne. In particular, our team used the National Ski Areas Association (NSAA) Sustainable Slopes Initiative as the backbone of our analysis, tailoring it to include recommendations for a four-season resort such as Boyne.

Once our purpose was clearly defined, we visited Vail Mountain, Aspen Ski Company, and Winter Park, all of which are located in Colorado and are recognized by the Sustainable Slopes Initiative for their leadership in environmental sustainability. Discussions with staff at these resorts provided ideas about specific changes Boyne Mountain could implement, barriers and opportunities ski resorts face, and the feasibility of various initiatives. These discussions and site visits also helped us establish a working set of best practices in ski resort sustainability.

We interviewed Boyne Mountain personnel about their current operating procedures, sustainability initiatives they've considered or implemented, and opportunities they saw to improve efficiencies or lessen environmental impact. We examined utility bills, site maps, and purchasing agreements to obtain a working understanding of Boyne Mountain's current practices and recent business. We compared the best practices in resort sustainability against Boyne Mountain's current practices in a "gap analysis" that allowed us to see in which areas the most improvement was need. We then developed potential project component ideas that, if implemented, would close the major gaps, bringing Boyne Mountain on par with best-in-class resorts. These ideas were presented to Boyne Mountain personnel, who identified their own set of high-priority project components and provided feedback on the feasibility of implementing new sustainability practices.

We then selected ten project components which would have the highest impact on the sustainability of the resort while addressing Boyne management's priorities and fitting the skill sets of our group members. For each project component, we developed detailed recommendations on how Boyne Mountain can effectively manage the resort in a more sustainable way.

Projects and Recommendations

Our review identified the following project components, which we believe are logistically feasible for Boyne Mountain's current staff and resource base, environmentally beneficial, and financially valuable:

- Energy Efficiency and Renewable Energy (Chapter 3)
- Resort-wide Recycling Program (Chapter 4)

- Composting Program (Chapter 5)
- Educational Gardens (Chapter 6)
- Audubon Sanctuary Golf Course Certification (Chapter 7)
- Sustainable Purchasing Guidelines (Chapter 8)
- Green Marketing Plan (Chapter 9)
- Internal Communications Plan (Chapter 10)
- Employee Reward System (Chapter 11)
- Sustainable Financing (Chapter 12)

Key Insights and Findings

Our research uncovered four key takeaways:

1. Resorts have a direct impact on the environment, which can be mitigated.
The daily operations of a large scale resort like Boyne produce real environmental burdens, from greenhouse gas emissions to solid waste. However, there are several cost-effective and straightforward ways to reduce this burden, improving resorts' impact on the environment and raising the long-term sustainability of the business itself. Practices like recycling and energy conservation, now considered standard by most businesses, should be implemented immediately; not only will Boyne reduce its environmental footprint, it will also enjoy lower utility bills. Longer term projects such as the planting of native, educational gardens can ease the water and fertilizer demands of the resort property; minimize harmful effects to surrounding natural areas; provide habitat for desired wildlife; and demonstrate to guests the importance of sustainable land management.

2. Sustainability must be integrated throughout organizational structure of the business.
A top down commitment to sustainability will be necessary to significantly change Boyne's practices. The CEO must set the direction by explicitly incorporating environmental stewardship into the core values of the company. The executive leadership team should then be tasked with setting and adopting clear annual targets that support the general goal of improved sustainability. Managers' decision-making processes, including budgeting, project valuation, and employee performance evaluation, must incorporate environmental impact and long-term considerations. Although many team members at Boyne Mountain are enthusiastic about improved sustainability, the current budgeting and incentive structure discourages resort-wide adoption of sustainable practices. Other resorts have successfully incorporated sustainability into their management structure through such mechanisms as resort-wide energy, water, and waste reduction goals, a separate capital pool for "green" projects, and employee rewards for environmentally friendly behavior.

3. Customers are expecting "greener" resorts, and suppliers are making this easier to achieve.

American consumers are increasingly using environmental criteria to make purchasing decisions, including which resorts they vacation at. While the Midwest clientele may be somewhat behind this trend curve, Boyne Mountain can move proactively to boost its environmental credentials before customers start pointing out weaknesses. More and more, travelers care about their resorts' sustainability practices and will be reward greener establishments with repeat visits and positive word-of-mouth marketing. Furthermore, Boyne Mountain spends hundreds of thousands of dollars annually on supplies for its shops, restaurants, and lodging facilities. Sourcing environmentally preferable products is an easy way to make a positive environmental impact, since environmentally preferable alternatives exist for most major product categories Boyne needs. Furthermore, doing so is a simple way to improve the resort's image with customers as an environmentally responsible company.

4. Changes in state energy regulations present an opportunity to implement energy saving technologies.

New state regulations will require small improvements in energy efficiency by large customers like Boyne Mountain, giving an added incentive to implement the energy project components suggested in our report. By strategically planning for long-term changes in regulations, Boyne Mountain could save money and reduce energy use while marketing itself as a leader in sustainability.

The projects and management suggestions included herein provide a workable framework for a multitude of components that will improve Boyne Mountain's sustainability as resort.

Boyne Mountain Environmental Sustainability Plan

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Chapter 1:
Project Background and Approach

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Introduction

The livelihood of the ski industry depends on a healthy environment and a climate that yields consistent snowfall levels and temperatures low enough to promote a long ski season. With global climate change a real threat to our winter landscapes, the ski industry should be the first to embrace measures to reduce greenhouse gas emissions. Likewise, the golf industry relies on green fields, freshwater ponds, and the beautiful scenery of natural environments. Resorts have a significant influence on local economies as well as social and natural environments, and should be leaders in setting both economic and environmental standards. Many are willing to take action to help mitigate environmental costs, but lack the expertise and resources to do so.

Traditionally run resorts place a heavy burden on the environment. They use large amounts of water for snowmaking and irrigation, require considerable amounts of energy for hotel and ski lift operations, fragment wildlife habitats with ski runs and golf fairways, decrease water quality, and create substantial waste. Some resorts in the East and Midwest have acknowledged this problem, but few have taken sufficient action to minimize it.

Many resorts in the western United States have incorporated environmental stewardship efforts into their area management plans. Their financial success depends on the delicate balance between business and the environment, and the sustenance of the local ecology is often at the mercy of recreation industries. Budgeting for "green" and environmentally sound programs is easy for large resorts such as Aspen and Vail, but not as obviously feasible for the smaller resorts that operate under much stronger budgetary constraints. The purpose of our project is to develop an environmental sustainability plan for a smaller, Midwestern four-season resort using the principles and methods that larger resorts have successfully employed.

Boyne Mountain is a four-season resort located in Boyne Falls, MI in the Northern Lower Peninsula. Boyne Mountain is a family-owned resort that is part of Boyne USA, which now owns 12 resorts in the United States. The resort includes a ski area, two golf courses, several lodging options and restaurants, and a water park. Thus far, the resort has not taken comprehensive action to address its environmental footprint.

The Sustainable Slopes Initiative (SSI) of the National Ski Areas Association (NSAA) provides resorts with a voluntary environmental charter that they can endorse as their first step towards sustainable management.[1] The SSI has published a generic sustainable management plan that provides useful insight on how to quantify environmental performance, and a number of case studies of other resorts' successes. After receiving the guide, resort management decides how to implement changes within their own operations, which can be difficult to accomplish. Furthermore, it does not address lodging, restaurants, or golf courses, but rather focuses exclusively on ski areas. Our plan will help bridge these informational gaps by creating a site-specific sustainable management plan for Boyne Mountain, using SSI as a guideline.

Our project starts with an examination of the problem of environmental degradation from resort operations, followed by an overview of our client resort. We then provide the results from a precedent study of resorts that have successfully implemented progressive environmental programs. The practices of these environmentally friendly resorts we define as our "best practices," which we then compare to Boyne Mountain's "current practices," which are a baseline assessment of Boyne's current operations.

Our recommendations for Boyne Mountain are broken into ten discrete project components. Each project component describes a specific suite of actions Boyne can take to improve the sustainability of its operations. These project components span the areas of: energy use reduction, waste reduction via recycling and composting, on-site ecosystem function, on-site biodiversity, third-party certification, purchasing guidelines, green marketing, internal communications, employee incentives, and financing. Our project demonstrates the business value and feasibility of environmental stewardship for resorts of all sizes and locations.

Problem Statement

Resorts centered on outdoor recreation rely upon a healthy environment to provide the conditions in which their featured activities, such as golf and skiing, take place. Climate change may be the most significant problem ski resorts face this century.[2] A 1997 Environmental Defense Fund report predicted that the average ski season length in New England could be decreased by up to 20% with global warming of 4° C, which is within the estimated range of climate change within the next 100 years. It is also predicted that more precipitation will fall as rain rather than snow, causing rapid deterioration of snow conditions, which will require additional snowmaking to recoup snow loss.[3] Another report, sponsored by Aspen Mountain and Park City Mountain Resort, found that ski resorts in Colorado will have to carve runs higher up the mountains and triple their snowmaking in order to keep up with global warming over the coming decades. Resorts in Pennsylvania, West Virginia, Oregon, Washington, and California's Sierra

Nevada (and presumably Michigan) will likely be forced out of business as air temperatures continue to warm.[4]

Conditions at ski resorts in Europe are faring no better. Numerous winter sports events in Europe have been postponed or cancelled this year (2009), such as the Tour de Ski and downhill World Cup competitions in France and Switzerland. At some German ski resorts it has not snowed in nearly a year. A new scientific report entitled "Climate Change in the European Alps," published by the Organization for Economic Cooperation and Development (OECD), predicts that by 2050 most of Europe's ski resorts will have disappeared along with the Alpine glaciers.[5]

While the future of golf resorts is less well-documented, water scarcity is already becoming a real issue in many parts of the US and may render irrigation of "unnecessary" areas like golf courses prohibitively expensive in the future. New regions of the US previously considered immune to water scarcity issues, such as the Southeast, are ratcheting up water rates and implementing new restrictive regulations on water use.[6] Trends such as these could drive up costs of golf course maintenance to prohibitive levels. In addition to water, golf courses benefit from scenic natural landscapes. Degrading the aesthetic attributes of surrounding landscapes (which results from declining environmental health) reduces golfers' enjoyment and may impact their willingness to pay.

The ski and golf industries therefore have a vested interest in reducing their own environmental burdens, which are substantial. Ski resorts consume vast quantities of energy to power ski lifts and snow guns, use large amounts of water for snowmaking, create great quantities of waste, and damage natural habitats. Golf resorts are not as energy-intensive as ski resorts, but use huge amounts of water for irrigation, use large amounts of chemical fertilizers and pesticides that contaminate surrounding areas, and fragment habitats with vast expanses of turf.

However, while some resorts in Europe and the western United States have started to address these issues, most of the smaller resorts, such as those in the East and Midwest of the US, have lacked the budget, expertise, and external consumer "push" to do so.

Boyne Mountain: An Overview

Boyne Mountain is a family-run, four-season resort located in Boyne Falls, Michigan. The resort prides itself on 60 years of successfully offering leisurely, entertaining vacations to families throughout the Midwest. The resort is built around Boyne Mountain itself, with 10 chair lifts servicing 415 acres of skiable terrain. The mountain also hosts a man-made terrain park and a ski school. At the base of the mountain are several condominium complexes, which are owned privately but managed by Boyne Realty. The main lodge is the Mountain Grand Lodge (MGL), a luxurious hotel with 220 rooms and

larger suites. Other on-mountain lodges include the BoyneHof, Clocktower, and Edelweiss. Situated in the MGL complex are Avalanche Bay, Michigan's largest indoor water park, and the award-winning, full-service Solace Spa. Three outdoor pools surround the MGL.

On the other side of the mountain, next to Deer Lake, lie the award-winning Alpine and Monument golf courses (both 18 holes) and pro shop. In between the golf course and the ski mountain are 400 acres of wooded land known as "The Reserve," which was recently sold for development. A variety of eateries and restaurants (11 in total) are situated throughout the ski area, golf course, and lodging complexes. See **Appendix A** for a map of the Boyne property.

Boyne Mountain is owned by Boyne USA, the third largest resort network in North America. Additional properties include Big Sky Resort in Montana, Crystal Mountain in Washington, and Sugarloaf in Maine. Because of this corporate management structure, certain decisions that impact Boyne Mountain's operations can only be made at the Boyne USA level. We have indicated such instances throughout our report.

Project Goals

The purpose of this report is to outline environmental sustainability projects that small, Midwestern resorts can implement, using the principles and methods that larger resorts have successfully employed combined with the specific priorities and constraints of smaller properties. We present a table of "best practices" compiled from resorts across the United States and "current practices" existing at Boyne Mountain today. We then go into greater detail to provide specific recommendations for projects we think are well suited to Boyne. Once implemented, these projects should significantly reduce the resort's environmental impact, from energy use to habitat alteration to waste production.

Each chapter of the report focuses on a different area, such as energy use, recycling, or purchasing, and makes recommendations for concrete changes Boyne Mountain can make to become more sustainable. It is not an exhaustive list of all possible projects or improvements by any means; it represents what we believe to be the best selection of projects based on our assessment of Boyne Mountain's current environmental efforts, future priorities, and tolerance for up-front capital expenditures and payback periods. We chose to explore only those projects that we believe Boyne Mountain can implement now, whether all at once or in stages, and from which it will reap substantial, tangible benefits.

Ultimately, efforts to become more sustainable have to be ongoing. Whether undertaken by a business or by an individual in his or her personal life, it requires constant vigilance and self-reflection on how to reduce our use of resources and choose

the resources we do use more wisely. Being more environmentally responsible will not always save money (though it often does). When it comes to purchasing products that are made of recycled materials, or grown locally by family farmers, it can be considerably more expensive. But we believe that businesses can stand out by doing the right thing, attracting more customers, and increasing customer loyalty. Consumers are becoming more educated, and a company's environmental practices are becoming an increasingly important differentiator. We believe that Boyne Mountain's future lies in its ability to make a concerted effort to improve its practices, and to communicate those efforts effectively to its customers.

The projects outlined in this report represent important first steps towards a more sustainable business—both environmentally and economically. Once they have been implemented, it is up to Boyne Mountain to continue to monitor its environmental impact and continually work to lessen it. And it is up to the rest of us to reward businesses such as Boyne Mountain that invest in lessening their environmental impact by giving them our business, and by letting them know we are paying attention and care.

Scope

Our project sought to align Boyne's needs with the interests and expertise of our team members (see **Appendix B** for Team Member Profiles). We organized our activities into the following seven areas:

Energy	Water	Waste
• Recommend actions to reduce energy use and water consumption, improve waste water quality, and reduce landfill waste volumes through recycling, composting, and hazardous waste reductions • Determine methods to improve operational efficiency and reduce pollution		

Design	Sourcing	Marketing & Education	Decision-making
• Create sustainable design for public spaces • Design plans for future development and ecological restoration	• Develop "green" sourcing practices (e.g. packaging, non-toxic ingredients)	• Determine customer impact of promoting environmental efforts • Recommend marketing tactics and education activities	• Integrate sustainability into all departments • Incentivize and evaluate employees on sustainability actions

Figure 1: In-scope topic areas

These areas aligned directly with the following sections of the Sustainable Slopes Initiative:

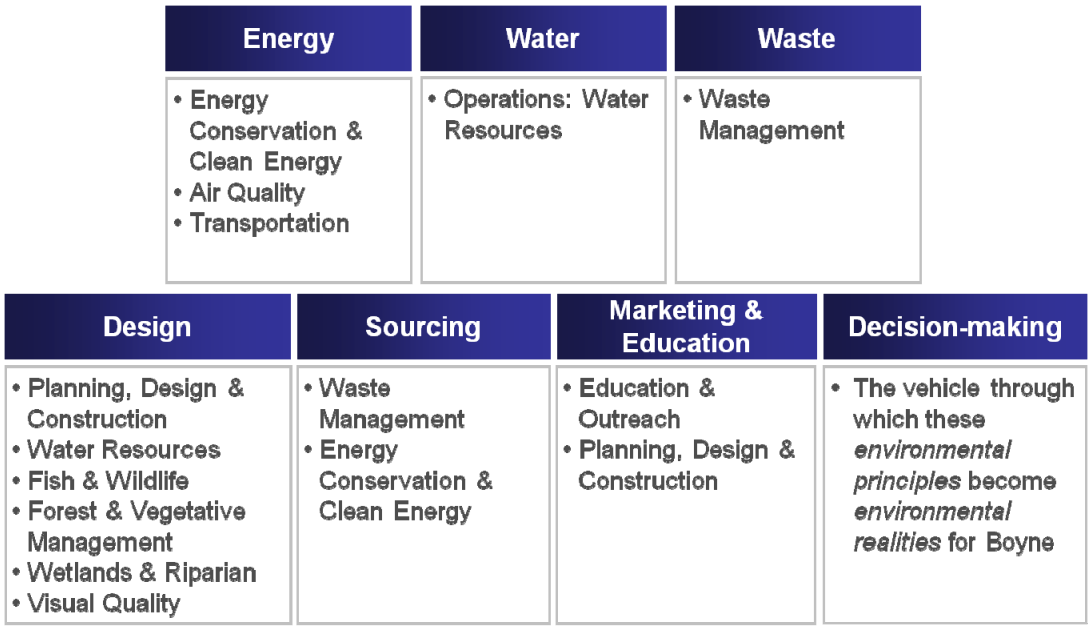


Figure 2: Sustainable Slopes guidelines addressed

We considered the following aspects of Boyne Mountain in our project:

- Ski area
- Base area grounds and buildings
- Mountain Grand Lodge
- Solace Spa
- Other Boyne-owned lodging
- Golf courses
- Boyne-owned restaurants

We chose to exclude certain units given our limited ability to influence their operations through our project:

- Privately owned condominiums and undeveloped properties (managed by condo owners' association, not Boyne Mountain)
- Avalanche Bay (recently implemented several improvements; water park operations are outside the scope of our team members' expertise)

Approach

Our project followed these seven phases:

1. **Perform background research:** The team reviewed publicly available data such as online case studies on other resorts' environmental initiatives and USGS data to understand the latest trends in environmental management at four-season resorts. We reviewed the Sustainable Slopes charter and read existing literature on the environmental impact of ski and golf resorts to gain a better understanding of what it means to be a "sustainable" resort. We also worked with Boyne Mountain to specify the resort's particular priorities and goals with respect to sustainability.
2. **Define best practices:** To shape our recommendations for Boyne, we first had to define the best-in-class practices for environmentally sustainable resort management. In order to understand what has made leaders in this field successful, we visited and observed three resorts in Colorado that had been recognized by the Sustainable Slopes Initiative for their leadership in environmental sustainability: Vail Mountain, Aspen Ski Company, and Winter Park. The intent of our visits was to observe their operations and document their environmental initiatives, outcomes, and lessons learned. Discussions with resort staff provided ideas on specific changes Boyne Mountain could implement, advice from resorts on the barriers and opportunities they faced, and a sense for the feasibility of various initiatives. Furthermore, we performed internet research on other resorts recognized by the Sustainable Slopes Initiative, as well as "green" hotels, corporations, and sustainable public spaces to further build our arsenal of ideas and examples.
3. **Collect current state data:** Next, we sought to develop a comprehensive and detailed understanding of Boyne's current operations with respect to our seven topic areas. To do this, we conducted interviews with Boyne personnel, toured the site, and examined resort data such as utility bills.
4. **Compare current to best practices:** We compared the best practices identified in Step 2 against Boyne's current practices observed in Step 3 to determine the "gap" between actual and desired performance. This allowed us to identify those areas where our recommendations could have the largest potential impact. We chose to focus on those areas with the largest gap, so that we were not recommending improvements for aspects on which Boyne has already made significant progress towards environmental sustainability.
5. **Generate project components:** We used the best-current practice comparison and our research from other resorts to generate ideas for potential projects Boyne could implement to reduce its environmental impact. These ideas were presented to Boyne Mountain personnel, who identified their preferences from among the suggested projects. The project components presented in this document were chosen based on priority to Boyne (including feasibility of implementation) and our project team's skill set.
6. **Prepare detailed recommendations:** For the ten project components selected, we developed detailed recommendations. The exact content of each set of recommendations differed depending on the type of project. These

recommendations can be found in Chapters 3-12. Together, they comprise our Environmental Sustainability Plan for Boyne Mountain.

7. **Deliver recommendations:** Recommendations in this document will be shared with Boyne Mountain in a live presentation and a bound hard copy deliverable.

Our project began in April of 2008 and ran through April of 2009. The following graphic illustrates our timeline:

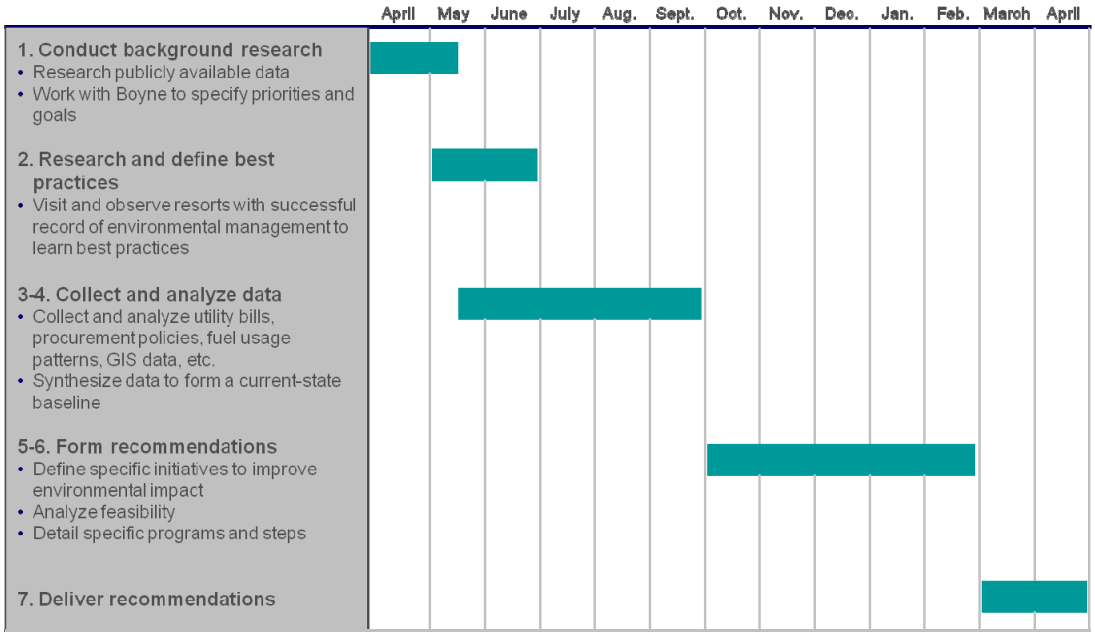


Figure 3: Project timeline

Literature Review

Several frameworks have been developed for examining the transition of resorts toward sustainable practices. Todd and Williams propose three-step Environmental Management Systems (EMS) including 1) codes of conduct or environmental policies, 2) translation of principles into 'greening' practices, and 3) implementation of environmental auditing programs to assess the effectiveness of these practices.[7]

The voluntary Sustainable Slopes Initiative (SSI), begun by the National Ski Areas Association (NSAA), has attempted to outline the first two steps, environmental goals and best practices. One hundred and eighty-four ski areas have endorsed the Sustainable Slopes charter. However, the progress of voluntary adoption of green practices within SSI member ski resorts has been criticized for failing to demonstrate superior performance.[8] Citing several other studies of voluntary programs, Rivera et al assert, "Purely voluntary environmental programs (VEPs) are unlikely to promote superior environmental performance because of their lack of coercive mechanisms to prevent opportunistic participants from free-riding on program benefits such as having a 'green' reputation."[2]

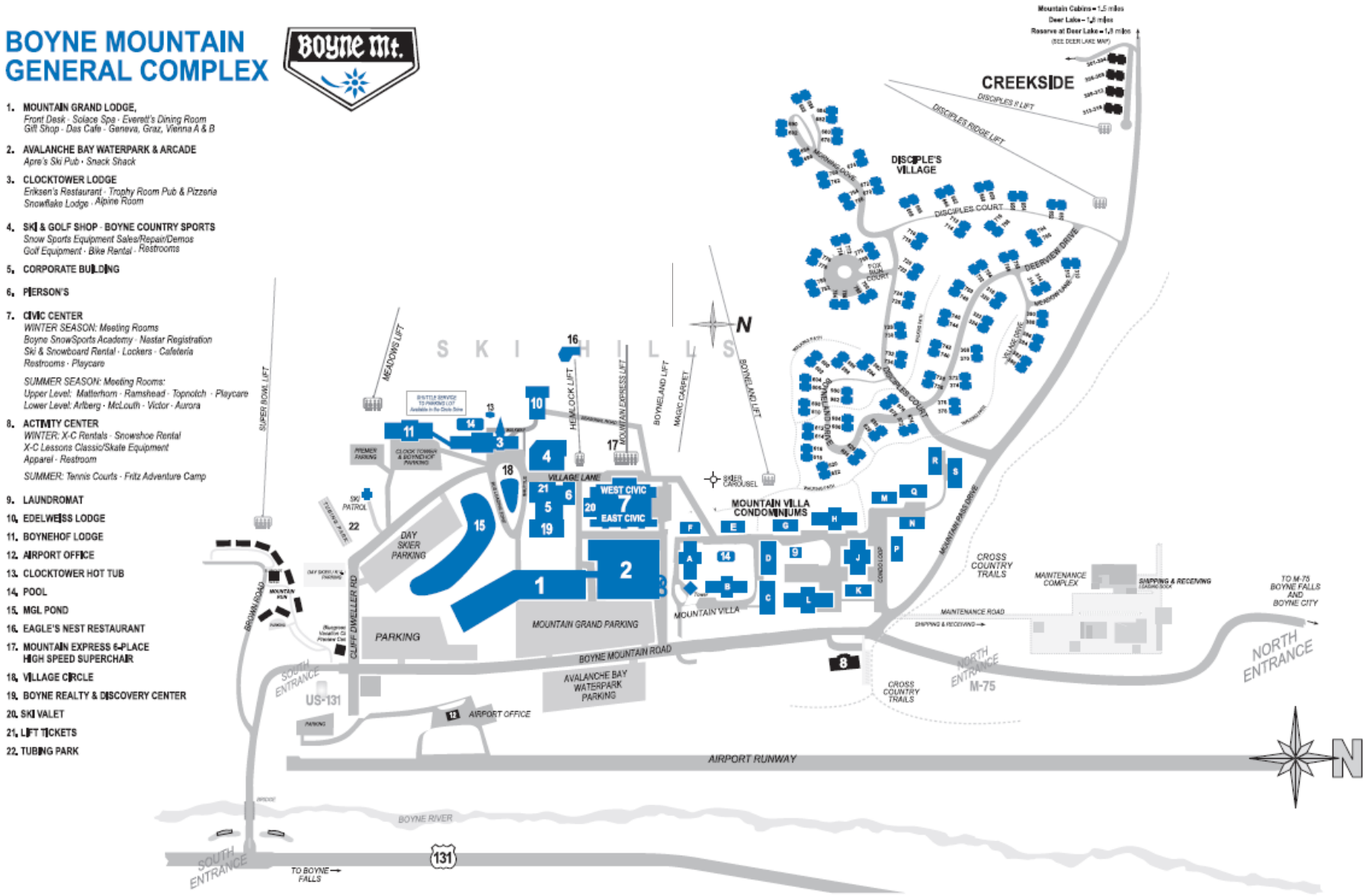
While resorts subscribing to Sustainable Slopes may not be differentially improving green practices, there is data to suggest that the industry as a whole is moving toward better environmental practices and policies. “Keep Winter Cool” is a partnership between the National Resources Defense Council (NRDC) and NSAA to bring attention to global warming and publicize ski area improvements.[9] With the help of the NRDC, 71 ski areas endorsed the U.S. Climate Action Partnership (USCAP), which calls for legislation that would achieve emission reductions of 60-80% by 2050.[10] At present, the majority of reported progress is from:

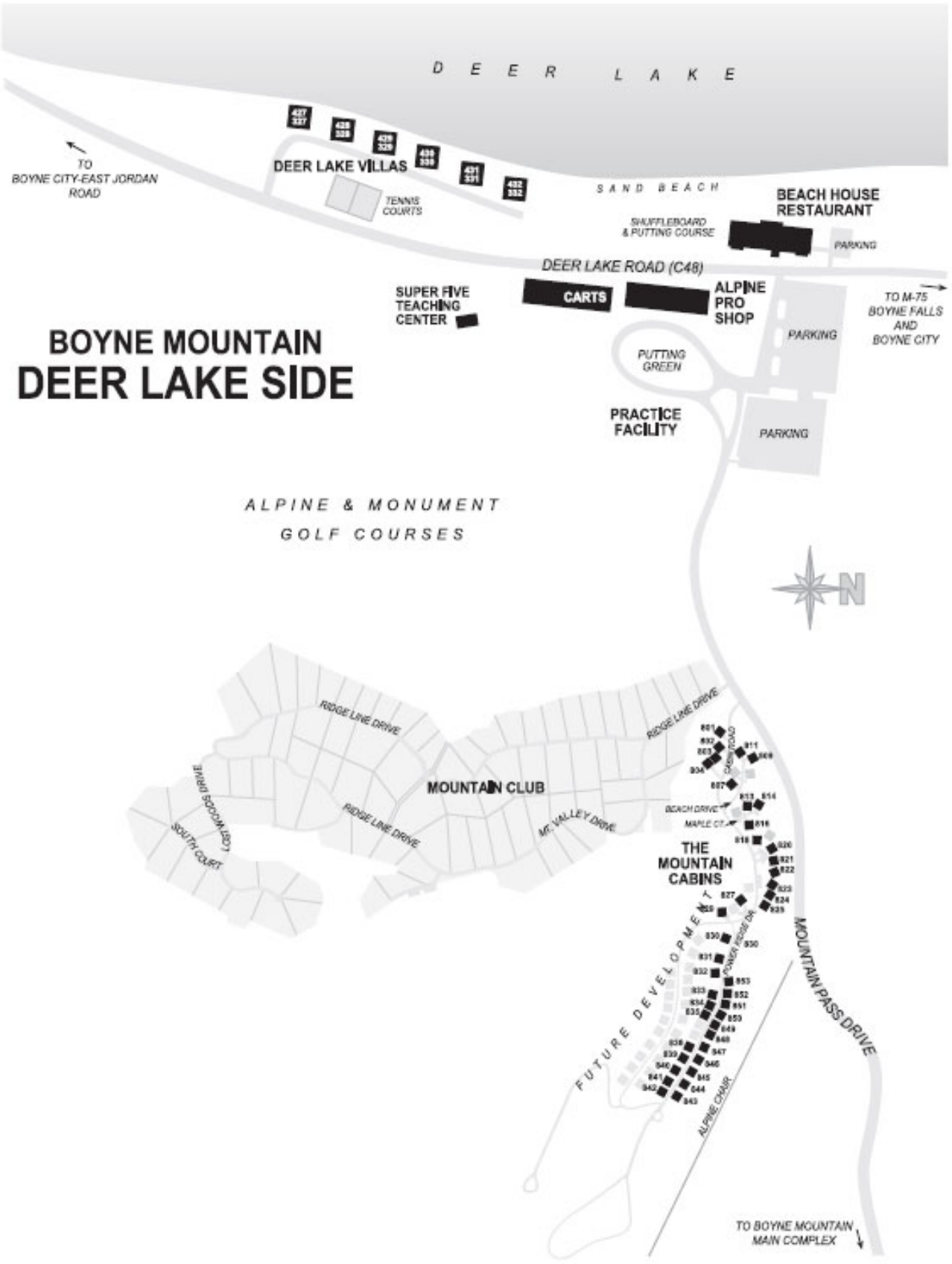
- Purchasing offsets for electricity consumption
- Improving recycling efforts
- Installing energy and water efficient infrastructure
- Encouraging community transportation efficiency (e.g. carpooling discounts)

Our project with Boyne Mountain can be examined in the context of general attempts at “greening” resorts and the varied success of voluntary environmental practices (VEPs). External pressures on the resort industry come from environmentalists, pending federal climate change legislation, the potential for more stringent regulation by the United States Forestry Service (USFS), and customers interested in promoting eco- or sustainable tourism. Internal pressures from owners or staff at resorts combined with economic advantages from higher efficiency practices must be considered as well. Local pressures may be more significant than national issues. For example, habitat near resorts has frequently suffered from poor management and fragmentation,[11] and these local environmental issues can have direct impact. For example, a golf/ski resort in Antrim County, Michigan, was sued in 1999 over withdrawal of water from a nearby pristine stream, forcing the resort to alter its operations.[12]

While many studies document the effects of resorts on habitat, their degree of sustainability, and the successes and failures of VEPs, our project presents a unique case study of a Midwest four-season resort. We provide a comprehensive analysis of the strategies most applicable to Boyne, based on what has worked at other resorts. We also suggest innovative ideas to differentiate Boyne Mountain from other resorts. By providing a comprehensive baseline study and set of recommendations, our project helps fill a lacuna in the literature regarding what specific systems and processes can be utilized on a voluntary basis by a four-season resort.

Appendix A: Boyne Mountain Map




DEER LAKE
TO BOYNE CITY-EAST JORDAN ROAD
DEER LAKE VILLAS
TENNIS COURTS
SAND BEACH
BEACH HOUSE RESTAURANT
SHUFFLEBOARD & PUTTING COURSE
PARKING
DEER LAKE ROAD (C48)
SUPER FIVE TEACHING CENTER
CARTS
ALPINE PRO SHOP
TO M-75 BOYNE FALLS AND BOYNE CITY
BOYNE MOUNTAIN
DEER LAKE SIDE
PUTTING GREEN
PARKING
PRACTICE FACILITY
PARKING
ALPINE & MONUMENT GOLF COURSES
N
RIDGE LINE DRIVE
RIDGE LINE DRIVE
MOUNTAIN CLUB
RIDGE LINE DRIVE
MT. VALLEY DRIVE
LOG WOODS DRIVE
SOUTH COURT
CROSS ROAD
BEACH DRIVE
MAPLE CT.
THE MOUNTAIN CABINS
FUTURE DEVELOPMENT
TOWER RIDGE DR.
MOUNTAIN PASS DRIVE
ALPINE CHAIR
TO BOYNE MOUNTAIN MAIN COMPLEX

Appendix B: Team Member Profiles

Our team organized our research as follows:

Working Group	Lead	Support
Water Use	Geoff	Imogen
Energy Use	Imogen	Geoff
Waste	Eric	Laurel
Sourcing & Marketing	Laurel	Imogen
Ecology & Design	Lauren	
Finance & Decision-making	Leonore	

Brief biographies of each team member are as follows:

Eric Bruski

With eighteen years of skiing and snowboarding experience and a background in Environmental Science, Eric has a strong understanding of ski resort operations from a guest's perspective, as well as significant knowledge of the environmental implications of management practices. This makes him valuable as a ski resort sustainability consultant as he understands the resort from multiple angles. His experience in construction and development will also prove useful when looking into the real estate development component of the operation. He is literate in the construction, development, and ecological sectors and is therefore an effective translator within and among these sectors.

Leonore Hijazi

Leonore came to the University of Michigan after serving as a Peace Corps volunteer in Benin, West Africa in the role of Environmental Action Agent. Working with community groups in her rural village, she led environmental education activities with secondary school students and created workshops for farmers wishing to employ agroforestry methods in their fields. Leonore's career goal is to work within the tourism industry, perhaps for a multinational hotel chain, to push the industry toward greater sustainability. Toward that end, she is working on both an MBA and an MS in Environmental Science and will use her knowledge of finance to ensure profitability of project recommendations. Leonore graduated from Georgetown University's School of Foreign Service concentrating on International Culture and Politics and African Studies. She loves travel, the study of culture and languages, and nature-based tourism, including skiing.

Lauren L. Hoffman

Lauren is a dual degree student studying both landscape architecture and terrestrial ecology in the School of Natural Resources and Environment at the University of Michigan. She came to graduate school with a background in resource ecology and management and art sculpture. She was able to culminate both of these interests into a single education stream of ecology, engineering, and design through which she incorporates ecosystem function with aesthetic quality to create beautiful, functional, public spaces. Lauren's career experience includes working as an instructor at a ski resort, and working in a local Ann Arbor landscape architecture and planning firm. Her extensive education in natural systems and design ensure that the client is aware of the ecological value existing on their property, and the environmental function that can serve as an amenity. Lauren enjoys every form of outside recreation and spending time with her young daughter.

Laurel H. Martin

Laurel is a student in the Erb Institute for Sustainable Enterprise, pursuing graduate degrees from both the Ross School of Business and the School of Natural Resources and Environment at the University of Michigan. Focusing on environmentally sustainable business operations, her recent work includes assessing the potential impact of climate change legislation on a cement manufacturing client and creating their emissions reduction strategy, and developing the process, strategy, and tools for a retail client's nascent food sourcing department. Prior to starting her degree at Michigan, Laurel worked as a Consultant for Deloitte, where she helped clients across a variety of industries devise and implement strategic solutions to their most pressing business problems. Laurel graduated Summa Cum Laude from Middlebury College in Vermont with a B.A. in Economics. In her free time, she enjoys skiing, hiking, and cooking, and is particularly concerned with the environmental impact of ski area operations.

Geoff Michael

Geoff is the owner of Big Sky Recording in Ann Arbor and a student in the sustainable systems program at the School of Natural Resources. Voted *Best Recording Studio* by *Current Magazine* 2004 through 2007, the experience of managing Big Sky, working with employees and with hundreds of clients gives Geoff a solid understanding of the business perspective. Geoff also designed Virtual Faders Automation, a computer based mixing system for studios with clients including Grammy award winning producer Bruce Swedien. Prior to starting the masters program at Michigan Geoff taught recording at a local community college. Geoff graduated Summa Cum Laude from Eastern Michigan University in 2005 with a B.S. in Biology. He is interested in helping business become more environmentally sustainable. He likes skiing and windsurfing and is just getting hooked on snowboarding.

Imogen Taylor

Imogen comes to the University of Michigan's Erb Institute for Global Sustainable Enterprise after a decade working in New York state and New York City politics. In New York, she managed campaigns, advocated for constituents, and advised state and city elected officials on issues and strategy. With a life-long passion for environmental issues including renewable energy, energy efficiency, and green building, Imogen is pursuing an M.B.A and an M.S. in Sustainable Systems. She is interested in helping businesses of all kinds transition into more sustainable ways of operating and can help build relationships to bridge the gap between business and government. Imogen is a graduate of Wesleyan University with a B.A. in Government.

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Chapter 2:
Best & Current Practices

Table of Contents

Introduction

This section details the findings from our best practices research and current state observations. We used this information to determine a qualitative "gap" between Boyne Mountain's current and the resort industry's best practice. This showed us where the biggest improvement opportunities were, allowing us to focus our project components on areas with the highest potential for environmental impact.

Methods

"Best practices" are defined as the highest environmentally sustainable precedent set by an existing resort. This information was gathered from several sources:

- *Internet research from the Sustainable Slopes Initiative's "Green Room":* This site contains descriptions submitted by resort managers of the specific initiatives their resorts have implemented to improve their environmental impact. This gave us a baseline of what is being done at similar resorts.
- *Internet research from Audubon Certified Sanctuary Program:* Similar to the Sustainable Slopes Initiative, the Audubon Society maintains detailed guidelines of its environmental requirements, as well as anecdotes from members who have successfully met them.
- *Internet research from "green" business:* We also looked at what corporations, hotels, and design firms were doing to green their operations. Boyne Mountain is not just a ski slope like some members of the Sustainable Slopes Initiative; it is also a business, lodging provider, and manager of landscaped areas. Therefore, we gleaned many creative ideas by expanding our best practices search to non-resort entities.
- *Site visits to resorts recognized for their environmental initiatives:*[1] We spent a full day at each of three Colorado resorts lauded for their progressive stance on environmental management. To understand better the interaction between "green" initiatives, budgets, management structure, environmental and technological constraints and employees, we wanted to directly interview managers in the thick of trying to make change. At each resort we discussed and took notes on what projects had been undertaken in each of the areas of our study, and how management handled the upfront costs and benefits of the projects. Through interviews and site tours, we discovered the "lessons learned" from these seasoned experts in terms of what projects they had tried and failed; what worked and why; ideas for how to apply their projects to smaller and less financially sound resorts; and strategies for improving the likelihood of success.

  The three resorts focused on different aspects of sustainability. Each has leveraged their particular strengths to maximize sustainability. At Aspen, we interviewed Auden Schendler, Executive Director of Sustainability, and Matt Hamilton. Mr. Schendler is

well known for his critique of LEED, and for his focus on high-level change in energy production and use. Citing climate change as the crucial issue, he has implemented many energy efficiency changes, green construction projects, and demonstration projects. Touring the site we saw sustainability projects from the cutting edge to the mundane; from clever implementation of micro hydropower to geothermal heating for the new LEED certified golf clubhouse to strategies for minimizing snow cat idling and wood choice for doors.

However, energy use at Aspen continues to increase. As such, Aspen is an example of the overwhelming scale of the energy problem, where implementing cost effective measures resort wide has not produced the kind of change necessary to reduce the threat of global warming. Mr. Schendler is therefore focused on bringing about change in energy policy by using Aspen's substantial political clout in educating guests and influencing political change. For example Aspen lobbied the board of directors of the local utility to invest in a commercial scale solar array.

At Winter Park we interviewed Doug Laraby, Director of Planning & Development, and Hal Newberry, Base Operations Director. Winter Park has much smaller budget than Aspen and Vail, but has had success from persistent push for sustainability. They've installed a state of the art energy monitoring system developed by their chief electrician, which saves five million kWh per year. While they don't have a budget for sustainable projects, the individual managers are able to divert funds into green projects if the payback period is short enough. The highly visible recycling program was implemented at low cost and breaks even on a monthly basis. It allows employees to bring in recyclables and has been well received by customers. In another example, they made what they felt was a insignificant switch to biodegradable cutlery which resulted in unexpected local media attention. This publicity then led to other grants and awards possibilities.

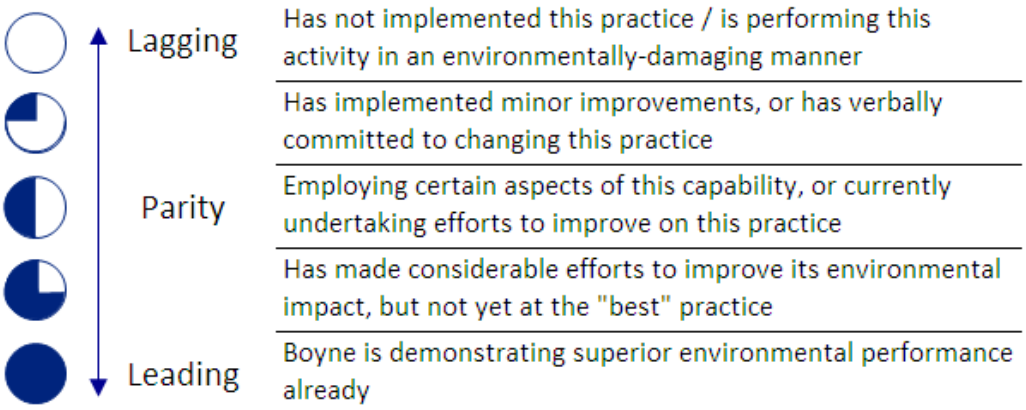
Vail is by far the largest and most profitable resort and is in the process of developing a vast "green" base resort. Luke Cartin, Environmental Manager, credited their environmental successes to top-down support from the new CEO for as well as staff buy-in through education and meetings. Mr. Cartin also stressed the culture of risk taking, that they appreciate that some projects won't work, but that failures are a necessary part of the process.

"Current practices" describe Boyne Mountain's actual operations, in terms of the practices in place at Boyne and how well they are performing on environmental criteria. These were gleaned primarily from interviewing Boyne Mountain team members listed at the end of this section. We have included examples from actual resorts and companies to illustrate potential ways these practices can be implemented, and to show that they are indeed feasible.

We also collected and analyzed primary data from the following sources:

- Utility bills to determine baseline energy and water consumption, and waste amounts and disposal methods
- Procurement policies and major vendors / products to determine extent to which environmental considerations are incorporated in sourcing decisions
- Fuel usage patterns to identify potential areas for conservation
- GIS data on topography, drainage, soils, and vegetation to determine ecological quality and abiotic conditions of Boyne's property

We then compared best and current practices to determine our perceived gap between the two, as measured by the following scale:



Energy

Best Practice	Example	Current Practice	Rating
General			
Conduct an energy audit to look for heating and cooling leaks in buildings (blower door tests, infrared camera imaging, etc.)	Aspen Ski Company joined the U.S. EPA's Energy Star Buildings program, and has committed to improving the efficiency of 60% of its buildings over 5 years	Initial audit on lighting efficiency conducted by Dillon Energy Services, but did not include assessment of building envelopes	
Get useable baseline numbers on electricity consumption separated by use (for lifts, snowmaking machines, lodging electricity, office electricity, heating and cooling for lodging, office space, etc.)	Winter Park designed and installed an energy monitoring and control system in 1997 that it has used to track energy use patterns over time, including their specific source and peak hours	Does not have a way to measure electricity consumption separated by use	
Use light-emitting diode (LED) Christmas lights	This is becoming standard practice	Boyne uses traditional incandescent Christmas lights	

Best Practice	Example	Current Practice	Rating
Purchase Energy Star appliances to reduce energy consumption	Aspen Mountain and Aspen Ski Co. have committed to buying only Energy Star appliances and computers	Purchasing is based mainly on upfront, rather than long term costs; but recently purchased a more efficient laundry system	
Switch all incandescent bulbs to compact fluorescent (CFLs) and switch fluorescent tubes to T8 where possible	Jiminy Peak, Aspen, Vail, Alpine Meadows, Angel Fire, Jackson Hole, Keystone, Snowmass, Sugarbush, and Sunday River ski resorts have all implemented major lighting retrofits	Boyne has changed most non-decorative lighting to CFLs, but this does not include lobby, hallway, and restaurant lighting	
Install motion sensors in lodge hallways and stairwells, restrooms, utility rooms, meeting rooms and offices, etc.	Alpine Meadows Ski Resort is one of many that has replaced light switches with motion sensors	Boyne has installed motion sensors in utility rooms, but not in any guest-facing areas	
Implement web-based system to better manage energy use for lift operations, heating and cooling, lighting, snowmaking, golf course irrigation, etc. (use this especially to ensure not making snow during peak times, if possible)	Winter Park's AreaNet allows the user to both monitor and control energy use by remotely shutting down systems as necessary, for instance when approaching peak use	Boyne has no such system in place	
Install green roofs to save energy, decrease run-off, and increase the life of the roof	Mt. Washington Resort and Golden Arrow Lakeside Resort have installed green roofs	Boyne has no green roofs	
Encourage employee carpooling to the resort, and provide bicycles for employees to get around the resort while there	Arapahoe Basin, Blue Mountain, Jackson Hole, Keystone, Mt. Rose, Squaw Valley, and Sugarbowl resorts all have programs to encourage employee and guest carpooling. Vail provides bicycles for employees to get around the resort instead of driving maintenance vehicles	Boyne does not actively encourage carpooling or provide bicycles for employee use	
Install photovoltaic (PV) arrays and solar hot water heaters	Vail resort uses solar hot water and thermal collectors and has a PV array, Aspen Highlands Patrol headquarters has a 2.3 kW PV array, and Sierra-at-Tahoe's Grandview Bar and Grill uses solar-heated hot water to provide radiant heat	Boyne does not currently have any PV arrays or solar hot water heaters	
Buy Renewable Energy Credits (RECs) to offset use of fossil fuel energy	Alta Ski Area, Aspen, Beaver Creek, Breckenridge, Buck Hill, Crested Butte, Crystal Mountain, Deer Valley, Heavenly Mountain, Keystone, Mt. Sunapee, Mt.	Boyne does not currently purchase RECs or carbon offsets	

Best Practice	Example	Current Practice	Rating
	Ashland, Okemo, Park City, Shawnee, Snowmass, Steamboat, Stevens Pass, Stratton, Sugarbowl, Sugarloaf, Sunday River, Vail, and Wolf Creek all purchase RECs to offset at least some portion of their electricity use		
Ski Area			
Purchase 4-stroke snowmobiles (which are 50% more fuel-efficient than traditional 2-stroke) and downsize fleet	94.5% of Vail Mountain's snowmobile fleet is 4-stroke, with no reduction in performance	All snowmobiles are 2-stroke; have more vehicles than needed	
Stay apprised of improvements in biodiesel technology for snowgrooming equipment	Alpine Meadows, Aspen, Grand Targhee, Jackson Hole, Mammoth, Mt. Hood Meadows, Northstar-at-Tahoe, Snowmass, and Wisp resorts all use biodiesel	Boyne does not use any biodiesel	
Employ "peak shaving" strategies to cut down on electricity use during peak times, which is what drives overall grid capacity (and hence the number and size of coal-fired plants in a given region)	Aspen, Vail, Winter Park, and Durango Mountain resorts all practice peak shaving	Boyne does not practice peak shaving	
Install harmonic filters on lifts, snowmaking guns, and compressors to stabilize energy demand for specific power uses	Aspen, Vail, and Jiminy Peak have had harmonic filters installed	Boyne does not have harmonic filters	
When replacing ski lifts, use best available technology to maximize energy efficiency (top drive more efficient than bottom drive)	Vail works closely with Doppelmaier and Poma to design new lifts such that latest technology incorporates environmental considerations; The Canyons Resort in Utah uses state-of-the-art lifts that require minimal power	Equipment decisions are based on cost; using several very old chairlifts; only 3 are Doppelmaier, which are best-in-class; unclear how much energy is saved with newer technology	
Lease or purchase best available technology snowcats and utility cats to maximize fuel efficiency; purchase remanufactured vehicles where possible	Aspen snowcats are on 2-year leases, ensuring they always have the latest most fuel-efficient model. Most major snowcat manufacturers "remanufacture" their vehicles, drastically reducing energy and waste required to produce a vehicle	Majority of cat fleet is from 1980s and 1990s	

Best Practice	Example	Current Practice	Rating
Convert to more efficient snowmaking guns requiring less water and electricity	Arapaho Basin, Aspen, Beaver Creek, Boston Mills / Brandywine, Breckenridge, Bretton Woods, Buttermilk, Cascade Mountain, Jiminy Peak, Keystone, Killington, Loon Mountain, Pats Peak, Sunday River, Vail, and Wachusett Mountain have upgraded their snowmaking guns to more efficient models	Boyne is in the process of upgrading their snowmaking guns	
Capture heat from snowmaking compressors and use it to heat buildings	Jiminy Peak and Snow Summit Mountain resorts capture waste heat generated by the snowmaking system to heat buildings	Boyne does not practice waste heat capture	
Redesign slope lighting to provide less, but better quality light	Wild Mountain, Telluride, and Pats Peak redesigned their night lighting systems, dramatically reducing their electricity use	Boyne uses mostly metal halide bulbs, and some incandescent bulbs	
Use block heaters to warm snowcat engines instead of letting them idle; this requires installing outlets wherever snowcat drivers take their breaks	Aspen Ski Co. uses block heaters to warm snowcat engines	Boyne snowcat drivers do not let the engines idle	
Golf Course			
Employ electric, rechargeable golf carts	Aspen Snowmass' fleet is 100% electric	Boyne already uses 100% electric carts	
Lodging			
Install a key card-activated HVAC and lighting shut-down system in guest rooms	Jiminy Peak has installed a similar system	Boyne is experimenting with this system in a pilot room, the “Green Room”	
Maintenance Building			
Insulate all un-insulated buildings	Standard practice	Boyne is planning to insulate the maintenance building	
Restaurants			
Install curtains in the coolers	Standard practice	Boyne is planning to install curtains in the coolers	

Water

Best Practice	Example	Current Practice	Rating
Ski Area			
Use high efficiency snowmaking guns	Arapahoe Basin and Jiminy Peak cut snowmaking electricity consumption in half by switching to the LP3 gun	Recently purchased new guns; not airless, but 30% better than baseline	
Use dirt formed half pipe and terrain park	Vail shapes terrain park from dirt to require less snowmaking	Halfpipe base is dug out in summer; jumps and starting ramps are not	
Ski Area			
Install computer-controlled snowmaking system	Loon Mountain has installed such a system so snow is made at optimum times	Does not have a computerized system, but coordinates with snowmaking staff and adjust snowguns as needed	
Inspect system regularly to identify and fix leaks	At Mt. Rose, employees inspect and monitor watering systems to reduce water loss and optimize efficiency	Staff inspects hoses and above ground pipes in summer	
Lodging			
Encourage guests to reuse towels, conserve water, etc. by using social norms to influence behavior change	Hotel industry standard; a recent study showed that stating "75% of guests who stayed in this room reused their towels" improved guest participation rates in towel reuse program significantly	Encourages towel reuse on multiple-night stays, but does not employ social norms	
Install water-efficient laundry machines	Vail has implemented a UV sterilization and wash water recovery system that drastically reduces freshwater needs for laundry	Boyne has installed a UV sterilization for its washing machine to save water	
Install low flow showerheads	New Bricor model is highly effective and affordable; $65/each	Boyne uses standard flow showerheads	
Install auto shutoff devices in public restrooms	Winter Park implemented these after reviewing an influential study from Minneapolis on ways to use less water (*Water Conservation in the Twin Cities Metropolitan Area*)	Auto shutoffs are not used	
Install composting toilets for employees where possible, e.g. shop or ski patrol hut	Arapahoe Basin uses composting toilets in its mid-mountain warming hut, the Snow Plume Refuge	Standard toilets are used for employees	

Best Practice	Example	Current Practice	Rating
Install waterless urinals in restrooms	Used in many public restrooms	Standard urinals are used in lodges	
Switch to low flow sink fixtures	Sustainable industry standard	Standard fixtures are used in guest rooms	
Switch to low flow/dual flush toilets	Sustainable industry standard	Standard toilets in guest rooms	

Waste

Best Practice	Example	Current Practice	Rating
General			
Provide adequate recycling containers on site throughout the property	Winter Park and Keystone resorts have extensive in-room and on-mountain recycling programs	No recycling containers in place, but informal plan is underway to purchase them	
Provide clear signage to facilitate guest and employee behavior change	Vail and Winter Park have clearly labeled containers located in prominent places	Very little to no signage posted for employees or guests about recycling	
Partner with municipality / current waste provider to expand recycling services and facilitate consolidation	Vail partnered with county to get expanded recycling capabilities, such as allowing more types of plastics to be recycled in addition to #1 and #2	No partnerships developed with local municipalities to facilitate increased recycling capacity	
Donate used furniture, silverware, and other durable goods to local charity	Vail donates such items to Salvation Army	Metal gets sold as scrap, wood gets burned, and mattresses aren't recycled because it is difficult to do	
Purchase low-cost equipment to consolidate / prep waste such that volumes are reduced and materials can be recycled or sold	Vail has cardboard compactor, bulb eater, and can-puncturer such that it can prepare and dispose of these wastes without landfilling them	Cardboard compactor has been discussed but not purchased and other materials are disposed of in biannual Hazmat recycle day	
Ski Area			
When replacing chair lifts, sell old usable equipment and chairs to other ski areas; recycle scrap metals and snowcat treads	Vail sells old chair lifts to other mountains, raffles chairs off to guests, and recycles the unwanted scrap metals	J&K recycling in Gaylord accepts metal parts in a container that they provide to Boyne grounds; Boyne	

Best Practice	Example	Current Practice	Rating
		valuable pieces, but still maintains "boneyard" for old equipment	
Golf Course			
Set up recycling stations at golf cart check stations	Aspen has adequate golf course recycling practices in place	Individual employees recycle returnable cans and bottles	
Lodging			
Reduce use of printed materials such as multiple-copy receipts, brochures and trail maps	Marriott and Starwood hotels both have strong green credentials where printed materials are kept to a minimum	Printed materials are not excessive but further reductions could be made	
Food & Beverage			
Compost solid food wastes on site or donate to local farm	Winter Park has an agreement with a local pig farmer for daily pick up of food scraps	No program in place but have had discussions with local pig farmer	
Use glass and silverware instead of paper and plastic to reduce waste	Various resorts use mugs, glass, and silverware in dining halls	Use paper and plastic in cafeterias, glass and silver in fine dining areas	
Spa			
Use bulk lotions and creams in recyclable containers	Boyne's current practice is very good	One gallon recyclable containers for most bulk creams and lotions used	
Retail			
Minimize packaging and recycle shipping materials	Vail compacts cardboard and sells it to recycling company	Recycle some of their shipping materials; have proposed purchase of cardboard compactor	
Back Office			
Recycle office paper	Most major corporations	Some bins in place, but still not culturally ingrained	
Recycle print cartridges	Most major corporations	No program in place	
Recycle old computers and electronics	Vail recycles all of its outdated/broken electronics	No program in place	

Design

Best Practice	Example	Current Practice	Rating
General			
N/A			
Ski Area			
Focus on protection of natural systems and wildlife	Aspen and Keystone resorts use signage and protection fencing to limit access to sensitive ecological areas and habitat that may be particularly sensitive at certain times of the year	No focus on natural systems; no natural inventory has been done on the property; wildlife is not a consideration in any of their missions	
Drainage of snowmaking water melts into a retention area where it can be re-used for irrigation or snowmaking, or treated in a constructed wetland prior to returning to the natural water cycle	Keystone resort contains a series of mitigation wetlands, educational wetlands, and natural wetlands along the Snake River, which flows through the Keystone base village area	Some runoff does go into retention ponds at the base of the hill, but the extent to which this water is reused is questionable. This water is not treated at all before being returned to the natural system	
Use grey water for snowmaking and irrigation	The Tribe's Seven Feathers Hotel & Casino Resort in Canyonville, Oregon has a grey water system which is then used for irrigation	No grey water is re-used. It enters the sewer system	
Use dirt where possible to pre-form the slopes to minimize making snow for slope formation	Aspen grades their terrain park and uses snowmaking only to cover the dirt, not to create the shape of the slope	Boyne uses dirt for part of their half-pipe, but not for jumps	
Highlight sustainable principles throughout the mountain	Aspen and Vail use signage throughout their resort to promote their green actions; such promotion may also be used to point out sensitive ecology or habitat	Sustainable principles not a priority or a focus on any part of the mountain	
Golf Course			
Minimize mowed area	Aspen golf course minimizes the areas they mow, not only on the golf course itself, but also in the surrounding grounds. Native wildflower and grass growth is an aesthetic that they have incorporated into their landscaping plans	Boyne does not focus on minimizing mowed areas, nor do they use any lawn-alternatives in their golf course. They have also not done any assessment of the amount of mowed areas that could possibly be reduced	

Best Practice	Example	Current Practice	Rating
Use native plants and prairie grasses where applicable for rough	Aspen golf course uses native Colorado grasses and forbs in their rough areas, which require less irrigation and no fertilization	Not a focus, and where native plants exist, they are not intentional or managed. No floristic inventory has been done to determine the extent of natural areas	
Minimize fertilization	Aspen golf course uses native Colorado grasses and forbs in their rough areas, which require no fertilization; fertilized areas include only fairways and greens, which are only fertilized when necessary	Boyne uses conventional fertilizers on its golf course, but is willing to test different organic alternatives	
Minimize irrigation	Aspen golf course uses native Colorado grasses and forbs in their rough areas, which require less irrigation. Landscaped areas use drought-resistant plants that do not need irrigation once established. Where watering is necessary, it is done at night to minimize evaporation, and they use water from their retention ponds rather than from a natural aquatic ecosystem	The golf course is irrigated; no studies have been done to determine how to minimize irrigation and no monitoring equipment exists to determine how much water is used on the golf course	
Find fertilizer alternatives, preferably organic	Aspen golf course uses organic fertilizer on their golf course and grounds	Organic fertilizers have not been considered by Boyne	
Research options for grasses and ground cover that may need less mowing or less fertilizer	The UM botanical gardens did research for alternative lawns using a variety of other types of grass with lower water and fertilizer needs	No research has been done into alternative groundcovers	
Make sure drainage is treated before it enters a natural stream or lake	Brown Park in Ann Arbor just constructed a large wetland to help treat the water in Mill Creek before it enters the Huron River	No treatment exists for stormwater	
Seek Audubon Cooperative Sanctuary System certification	Aspen has this certification for their golf course	No certification has been sought	
Lodging			
N/A			
Food & Beverage			
N/A			
Spa			
N/A			
Avalanche Bay			
N/A			

Best Practice	Example	Current Practice	Rating
Retail			
N/A			
New Development			
Create high-density, walkable communities with direct access to Boyne's amenities to minimize the use of cars within the resort	EverVail, a new residential and commercial community at Vail, uses these principles as a basis for the ecological design of its development	Individual family vehicles are used widely on the resort. The main lodge complex works in this way, but the rest of the resort does not function as a cohesive whole	
Follow LEED (Leadership in Energy and Environmental Design) practices	EverVail, as well as Aspen's Snowmass, strives for LEED certification when planning and designing new developments	No LEED practices have been consciously pursued at Boyne	
Use locally sourced building materials where possible	All EverVail buildings and Aspen's Snowmass golf club house use locally sourced or recycled materials	New children's center building was moved from downtown rather than building a new building. However, this was not done in the name of sustainability, nor is it advertised as such. Practices such as this should be a norm rather than an exception. No other development has used these re-use principles	
Screen contractors, designers, and consultants for environmental credentials	Green building principle	Environmental credentials are not a priority	
Work in accordance with natural features and ecosystems	Green building principle	Steep slopes and natural features that act as barriers to development are acknowledged, but not natural features valuable to wildlife or ecosystem processes	
Grounds			
Use drought-tolerant plants and native plants to minimize irrigation needs	Ecology management principle	These are not criteria on which Boyne has chosen plant material	
Use soil amendments to increase the water-holding capacity of the soil to minimize irrigation needs	Ecology management principle	Soil amendments have not been used, irrigation is regular	

Best Practice	Example	Current Practice	Rating
Use computerized irrigation equipment	Winter Park's computer system allows them to control all irrigation devices from a single computer	Irrigation is on timers, and must be turned off manually. We saw sprinklers on in the middle of the day during sunshine	
Designate an appropriate area for composting on site	Keystone Resort in Colorado has a high altitude composting site at their resort for restaurant food residuals	No composting is done on site	
Identify areas with high quality natural inventories	Vail and Aspen are on National Forest land, so they have extensive knowledge of the ecosystems and wildlife that share their resort, and management practices that help preserve their habitat	No natural inventory has been done	
Identify watershed quality of areas draining into on-site fluvial systems	Identifying where the water has been can give clues to any contamination that may be present in the water systems on the property	No such analysis has been done	
Identify needs of restoration on site and organize volunteer efforts	Natural areas in Michigan, such as state parks, the Henry Ford Estate, and the UM botanical gardens have extensive volunteer work days where they organize restoration efforts	No restoration efforts have been made	
Maintain stream buffers and limit access to sensitive areas	Green building principle	This has not been done or advertised in the name of sustainability. Any buffers remaining around stream areas are their due to sites unsuitable for development	
Prevent erosion into fluvial systems where possible, and provide areas for sediment to settle out of water before the water moves on in the system	Ecology management principle	This has not been analyzed or done intentionally on the property	
Use sustainable stormwater practices allowing as much stormwater as possible to run over land and percolate back into the water table rather than going into the sewer	Green building principle	This has not been intentionally designed for	

Best Practice	Example	Current Practice	Rating
Understand natural inventory, and habitat changes of species at different times and take into account when planning activities for the resort	Ecology management principle	No natural inventory or wildlife analysis has been done	
Join the Wildlife Habitat Council's Habitat Certification/International Accreditation Program	Aspen Golf Course	No certifications have been applied for	
Adopt a vegetative management plan	The national forests have a forest management plan that they have to follow. It is just as important for private properties of this size to have a forest management plan as well	No vegetative management plan exists for the natural areas on the resort, and since it is private land, unlike the resorts in the west, there is no government-funded management plan in place either	
Control invasive species	Ecology management principle	No invasive species management or education is in place	
Revegetate disturbed areas with native plant species and grasses	Ecology management principle	State of erosion around disturbed areas is not known, but this is not a focus of development on the resort	
Use prescribed burns and other restoration efforts to help maintain a high-quality woodland in the natural areas of the site	Ecology management principle	No restoration efforts have been made	
Define a trail system that provides access to highlighted ecosystems while avoiding access to sensitive systems	Ecology management principle	The existing trails have not been designed or analyzed in this way	
Identify local environmental groups who may have resources and interest in partnering their expertise	Michigan Wild Ones are a group of volunteer organizers that promote native plants and invasive plant removals	No environmental groups have been identified or contacted	
Identify local camps such as boy scouts or a boys and girls club who may have interest in using Boyne as a location for environmental education and stewardship	Many areas have environmental education day camps that take advantage of natural areas as locations for education. An example is the Leslie Science Center in Ann Arbor	No local camps have been identified or contacted	

Best Practice	Example	Current Practice	Rating
Have gardens and specific landscaped areas highlighting the ecology of the area such as native gardens, butterfly gardens, monarch gardens, etc.	UM Botanical gardens have a good set of demonstration gardens where they can showcase innovations in green development and gardening	No ecology gardens exist on the site	

Sourcing

Best Practice	Example	Current Practice	Rating
General			
Establish formal environmental purchasing guidelines that specify preferred and banned materials, material properties (recyclable, recycled, renewable, etc.), and standards for supplier environmental practices; ideal practice would be supplier "scorecard" for environmental criteria	Kimpton Hotels, with 50 properties throughout North America, follows rigorous environmental purchasing guidelines as part of its EarthCare program. This program has helped the hospitality company reduce its environmental impact. For example, it replaced 50,000 gallons of cleaning chemicals with non-toxic alternatives in just one year.	No formal policies in place, though consistently makes conscious effort to consider environmental implications of purchases	
Ski Area			
See “Energy” section above			
Golf Course			
Purchase organic fertilizer (can be made from variety of materials, including food waste, animal meal, guano, and soy meal)	Vail uses organic fertilizer. Several landscaping / golf course companies now offer organic products they claim are as effective as chemical-based ones. Brands include Converted Organics and Organic Growing Systems	Using traditional nitrogen-based fertilizer	
Lodging			
Purchase real glasses and ceramic coffee mugs	Most upscale hotel chains (e.g. Marriott, Starwood) offer real glasses and ceramic coffee mugs in rooms	Using disposable plastic (non-recyclable) cups in Boynehof / Clock Tower; all others are glass	

Best Practice	Example	Current Practice	Rating
Provide guests with eco-friendly soap, shampoo, conditioner, and lotion in small recyclable or recycled containers; even better is to do away with mini bottles and use bulk containers	Several major hotel chains use Aveda products, which employ natural and organic ingredients and post-consumer recycled packaging, and is supplied with 100% renewable energy. Starwood's Element line of hotels and the GAIA Anderson Hotel & Spa (American Canyon, CA) use bulk dispensers	Currently not using eco-friendly amenities, but Boyne Design Group is researching alternatives and intends to replace current selection	
Use recyclable carpets and low- VOC (volatile organic compounds) paints / sealants when remodeling or building new rooms	Starwood's *Element* line of hotels uses recycled carpets and low-VOC paints. Interface and many other carpet companies offer commercial-grade recycled carpet options	Currently purchasing low-VOC paints / sealants and recycled carpet	
Purchase FSC-certified (Forest Stewardships Council) wood furniture or low environmental impact furniture (e.g. Herman Miller)	Vail uses Herman Miller desks and chairs, which have been designed to reduce the products' life cycle impact; Starwood's Element line of hotels has FSC-certified bed frames	Not currently buying FSC-certified wood products or low environmental impact furniture	
Use office and conference supplies (e.g. pens, paper) made from post-consumer recycled materials	Marriott uses pens made from 75% recycled materials. All printed materials and paper pads at Kimpton Hotels are from 100% recycled paper; they even print with soy-based inks	Using conventional office supplies	
Use bedding and towels made from organic and / or highly renewable materials (e.g. bamboo, hemp)	Kimpton Hotels uses organic linens and bedding	Unable to find eco-friendly linens that meet durability and design requirements	
Use mattresses and couches / cushions made with soy (reduced petroleum content)	Starwood's Element line of hotels uses couch cushions made from soy	Purchases 15% soybean oil reduced-petroleum mattresses (TBD on other in-room / in-lodge furniture)	
Purchase non-toxic, biodegradable cleaning supplies in concentrated formula	Kimpton hotels uses natural cleaning products; they have even altered the formulas to match the water type of each of their various locations	Using "environmentally-friendly" product from Ecolab (Oasis Pro 66). Concentrated product (reduced packaging), not as harsh as some, but still contains chemicals	

Best Practice	Example	Current Practice	Rating
Offer free newspapers at front desk rather than giving one to every room	"Ecotel" chain of hotels observes this practice	Offers newspapers in stacks in lobby rather than at every room	
Offer pitcher of filtered water instead of single-serve PET bottles	Scandic Hotels (in Scandinavia) not only doesn't offer bottled water in rooms; they have banned all onsite bottled water sales	Uses pitchers, unless bottled is requested by the guest	
Purchase energy- and water-saving laundry appliances	Vail uses all Energy Star appliances; furthermore, they have a reuse system that takes rinse water from the washing machine to use for the next cycle	Boyne just converted to new oxygen injection process to eliminate need for hot water, reduce need for cleaning solution, and drastically reduce bleach	
Food & Beverage			
Maximize organic and natural food offerings in restaurants	Vail has committed to using all-natural, free range beef and as much organic dairy products as suppliers can provide	Tried serving organic meats, but stopped due to customer complaints about taste and price	
Offer fair trade, shade-grown, and / or organic coffees and teas	Most major retail coffee chains (Caribou, Espresso Royale, Starbucks) offer fair trade and shade-grown options. Most major grocery stores (everyone from Wal-Mart to Whole Foods) offer fair trade, organic, and shade-grown options. More recently, restaurants are beginning to re-source, most notably McDonalds: the fast food giant switched to Newman's Own Organic coffee, made by Green Mountain Coffee Roasters	Currently under purchasing agreement with Sysco to purchase 90% of all food & beverage from them. Recently started offering fair trade Ferris Coffee; chai mix in Das café is organic	
Offer Marine Stewardship Council certified seafood (best practice); next-best option is to buy only those species who are not threatened / in danger of collapse (e.g. Alaskan pollack and salmon, farmed rainbow trout)	Xanterra Park & Resorts (operates restaurants in several national parks, including Yellowstone and Grand Canyon) was first hospitality chain to commit to serving only MSC-certified seafood. US Food Service is starting to offer MSC-certified products	Not offering MSC-certified products (again, this is limited by Sysco agreement); no formal consideration of the sustainability of the fishery / species	

Best Practice	Example	Current Practice	Rating
Partner with suppliers to increase availability, reliability, and quality of supply	Vail has entered long-term partnerships with Coleman's Natural Meats and Horizon Organics in order to "move the market", as sufficient volumes of certain products are not yet available	No official contracts / partnerships aside from Sysco contract, who does not provide a wide assortment or large enough supply of organic / natural products	
Maximize local food offerings in restaurants through "specials" and seasonal side dishes and desserts	One of Vail's restaurants has a "Farmer's Market Day" once a week, where the entire menu is based on locally grown foods	Purchases some locally-grown produce and Lake Michigan fish	
Use durable (ceramic, metal, cloth) plates, cups, napkins, and cutlery in as many food service locations as feasible	Arapaho Basin uses durable, reusable cups even in their cafeteria to reduce waste	Uses durables in Everett's, Eriksen's, Beach House, and Banquet center, but uses disposable items in other locations	
Where disposable plates, cups, and cutlery necessary, use biodegradable / non-petroleum-based / high recycled content materials (make sure biodegradable materials are composted)	International Paper offers 100% post-consumer recycled paper cups with corn-based coating; NatureWorks LLC offers a whole line of PLA (corn)-based food carrying containers; SpudWare makes potato-based cutlery	Using recycled paper cups and napkins, and biodegradable to-go containers and silverware; however, not composting biodegradable materials	
Purchase energy- and water-saving dishwashing appliances	Vail uses all Energy Star appliances. It also has a heat exchange system for dishwashers	Boyne uses traditional dishwashing equipment, though they have researched alternatives	
Spa			
Purchase natural / organic amenities (lotions, oils, etc.)	Numerous spas throughout the country tout their organic amenities, including the Blue Marble Spa, Hyatt Regency San Diego, Uhma Spa & Shop in South Beach, Chill Spa in Jackson Hole, and International Orange in San Francisco	Some products are partially organic or natural, but there is no major initiative / commitment to shift towards a more deliberate, high-volume sourcing strategy for spa amenities	
Use recyclable bulk containers for amenities	Q Hotel & Spa in Kansas City; countless others	Uses and recycles bulk containers	
Use bedding and towels made from organic and / or highly renewable materials (e.g. bamboo, hemp)	Chill Spa in Jackson Hole uses 100% organic cotton robes, towels and linens	Unable to find eco-friendly linens that meet durability and design requirements	

Best Practice	Example	Current Practice	Rating
Offer guests eco-friendly products in spa gift shop	Uhma Spa & Shop in South Beach, Urban Sanctuary in Atlanta, and International Orange in San Francisco all offer such products, including robes made from organic cotton and natural / organic lotions, soaps, etc.	Not offering anything with this intent	
Purchase non-toxic, biodegradable cleaning supplies in concentrated formula	Blue Marble Spa and Hyatt Regency San Diego both use eco-friendly cleaning supplies	Using same cleaner as housekeeping - Ecolab (Oasis Pro 66). Concentrated product (reduced packaging), not as harsh as some, but still contains chemicals	
Avalanche Bay			
(See "Food & Beverage" section)			
Retail			
Offer customers eco-friendly alternatives such as organic cotton t-shirts and organic snacks	GAP has major initiative to offer full line of organic, unbleached cotton clothing; organic snack options abound, e.g. Green & Black chocolate, Newman's Own cookies and pretzels, etc.	Has some organic / eco-friendly clothing lines (e.g. Patagonia, Horny Toad) and organic snacks, comprising approximately 15% sales	
Minimize packaging (both in the bulk shipping process and the retail unit itself)	Wal-mart has strict packaging specifications suppliers must meet. Has packaging scorecard which rates suppliers on volume and recyclability / reusability / biodegradability of packaging	Recycles all cardboard from shipping, but has not made any effort to reduce packaging volumes on retail units; landfills all plastic from shipping packaging	
Institute formal environmental check as part of procurement process: Develop standards; work with major suppliers to understand their environmental practices; discontinue business with suppliers with poor environmental records	Many major corporations including Wal-mart, Coca-cola, Nike, and Starbucks specifically rate suppliers on environmental practices	Does not have any special environmental considerations for retail purchases	
Back Office			
Purchase FSC-certified wood furniture or low environmental impact furniture	Vail purchases Herman Miller design-for-environment furniture for all back offices	Does not have any special environmental considerations for furniture purchases	

Best Practice	Example	Current Practice	Rating
Purchase 100% post-consumer recycled paper, and highest available recycled content paper products (e.g. folders, binders)	Wide selection of products available at Staples and Corporate Express	Purchasing recycled notepads; all other products are "traditional"	
New Development			
(See the "Lodging" section)			
Grounds			
Purchase organic fertilizer (can be made from variety of materials, including food waste, animal meal, guano, and soy meal)	Vail uses organic fertilizer. Several landscaping / golf course companies now offer organic products they claim are as effective as chemical-based ones. Brands include Converted Organics and Organic Growing Systems	Using traditional nitrogen-based fertilizer	
Purchase re-refined / recycled motor oil	Both the City of Portland and King County (Seattle) use 100% rerefined motor oil for their fleets of municipal vehicles	Uses traditional motor oil, but does recycle it	
Purchase and recycle extended-life antifreeze	City of Portland uses only extended-life antifreeze, and recycles / repurchases it when done. Product options include Zerex (by Valvoline) and Prestone	Uses traditional antifreeze, but does recycle it	

Marketing & Education

Best Practice	Example	Current Practice	Rating
General			
Incorporate environmental goals into company mission / values / principles; CEO should clearly communicate and champion these values throughout the organization and to external stakeholders	One of Aspen's 9 "Guiding Principles" is "Remain responsible stewards of our mountain environment." Many large corporations, such as Coca-Cola (one of whose 5 vision statements is "Planet: Being a responsible global citizen that makes a difference") embrace environmental values	Environment not explicitly mentioned in main corporate mission / values	

Best Practice	Example	Current Practice	Rating
Establish regular communication vehicles from executive leadership to employees regarding environmental initiatives (such as through a monthly newsletter or quarterly staff meeting)	Grand Targhee Resort, WY has bi-weekly environmental newsletter to employees. Sugarloaf, ME dedicates a section of its employee newsletter to environment. Aspen's intra-company "Green Letter" updates employees on activities, environmental programs, new protocols, new trainings, and highlights employees who are making a difference within the company	Sometimes Green Committee will include updates in weekly employee email; no regular environmental messages from senior leadership	
Include environmental messages in communication vehicles from the resort to condo owners & associations	Keystone's environmental department regularly contributes to the Keystone Homeowner's Newsletter	Quarterly condo assn. newsletter sometimes used to communicate environmental projects; however, message is typically about cost savings, not environmental benefits. Could be more deliberate / educate the owners	
Issue sustainability report every 2 years that clearly communicates environmental goals and statistics on usage of water / energy / waste, etc., and explains all ongoing efforts, partnerships, and awards	Aspen issues biannual report, taking a very honest approach to its progress to date and challenges they face. Many major corporations release annual or biannual sustainability or corporate social responsibility reports (one study found that 82% of the large global corporations it surveyed issued such a report)	Does not issue a sustainability report	
Build "corporate partner" relationships with key suppliers to co-brand environmental efforts and learn from one another's experiences with sustainability initiatives	Aspen has worked with consumer products companies, designating them Aspen's "prime supplier" in exchange for working to improve its environmental efforts	Has taken advantage of such opportunities in the past (e.g. Head's environmental campaign). However, this isn't something that can be driven at a Boyne Mountain level (must to be corporate-wide)	

Best Practice	Example	Current Practice	Rating
Communicate environmental efforts honestly to avoid accusations of greenwashing; do not exaggerate claims	Many companies come under fire for over-stating their environmental beneficence. For example, BP was criticized for touting its green-ness in a series of TV ads while its pipes were bursting, leaking toxic substances into the ground and air.	Not much of an environmental PR campaign to speak of, but nothing has been exaggerated to date. Perhaps not as communicative / transparent as they could be.	
Train customer-facing employees on Boyne's environmental efforts, so entire staff is comfortable responding to guests' questions. Focus on hotel lobby staff, head waiters, ski instructors, golf instructors, pro shop employees, and ski lift operators	Northstar-at-Tahoe, CA trains employees during company orientation on the resort's commitment to the environment and waste reduction. Keystone's new employee education program includes environmental education (including to Spanish speaking employees). Aspen uses the Environmental Affairs department each fall to train new and returning employees in the resort's sustainability theory, guiding principles, hazardous waste, recycling protocols, and other environmental programs. Sugarloaf, ME requires twice-yearly training day that includes a session on environment	Some information received during orientation (in brochure format). Employees are encouraged to reference stewardship page of Boyne's website. No formal "training" per se	
Participate in government advocacy efforts to support initiatives that will help Boyne's goals, e.g. expanded recycling and federal climate change regulation	Arapahoe Basin and Aspen worked with the Colorado Department of Health and Environment in a 3-year pollution prevention partnership. Aspen is highly engaged in government lobbying efforts at all levels	Has not done anything to date. Not feasible at the Boyne Mountain level	
Incorporate green messaging into existing marketing materials (brochures, magazine ads, etc). Continue to emphasize other attributes (comfort, design, leisure, etc.), but highlight Boyne's environmental stance provides an added bonus	Aspen has run full-page ads in skiing magazines emphasizing its environmental credentials as a way to draw in new guests	Does not explicitly communicate any environmental messages to guests / potential customers. Don't feel they have the right data on how customers would respond	
Encourage news coverage of environmental initiatives (particularly any special events)	Vail uses local cable television programs to publicize its efforts	Nothing to date	

Best Practice	Example	Current Practice	Rating
Gauge customer perceptions by conducting surveys or updating comment cards to include questions about sustainability (e.g. "how important to you is protecting the environment while you're on vacation?" "Did you order any organic meals during your stay? If so, please rate your satisfaction with the meal, in terms of taste and price"). Use feedback to improve guest appeal of environmental programs	No publically available information on this	Issues annual season pass holders survey and has guest comment cards available. These have not included any environment-related questions in the past. Have struggled with how to manage data they DO get. Are open to conducting a survey, but have not done one yet	
Dedicate portion of website to environmental initiatives	Aspen, Wachusett, MA and Winter Park, CO maintain in-depth environmental webpages detailing their efforts	Has single web-page listing environmental efforts. Not best in class in terms of content included, but they do have it, and it is easy to get to from the Boyne home page	
Partner with local stakeholder groups such as school systems, NGOs, businesses, and the public on initiatives and opportunities for protecting and enhancing the environment	Copper partnered with the US EPA, Army Corps of Engineers, and US Forest Service to develop a communication and coordination strategy with various state and local agencies concerned with mountain resort issues. Mad River Glen, VT hosted the Northern Forest Stewardship Conference with leaders from environmental and conservation organizations, academia, state government, and land managers to talk about how recreational facilities can foster the conservation of natural resources while remaining economically viable	Have not done this yet. They do partner with local community organizations (particularly schools), but not on environmental projects	

Best Practice	Example	Current Practice	Rating
Create funding mechanisms to support environmental restoration projects throughout the local community	Employees of Arapahoe Basin can participate in an Employee Environmental Fund by making pre-tax donations to various environmental organizations. Approximately $2,000 per year is given to conservation causes. Vail Resorts partners with the National Forest Foundation, a non-profit partner of the U.S. Forest Service that helps the USFS improve the health of the national forest system, to raise funds for conservation projects in the surrounding areas. The Grand Targhee Environmental Foundation was established by resort employees to provide support for environmental projects in Teton Valley.	Does not fund any environmental projects	
Encourage and incent employee participation in voluntary environmental restoration projects (e.g. stream clean-up)	Several resorts participate in Adopt-a-Highway programs (e.g. Blue Mountain, ON, Mt. Bachelor, OR). Keystone coordinates with environmental NGOs to do annual Earth Day projects. Many large corporations dedicate paid day of work to company-wide day of service	Participates in Adopt-a-Highway. 2 years ago, did mountain-wide garbage challenge in spring. No other environmental volunteer events. No specific incentives to participate	
Run promotional campaigns that offer resort perks in exchange for greener behavior, or provide entertainment combined with green marketing	Vail and Crystal Mountain, MI both offered a free one-day lift ticket to all customers who signed their houses up for a year's worth of renewable energy credits. Cranmore Mountain Resort, NH ran a "Bio-Diesel Day" where it offered free lift tickets guests who drove hybrid or bio-diesel vehicles to the resort. Pebble Creek, ID and Squaw Valley, CA hosted a "Sustainable Slopes" Day, with discounts for guests who carpooled, Keep Winter Cool poster contest for kids, etc.	Has never offered any promotions like this	
Support and leverage existing campaigns that align with Boyne's environmental goals	Keep Winter Cool campaign; Sustainable Slopes initiative	Not part of any larger campaigns	
Ski Area			

Best Practice	Example	Current Practice	Rating
Provide visible signage communicating Boyne's on-mountain sustainability efforts, such as recycling and renewable energy	Aspen's microhydro dam is in the middle of a ski run, with an educational display explaining how the dam works	No signage	
Provide visible signage explaining the local ecosystem (habitat, flora & fauna, water sources, etc.)	Beaver Creek has an on-mountain Environmental Learning Center with displays on wildlife, renewable energy, etc. The building doubles as a warming hut. Arapahoe Basin, CO installed vegetation and wildlife awareness signs to inform and educate guests. Alpine Meadows, CA has two interactive displays in the base area to help educate guests about the resort's natural environment. Gore Mountain, NY has an on-mountain interpretive center, as well as displays on several gondolas	No signage	
Develop environmental education component of ski school and / or summer camp. Communicate not only Boyne's environmental efforts, but the general environmental impact of skiing (water for snowmaking, energy to run lifts, etc.)	Snowmass has a "Winter Wild Things" program for children that delivers informative and interactive lessons to children concerning winter alpine ecosystems. Mad River Glen, VT has comprehensive education program including educational snowshoe treks, evening slide shows and guest speakers, adventure-based educational programs in spring, summer, and fall, guided hikes, group and family outings, and a Naturalist Adventure Summer Camp for children. Mammoth, CA's Nature Rangers program provides ski school students with "fun environmental education adventures"	Fritz's Adventure Camp incorporates environmental education. No summer camp offered	
Golf Course			

Best Practice	Example	Current Practice	Rating
Participate in Audubon Cooperative Sanctuary Program ("an award winning education and certification program that helps golf courses protect our environment and preserve the natural heritage of the game of golf")	All Aspen and Vail course are Audubon-certified sanctuaries. There are 2,110 Audubon-certified courses worldwide, including Bear Creek Golf Club on Hilton Head Island and Hammock Dunes in Palm Coast, FL	Have considered applying, but are not yet a member	
Provide visible signage communicating Boyne's golf course sustainability efforts, such as turf management and Audubon certification	Blue Mountain Resort, ON takes children on nature tours of its golf course	No signage	
Provide visible signage explaining the local ecosystem (habitat, flora & fauna, water sources, etc.)	Arapahoe Basin, CO installed vegetation and wildlife awareness signs to inform and educate guests	No signage	
Lodging			
Provide visible signage in MGL lobby communicating Boyne's overall environmental initiatives, and hotel-specific efforts in particular	Snoqualmie, WA ran an outreach campaign with posters explaining the resort's environmental efforts	No signage	
Provide in-room cards explaining CFLs, motion-sensing lights, towel reuse program, and recycling options (and explain how each of these contributes to reduced environmental impact)	Marriott and Starwood provide in-room cards explaining water-saving benefits of towel reuse program	No information communicated in the rooms themselves	
Food & Beverage			
Develop symbols to denote organic, natural, and local products (e.g. a green leaf, state of MI icon). Include these symbols on printed menus next to all relevant menu items	Vail has symbol system for menus	Not currently doing this	
On printed menus or through signage in the restaurant, explain the respective benefits of organic, natural, and local food. Tell a story about the health of the environment, health of the guest, and health of the local community	Vail has done this through signs (e.g. pictures of local farmers); servers are knowledgeable as well	Not currently doing this	
Spa			

Best Practice	Example	Current Practice	Rating
Include green messaging in spa brochure to explain efforts to reduce water, use environmentally friendly products, etc.	No specific example available	Not currently doing this	
Avalanche Bay			
N/A			
Retail			
N/A			
Back Office			
Encourage frugal use of paper and office supplies	Several major corporations, including Citigroup, PepsiCo, and Starbucks, have committed to specific office paper reduction goals. Environmental Defense Fund has created tools for reducing corporate paper use: http://www.edf.org/page.cfm?tagID=1439	Employees are encouraged to reduce and recycle; bins are conveniently located throughout back office. No explicit incentives	
Encourage employees to turn off the lights / computers when leaving desks	No specific example available	There are motion sensors and general pride about turning off lights and computers. No official incentives	
New Development			
Provide signage indicating sustainability efforts of new developments, e.g. low flow plumbing, energy efficient lighting, any other LEED efforts	Aspen's new LEED-certified golf pro shop has prominent signage explaining its green characteristics	Not currently doing this	
Communicate new development plans to local environmental groups	Gore Mountain, NY presented its new development plans to the Sierra Club, the Audubon Society, and other local environmental organizations to answer questions / develop buy-in. Mount Hood Meadows Ski Resort conducted 5 focus groups with community members to hear broad concerns involving the resort and the community. They then formed a Community Advisory Group to share information on our resort's expansion planning process, and hear specific responses and questions from the Advisory Group members concerning our development plans	Not currently doing this	

Best Practice	Example	Current Practice	Rating
Grounds			
N/A			

Decision-making

Best Practice	Example	Current Practice	Rating
General			
Maintain separate and clear funding process for sustainability initiatives; adjust amount spent on sustainability projects to reflect its true importance	At Vail, while most projects require a payback period < 1 year, the CEO and CFO understand longer-term timeframe/payback period of environmental investments. They also practice a partnering concept: If $10K is saved through lower energy bills from CFLs, can use $10K to pay for another environmental project. At Arapahoe Basin, purchasing guidelines allow a certain premium price for recyclable items or items from green supplier	Primarily bases project funding decisions on return on investment (ROI), though allows some influence by "other factors"; frequently refers to estimated payback period; no evidence of partnering concept. With respect to sourcing, if an item is marginally more expensive Boyne will purchase it, especially if it saves money "down the road"	
Recognize or reward employees who contribute toward company sustainability	Vail provides incentives for employees, such as an "eco-hat" for recycling, refreshments to employees for hitting certain goals	Currently no incentives in place	
Include progress toward sustainability objectives in performance evaluations	No example available	Twice yearly performance evaluations. Currently do not include any sustainability content/criteria	

Best Practice	Example	Current Practice	Rating
Implement sustainability objectives in each department of the company	Vail enjoys top-down support from C-level for environmental initiatives, which generates buy-in from staff; every Vail Resorts Mountain has its own Env. Manager; CEO very env. minded, changed mission statement to include greater importance for environment. Aspen gets top-down direction from its Energy Plan, as well as leadership from CEO and buy-in from employees	Each resort has its own Green Committee (headed by Steven Kirchner) in which environmental initiatives are discussed. This is a way for top-down initiatives to filter throughout company. Also has an Energy Committee. However, no official sustainability / environmental position	

Boyne Mountain team members

- Niki Dykhouse, Housekeeping Supervisor
- Bernie Friedrich, Retail General Manager
- Jim Gibbons, Grounds Operations
- Ed Grice, General Manager
- Sean Handler, Director of Spas
- Roy Haworth, Restaurant Manager and Resort Accommodations Manager (2009)
- Amanda Haworth, HR Manager
- Cindy Johnson, Controller, Avalanche Bay
- Phil Jones, Resort Accommodations Manager (through 2008)
- Meagan Krzywosinski,HR Recruitment & Training
- Brian Main, Resort Sales Specialist & Marketing Manager
- Dave Newman, Boyne Mountain Area Manager
- Patrick Patoka, Avalanche Bay Director
- Casey Powers, Head Golf Professional
- Becky Quakenbush, Dept. Supervisor, Geschenk Laden Gift Shop
- Tom Reed, Tri-Turf Vendor
- Sarah Rocheleau, Boyne Design Group
- Mark Skop, Golf Course Superintendant

[1] "NSAA : National Ski Areas Association : The GREENROOM." NSAA : National Ski Areas Association : The Green Room. 31 Mar. 2009 <http://www.nsaa.org/nsaa/environment/the_greenroom/>.

Introduction to Recommendations

We began this project by conducting a literature review of best practices in the ski and golf industries, visiting three resorts that are at the forefront of incorporating environmental sustainability into their operations, and researching innovative sustainability projects at other resorts and environmentally sustainable corporations. This gave us ideas for *potential* projects four-season resorts can implement to improve their environmental impact. Then, the gap analysis in the previous chapter allowed us to identify those areas in which there was the biggest opportunity for improvement (i.e. the empty and quarter-full circles). We were then able to compile a list of possible projects that we felt would have a significant environmental impact, were most relevant to Boyne Mountain, and had the greatest chance of acceptance by the management.

For instance, Boyne Mountain has a very low tolerance for projects requiring large, upfront capital expenditures, and those with a payback period longer than 5 years. It was therefore impossible to make a case for projects like geothermal heating and cooling systems, or a wind turbine or large photovoltaic array installations. Similarly, while water conservation is an important ecological principle, from a business perspective it is relatively unimportant to Boyne. The water used for Boyne's heavily water-intensive activities (such as snow making and golf course irrigation) is sourced from wells and retention ponds, so there is no direct cost associated with it, and therefore no direct financial savings to be gained from its conservation. Our aim with this report is to make recommendations that are useful to Boyne, and that Boyne is likely to implement. As Boyne is unlikely to implement water conservation practices from which it will not reap any financial benefit, we did not include any such recommendations in this report.

After compiling our list of possible projects, we then met with the management and staff of Boyne Mountain to review our recommendations and solicit their feedback. At this point, we jettisoned a number of proposals, either because Boyne was already making improvements along the lines we had proposed, or because Boyne personnel felt the project was of a low priority or unlikely to be supported by Boyne USA.

What follows is a series of recommendations for projects that were inspired by best practices in the industry, but have been tailored to suit Boyne Mountain's particular needs and constraints. We feel that each project is not only reasonable and worthwhile, but beneficial to Boyne Mountain's bottom line. After all, for Boyne Mountain to survive and flourish, its practices must be economically, as well as environmentally, sustainable.

Chapter 3:
Energy Efficiency and Renewable Energy

Table of Contents

Abstract

This document describes energy efficiency and renewable energy projects that are feasible for Boyne Mountain. It begins with an overview of Boyne Mountain's energy use and recent state legislation that will require Boyne to systematically reduce their energy use. Five projects are described that can improve Boyne's energy efficiency: *Harmonic Filters, Night Skiing Lighting Upgrade, Pool Covers, Snowgun Upgrade* and *Energy Monitoring*. Two renewable energy projects, *Solar Pool Heating* and *Solar Golf Cart Charger*, are also proposed. We give background and examples for each project, make specific recommendations, and calculate NPV where appropriate.

Purpose & Scope

The purpose of this chapter is to provide Boyne Mountain management with a list of projects they can implement that will allow them to reduce their energy use.

Table 1: Ratio of present value of savings to upfront costs

Project	Upfront Costs	Annual Savings	Present value of savings	Ratio of PV savings to cost
Harmonic Filters				
Lifts	$35,063	$7,357	$91,682.79	2.61
Snowmaking Pumps	$30,172	$13,088	$163,108.51	5.41
Well Pumps	$4,032	$1,406	$17,528.08	4.35
Total Harmonic Filters	$69,267	$21,852	$272,319.38	3.93
Snow Guns	$122,640	$24,189	$301,445.76	2.46
Lighting: Switch to Metal Halide	$6,000	$112	$1,392.86	0.23
Lighting: full Retrofit	$54,000	$1,677	$20,892.97	0.39
Solar Pool Heater	$20,000	$8,998	$159,960	8.00
Thermal Pool Cover	$2,660	$7,870	$154,740	58.17

Mountain Energy Use

Kilowatt Hour Use

Because all mountain electricity use—lifts, snowmaking, pumps, lift shacks, and many residences—are all billed to one meter with monthly totals, electricity consumption per category can only be estimated from the horsepower of the motors and the hours of use.[i] Our estimates are in line with actual use figures from Consumers Power over the period of 2001 to 2007.

The lifts, snowmaking, and lighting account for the majority of energy use on the mountain:

- Lifts run seven days a week, generally from 9:00 am to 4:00 pm. Five of the lifts (Boyneland, Mountain Express, Victor, Kaisar Carpet, and the Tube Park) also run four nights a week.
- Snowmaking is done 24 hours a day when conditions permit. Boyne management estimates snowmaking runs 800 to 900 hours per season.
- Well pumps supply water for snowmaking to a reservoir at the top of the mountain
- Night skiing is offered in the evening four nights a week, lit by 180 light fixtures.

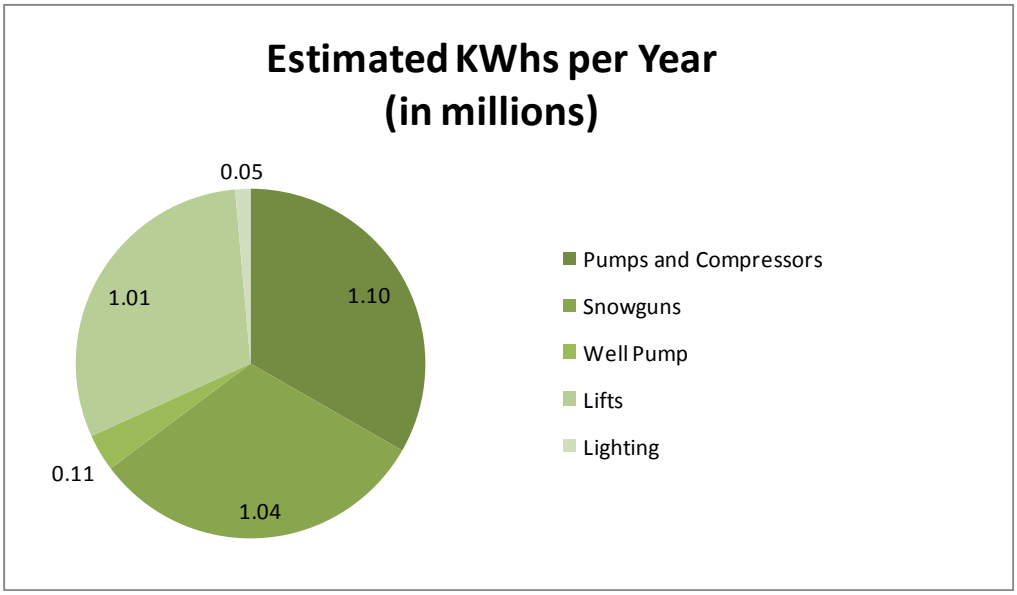


Figure 1: Estimated Mountain Operations Energy Usage

[i] A perfectly efficient motor would use 0.746 kW of electricity per horsepower. To estimate power use we use this 0.746kW/hp figure multiplied by the horsepower and the hours of use. This gives an under-estimate of power use, but we also assume all lifts are running every day all season, which slightly overestimates use. A monitoring system to track electricity usage real-time by source would be useful to calculate a baseline for power use and track improvements; this is discussed in the *Energy Monitoring* section.

Based on an average season, the lifts use around 1 million kWh of electricity, and the snowmaking pumps and guns use around 2.5 million kWh[1]. Together they use a total of 3 to 4 million kWh over the 4-month ski season (**Error! Reference source not found.**). Actual invoiced electricity used for Boyne Mountain over the period of 2001 to 2005 ranges from 2.5 million kWh to 4.4 million kWh per season, with an average of 3.7 million kWh.

Boyne management is well aware of the cost in electricity of making snow and running lifts. This is reflected in the development and upgrading of the snowmaking guns to "Low-e" guns, which use 30% less power, and 20% less water. Unnecessary use of the lifts in summer is avoided and necessary maintenance operations are timed to minimize monthly peak usage fees.

Peak Demand

Large electricity consumers like Boyne Mountain are charged a peak demand usage fee on top of their kilowatt-hour rates. Peak power use is not a measure of the number of kilowatt-hours used; it is the maximum amount of power demanded by Boyne Mountain for more than fifteen minutes. For electric utilities, peak demand determines the need for building new power plants or bringing less efficient plants on-line to supply their customers' demands. For example, assuming all other demand stays constant, the utility needs to provide extra power for the chairlifts during the day, but at night and during the summer this extra capacity sits idle. The peak demand usage fee compensates the utility for having to maintain greater capacity than is regularly needed. Peak power use during each month is billed separately as "*on peak bill capacity.*" Consumers Power of Michigan also charges a "*maximum demand charge capacity*" fee for the largest power usage per year, so peak power used during the ski season creates an additional monthly fee all year round.

Large consumers of power try to lower peak usage, a practice commonly called "peak shaving," to reduce the maximum metered demand fees for each billing cycle. This both lowers the overhead for the consumer, and reduces the pressure on the utility to build new plants. Especially now, in the early stage of large-scale renewable energy generation, utility companies are pressured by increasing demand to build additional power plants fueled by non-renewable resources. These plants require large capital investments in unsustainable technologies requiring decades for payback, making the transition to new renewable resource technology all the more difficult. In Michigan, coal plants provide 60% of our power.[2] Prior to building new plants, utilities usually power up less efficient backup facilities, which tend to be more polluting, to meet peak demand.

All the lifts running together draw a peak power of approximately 1,100 kilowatts. Snowmaking pumps and compressors (with 120 guns) draw about 1,500 kilowatts, for a combined total (when used concurrently, as they often are) of 2,600 kilowatts. The

motor sizes on snowmaking guns vary; typical power use by the snow guns is about 1,000 kilowatts.

Renewable Energy Credits and the Renewable Portfolio Standard

Public Act 295 (PA 295), a new Michigan law passed in October of 2008, known as the "Clean, Renewable, and Efficient Energy Act," requires utilities to provide a minimum amount of renewable energy capacity. This requirement is known as a Renewable Portfolio Standard (RPS). Michigan's RPS requires that utilities source 10% of their electricity from renewable sources by 2015, with interim steps in 2012, 2013, and 2014. Utilities can satisfy this requirement either by generating energy from renewable sources themselves (though large utilities are not permitted to own more than 50% of their renewable energy generating capacity[3]), or by purchasing Renewable Energy Credits (RECs).

A REC represents a megawatt-hour of renewable energy and is sold through brokers or on markets. The REC is not the electricity itself, it is just a certificate that represents the electricity generated, and is certified as such by companies such as Green-e. Market rates for RECs vary considerably, depending on the state regulations, availability of renewable energy, and demand. This type of requirement for utilities—a Renewable Energy Portfolio Standard (RPS)—has already been established in 28 other states besides Michigan (and five additional states have adopted non-binding procurement goals).[4]

In Michigan there is currently a market for voluntary RECs. The use of these RECs is not mandated by state regulations; they are sold to businesses and individuals who choose to voluntarily offset their carbon emissions. (For example, the optional "Green Currents" program offered by Detroit Edison allows customers to purchase renewable energy credits.) These RECs are certified according to different rules than the RECs associated with the RPS, frequently using Green-e or equivalent standards. Because these voluntary RECs are trying to promote new renewable energy development, the existing Boyne hydro dam is not eligible. However, because the RPS is designed to encourage a market for RECs from the generation of all types renewable energy, the requirements for RPS RECs are usually less stringent. The details are currently being worked out by the Michigan Public Service Commission, but may permit sale of RECs from the hydro dam.[5]

PA 295 also requires that electric utility providers implement energy efficiency plans for each customer class. Utilities will pass the cost of these efficiency plans on to consumers through a surcharge on their monthly bill. However, Boyne can avoid these additional charges by filing a "self-directed energy optimization" (EO) plan, as businesses with an annual peak demand in 2008 of 2 MW or above are eligible to opt out of the utility's program and implement their own self-directed program. The self-directed EO plan must indicate how they will meet or exceed the new state energy optimization standard for electricity.[6]

Businesses that choose to file their own EO plan must meet the following requirements:

> (a) Biennial incremental energy savings in 2008-2009 equivalent to 0.3% of total annual retail electricity sales in megawatt hours in 2007.
> (b) Annual incremental energy savings in 2010 equivalent to 0.5% of total annual retail electricity sales in megawatt hours in 2009.
> (c) Annual incremental energy savings in 2011 equivalent to 0.75% of total annual retail electricity sales in megawatt hours in 2010.
> (d) Annual incremental energy savings in 2012, 2013, 2014, and 2015 and, subject to section 97, each year thereafter equivalent to 1.0% of total annual retail electricity sales in megawatt hours in the preceding year.[7]

By implementing projects such as the ones listed in this chapter, Boyne should have no problem exceeding these requirements. In fact, we recommend Boyne commit to a goal of reducing their electricity use by a full 1% per year, beginning this year (2009).

Harmonic Filters

Large electric motors can produce harmonic distortion in the electrical system resulting in additional power use and higher operating temperatures. This distortion causes the motors to run less efficiently resulting in additional power use, higher operating temperatures, and shortened lifespan of motors and controls. Harmonic filters and other products that reduce the harmonic distortion can reduce energy consumption by up to 15% depending on the size of the motor and type of drive.[8] The electric motors for lifts and snowmaking compressors range from 20 hp for some of the smaller water pumps to 75 hp for some of the smaller lifts to 400 hp for the six person Mountain Express lift, and 350 hp for the large screw type air compressors. The addition of harmonic filters has the added value of decreased maintenance and extended motor life. However, while these advantages are generally accepted, they are difficult to quantify and are not included in our analysis.

Spotlight on: **Holy Cross Energy**

In 1990, Holy Cross Energy, the utility that supplies power for Aspen Skiing Corporation (ASC), installed harmonic filters on seven lifts on Snowmass Mountain. Holy Cross was motivated by other customers' complaints of poor power quality, caused by the large power draw from the lifts at Snowmass. ASC agreed to pay back the utility for the installation out of savings from improved efficiency of the lifts. Estimates based on utility bills showed a 5% savings. At the time, the installation cost was about $250,000. Improvements in harmonic filter technology have reduced the upfront cost of the filters and installation; we estimate the upfront cost for all Boyne Mountain lifts to be under $40,000.

Source: Greening Your Ski Area, A Pollution Prevention Handbook http://peakstoprairies.org/p2bande/skigreen/, Accessed 03/30/09

Recommendations

Over the last 20 years the installation cost of harmonic filters and power factor correction technology has decreased, and the accuracy of estimated energy savings from increased efficiency is well documented. The up front costs and long term benefits of installing harmonic filters differ for each motor and may not be cost effective on some motors. Motors over 100 hp tend to be more efficient, benefiting proportionately less from treatment, but because of the greater power use, may still generate significant benefit.

Table 2: Estimated Potential Energy Savings per Season

	Peak Usage (kW)	Estimated Peak Savings (kW)	Usage per Season (Million kWh)	Estimated Savings per Season (kWh)
Snowmaking pumps and compressors	1,785	109	1.35	82,679
Lifts	1,082	65	1.01	60,031
Well Pumps	134	13	0.11	11,414
Total	**3,001**	**187**	**2.47**	**154,124**

Current use and potential peak and kWh savings from harmonic filter installations on lifts, snowmaking pumps and compressors, and well pumps is shown above (Table 1**Error! Reference source not found.**) and discussed in detail below.

- *Lift motors:* 12 of the 14 lifts at Boyne Mountain use 250,000 kWh per month. Installation of harmonic filters on these 12 lifts would result in a savings of 15,000 kWh per month during the ski season, and a reduction in peak usage of 64kW. Two lifts, Carousel and Magic Carpet, are too small to be included in the project because the upfront costs far outweigh the benefits. The other lifts range from 15hp to 400hp, with most lifts in the 100hp to 150hp range. The lifts are running during Consumers Power peak hours (11:00 am to 7:00 pm) and account for about one third of ski season electricity use on the mountain main meter. The reduction of peak usage would lower the utility bill year round (see utility pricing Appendix A). However, the variable speed motors used by lifts require a higher upfront treatment cost and have a lower efficiency gain compared to fixed speed motors.
- *Snowmaking air compressors and water pumps:* One variable-speed and six fixed-speed compressors provide compressed air for the snow guns and use an estimated 590,000 kWh per season. The seven fixed speed water pumps supply water for the snow guns and use an estimated 761,000 kWh per season. Treatment of the compressors and water pumps would result in an estimated savings of approximately 83,000 kWh per season, and reduce peak usage by 109 kW.
- *Snowmaking well pumps:* To ensure an even supply of water to the snowmaking pumps, water is pumped from wells up to a 500,000-gallon reservoir at the top of the hill. The fixed speed well pumps are 20 hp to 40

hp motors and use an estimated 114,000 kWhs per season. Because of their small size and fixed drive, the well pumps benefit proportionately more from treatments resulting in a peak savings of 13 kW and total savings of approximately 11,000 kWhs per season.

Despite the substantial power consumed by the snow guns, the 10 and 15 hp motors on each gun are probably not good candidates for harmonic filters. Because of the small size of the motors, the payback time to recoup the initial cost of treatment would be significantly longer. Also, Boyne Mountain has a much larger inventory, 334 snow guns, than are used at any given time. Typically snowmaking involves about 120 snow guns. The larger inventory means snow guns don't have to be carted in between trails; many are dedicated to particular runs or areas. But the large inventory also means many guns are being used less than the average 850 hours per year, making the payback period even longer. 149 of the main guns are the 15 hp "Boyne Snowmaker" which are being converted to a 10 hp "Boyne Low E" gun, using less electricity and water.

A firm specializing in energy efficiency technologies, Energy Saving Solutions (ESS), has already prepared a proposal for installing harmonic filters at Avalanche Bay. After doing an inventory of the existing motors, ESS calculated the cost of harmonic filter installation, and the financial payback period based on projected savings at the current electric utility rate. For Avalanche Bay the after-tax payback period was projected to be 16.1 months. If the payback period is not met, ESS will pay the difference between the projected payback and the current savings amount. ESS has a significant track record of work with large and midsize energy users, and makes conservative projections based on their long experience.[ii] According to ESS representatives, the payback period is usually shorter than estimated.

Another option for Boyne Mountain may emerge with a new state program "Michigan saves" or "PAYS" which will requires utilities to come up with measures to save a small percentage of energy through efficiency measures.[9] PAYS would function like the Holy Cross / Snowmass partnership, financing the improvements. The utilities would finance the harmonic filter installation, backed by a local bank, and then be repaid out of the savings. PAYS is still being structured by Michigan public service commission, but may be another option.

The passage of Public Act 295 of 2008, the "Clean, Renewable, and Efficient Energy Act" will require filing a "*self-directed energy optimization*" (EO) plan, to indicate how Boyne Mountain will meet or exceed the new state energy optimization standard for electricity[10]. To comply with the EO requirements for yearly energy efficiency improvements, the harmonic filter treatments could be phased in yearly increments.

[ii] ESS is currently contracted to treat every GE factory in the U.S.

Improvements in harmonic filter technology have reduced the upfront cost of the filters and installation; we estimate the upfront cost for all Boyne Mountain lifts to be under $40,000. The upfront cost for snowmaking pumps, compressors and wells is estimated around $35,000.

Impacts

Using typical estimates of percent efficiency increases for each motor size and drive type,[11] we estimate harmonic filter installations could save approximately 60,000 kWh per season on lifts and 106,000 kWh per season from snowmaking pumps and compressors, with an additional 11,000 kWhs from the well pumps.

Table 3: Estimate of Yearly Dollar Savings from Harmonic Filter Installation

Component	Peak Reduc-tion (kW)	Yearly Reduction (kWh)	Yearly Savings From Monthly Peak Reduction	Yearly Savings from Reduced Maximum Demand Charge	Estimated Savings per Season (kWh)
Lifts	65	60,031	$2,834	$985	$3,538
Snowmaking	125	106,212	$5,478	$1,904	$5,706
Well Pumps	13	11,414	$589	$205	$613
Total	**203**	**177,657**	**$8,901**	**$3,094**	**$9,857**
				Total Yearly Savings	**$21,852**

The yearly savings on utility bills (Table 2**Error! Reference source not found.**) are calculated by adding the savings in on and off peak kilowatt hourly charges with the monthly peak "on peak bill capacity" and the yearly peak "maximum demand charge capacity". Monthly "on peak bill capacity" is $10.96 per kW, and "maximum demand charge capacity" is $1.27 per month based on the highest peak for the last 11 months. Kilowatt hourly rate for lifts is figured at peak rates ($0.0589/kWh). Because snowmaking can run 24 hours a day, kilowatt-hour rates for snowmaking and well pumps are figured at an average between peak and off peak, ($0.0537/kwh). Using energy saving percentage data from ESS for each motor size and drive type, we estimate peak demand savings from harmonic filters on lift motors to be 64kw and from snowmaking 110kw.

In Michigan, electricity generation produces 1.58 lbs / kWh of CO_2.[12] The estimated savings of 178 kWh would reduce the emissions of CO_2 by 280 tons per year. The savings at current utility rates would be $21,852 per year. Assuming no increase in electricity prices and a 5% interest rate, the NPV of the project is $367,705.

Next Steps

To begin the process, an on-site inventory of motors, drives, and hours of use must be conducted by an outside firm. The assessment forms the basis for a more precise prediction of installation costs and benefits. With the results of the assessment, Boyne Mountain management can choose the rate at which the project is phased, (e.g. doing all the treatment installations at once, or over a period of years). Energy Saving Solutions (ESS) already has a relationship with Avalanche Bay, we recommend contacting Jerry Johnson at ESS.

Snowgun Upgrade

Spotlight on: **Boyne Mountain**

Boyne was an early developer of snowmaking technology, and its main snow gun, The Boyne Snowmaker, was developed locally. Over the past several years they've upgraded 55 of these to a new "Low-e" gun, which uses a third less electricity and 20% less water.

During the winter, Boyne Mountain makes as much snow as possible, limited only by the weather and the compressed air and water capacity of the snow making system. Typically, usage for the system is about 115 snow guns running an average of 850 hours over the season. We estimate power usage by the snow guns alone of approximately 1 million kWhs of power per season. Boyne Mountain is in the process of converting the 15 hp *Boyne Snowmaker* to 10 hp *Boyne Low-e* snow guns. If 60 additional guns were converted and use of the *Boyne Snowmaker* was phased out, we estimate a savings 188,000 kWhs per season, a savings at current utility rates of $24,189 per year. Cost of the upgrades is $123,000, with a net present value of the project of $361,116. Effects of the conversion are complicated by two factors: first, not all guns are used all season, and guns are distributed around the resort, so benefits from an individual gun are likely to be lower, and second, the *Boyne Low-e* guns use less water, allowing more guns to be used (to make more snow) within the water and compressed air limits of the system. Although the use of these additional guns would lower the savings somewhat, there would still be significant savings of 95,000 kWhs.

Background

Snow is the crucial ingredient for skiing and snowboarding; it's the "product" that Boyne Mountain sells during the winter. Like many ski areas, Boyne uses snowmaking to bring an earlier opening day, extend its season into the spring, and to improve the quality of its customers' skiing or snowboarding experience. When conditions are good for making snow, Boyne Mountain runs about 115 snow guns.

Water is pumped from wells on Boyne Mountain's property to reservoirs near the top of the hill. From there, it runs to high powered pumps that feed the snow guns. The snow guns also require compressed air, which is produced from large air compressors. There are a variety of snow guns distributed around the resort. The majority (149 guns) are the *Boyne Snowmaker* model, developed for Boyne Mountain, which uses an additional

15 hp motor. These snow guns are being converted to the *Boyne Low-E* guns which use 20% less water and a 10 hp motor. Of the original 204 Boyne Snowmakers, 55 guns have already been converted to Low-E guns. A number of other guns are used, some requiring no additional motor, and some with smaller motors.

Recommendations

Boyne Mountain has already converted about 55 guns to the Low-E model. The continued upgrading of snow guns to Low-E guns will cut electricity usage by 30% and water usage by 20% per gun. Upgrading reduces energy use per gun but also allows more guns to be run on the existing pump system. In fact, electricity savings may be partially offset by increasing numbers of guns in operation. For example, switching from using 15 hp guns to 10 hp guns would create an energy savings of 33%; but because of the lower water use, up to 20% more guns could be used, making more snow more quickly, while reducing energy savings.

For this project, we propose a goal of upgrading 60 additional guns to allow most snowmaking to be done with Low-E guns. Each gun conversion kit costs $1,900 plus an estimated $148 in Boyne Mountain staff labor, and each upgraded gun saves an estimated 3,400 kWhs per season. Total cost of the upgrade of 60 additional guns is about $123,000.

Impacts

Running an average of 850 hours of snow making with 120 snow guns at a time, and assuming a mix of 40 Low-E guns, 60 Boyne Snowmakers, and 20 other non-powered goosenecks and duckbills[iii], snow guns currently use just over a million kWhs per season. Upgrading the 60 Boyne Snowmakers to Low-E guns (assuming no more Low-E guns are operated) would save 188,000 kWhs per season. This also assumes that all converted Low-E snow guns are used, and none of the remaining 89 Boyne Snowmakers are used. Since some of the snowmaking occurs during peak usage hours, these savings will have year round benefits.

If all 60 converted guns are used instead of Boyne Snowmakers, the savings would be $24,189 per year at current utility rates (**Error! Reference source not found.**). Assuming no increase in utility rates and a 5% discount rate, the NPV of the project is $361,116.

If additional Low-E guns are used to take advantage of the 20% water savings, we can estimate 75 Low-E guns running instead of 60. The total energy use is 571,000 kWhs with 60 Boyne Snowmaker guns versus 476,000 kWhs with 75 Low-E guns, a savings of 95,000 kWhs per season. However, if the water pumping and compressed air capacity is

[iii] Duckbills and Goosenecks are low output snow guns which only need compressed air and water.

expanded, even more guns could be run, increasing snowmaking capacity. This increased capacity would require more energy, defeating the energy saving benefits of upgrading to Low-E guns.

Table 4: Savings from Upgrading 60 Boyne Snowmakers to Low-E Snowmakers

Component	Peak Reduc-tion (kW)	Yearly Reduction (kWh)	Yearly Savings From Monthly Peak Reduction	Yearly Savings from Reduced Maximum Demand Charge	Estimated Savings per Season (kWh)
Upgrade 60 Snowguns to Low-e	222	188,328	$9,713	$3,377	$11,09
				Total Yearly Savings	**$24,189**

Next Steps

The continued upgrading to Low-E snowguns should be part of Boyne's sustainability planning and budget. However, we note that the energy savings from the Low-E guns may not be as cost effective as other proposed projects. In addition, there is a potential to increase overall energy consumption if a growing number of snow guns used at once creates a demand for additional water and compressed air pumps.

Night Skiing Lighting

The current lighting source for night skiing at Boyne Mountain is over 90% metal halide. While not as efficient as LED lighting, metal halide is presently the most efficient source for large scale outdoor lighting at a reasonable cost. Although the lights provide sufficient levels of light, the depth perception and glare could be improved. New studies demonstrate significantly lower lighting levels with carefully directed light result in a better night skiing experience. This approach to lighting also causes less light pollution and lower energy consumption. We recommend that Boyne Mountain convert any remaining incandescent lighting to metal halide, and explore a redesign of the lighting system based on directional reflectors and lower wattage bulbs.

Spotlight on: Wild Mountain, MN & Telluride, CO

Wild Mountain replaced old reflectors with directional units to reduce skyward light pollution and reduce lighting requirements by focusing the light where it's needed. Telluride replaced its night lighting for tubing with a low light system designed by Clanton & Associates.

Source: National Ski Areas Association "Green Room"

Options for Lighting

New technologies and increasing energy prices make a new lighting approach an attractive tool for management to reduce costs and energy usage. Boyne Mountain has taken advantage of new fluorescent and compact fluorescent lighting technology to upgrade most of its indoor facilities to higher efficiency lighting. The lighting source for night skiing at Boyne Mountain is over 90% metal halide, presently an efficient light source for outdoor lighting. The current cost and undesirable color of high-power light emitting diodes (LEDs) for large area sport lighting disqualify them as a realistic choice at this time. However, while metal halide bulbs are currently the best choice, we recommend pursuing two ways to improve the night skiing lighting system.

First, the remaining fifteen incandescent bulbs could be switched to metal halide. Second, the quality and delivery of light should be reconsidered. In addition to energy savings, the value of night skiing lighting improvements needs to include the quality of the skier's experience and safety, and the "light pollution" of lighting up the night sky. Boyne could become a leader in environmentally sensitive, efficient lighting, providing an exceptional night skiing and boarding experience. At present, the bright glow of Boyne Mountain in the night sky may suggest ski and snowboard fun continuing into the night, but as energy use and climate change concerns increase, it may appear as a wasteful use of electricity, and a disregard for the local community's enjoyment of the

night sky. Boyne's present system does provide substantial light; however, the quality of light could be greatly improved by a system redesign.[13]

Required light levels

Redesigning the lighting system could reduce energy use and light pollution as well as offering a better night skiing experience.

Nancy Clanton is an avid skier, and award winning lighting designer in Boulder, Colorado. Frustrated with night skiing lighting, her firm set up a test at Vail. She had seen people skiing comfortably under full moonlight, and had skied at night with bright but poorly directed lighting like the unpleasant flat lighting of a cloudy day. Using Vail ski patrol and ski instructors skiing at high speeds and a vision scientist, she set up a test of low light with high contrast skiing conditions. Intent on finding the optimum levels of lighting, she asked when the skiers felt the lighting was too low for them to feel safe. Remarkably, the skiers felt safe until the lighting was reduced below 0.3 lux.[iv,14] The vision scientist also agreed that there was plenty of light for safe skiing at that level. The lighting was designed to provide high contrast to indicate surface texture and bumps with natural shadows. The key is the use of fully asymmetrical luminaries, like the kind used in highway tunnel lighting, supplying light parallel to the hill, pointing downhill only. Clanton Associates recommends no higher than 1 lux levels on the snow, requiring about 5 lux of lighting from the sides; this is less than 20% of the current lighting level at Boyne Mountain. The test used 150 watt metal halide bulbs, compared to the 1000 watt used at Boyne.

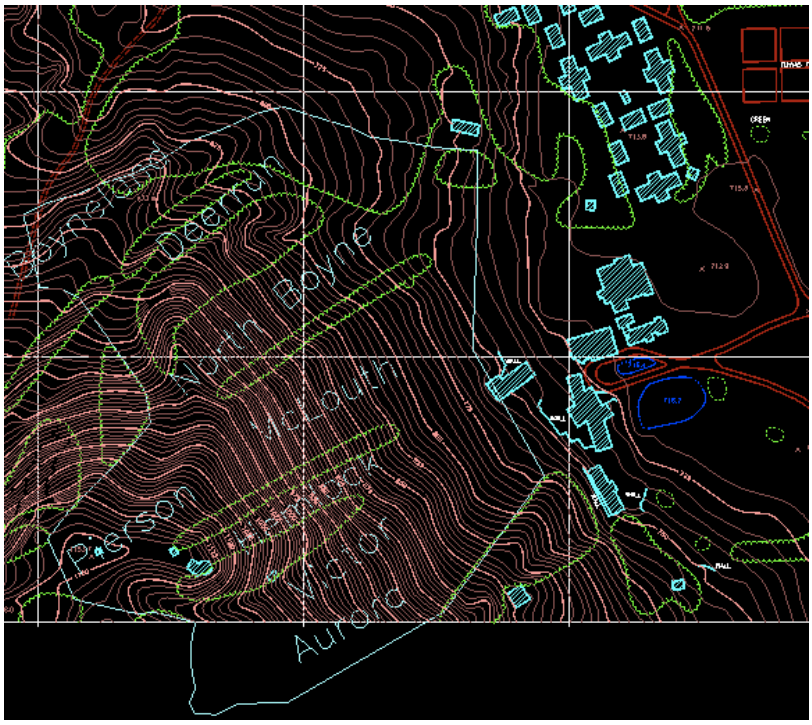


Figure 2: Night Skiing Area (Outlined in Blue)

[iv] Lumens are a measure of the intensity of light. A lux is a lumen per square meter.

Boyne night skiing is lit with about 165 fixtures of 1000-watt metal halide bulbs, and 15 fixtures with 1000-watt incandescent bulbs. A 1000-watt metal halide bulb produces an average 88,000 lumens, and the incandescent about 36,000 lumens.[15] Boyne illuminates about 270,000 m^2 of terrain at night (Figure 5**Error! Reference source not found.**). Assuming about 70% of the light ends up on the slopes (as 30% is lost to the sky and glare), the average light is about 35 lux. This is in the range of typical outdoor night light levels cited by lighting manufacturers as the traditional minimum levels for recreation.[16]

Recommendations

First, we recommend changing the remaining lower efficiency, incandescent bulbs to metal halide. This would result in a reduction of 2,300 kWh per season, and a savings of $112 per year in utility bill savings. Furthermore, because metal halide bulbs last about 6 times longer than incandescent bulbs they would save maintenance time with less frequent bulb replacement.

In addition, we recommend a comprehensive redesign of the system by an environmentally sensitive firm with experience in outdoor lighting. Of course, improving the lighting system will require more than turning off some lights or switching to lower wattage bulbs. Replacement of most luminaries (the fixture and reflector housing the bulb) with more directionally controlled beams would be required as well. The implementation will depend on a specific design for Boyne. Because the design will be tailored to Boyne's topography and existing structures, the cost estimation of this project is beyond the scope of this report. However, the project could be implemented in phases, perhaps beginning with just one or two secluded trails (e.g. Boyneland) as a test, and to fulfill state requirements for reductions in energy use.

The current lighting uses about 46,000 kWhs per season. A redesign able to lower that by half would result in a savings of 23,000 kWh's per season. The highly visible reduction in the amount of light pollution in the night sky would be another sign of Boyne's commitment to sustainability. And, as with the demonstration projects, skiers would take home the value of more environmentally sensitive night lighting, and an awareness of the enhanced functionality and beauty of less intense night lighting.

Next Steps

We recommend contacting a lighting firm familiar with environmentally sensitive lighting *and* the requirements for night skiing and boarding to discuss options for a redesign of the system. Clanton & Associates in Boulder, CO is a good example of a qualified firm with experience in these areas.

Solar Pool Heating

Solar pool heating is the most cost-effective use of solar energy, and therefore has a payback period that is substantially shorter than that for photovoltaic arrays (which produce electricity rather than hot water). They have very low annual operating costs, and typically last longer than gas and heat pump pool heaters.[17] Depending on the climate and length of the swimming season, solar collectors can provide a significant portion, or all, of a swimming pool's heating needs.

Installing solar pool heaters for each of Boyne's three swimming pools would dramatically reduce Boyne's use of natural gas during the summer. Through this reduction in gas use, the systems would pay for themselves in under three years.

Spotlight on: Fountaingrove Athletic Club

The Fountaingrove Athletic Club in Santa Rosa, CA installed 3,600 square feet of solar heat exchangers, which supply 90% to 100% of the pool's heating needs from May through September. This saves the business $25,000 a year on natural gas costs. The system is expected to pay for itself in three years.

Source: Alternative Power Solutions, Industrial Case Studies: Commercial Solar

How solar pool heaters work

Solar pool heaters work by circulating pool water through a solar collector on the roof of a building adjacent to the pool. The collector absorbs the sun's heat, and transfers it to the pool water. A filter removes debris before water is pumped through the collector, and a pump circulates the water through the filter and collector and back to the pool.

The size of the collector necessary to heat a pool depends on the size of the pool, the length of the swimming season, average regional temperatures, the desired pool temperature, the collector efficiency, the orientation and tilt of the collector, the site's solar resource, and whether or not the pool is kept covered when not in use. Depending on these variables, the collector should be sized between 50% to 100% of the pool's surface area. Generally speaking, the larger the collector, the longer the swimming season. In a climate like Florida's, where a pool could be heated year-round, solely by solar collectors, you would want the collector to be roughly equal to 100% of the surface area of the pool. In a climate like Michigan's, where solar collectors can only be used in warmer months (otherwise the water would freeze inside the collector), smaller collectors can be used, ranging from 50% of the pool's surface area for pools adjacent to south-facing roofs, and 75% for east-facing roofs.

Cost and Savings

Boyne has three outdoor swimming pools, the smallest of which has a surface area of 1,750 square feet, and the largest of which has one of 2,394 square feet. As all three pools are adjacent or attached to buildings with an east-facing roof, the size of the collector for each one should be about 75% of the size of the pool. The price of the collector, including installation costs, would be about $16,500 for the smallest pool (1,750 square feet), $17,000 for the middle-sized pool (1,820 square feet), and $20,000 for the largest one (2,394 square feet).[18]

The largest pool, located in the Mountain Grand Lodge, is half indoors and half outdoors, and is open year round. During the summer months, Boyne expends about 2,213 CCFs (each CCF represents 100 cubic feet) of natural gas per month to heat this particular pool. The cost of natural gas fluctuates wildly, so the cost of heating this pool during the summer has varied within the last six years from under $1,000 per month to about $3,500 per month. In order to estimate a payback period for a solar heating system for this pool, we must use an estimated future price of natural gas. The Energy Information Administration (EIA) predicts that the price for commercial users between 2010 and 2020 will average $10.69 per million Btu[19] (British thermal units), which is roughly equivalent to $1.07 per CCF (as the thermal value of a cubic foot of natural gas is approximately equal to 1,000 Btus). At this price, the cost of heating the Mountain Grand Lodge (MGL) pool during the summer months would equal about $2,368 per month (this number would obviously vary due to variations in ambient temperature and humidity levels, in addition to natural gas prices), or about $9,472 for the four months of June through September.

From June through September the solar pool heating system can be expected to provide between 90% and 100% of the necessary heat. In May and October it would provide about 50%. (After October it should be drained until the following May, to avoid the water freezing in the pipes.) In order to provide a conservative estimate of the payback period for this system, we will ignore the benefits accrued in May and October, and consider only the benefits accrued during June through September.

Each summer, Boyne Mountain would save about 95% of the energy they currently expend during the four months of June through September to heat the MGL pool. This would amount to about $8,998 per year. Using an interest rate of 5%, the Net Present Value (NPV) of the project is $159,960.[v] (This number represents the savings associated with installing a solar pool heater just for the MGL pool. The savings would be even greater if Boyne installed similar systems for the other two pools.)

[v] Using the standard interest rate of 10% would yield an NPV of $69,980—still a worthwhile project. However, given current market conditions, we felt that a 5% interest rate was more realistic.

Impact

There are 12.0593 pounds of CO_2 per CCF of natural gas. If Boyne saves 8,852 therms of natural gas per year (2,213 therms in each of the four summer months), they will avoid the release of 106,749 pounds of CO_2 into the atmosphere.

Next Steps

Boyne Mountain should install a solar pool heater for one of their pools this spring, and assess its impact and performance over the course of the summer. Assuming they are satisfied with the results, they should install systems for the two remaining pools the following summer. The money the save from reduced payments for natural gas this summer will help to pay for the up-front cost of installation for the systems installed next summer.

Thermal Pool Covers

Evaporation is by far the greatest source of heat loss from swimming pools. It takes only one Btu of energy to heat one pound of water one degree, but each pound of 80 degrees Fahrenheit water that evaporates takes with it 1,048 Btus of heat.[20] Preventing the water that has already been heated from evaporating is therefore even more important than improving the efficiency of the heating system.

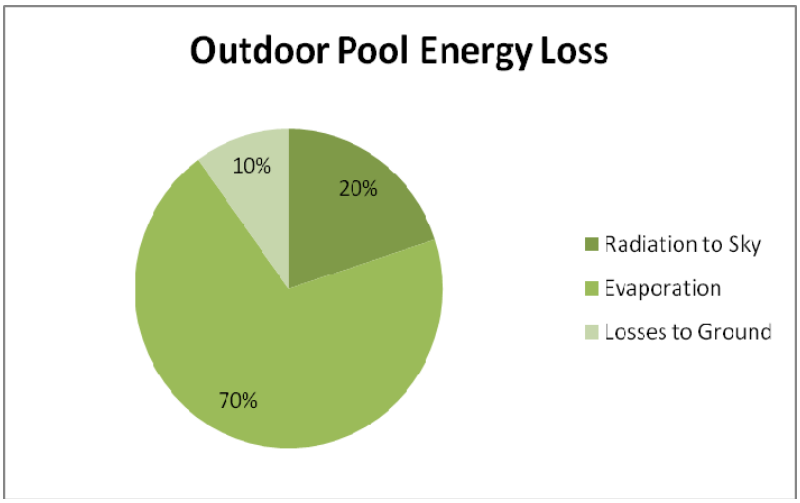


Figure 3: Outdoor Pool Energy Loss Characteristics. Source: U.S. Department of Energy.

The rate of evaporation depends upon the pool temperature, air temperature and humidity, and the wind speed at the pool's surface. A wind speed of seven miles per hour at the pool's surface can increase the pool's energy consumption rate by as much as 300%.[21] For this reason, installing wind breaks—such as bushes, trees, or fences—around the pool can be a good technique for reducing energy use (though care should be taken that the windbreak is high enough and close enough to the pool that it does not create turbulence over the pool, which would increase the evaporation rate). The most effective technique for reducing evaporation, however, is simply covering the pool when it is not in use.

Spotlight on: Boyne Mountain

Boyne Mountain currently covers two of their pools at night—the 1,820 square foot outdoor pool at the Clocktower building, and the 2,394 square foot indoor/outdoor pool at the Mountain Grand Lodge. Doing so saves them roughly $18,000 a year in heating costs.

See appendix for calculations

Recommendations

Using the U.S. Department of Energy's estimations of natural gas savings from pool cover use as a basis for comparison (see Appendix B), we estimate that covering the condo pool at night would save Boyne Mountain roughly 7,532 therms[vi] of natural gas per year (assuming the pool is used for five months a year, from May through September). Using the conversion factor of 1.024 therms per CCF, this is equal to 7,355 CCF. At the EIA's estimated cost of roughly $1.07 per CCF, the savings would equal $7,870 per year.

We found thermal pool covers online from a company called Recreonics for $1.52 per square foot. A 1,750 square foot cover would therefore cost $2,660. At this cost, the cover would pay for itself in under two months!

Impacts

There are 12.0593 pounds of CO_2 per CCF of natural gas. Saving 7,355 CCF of natural gas would avoid the release of 88,696 pounds of CO_2 into the atmosphere.

Next Steps

Boyne Mountain should purchase a thermal pool cover for the condo pool, and use it diligently every evening.

[vi] A therm of natural gas is roughly equal to 100 cubic feet. The conversion factor is 1.024 therms per CCF.

Solar Demonstration Golf Cart Charger

To demonstrate the use of photovoltaic cells to generate electricity directly from the sun, a simple solar panel demonstration system should be installed to charge golf carts. The system would be easy to install, without the need for a grid tie or additional batteries. The panels would be visible to golf course guests, who could physically experience riding in the solar-powered golf carts.

Why demonstration projects are important

The fact is, even if all our suggestions for improved sustainability were implemented, most ski resorts would still be far from a "sustainable" business in the strictest sense of the word. The required comprehensive change in our global sustainability can't be made just by small individual changes:

"*There's a colossal misperception that if you bike to work once a week and recycle your garbage, then global warming will be fixed up. The problem is that, even if everyone did that, the attempt to stop global warming would fail by a factor of, oh, roughly of 100, from what we really need to be doing.*"

Jerry Mahlman, Former director of the National Center for Atmospheric Research

Spotlight on: Aspen Ski Company

Aspen Highlands Patrol headquarters is powered by a relatively small 2.3 kilowatt PV array. This great photo has gotten tremendous press for ASC and drawn attention to PV panels as functional and "cool."

Source: Auden Schendler, Personal Communication, 5/20/2008.

It is essential that we develop the market for renewable energy technologies. This small demonstration project will have little impact on the overall energy use of the resort. However, it will inspire and inform guests by providing firsthand experience about the future potential of renewable energy. Guests at Boyne Mountain include many influential business and political leaders, who could potentially impact renewable energy decisions on a larger scale. A ride in a solar-powered golf cart could have a lasting impression.

How solar cells work

Enough of the sun's energy falls on the earth every minute to supply all of the world's energy needs for an entire year. One of the ways of harnessing that energy is by converting it to electricity using photovoltaic panels, also called solar cells.

Solar cells are made up of two layers of semiconducting material. When sunlight hits the solar cell (in the form of photons) it knocks electrons loose, which flow out of the cell through tiny wires, creating electricity. Individual solar cells are connected together to form panels or modules, which range in output from 10 to 300 watts. These in turn are connected together to form an array, which can be mounted at a fixed angle on a roof, or can be ground-mounted. Those that are ground-mounted are sometimes built with a tracking system, which allows the panels to move, capturing more of the sun's energy as it traverses the sky during the course of the day.[22]

For a demonstration-sized project that would be used to re-charge electric golf carts, a fixed-angle system would be used; but in order to maximize its visibility, rather than mounting the system on a roof, Boyne might want to create a solar "re-charging station." This could consist simply of a solar array mounted on 4 pillars, with room underneath to connect the golf cart, and a sign to educate visitors about the array and Boyne's efforts to reduce its use of fossil fuel-derived energy.

Cost

At present, the upfront cost of a photovoltaic system PV is too high relative to the current low price of grid-supplied electric power to make large-scale installations of PV financially viable in most parts of the U.S. without targeted subsidies and rebates. However, like the personal computer, growing demand will continue to drive manufacturing costs down over time, making PV more feasible. There has been a steady decrease in price per watt of PV over the last several decades; today, it costs less than one percent of what it cost in 1970![23] Manufacturers are hoping to achieve "grid parity" by 2012.[24] Grid parity is the point at which the lifetime cost of power from PV is the same as the cost from the power grid. In some areas, such as Hawaii, PV-generated power is already less expensive than grid power generated from fossil fuels.

Choice of golf carts for the demo system

Most of the cost of a large system is in the PV panels, but in a small demonstration system the grid tie, battery backup, and inverters would be a large proportion of the cost and time to install. To make this demonstration as easy and inexpensive as possible, we chose to power golf carts because they already have batteries operating at low DC voltages, and would not need a grid tie. Furthermore, they are highly visible and interactive, providing a direct connection to the guest. The only cost other than the panels is the installation and a small voltage regulator to charge the batteries at the appropriate rate. The entire system should cost under $8,000.

Boyne's golf carts each contain six 6-volt batteries. A full charge takes eight hours with a 16-amp charger. We consulted with solar system installer Mike Buday of Mechanical Energy Systems in Canton, MI, and he recommended an 875-watt system (five panels of 175 watts each). This would be large enough to fully charge at least one golf cart[vii] per day.

Given the low cost of electricity, it would take a very long time for this system to pay for itself purely on the basis of electricity cost. However, this is not the intent. The real benefit for Boyne is the impact the project would have on users of the resort; both in terms of positive marketing and public relations for Boyne, and in terms of educating customers and encouraging them to embrace renewable energy technologies.

Impacts

The impact of installing a demonstration-sized array would be greater than the simple displacement of grid-supplied (fossil fuel-sourced) electricity. As noted above, it would serve as an educational tool, encourage conversation about renewable energy, communicate Boyne Mountain's commitment to sustainability, and hopefully, spur guests to investigate installing their own solar systems, and urge policy makers to invest in renewable energy.

Next Steps

Boyne Mountain should install a small, south-facing solar array in the area where customers pick up their golf carts, creating a "Solar Charging Station." It should include a sign that explains how much electricity the array is generating, how much fossil fuel-generated electricity it is displacing, and the environmental implications of that displacement. It should also communicate the need for a general shift away from fossil

[vii] While a full charge requires eight hours, in practice Boyne generally uses each cart for just 18 holes each, rather than 36, and then recharges them, so that it only requires two to four hours. For this reason, they would probably be able to recharge 2 carts per day (since they are not being fully discharged).

fuel use in every aspect of our lives, and invite readers to learn more about Boyne Mountain's sustainability initiatives and goals.

Energy Monitoring

Energy monitoring systems allow management to track where and when energy is being used. Many large energy users, including ski resorts, have implemented such systems. Tracking energy use will enable better management of electricity use, supply baseline data for future improvements, and provide the opportunity to discover unnecessary electricity use. A starting system to monitor real time mountain use at the meter could be implemented for under $10,000. If pending legislation permits the sale of Renewable Energy Credits from electricity generated by the hydro-dam, an additional interface should be added to monitor the dam output.

Why Energy Information Systems are useful

Energy Information Systems (EIS) allow the monitoring of when, where, and how much energy is being used by a given facility. Like the real-time miles per gallon readouts on new hybrid cars that help drivers learn how to get better gas mileage by seeing current use, an EIS lets the facilities manager understand exactly how energy is being used. Like the car mileage readouts, an EIS helps managers learn how to "drive" their business without using as much electric power. Without monitoring, energy management is guesswork. According to Capehart et. al., "the philosophy 'if you can measure it, you can manage it' is critical to a sustainable energy management program."[25]

EIS's have been or are being implemented in most government buildings, and many manufacturing facilities and other businesses have demonstrated significant energy savings[26] from them. Until recently, the upfront cost of these systems was between $100,000 and $450,000 and therefore prohibitive for Boyne Mountain. However, the increased demand for energy monitoring has spurred the development of systems that cost only a fraction of this.

Installing real-time electricity monitoring systems throughout the resort will enable better management of electricity use, supplying baseline data for future improvements, and providing the opportunity to discover unnecessary electricity use.

Baseline and verification of efficiency improvements

The ability to track savings from specific technology changes or use changes will help management see return on investments in energy efficient products or changes in staff procedures. The current monthly usage bills for the entire mountain operations, Avalanche Bay, and Mountain Grand Lodge, make clear analysis of savings from specific efficiency strategies very difficult to quantify. Management has little incentive to spend additional money upfront for higher efficiency technology if only the costs are documented. Measuring baseline data and subsequent improvements from separate operations allows the benefits to be counted as well. These documented savings can then be reinvested in further technology improvements or used as bonuses to reward energy savings from staff operational changes.

Spotlight on: AreaNet

The Winter Park Ski area in Colorado designed and installed an energy monitoring and control system, dubbed "AreaNet," in 1997. The system is able to both monitor energy use and control use, for example, shutting off the power to heaters in the lift shacks when they are unnecessary. The system cost $100,000 to install, and has been gradually expanded, now including electric heat controls in buildings, motor rooms and lift shacks, sidewalk snowmelt, and some lighting controls. Winter Park estimates that AreaNet saves 5 million kWh's annually.

Hal Newberry, Base Operations Director, Winter Park Resort, personal communication, 6/04/08

Provide an opportunity to discover unnecessary energy use

EIS allows managers to discover where use is unnecessarily high, either from patterns of use or broken or inefficient equipment. While we can't predict what inefficiencies will be found, numerous studies demonstrate that users of EIS do discover significant ways to increase efficiency. For example, being able to monitor energy use 24 hours a day may illuminate unnecessary night energy usage. The University of California, Santa Barbara (UCSB) installed an EIS in 2001 focusing on buildings they suspected of high energy use. Immediately after installing the system, the facility manager noticed that nightly power consumption in the physics building was not reduced, despite the building being unoccupied at night. Further investigation revealed that the staff had long ago disabled the evening setback of the HVAC fan system to supply more fresh air at night. By compromising at a 50% fan speed they were able to save about $33,000 per year.[27]

Monitor hydro-dam power

Power generated by the hydro-dam could potentially be sold for RPS credits as soon as 2010, when Michigan begins enforcement of the new RPS legislation.[28] Any other renewable energy projects that Boyne Mountain undertakes should also be monitored for possible sale of RECs. Tracking the power output of the dam also generates a baseline for future improvements to the generator at the dam.

System components

Modern monitoring systems consist of 3 basic components:

Current transformer: A small, insulated coil of wire is installed on the main power wire, either at the breaker box supply (e.g. to monitor a building) or near the specific equipment to be monitored. As current flows through the supply wire, a small current is generated in the current transformer that is sent to the interface.

Interface: The interface converts the signal from the current transformer into digital information and calculates the actual power flowing in the wire. The reading is time stamped and is then sent to the computer. Older and more comprehensive systems use Programmable Logic Controllers (PLCs) to monitor dozens of inputs. A serial output can be directly connected to a server, or to a modem if distantly located from the computer network. New smaller systems use a simple, inexpensive interface with Ethernet or other outputs tied directly to a computer.

Computer with real time monitoring and data logging software: Older, more comprehensive systems also used a network server hub to connect to the interface(s). Newer systems just run the software continually on a personal computer. The software reports current use and energy power quality, as well as trends in use over time.

Recommendations

Power monitoring could be implemented in phases beginning with a simple real time monitoring of the mountain main meter. This will begin to baseline energy use, facilitate peak shaving, and possibly unearth unnecessary usage. A second interface to monitor power generation from the hydro dam will position Boyne Mountain to be able to sell kWhs as RECs. Other renewable energy projects, e.g. wind turbines and photovoltaic cells, should also be monitored for potential REC sales.

A second phase of power monitoring would include separate sensors for each area of energy use, lifts, snowmaking pumps, well pumps, etc. This level of monitoring could lead to further savings, such as detecting a well pump that cycles frequently, drawing unnecessary power.

An example initial system would consist of an interface like the Acuviem-II ($525), plus 3 phase current sensors, about $100 each (**Error! Reference source not found.**).[29] Once connected to the internet, data would be logged on a standard PC in another location, typically an office. This product comes with simple data logging software, though other software is available. Data can be exported to a spreadsheet for careful analysis.

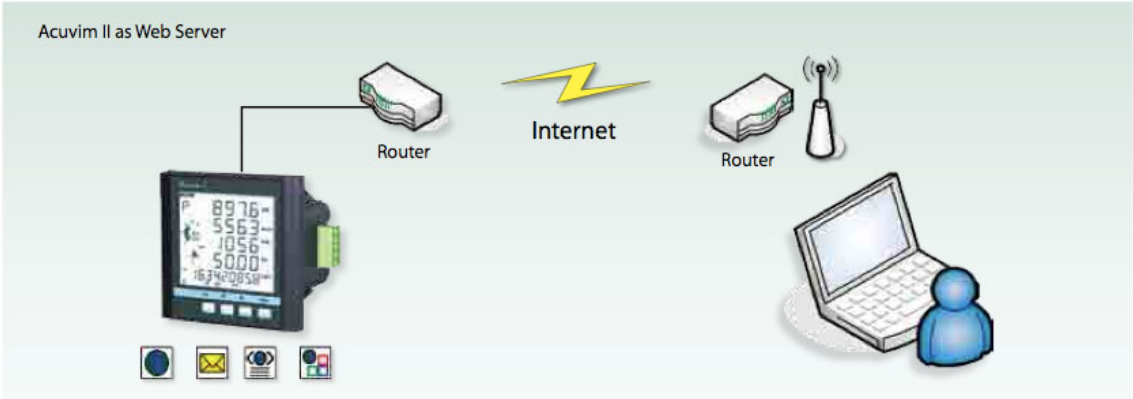


Figure 4: Example of interface, network, and PC connection in simple monitoring system. Source: Accuenergy Corporation.

Peak Shaving

By being able to monitor use real time, management can make more informed decisions that will lower monthly and yearly peak use fees. From years of operations, Boyne Mountain management has a good feel for the costs associated with snow making and lift usage. The EIS would allow them to fine tune decisions about lifts, snowmaking and water pumping to the reservoir, based on actual kilowatt usage.

Combined with the project to remotely control the dam, monitoring the real time peak would allow synchronizing maximum dam output with any short-term power requirements. For example, the need to run lifts in the summer for short periods creates a high on peak bill demand for the month from just a short period of lift use. Running the hydro dam at full capacity would lower that peak demand. During the winter, with lifts and snowmaking running, simply monitoring the mountain main meter in real time will make clear when the monthly peak is being approached, and should trigger full use of the hydro damn. As Boyne Mountain implements other sources of renewable energy, these too could be ramped up during peak usage.

Next Steps

The project should start small, with real time monitoring of the mountain main meter. Third party services may be required, or Boyne Mountain's electrician may be able to spearhead the project. The number of consultants and installers in this field is growing rapidly. Winter Park Resort has also offered to be a resource and has ten years of experience and energy savings from their system.

Addendum

Michigan has very good wind resources, particularly on top of ski slopes. We therefore analyzed the feasibility of installing a wind turbine on site, as Jiminy Peak resort in Massachusetts has done. However, there is a public airstrip on Boyne Mountain property, which prevents the installation of a wind turbine within a 4-mile radius.[30] In addition, the upfront costs associated with installing a large wind turbine are substantial (Jiminy Peak's installation cost $3.9 million, but was eligible for state grants and rebates that are not currently available in Michigan). As a small, family-owned resort, struggling to weather a deep recession, such large capital expenditures are simply unrealistic.

Appendix A: Consumers Energy Pricing Structure

IN AN EMERGENCY, CALL US 24 HOURS A DAY AT 1-800-805-0490.

If you have questions about your bill, call 1-800-607-5645; about our services or rates call 1-800-805-0490; or visit us on the Internet at www.consumersenergy.com. If you are calling about a past due or shut off notice, call 1-866-815-2062.

NAME BOYNE USA RESORTS
SERVICE ADDRESS 2754 BROWN RD
BOYNE FALLS MI 49713-0000

ACCOUNT NO. 10 00 00 2254 44
BILLING PERIOD 12/17/08-01/20/09
DAYS BILLED 35
DUE DATE 03/02/09

RATE: 1220 Elec Gen Pri Rate GPD Com
BILLING DEMAND: 2926.0
HISTORICAL MAX KW: 4020.0
RESERVED CAPACITY: 4150.0
CUSTOMER VOLTAGE LEVEL: 2
CURR MAX KW: 3076.0
POD: 0000003568337
POWER FACTOR: 0.86

METER NUMBER	LOCATION	BEGIN READ	END READ	READ TYPE	DIFF	METER CONSTANT	ENERGY USE	UNI
14546	2754 BROWN RD	518	879	ACT	361	2400	866400	KWH
						TOTAL METERED ENERGY USE	866400	KWH

RECORDED ACTUAL INTERVAL USAGE 867055 KWH
TOTAL RECORDED INTERVAL USAGE 867055 KWH

ACCOUNT STATUS

Last Month's Consumers Energy Account Balance	$120,915.45	
Payment Received	$0.00	
Account Balance Before Current Charges		$120,915.45

**Reminder - Previous Balance Due 03/02/09

Any payments applied after the billing date of Feb 05, 2009 are not included.

CURRENT BILL

RATE 1220 12-17 TO 12-31 BILLING FACTOR .428571				
Electric Delivery Charges				
Regulatory Asset Recovery	484330 KWH	@ 0.000900	$435.90	
RATE 1220 01-01 TO 01-20 BILLING FACTOR .571429				
Electric Delivery Charges				
Regulatory Asset Recovery	382725 KWH	@ 0.000800	$306.18	
RATE 1220 12-17 TO 01-20				
Electric Power Supply Charges				
On Peak Bill Demand Capacity	2926 KW	@ 10.960000	$32,068.96	
On Peak KWH Charge - Energy	195445 KWH	@ 0.030136	$5,889.93	
Off Peak KWH Charge - Energy	671610 KWH	@ 0.019712	$13,238.78	
Power Supply Cost Recovery	867055 KWH	@ 0.022730	$19,708.16	
Electric Delivery Charges				
System Access Charge			$400.00	
Max Demand Charge - Capacity	4020 KW	@ 1.270000	$5,105.40	
Elec Distribution Charge	867055 KWH	@ 0.003009	$2,608.97	
Security Recovery Factor	867055 KWH	@ 0.000200	$173.41	
Securitization Charge	867055 KWH	@ 0.001358	$1,177.46	
Securitization Tax Charge	867055 KWH	@ 0.000611	$529.77	
Total Electric				$81,642.92

In accordance with Michigan Public Service Commission Order U-14148 of 2005, the Regulatory Asset Recovery surcharge for Jan. 1-Dec. 31, 2009, is $0.0019 per kilowatt-hour. If annual peak demand is 15 kW or greater, the surcharge is $0.0008 per kWh.

SALES TAX $4,898.58

TOTAL CURRENT BILL DUE ON OR BEFORE 03/02/2009 $86,541.50

Your current bill has been prorated or has a rate/price change. If you have a question about your billing calculation, please call 1-800-972-7751.

TOTAL AMOUNT DUE $207,456.95

After the due date, a 2% late payment charge will be applied to the unpaid balance.

12-MONTH HISTORY

	Dec 08	Nov 08	Oct 08	Sep 08	Aug 08	Jul 08	
Elec-KWH	1158686	151971	156056	253336	295591	278007	
Max Demand	4020	708	484	599	657	645	
	Jun 08	May 08	Apr 08	Mar 08	Feb 08	Jan 08	TOTAL HISTOR
Elec-KWH	159552	106704	258132	438940	804330	783354	4844659 KWH
Max Demand	518	553	979	1509	3295	4147	

Consumers Power invoice notes:

- *On Peak Bill Demand Capacity:* The highest 15 minute peak use of electricity during the billing period (each month), measured from 11:00 AM until 7:00 PM.

- *Maximum Demand Charge – Capacity:* The highest 15 minute peak use of power over the last 11 months; can be on peak or off peak.
- *Power Factor:* If the power factor is above .90, the customer receives a credit of 2% of the demand charge. Below .80 the customer is billed an additional fee: (.80/power factor – 1) * Maximum Demand Charge. Between .80 and .90 there is no change in the bill.
- *On Peak kWh Charge:* Kilowatt-hours used during peak hours of 11:00 AM to 7:00 PM.
- *Off Peak kWh Charge:* Kilowatt-hours used after 7:00 PM, or before 11:00 AM

Appendix B: Pool Savings

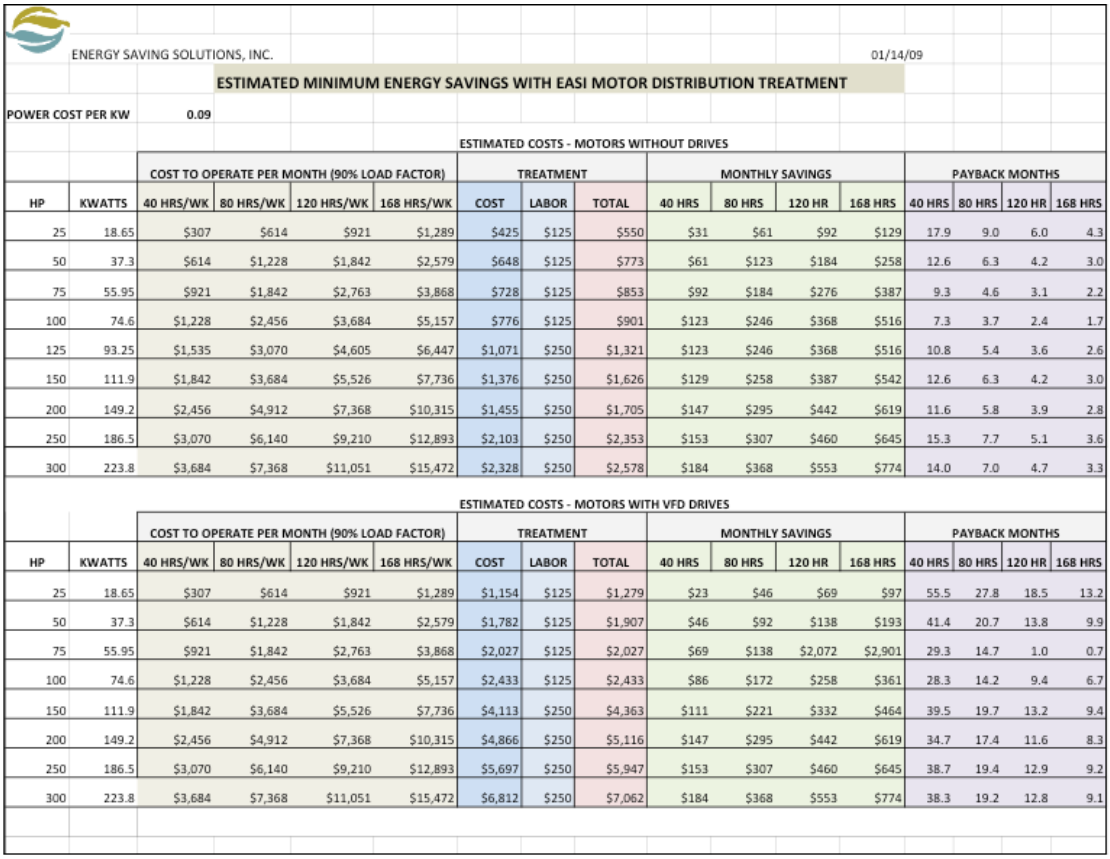
According to the U.S. Department of Energy, the use of a pool cover on a 1,000 square foot outdoor pool in Chicago that is heated to 82 degrees Fahrenheit by an 80% efficient natural gas heater and used May through September will save $2,152 a year, at $.50 a therm.[31] Dividing $2,152 by $.50 gives us an estimated savings of 4,304 therms of natural gas per 1,000 square feet of pool.

As the Clocktower pool is 1,820 square feet, we multiplied the estimated savings for a 1,000 square foot pool (4,304 therms) by 1.82, to get an annual savings of 7,833 therms. At $.50 a therm, this would equate to an annual savings of $3,916.50. However, since natural gas has historically cost closer to $1.00 per therm in Michigan, we multiplied this number ($3,916.50) by 2 to more accurately reflect the actual price of natural gas. This gives us a total annual savings of $7,833 for the Clocktower pool, at $1.00 per therm, from using a pool cover.

As the pool at the Mountain Grand Lodge is 2,394 square feet, we multiplied 4,304 therms by 2.394, which gives us an annual savings of 10,304 therms, or $10,304 at $1.00 per therm. The savings accrued from covering both pools is equal to the sum of these two totals: $7,833 + $10,304 = $18,137.

The condo pool is 1,750 square feet. Multiplying 4,304 by 1.75 gives us a savings of 7,532 therms. At $1.00 per therm, this would equal $7,532. To convert to CCF, divide 7,532 by the conversion factor 1.024, which yields about 7,355 CCF. At the EIA's estimated cost of roughly $1.07 per CCF, this equates to an annual savings of $7,870.

Appendix C: Motor Treatment Energy Savings



ENERGY SAVING SOLUTIONS, INC. 01/14/09

ESTIMATED MINIMUM ENERGY SAVINGS WITH EASI MOTOR DISTRIBUTION TREATMENT

POWER COST PER KW 0.09

ESTIMATED COSTS - MOTORS WITHOUT DRIVES

		COST TO OPERATE PER MONTH (90% LOAD FACTOR)				TREATMENT			MONTHLY SAVINGS				PAYBACK MONTHS			
HP	KWATTS	40 HRS/WK	80 HRS/WK	120 HRS/WK	168 HRS/WK	COST	LABOR	TOTAL	40 HRS	80 HRS	120 HR	168 HRS	40 HRS	80 HRS	120 HR	168 HRS
25	18.65	$307	$614	$921	$1,289	$425	$125	$550	$31	$61	$92	$129	17.9	9.0	6.0	4.3
50	37.3	$614	$1,228	$1,842	$2,579	$648	$125	$773	$61	$123	$184	$258	12.6	6.3	4.2	3.0
75	55.95	$921	$1,842	$2,763	$3,868	$728	$125	$853	$92	$184	$276	$387	9.3	4.6	3.1	2.2
100	74.6	$1,228	$2,456	$3,684	$5,157	$776	$125	$901	$123	$246	$368	$516	7.3	3.7	2.4	1.7
125	93.25	$1,535	$3,070	$4,605	$6,447	$1,071	$250	$1,321	$123	$246	$368	$516	10.8	5.4	3.6	2.6
150	111.9	$1,842	$3,684	$5,526	$7,736	$1,376	$250	$1,626	$129	$258	$387	$542	12.6	6.3	4.2	3.0
200	149.2	$2,456	$4,912	$7,368	$10,315	$1,455	$250	$1,705	$147	$295	$442	$619	11.6	5.8	3.9	2.8
250	186.5	$3,070	$6,140	$9,210	$12,893	$2,103	$250	$2,353	$153	$307	$460	$645	15.3	7.7	5.1	3.6
300	223.8	$3,684	$7,368	$11,051	$15,472	$2,328	$250	$2,578	$184	$368	$553	$774	14.0	7.0	4.7	3.3

ESTIMATED COSTS - MOTORS WITH VFD DRIVES

		COST TO OPERATE PER MONTH (90% LOAD FACTOR)				TREATMENT			MONTHLY SAVINGS				PAYBACK MONTHS			
HP	KWATTS	40 HRS/WK	80 HRS/WK	120 HRS/WK	168 HRS/WK	COST	LABOR	TOTAL	40 HRS	80 HRS	120 HR	168 HRS	40 HRS	80 HRS	120 HR	168 HRS
25	18.65	$307	$614	$921	$1,289	$1,154	$125	$1,279	$23	$46	$69	$97	55.5	27.8	18.5	13.2
50	37.3	$614	$1,228	$1,842	$2,579	$1,782	$125	$1,907	$46	$92	$138	$193	41.4	20.7	13.8	9.9
75	55.95	$921	$1,842	$2,763	$3,868	$2,027	$125	$2,027	$69	$138	$2,072	$2,901	29.3	14.7	1.0	0.7
100	74.6	$1,228	$2,456	$3,684	$5,157	$2,433	$125	$2,433	$86	$172	$258	$361	28.3	14.2	9.4	6.7
150	111.9	$1,842	$3,684	$5,526	$7,736	$4,113	$250	$4,363	$111	$221	$332	$464	39.5	19.7	13.2	9.4
200	149.2	$2,456	$4,912	$7,368	$10,315	$4,866	$250	$5,116	$147	$295	$442	$619	34.7	17.4	11.6	8.3
250	186.5	$3,070	$6,140	$9,210	$12,893	$5,697	$250	$5,947	$153	$307	$460	$645	38.7	19.4	12.9	9.2
300	223.8	$3,684	$7,368	$11,051	$15,472	$6,812	$250	$7,062	$184	$368	$553	$774	38.3	19.2	12.8	9.1

[1] Calculated from hours of snowmaking, lift usage, motor quantity and size supplied by Boyne Mountain.

[2] Scott DiSavino 12-Feb-09,Consumers Energy Delays Michigan Coal Power Project. http://planetark.org/enviro-news/item/51573

[3] Michigan Public Service Commission. Draft Summary 2008 Michigan Energy Legislation. By Tom Stanton and Julie Baldwin. 3 Mar. 2009 <www.dleg.state.mi.us/mpsc/electric/biomass/mpsc.pdf>.

[4] Renewable Portfolio Standards. 8 Jan. 2009. Pew Center on Global Climate Change. 27 Feb. 2009 <http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm>.

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Chapter 4:
Resort-Wide Recycling Program

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Abstract

This chapter details a resort-wide recycling program to be implemented at Boyne Mountain. It explains the environmental impacts of solid waste in landfills and the importance of minimizing the amount of waste generated by the resort. It then covers the logistics of starting and monitoring the recycling program and important steps that need to be taken during the creation of the program. This document also includes recommendations tailored to specific areas of Boyne Mountain. This information is to be used by Boyne Mountain to aid in crafting a comprehensive recycling program.

Spotlight on: **Keystone Resort**

Keystone Resort implemented a comprehensive recycling program that provided services to all employees and guests of its owned and managed properties. The company was able to divert 1,300 tons of solid waste (a 24.77% diversion rate) by recycling; that is the equivalent of 2.2 pounds per skier day. The program's success came from incorporating recycling into the resort culture.

Source: National Ski Areas Association "Green Room", http://www.nsaa.org/nsaa/environment/the_greenroom/index.asp?mode=greenroom&mode2=full&caseid=581&topic=T11, accessed 2/28/2009.

Purpose & Scope

The purpose of this document is to provide Boyne Mountain team members with an outline and feasibility analysis for a comprehensive recycling program. Reducing the resort's waste stream by way of a recycling program will help Boyne Mountain become a more sustainable resort. It will also greatly reduce the resort's ecological footprint while improving its triple bottom line of social, economic, and environmental benefits.

Environmental Impact of Landfills

Any ski resort that generates waste at a rate faster than it can be broken down by nature is not operating in a sustainable manner. Many landfills throughout the United States are at or near capacity, a result of increased waste generation per capita coupled with population growth. Americans produced 254 million tons of trash in 2007, the equivalent of 4.6 pounds per person per day.[1] Landfills are the final resting place for most of the products we use and are harmful to the environment in the following ways:

- *Greenhouse gas emissions:* Global methane emissions from landfills are estimated to be between 30 and 70 million tons per year.[2] When organic materials are compacted tightly in landfills they are left to decompose in anaerobic conditions. Methanogenesis takes place, emitting harmful methane gas as the organic material in landfills decomposes slowly, often for years after it is deposited. The fuels burned when transporting waste to landfills also emit large amounts of carbon dioxide.
- *Soil contamination:* When landfill materials begin to decompose, they often leach harmful chemicals into the surrounding soils. These chemicals can include battery acid, mercury and other heavy metals, antifreeze, and many other synthetic and carcinogenic substances. Soil contamination can spread beyond the landfill site when the protective bottom layer of a landfill becomes cracked or is otherwise unable to contain the landfill materials.
- *Groundwater contamination:* The same chemicals that contaminate the soils often make their way into groundwater as well. The diffusive properties of these contaminants can cause them to spread into ground and surface waters around the landfill. They can also jeopardize sources of potable water when they contaminate underground aquifers or groundwater in areas where people have wells for their drinking water.

Establishing a Baseline

A baseline set of metrics must be calculated to monitor the effectiveness of the resort-wide recycling program. The first order of business should include a waste stream analysis that can be conducted by Boyne Mountain waste management personnel. This analysis would consist of determining a representative sample of resort waste and sorting through it each day for a period of one to two weeks. Waste should be separated into categories and weighed each day to get an overall profile of waste composition (e.g. 30% paper products, 20% recyclable plastics, 10% glass, 10 lbs recycled). The information gathered in this exercise can be used to identify the major contributors to the waste stream and will help tailor the recycling program to focus on high-volume wastes.

The second metric to be determined is an estimate of the total amount of waste, on average, that is in the dumpster each time the waste management company empties it. This number doesn't have to be exact, but a fairly accurate estimate will make for easier accounting. This will allow the program monitor to simply multiply the amount of times the dumpster was emptied by the amount of waste per dumpster to determine the total amount of waste generated for any desired period of time. This establishes a pre-program baseline of total waste generated that can be used to track the success of the recycling program.

Once the total amount of waste generated is known, we must be able to collect information on how many visitors enjoyed Boyne Mountain in the same time period. Many ski-only operations will use the metric of waste generated per skier day. Since Boyne Mountain is a four-season resort, the appropriate metric is waste generated per visitor day. Visitors would include people coming to Boyne Mountain and enjoying any combination of resort activities. Having a baseline of waste generated per visitor day would allow Boyne Mountain to monitor the success of the program against this baseline.

Recycling Center Locations

There are a number of recycling drop-off stations in Charlevoix county, but the two most feasible locations for Boyne Mountain to drop off their recyclables are listed below:

- *Charlevoix County Road Commission:* located at 1251 Boyne Avenue in Boyne City, MI. This location is approximately five miles from Boyne Mountain and is open 24 hours per day, seven days per week
- *Boyne Valley Township:* located on Addis Road, west off of US 131. This location is approximately two miles from Boyne Mountain and is open Saturday from 8:00am-2:00pm year round, Wednesday from 2:00pm-7:00pm during the summer, and Wednesday from 2:00pm-dusk in the winter

Recyclable Materials

To create the most comprehensive recycling program, efforts need to be made to broaden the scope of the types of materials that can be accepted at the recycling center. Currently, the Charlevoix County Recycling Centers accept the following materials:

- *Newspapers, magazines, and catalogs*
- *Clear glass bottles and jars*
- *Tin and aluminum cans, foil and trays*
- *#1 and #2 plastic bottles, jugs and jars*
- *Corrugated cardboard and boxboard*
- *Office paper plus*
- *Colored glass*

While it is still important that Boyne Mountain design an effective recycling program for these materials, increasing the types of materials that are recyclable will enable Boyne to reduce its footprint even further. Also, leveraging for single-stream recycling would make it a lot easier for Boyne Mountain to implement the recycling program. In single-stream recycling, Boyne Mountain could have containers that accept all of the aforementioned recyclable materials, reducing their costs associated with sorting the recyclable materials stream.

Program Engineering

The resort-wide recycling program has a basic structure that is to be implemented across all sites on Boyne Mountain in general. It also takes into account the specific waste-reduction challenges of certain areas of the resort:

- *Ski Area*: Recycling or reusing ski lift and heavy equipment components
- *Golf Courses*: Recycling of on-course waste by Boyne Mountain personnel
- *Lodging*: Encourage guest recycling without compromising guest experience
- *Food & Beverage*: Facilitate cafeteria guests' participation in recycling
- *Back Office*: Engrain recycling in Boyne Mountain corporate culture

Container Design

The design of the recycling containers can have a great impact on use rates. After reviewing numerous container designs, the following attributes were determined to be most useful:

Shaped and colored lids
Shaped lids help guests and employees easily determine the appropriate receptacle for each type of material. Different colored lids further communicate that each container is separate and intended for a certain material.

Appropriate volume
Containers should be sized appropriately such that they are large enough to meet capacity demands, but small enough to make handling easy and minimize potential contamination losses.

Adequate signage
Signs on containers should be easy to read, simple, and effectively communicate the proper materials to include in each container. Graphics of newspapers or cans can help guests easily decipher what is appropriate for each container. Signs that highlight the environmental benefits of the recycling program are informative and encourage user compliance.

Container Location Considerations

The location of the containers can also greatly impact use rates. Placing containers in high traffic areas provide good visibility of the recycling program, but also have the highest risk of contamination. Containers located in areas only accessible to Boyne Mountain personnel have low visibility but the lowest risk of contamination. For containers to be most effective, they must be placed as close as possible to the areas where the waste is generated. They should also be right next to garbage cans so it is not inconvenient for guests to seek out recycling receptacles. The more effort that the recycling participants have to put into finding a recycling bin, the less effective the program will be.

Container Locations:

Cafeteria	4 containers
Avalanche Bay	2 containers
Mountain Grand Lodge Lobby	2 containers
Erickson's	1 container
Trophy Room	1 container
Snowflake	2 containers
Boyne Offices	2 containers
Golf Courses	4 containers
BoyneHof Lobby	1 container
Clocktower Lodge	1 container

Economic Feasibility

The table below is an estimate of the costs and benefits associated with Boyne Mountain's resort-wide recycling program.

Table 1: Recycling program economic analysis

COSTS	
Initial	$ 1,850
Annual	$ 1,000
Total	$ 21,850
BENEFITS	
Initial	$ -
Annual	$ 10,857
Total	$ 217,140
NPV	**$ 195,290**

The initial costs are comprised of the purchase of twenty recycling containers, five informative signs, and three large storage containers. An allocation of $1,000 per year was made to include labor costs of transporting the contents of the large storage containers to the recycling center. This number was based upon biweekly drop-offs during the ski season (December through April) and monthly drop-offs from May to November.

The annual benefits of the recycling program are due to reductions in the amount of times the dumpsters are emptied each year. It was assumed that both dumpsters on Boyne Mountain property were emptied weekly during the ski season (December through April) and monthly from May to November. It was assumed that the recycling program achieved a 25% reduction in the amount of waste generated, thus reducing the annual amount of dumpster pick-ups by 25%, or seven times per year.

The high net present value of this project, almost $200,000, warrants it as a very favorable project to implement. A discount rate of 5% was used for this analysis.

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Chapter 5:
Composting Program

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Abstract

This chapter outlines a resort-wide composting program that Boyne Mountain could implement in addition to its recycling program to further minimize its waste stream. It covers the environmental benefits of this program as well as the economic feasibility of implementing it. This chapter identifies the sources of input for the composting program and covers the science behind maintaining a composting operation. It also aims to recommend an efficient cycling of the raw materials from their generation to their end use. This is intended to be used by Boyne Mountain personnel as a guide to implement a composting program.

Spotlight on: **Blue Mountain, ON**

Blue Mountain resort established a composting program in 2003 including food wastes, fruits, vegetables, meats, bones, shell fish, poultry, dairy products, egg shells, coffee grounds, tea bags, paper napkins, hand towels and facial tissue. The program resulted in the composting of 50 tons of kitchen waste, and the resort has expanded its composting efforts in subsequent years.

Source: National Ski Areas Association "Green Room" http://www.nsaa.org/nsaa/environment/the_greenroom/index.asp?mode=greenroom&mode2=full&caseid=803&topic=T11, accessed 2/21/2009.

Purpose & Scope

The purpose of this document is to provide Boyne Mountain team members with an outline for and reference materials on a resort-wide, onsite composting program. Composting can drastically reduce the amount of waste generated by Boyne Mountain. In the process, three sources of solid waste are reduced and a valuable end product is created. The compost mix will include goose excrement as the nitrogen source, fall leaves and compostable paper product as the carbon source, and food scraps as the remainder of the organic material. The compost created should be used by the Boyne Mountain grounds crew as a fertilizer and soil amendment, helping the sandy soils in the area retain water.

The Science of Composting

If left alone in normal environmental conditions, all organic material will eventually decompose and turn into "compost", which is basically organic fertilizer. The goal in composting is to achieve an optimal set of conditions that enable timely and effective production of finished product.

- *Compost composition:* The ratio of carbon to nitrogen (C:N) inside a compost pile is very important. The bacteria and fungi that ultimately break down the organic materials operate most effectively under a small range of C:N ratios, so this balance must be considered but is easily achieved. The optimal C:N ratio is about 30:1 by weight, so achieving this balance is important when a compost pile is being created.[1] Insufficient nitrogen will slow down the composting process, but excess nitrogen will create ammonia gas that will make the compost emit an unpleasant odor.
- *Moisture:* The bacteria and fungi at work inside the compost pile can only use organic molecules if they are dissolved in water. A compost pile should retain a moisture content of 40-60% for timely compost creation.[1] A dry compost pile will have slowed microbial activity, causing the process to take much longer. A wet compost pile will create anaerobic conditions that again slow the decomposition process and cause the compost pile to emit an odor.
- *Oxygen:* Creating and maintaining an aerobic environment is very important for efficient and timely compost creation. Compostable materials with too much exposed surface area allow oxygen to enter the pile and speed the decomposition process. Most of the rapid decomposition takes place in the center of the compost pile, depleting it of oxygen. Replacing air throughout the pile is important and can be achieved through a combination of good composting bin design and timely turning of the compost pile.

- *Internal Temperature:* As the bacteria and fungi decompose the organic material, they create heat. A compost pile with an internal temperature between 90 and 140 degrees Fahrenheit is operating in an efficient range.[1]
- *External Temperature:* The temperatures required for efficient composting are difficult to maintain in the winter months. When cold air cools the compost pile, certain bacteria and fungi become dormant, while few others continue decomposition. This causes the composting process to slow down drastically over the course of the winter.

Materials to Use

An effective compost pile will be made up of a balance of nitrogen-rich and carbon-rich materials. The following are examples of materials that fit in each category:

- *Nitrogen Rich:* Green weeds, fruit trimmings, vegetable trimmings, goose manure, coffee grounds and filters, hair and fur
- *Carbon Rich:* Sawdust, straw, leaves, dry grass clippings, cardboard rolls, clean paper, shredded newspapers
- *Other Materials:* Dryer lint, vacuum cleaner lint, eggshells, fireplace ashes, tea bags, wool rags

Materials to Avoid

The following materials should not be included in the compost pile. They will emit odors that attract vermin or otherwise interfere with the composting process.[2]

- Black walnut tree leaves or twigs
- Coal or charcoal ash
- Dairy products
- Diseased or insect-ridden plants
- Fats, grease, lard, or oils
- Meat or fish bones or scraps
- Pet wastes
- Yard trimmings treated with chemical pesticides

Program Engineering

Three Bin Composting Structure

Although the exact structure will be built to the design specifications of Boyne Mountain personnel, the structure pictured below is representative of the scale of composting efforts needed.

Source: http://www.o2compost.com/images/Application_photos/Horses/Small_Bays/dePeyer.JPG

- *Bin 1:* Raw materials are combined to create the initial compost pile
- *Bin 2:* As the pile begins decomposing, it is moved to bin 2 (usually 6-8 weeks). This process also turns the pile, providing much needed oxygen to all decomposing surfaces.
- *Bin 3*: In 10-12 weeks when the pile is nearly decomposed, it is moved to bin 3, which operates as the storage bin for finished product. As compost is removed from Bin 3 for use, it is replaced by nearly-finished compost from bin 2. Bin 2 is then replaced by bin 1, resulting in an open bin that can accept more raw materials.

Program Logistics

Five collection containers will be located on Boyne Mountain property and will be used by staff and not guests. Acceptable wastes will be added to these containers both during food preparation and when bussing tables. Containers will be hard plastic or rubber and approximately 50 gallons in size. They should be emptied daily into the outdoor Bin 1 as part of the evening kitchen clean-up duties. Kitchen and wait staff will be given a quick tutorial on the importance of composting and on how to comply with the new program.

Implementation Challenges

To properly implement this program, Boyne Mountain personnel need to be aware of a few of the most common challenges of composting. It is very important that only the approved food waste materials get put into the compost pile. An occasional mistake will not jeopardize the composting program, but repeated inputs of improper materials will throw off the balance of the compost, causing it to grow unwanted bacteria, compost improperly, and emit odors that may attract vermin.

Benefits of Organic Compost

Organic compost is the finished product of the composting process. It can be used by Boyne Mountain to improve the grounds in the following ways:

- Suppresses plant diseases and pests
- Can reduce or even eliminate the need for chemical fertilizers
- Promotes higher yields in agricultural crops
- Amends contaminated, compacted, or marginal soils
- Removes grease, oils, solids, and heavy metals from stormwater runoff
- Destroys industrial volatile organic chemicals in contaminated air[3]

Economic Feasibility

The table below is an estimate of the costs and benefits associated with Boyne Mountain's composting program.

Table 1: Composting program economic analysis

COSTS		
Initial	$	2,761
Annual	$	660
Total	$	15,961
BENEFITS		
Initial	$	-
Annual	$	2,991
Total	$	59,820
NPV	**$**	**43,859**

The initial costs are comprised of the purchase of five collection bins and the construction of a covered three-bin composting structure. An allocation of $660 per year was made to include labor costs of transporting, layering, and mixing the compost at the various stages of decomposition. This allocation was made based upon monthly layering and mixing of compost from May through November.

The annual benefits of the composting program are due to an approximated 4% reduction in the waste stream. Additional annual benefits were gained from the production of 1,800 pounds of organic compost per year, valued at its retail price of $12 per 15 pound bag.

The impressive net present value of this program, almost $44,000 represents significant value and warrants the implementation of this program. A discount rate of 5% was used for this analysis.

[1] How to Compost.org. 23 Mar. 2009 <http://www.howtocompost.org>.
[2] "Basic Information | Composting | US EPA." U.S. Environmental Protection Agency. 23 Mar. 2009 <http://www.epa.gov/epawaste/conserve/rrr/composting/basic.htm#nottodo>.
[3] "Basic Information | Composting | US EPA." U.S. Environmental Protection Agency. 23 Mar. 2009 <http://www.epa.gov/epawaste/conserve/rrr/composting/basic.htm>.

Chapter 6:
Educational Gardens

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Abstract

This chapter discusses the importance of landscaping with native plants, ecosystem processes in the built environment, and how gardens can serve as a mechanism for environmental education. A conceptual design of the Mountain Grand Lodge area of Boyne Mountain identifies priority locations for educational gardens. These priority locations consist of 5 factors: high pedestrian traffic nodes on the main lodge area of the resort, visibility from outdoor seating areas and inside buildings, ample sunlight, suitable soil, and respecting the masterplan goals that Boyne Mountain has already accepted and maintained as a part of their current landscaping maintenance plan. With careful layout and maintenance, native plant gardens can provide a catalyst for education and conversation surrounding sustainability, provide beautiful, unique gardens to highlight certain important areas on the resort, increase biodiversity of wildlife (specifically for songbirds and butterflies), and provide educational outdoor play areas for children. The types of educational gardens appropriate for Boyne Mountain that are discussed in this chapter are: Children's Gardens, Butterfly Gardens, Songbird Gardens, and Stormwater Gardens.

***Spotlight on:* Keystone Resort**

Keystone's landscaping department has become dedicated to incorporating a majority of native plants into the resort's landscaping schemes. Using native plants has allowed them to minimize the amount of water used in irrigating their landscaped areas.

Source: NSAA's Green Room <www.nsaa.org>

Purpose & Scope

The purpose of this chapter is to provide Boyne Mountain team members with an understanding of the current state of landscaped areas and gardens on the Boyne Mountain property, and an understanding of the opportunity for using landscaping and gardening to increase guest and employee environmental education, while increasing the sustainability of Boyne Mountain through providing ecosystem services in the built environment.

Mountain Grand Lodge: View from West

Natural areas provide ecosystem services that we rely on for our existence on a global level. Allowing these ecosystem services to occur in the developed areas of Boyne provides benefits in the gardens and landscaped areas on the site, an opportunity for education of guests, and makes Boyne Mountain a more sustainable resort.

Ecosystem Services:

- Photosynthesis (Primary Productivity)
- Decomposition and Nutrient Cycling
- Nitrogen Fixation
- Pest Management
- Biodiversity
- Wildlife Habitat

Photosynthesis is the process by which plants get energy and materials for growth and reproduction from solar radiation, carbon dioxide, water, and mineral nutrients.[i] The byproduct is the release of oxygen into the atmosphere, which humans and other animals breathe. Plants also act to remove dust and particulate matter from the air. Areas of high photosynthesis therefore have increased air quality. **Primary productivity** of a plant community is the rate at which biomass is produced by plants.[ii] In other words, it is how productive the plants are (how efficient they are at photosynthesis), and is important because the more primary productivity an area has, the larger and more beautiful the plants are, the more food is available for herbivores, and the better the air quality.

Decomposition is the process by which organic matter is broken down into its inorganic components, which can then be used by other organisms as nutrients.[iii] Organisms that aid in decomposition are bacteria and fungi, as well as detritivores, organisms that eat

detritus. One of the most important nutrients for plants is nitrogen, which is relatively limited in the natural environment. Increasing the amount of available nitrogen can greatly increase the growth rate of many plants. Nitrogen is a main component of fertilizers. The problem with fertilizers is they are energy-intensive to make, they are expensive, and they are often applied in amounts that exceed what the plants can actually use. The excess nitrogen and phosphorus dissolves in rainwater and washes away into natural water systems causing eutrophication. **Eutrophication** is when there is an excess of nutrients in an aquatic system causing high amounts of primary production of aquatic plants, such as algae and phytoplankton.[iv] Aquatic environments can become oxygen limited, and when these organisms die, that is what happens. The aquatic microbes eat the large amounts of algae and phytoplankton, increasing their rates of respiration, using oxygen needed by other organisms. Depending on the amount of flow of the water, this lack of oxygen can cause large-scale death of many aquatic organisms.

The alternative to using inorganic fertilizers is to promote **Nitrogen Fixation** in the soil of the garden. Nitrogen fixation is the process by which atmospheric nitrogen is converted to a reduced form that is available to plants, essentially a plant nutrient.[v] Our atmosphere consists of 70% nitrogen, but it does not exist in a form that can be used by plants. Bacteria, such as Azotobacter and Rhizobium, and cyanobacteria fix nitrogen. Azotobacter is free living in the soil and accounts for only a small amount of fixation. Rhizobium, however, lives in a symbiotic relationship with certain plants and fixes a large amount of nitrogen. Legumes are plants that specifically have symbiotic relationships with nitrogen-fixing Rhizobium, and planting legumes in a garden can provide a constant, sustainable supply of nitrogen. Incorporating nitrogen fixing symbiotic plants can reduce the need for inorganic fertilizers by allowing the natural process of nitrogen fixation to occur directly in the garden bed. Allowing the ecosystem process of decomposition and nutrient cycling to occur in the landscaped areas can reduce the need for inorganic fertilizers, and reduce the risk of impacting natural aquatic systems negatively.

A third way to decrease the use of inorganic fertilizers is by using organic fertilizers instead. This can be achieved inexpensively by maintaining a compost pile on site. For a further discussion of the feasibility of compost generation on Boyne Mountain, see Chapter 5 of this document.

Although certain herbivores are important for biodiversity and maintaining ecosystem functions, there are other types that tend to exist in larger numbers and can become pests in the built environment. In the natural environment, these pests have natural enemies that keep their population numbers at bay. The ecosystem process of **pest management** can be brought into the built areas of Boyne by maintaining habitat for natural enemies close to or within the gardens. Pest population numbers can thus be kept low without the use of toxic pesticides.

Biodiversity is defined as the total number of species present in a defined area.[vi] Although Boyne has impressive biodiversity in its natural areas, the biodiversity of landscaped areas and gardens is very low. Although plant biodiversity is the only type of diversity that we have direct control over, the variety of plants used in the landscaping at Boyne can affect biodiversity at other trophic levels by providing more diverse food and habitat opportunities.

Native plants are plants that evolved in Michigan and have existed here for thousands of years. Native plants are preferable to non-native plants as sources of habitat because native wildlife has evolved to use these plants to a much greater extent than non-native plants that arrived in Michigan much more recently.

Benefits of Native Plants:

- Lower Water Needs
- Lower or No Fertilization Needs
- More suited for Northern Michigan Soils
- More Suited for Northern Michigan Climate including Drought, Native insects, and Disease
- Promotes Higher Trophic Biodiversity
- Habitat for Wildlife
- Lower Risk of Natural Areas Invasion
- Less Routine Maintenance

Plants native to Northern Michigan have evolved to be successful in the environmental conditions that Northern Michigan has to offer. This means that they require fewer additional resources in order for them to be successful. What this means for garden maintenance is less irrigation, fertilization, soil amendments, trimming, and mowing. Native plants are more resistant to drought, native insects, pests, fungi, disease, and damage from frosts. A higher diversity of native plants also results in a higher diversity of native herbivores, many of which are important for ecosystem services and plant reproduction and are beautiful and desirable for nature enthusiasts.

Non-native Plantings on West side of Avalanche Bay

Currently, Boyne Mountain is using some native plants in their landscaping and garden areas. However, there are more non-native plants being used than native plants. Of the non-native plants being used, Table 1 shows at least 8 of them are plants known to invade natural areas and out-compete native plants and reduce

biodiversity.

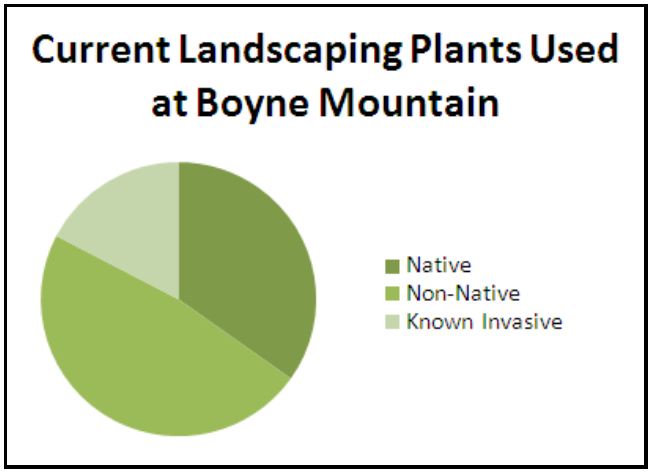


Figure 1: Current landscaping plants used at Boyne Mountain

Table 1: Invasive species used at Boyne Mountain

Botanical Name	Common Name	Nativity	Native to US	Invasive
Trees				
Acer platanoides 'Crimson King'	Crimson King Maple	Europe	N	Y
Picea abies	Norway Spruce	Eurasia	N	Y
Shrubs				
Berberis thunbergii 'Rose Glow'	Rose Glow Barberry	Japan & E Asia	N	Y
Euonymus alatus 'Compacta'	Dwarf Burning Bush	NE Asia & China	N	Y
Spiraea japonica 'Little Princess'	Little Princess Spiraea	Japan, Korea, & China	N	Y
Syringa vulgaris	Purple Lilac	SE Europe	N	Y
Vine				
Euonymus fortunei 'Emerald n Gold'	Climbing euonymus	Asia	N	Y
Grass				
Festuca ovina var glauca	Blue fescue	Europe	N	Y

These invasive plants can be replaced by native plants in the landscape without compromising any of the aesthetic benefits the invasive plants provided. Suggestions of native plant replacements for these invasives are provided in Table 2 below.

Table 2: Suggested alternatives for invasive species

Invasive Plant	Native Alternative	Aesthetic Benefits
Trees		
Acer platanoides 'Crimson King' Crimson King Maple	*Acer rubrum* Red Maple	Scarlet fall color, Bright red flower clusters on bare winter branches, red samaras ripen early
	Nyssa sylvatica Black Gum	Brilliant red fall color, small blue-black fruit, glossy oval leaves

	Acer macrophyllum Big-Leaf Maple	Smooth gray bark when young, hugr round lobed leaves, yellow fall color
Shrubs		
Berberis thunbergii 'Rose Glow' Rose Glow Barberry	*Fothergilla gardenii* Witch Alder	Fuzzy white flower clusters in early spring, oval scalloped leaves, orange to burgandy fall color
	Ceanothus americanus New Jersey Tea	Terminal white flower clusters in late spring/sumer, deep green foliage, yellow fall color
	Itea virginica Virginia Sweetspire	Fragrant white flower clusters, flaming fall color, green or red winter twigs
Euonymus alatus 'Compacta' Dwarf Burning Bush	*Aronia melanocarpa* Black Chokeberry	Domed clusters of white flowers in spring, clusters of black berries, brilliant red to burgundy fall color
	Vaccinium corymbosum Highbush Blueberry	Clusters of nodding white spring flowers, edible blueberries, brilliant red to burgundy fall color
	Rhus aromatica Fragrant Sumac	Small yellow flower clusters, red berry clusters, brilliant red fall color
Spiraea japonica 'Little Princess' Little Princess Spirea	*Spiraea betulifolia* Shiny-leaf Meadowsweet	White domed flower clusters in early summer, deep green leaves, yellow to orange and burgundy fall color
	Spiraea densiflora Mountain Spirea	Bright pink flower clusters in summer, yellow to orange fall color, dense twiggy winter form
Syringa vulgaris Purple Lilac	*Ceanothus thyrsiflorus* Wild Lilac	Clusters of fragrant blue flowers in spring and early summer, quilted evergreen leaves
	Chionanthus virginicus Fringetree	White frothy flowers in spring, bluish olive-like fruit in fall, yellow fall color
Vine		
Euonymus fortunei 'Emerald n Gold' Climbing Euonymus	*Arctostaphylos uva-ursi* Bearberry	Small elliptical evergreen leaves, waxy bell-shaped flowers, large red berries
	Decumaria barbara Climbing Hydrangea	Glossy elliptical semievergreen leaves, clusters of white flowers
	Vaccinium crassifolium Creeping Blueberry	Small elliptical evergreen leaves, waxy bell-shaped flowers, blue-black berries
Grass		
Festuca ovina var glauca Blue fescue	*Tridens flavus* Purpletop	Broad bright green blades, tall naked stem with open plume of purple flowers

Many herbivores of interest, especially butterflies, need host plants for their survival. **Host plants** are the plants butterflies feed on in their larval stage. While most adult butterflies are generalists, feeding from a wide range of nectar plants, most larval butterflies rely on a single species, or a group of closely related species, for food. By incorporating these host plants into the planting design, it increases the amount of habitat available to these species. **Wildlife habitat** is important because increasing the amount of wildlife in an area also increases biodiversity, and in order to have wildlife present, they need habitat and a food source available to them. For the gardens at

Boyne Mountain, we will focus on creating habitat for butterflies and songbirds as opportunities to increase wildlife biodiversity.

There are certain **Landscape Ecology** principles that are integral to understanding habitat creation and how successful it will be. Because wildlife migrate and move through the landscape to varying degrees, habitat gardens at Boyne Mountain will only be one stop in the entire matrix of habitat available to them. Understanding these variations in habitat cover and habitat value can allow Boyne to understand what habitat design would be most beneficial and useful for wildlife in Northern Michigan.

Landscape Ecology Principles:

- Matrix Theory
- Metapopulations and Source-Sink Theory
- Metacommunities
- Connectivity

Matrix Theory describes the landscape as a heterogeneous assemblage of variable abiotic and biotic conditions. Moisture, soil type, temperature, precipitation, aspect, slope, and other abiotic factors vary as you move across the landscape, as do the abundance of resources, enemies, pathogens, and other biotic factors. This heterogeneity can be described as 'patchiness', where each spatial area with similar conditions, or similar niches, is a 'patch'. Understanding how individuals, populations, and communities behave in a patchwork of variable habitats across the landscape is the essence of Matrix Theory. The patches are the pieces of viable habitat for a given species or group of species, and the matrix is the inhabitable space between the patches.

Metapopulations are groups of subpopulations that are defined by their rates of extinction and colonization. These subpopulations may occur in 5 out of 10 patches that hold suitable habitat for the species. The size of the subpopulation in each patch depends on the rate at which individuals enter the patch and leave the patch. This movement can be due to either birth and death, or dispersal. When a garden is built containing suitable wildlife habitat, it is essentially an unoccupied patch. Metapopulation theory says that the newly created garden patch will become colonized by wildlife depending on the rate of dispersal from an existing source subpopulation in an existing nearby patch. The concept that wildlife subpopulations will inhabit patches exhibiting varying degrees of habitat quality as long as a source subpopulation exists in a high quality patch within the vicinity is called **Source-Sink Theory**. Birds and butterflies disperse easily due to their gift of flight, and should populate a habitat garden in a short amount of time given that there is a source subpopulation in the vicinity.

Metacommunities are comprised of a set of local communities that are linked by dispersal. Like metapopulations, metacommunities exist in a heterogeneous matrix of

patches across the landscape and their presence in a given patch is dependent on dispersal from a source patch. Metacommunities are defined by groups of multiple potentially interacting species, rather than the groups of individuals of a single species that define metapopulations. When designing gardens for habitat, we are interested in supporting a community of wildlife rather than a single species, so metacommunity theory can help define the expected community in the garden given the communities of wildlife that exist in patches surrounding the garden.

The number of species expected to colonize a given patch is determined by dispersal constraints, environmental constraints, and internal dynamics.[vii] How many species and how many individuals of each species can get to the patch, whether there is quality habitat, abiotic conditions, and food sources for them to remain in the patch, and whether predators, competition, or parasites prevent them from remaining in the patch. The larger the patch size, the higher the colonization rates, and the higher biodiversity to expect in the patch at any given time. If the patch is isolated from other patches of habitat in the landscape matrix, then colonization rates will be much lower, as will the biodiversity. **Connectivity** between patches and dispersal corridors are extremely important to maintain high rates of colonization and high biodiversity in any given patch.

A habitat garden at Boyne Mountain will be colonized by the metacommunities surrounding the site at rates proportional to their distance and the size of the garden. Boyne can plant the perfect host plants, food sources, and provide the perfect habitat conditions, but if a source metacommunity does not exist in Charlevoix County, then biodiversity and wildlife presence will remain low. All of the species highlighted for habitat opportunities on Boyne Mountain are members of wildlife metacommunities in habitat patches in Charlevoix County, and have existing habitat patches within proximity to Boyne Mountain.

Through garden and landscape design, it is possible for Boyne to bring ecosystem services into their built environment, and decrease their intensive use of resources while maintaining the standard of beauty expected by their guests. Native plants used in gardening also provides an opportunity for guest and employee education about the benefits of native plants, how a large diversity of native plants can promote ecosystem services, and bringing sustainability and resource conservation into the goals of Boyne Mountain and their operations. In order for these benefits to be realized, however, the gardens and landscaping must first and foremost be beautiful. Aesthetics is the first thing noticed by guests, and is essential for gardens to gain the interest and support to act as an educational tool in a resort setting. Giving each garden a theme can help guide the design concept, the educational purpose, and the choice of plants. These themes can repeat, but there should be several varying themes that appear throughout Boyne.

Garden Themes Appropriate for Boyne Mountain:

- Children's Garden
- Butterfly Garden
- Song Bird Garden
- Stormwater Garden

The purpose and qualities of each of these garden themes are discussed at length in the following sections.

Children's Garden

Purpose

A children's garden is meant to provide a portal for children to experience the world around them. In the case of environmental education at Boyne Mountain, that means providing a safe location for children to experience the native northern Michigan environment.

- *Aesthetics:* A children's garden should be beautiful to gain interest and bring people into the garden. A garden without beauty defeats the first and foremost purpose of a garden… human enjoyment.
- *Education:* Children learn through all 5 senses, and a children's garden should engage each one in a unique way to facilitate the experiential learning in the garden. Using native plants can also allow for informal ecological education.
- *Exercise through play:* Giving children a place outdoors that they can call their own allows for spontaneous play and exercise. Being active outside has just as many health benefits for children as it does for adults, and they should have a space in which to play.

Design to the 5 Senses

Children experience their world and gain experiences through their 5 senses. A garden for children should be designed to stimulate all 5 senses simultaneously.

- *Sight:* The easiest way to gain visual interest from children is to provide bright colors throughout the season. Each color may illicit a different emotion from the visitor, and these colors should be chosen and used purposefully to promote different experiences in different parts of the garden.
- *Sound:* Plants sound different from each other when rustled by the wind, and attention should be paid to ensure a variety of sounds through the garden. Running water, birds, crickets, and other wildlife can also add to garden sounds.
- *Smell:* Certain plants have fragrances associated with them. Whether it is the flowers, twigs, bark, or leaves, a variety of smells should be available for children throughout all seasons.
- *Touch:* Different leaf textures, groundcovers, and tree bark can give very different experiences to the exploring child. A variety of textures should be available in the garden including large and small leaves, smooth and rough bark, very twiggy shrubs and relatively bare shrubs, soft grasses, hard pavers, and

prickly evergreen groundcovers, as well as special textural features of plants such as fuzzy leaves.

- *Taste:* Much like smell, certain plants have an associated taste. It is imperative that no poisonous plants exist in a children's garden, as even plants without an enjoyable flavor will inevitably be munched on by a curious tot. Edible plants can be an exciting discovery in a garden, where tasting is primarily an adult-free activity.

Forms

The forms used in the design of the garden may have different impacts on the experience of the visitors, and may be more or less accessible to children.

- *Round, Organic shapes:* Round shapes lend themselves well to a naturalistic garden, and exist in contrast to the city grid and geometric buildings that fill most children's everyday experiences. Using round shapes can provide a sense of fantasy space separate from the ordered world of the grown up.
- *Exaggerated Movement and Color:* Large movements of form and color can engage the child who may not notice more subtle forms. For example, large circles can be the basis for games such as ring around the rosey or tag, while large arcs can create different "rooms" for imaginative play. Bright contrasting colors also provide visual stimulation to babies as well as older children.
- *Height Appropriate Plantings:* Children are shorter than adults, and spend a lot more time with their focus toward the ground than adults do. It is important to keep this in mind when designing a children's garden, and remember that their vantage point is lower than ours, while maintaining necessary groundcover and shade trees.
- *Hardscape and Naturalistic Play Features:* Hardscape can provide a difference in texture on the ground. This change in materiality can suggest a change in space providing "safe" zones for tag, danger "shark" or "lava" areas, or places to sit and play without getting itchy grass on their skin. Play features can also be designed that are not traditional play structures. Examples include tunnels, oversized bird nests, benches, and swings.

Play

Children play. The outdoors and gardens therein can be designed to provide a set for a variety of common children's games. The gardens play as important a role as the games do in providing developmental stimuli for children. These common games should be taken into account in the design of a children's garden.

- *Digging:* Sand boxes, bare soil, and open gravel areas allow opportunities for children to "dig to china", make sand-castles, or create any number of miniature landscapes for their toys. Dirt can also be permanently formed into small mounds and valleys to give variety to the ground plane of the garden.
- *Climbing:* Children love climbing. Trees are a perfect opportunity for this, resulting in kids-only spaces above the earth. Low branches allow children to safely reach into the tree without reaching dangerous heights from which they could fall.
- *Swinging:* Conventional swings, tire swings, or simple rope swings are a classic favorite for the active child. Experiencing the garden at a different speed and height is the closest children can get to experiencing the flight of a songbird or a butterfly.
- *Hiding:* Refuges in bushes and trees, corners blocked by tall decorative grasses, and built structures such as arbors make for amazing forts, secret spaces, and games of hide-and-seek. These structures can be made out of natural materials to fit in with the environmental education goals of the garden.
- *Imaginative Play:* Playing make-believe can occur anywhere, but props and natural structures present in a garden catalyzes a unique definition of space. Props can include fruits from trees, sticks, or flower crowns. Natural structures can be hiding places, logs lain along the ground, or boulders for climbing and sitting.
- *Collecting:* Children love to collect and find special items. In a garden setting, these items can range from pinecones, stones, sticks, fallen leaves, and fruit from trees. These items can be used as props in imaginative play, or used for soups and potions.
- *Running:* Although plants, structures, and natural elements are important for a children's garden, so is room to move. A lawn-type space is indispensable when it comes to games of red rover, duck duck goose, or catch. The traditional open lawn-type space should not be forgotten when designing space for children.
- *Water:* Children, as well as adults, are fascinated by water. Whether it is a meandering mountain brook or a small birdbath, the presence of water, its sound, and the coolness of its feel are a great asset to any garden both for the human visitors, and their wildlife counterparts.
- *Creatures:* Habitats incorporated into gardens provide opportunity for discovery of natural wildlife, and can teach children to care for the other living beings with whom they share the earth.
- *Nurture:* Children who have the opportunity to care for a garden, pull weeds, or plant seeds, learn to care for something beautiful. Even a couple hours of care can have a great impact on their appreciation for the natural world around them,

and these activities can be incorporated into the summer children's programs on the resort.

Plant Characteristics to Avoid

Plants chosen for a children's garden have certain restrictions that must be respected in order to maintain the safety of the children as well as the safety of the garden.

- *Thorns:* Certain plants have thorns, prickles, or other sharp parts that can cause puncture wounds on curious children.
- *Dangerous Heights:* Although climbing can be an asset to a garden, branches that are reachable by children but too high for safety should be avoided.
- *Toxic Plants:* Plants chosen should be screened to ensure they pose no danger if ingested by the exploring infant or toddler.
- *Fragile Plants:* Children can be very rough on foliage. Plants that cannot handle being stepped on, pulled at, climbed on, or pieces broken off should not find a home in a children's garden.
- *Creatures:* Poisonous creatures such as snakes and frogs should not be afforded suitable habitat in a children's garden. Children should be taught to respect bees and other stinging pollinators as an important, but possibly painful, member of the garden.

Suggested Children's Garden Plant Profiles

Table 3

Botanical Name	Common Name	Function	Traits
Trees			
Abies balsamea	Balsam Fir	Props, collecting, wildlife, color, fragrance	Aromatic needles, soft, cones, songbirds eat seed, deer browse foliage, evergreen, attracts birds and butterflies
Acer rubrum	Red Maple	Climbing, color, texture, wildlife, collecting, props	Red flowers, fruit, leafstalks, and fall color, smooth silvery gray bark, shade tree, preferred species for browsing deer, attracts birds, Larval host for the Rosy Maple Moth
Acer saccharum	Sugar Maple	Climbing, wildlife, collecting, props, color	Red, yellow, orange fall color, attracts birds, sap made into maple syrup
Betula alleghaniensis	Yellow Birch	Fragrance, wildlife, texture	Branches and bark peel in thin, papery shreds, twigs and foliage smell of wintergreen, attracts birds
Carya illinoinensis	Pecan	Wildlife, color, edible, collecting, props	Edible nut, husks persistent on tree into winter, good shade tree, fall color, nuts eaten by birds, substrate for insectivorous birds, attracts butterflies, larval host of Gray Hairstreak Butterfly

Celtis occidentalis	Common Hackberry	Climbing, wildlife, texture, collecting	Older bark covered with conspicuous corky projections, rough leaves, dark purple berries arranged in clusters relished by birds, edible, attracts birds and butterflies, larval host plant for Tawny Emperor, American Snout, Question Mark, Mourning Cloak, Food source for Wild Cherry Sphinx moth
Cercis canadensis	Redbud	Fragrance, collecting, props, texture, color, edible, wildlife	Showy pink flowers in early spring March-may before leaves, flowers edible in salad or fried, Legume available for collection or play and is also edible, fragrant flowers, attracts birds
Chionanthus virginicus	Fringe Tree	Fragrance, texture, collecting, wildlife, hiding	White bloom april-may, soft stringy flowers, Sweet fragrant flower, bluish black berries browsed by wildlife especially birds, host plant for Rustic Sphinx moth
Cladrastis lutea	Yellowwood	Climbing, color	Showy pendent foot-long spikes of cream flowers only flower 2-3 times a decade, orange or yellow fall color, bark smooth and beech-like
Cornus florida	Flowering Dogwood	Props, color, collecting, texture, fragrance	Bird attracter, flowers BLOOM TIME, fruit Aug-Oct, alligator texture bark, leaves contain latex
Fagus grandifolia	American Beech	Climbing, texture, collecting, wildlife	Smooth, light gray bark, beechnuts edible and eaten by wildlife, attractive shade tree, attracts birds and butterflies, host plant of the Early Hairstreak
Hamamelis viginiana	Witch Hazel	Fragrance, Color, Props, Collection, Wildlife	Yellow strap-like flowers Sept-Dec, aromatic flowers, twigs, and leaves, fruit eaten by birds, medicinal uses
Juniperus flaccida	Weeping Juniper	Hiding, fragrance, collecting, props	Weeping form wonderful for hide and seek, fleshy cones good for collecting and props, scale like foliage, aromatic
Juniperus virginiana	Eastern Red Cedar	Fragrance, texture, color	Evergreen, aromatic tree, textured silvery soft bark, scale-like foliage coarse, pale blue fruits on female plants eaten by many kinds of wildlife including the Cedar waxwing, provides nesting material and cover, larval host of the Olive Butterfly
Magnolia acuminata	Cucumbertree	Wildlife, Edible, Texture, Collecting, Props	Cucumber-shaped fruit turns bright red in fall, fall color, fruits attract birds, fuzzy flower buds edible, flowers edible
Picea glauca	Whte Spruce	Wildlife, props, collecting, fragrant, texture, color	Wildlife use twigs, leaves, and seeds for food, nesting sites for birds, fragrant needles, attracts birds and butterflies, Host plant for the Columbia Silkmoth
Pinus strobus	Eastern White Pine	Wildlife, fragrance, texture, collecting	Long soft needles, pine fragrance, long soft cones, evergreen, attracts birds
Platanus occidentalis	Eastern Sycamore	Climbing, collecting, props, wildlife	Bark sloughs off in scales leaving smooth, whitish inner bark visible, huge leaves, globular fruits persist through december, fuzzy on the inside, shade tree, attracts birds
Quercus alba	White Oak	Climbing, prop, collecting	Acorns can be used as props, bark light gray, dried leaves persistent through winter, fall color, acorns eaten by birds, attracts birds and butterflies, larval host to Edwards Hairstreak

Taxodium distichum	Bald Cypress	Props, collecting, wildlife	Copper fall color, deciduous, nesting site, substrate for insectivorous birds, seeds eaten by granivorous birds, interesting foliage, larval host for Baldcypress Sphinx moth
Thuja occidentalis	Northern White Cedar	Fragrance, collecting, texture, color, wildlife	Evergreen aromatic repilian textured leaves, small roundish cone, provides food and cover for birds, edible, leaves contain vitamin C
Tsuga canadensis	Eastern Hemlock	Wildlife, props, collecting, fragrant, texture, color	Short-needled branches, small oval cones, attracts birds and butterflies, fragrant foliage, larval host to the columbia silkmoth
Shrubs			
Calycanthus floridus	Sweet shrub	Fragrance, color	Aromatic leathery leaves, dark red fragrane flowers with strap like petals april-july
Clethra alnifolia	Summer Sweet	Wildlife, fragrant	Spicy sweet fragrant white flower spikes July-Aug and fragrant leaves, yellow to orange fall color, dry fruiting capsules persistent through winter, attracts birds and butterflies
Cornus stolonifera	Red-osier Dogwood	Wildiife, color, fragrance	Red twigs add winter interest, white showy flowers May-June
Fothergilla gardenii	Dwarf Fothergilla	Honey fragrant flower, wildlife	White bloom april-may, soft puffy flowers
Fothergilla major	Large Fothergilla	Honey fragrant flower	White bloom april-may, soft puffy flowers
Hibiscus laevis	Scarlet Rose Mallow	Props, color, wildlife	large cup-shaped white and pink blossoms May-November, attracts butterflies, flowers and capsules can be used as props
Juniperus horizontalis	Creeping juniper	Fragrance, texture, collecting, wildlife	Evergreen, fragrant leaves like cedar, blue glaucus berries persistent through winter eaten by birds
Lindera benzoin	Spicebush	Fragrance, Collecting, Wildlife, Edible, Color	Fragrant spicy flower, crushed leaf, fruit, and twigs, pale yellow flowers before leaves in april, glossy red fruit in late summer-fall, yellow fall color, edible leaves, twigs, and fruit, attracts birds and butterflies, larval host for Eastern Tiger Swallowtail and Spicebush Swallowtail and a nectar source for Promethea Silkmoth
Magnolia virginiana	Sweetbay	Fragrance, collecting, wildlife, props	Fragrant lemon flowers April-July, leathery leaf texture, host plant for Sweetbay Silkmoth, fuzzy buds, seed follicle can be prop
Myrica gale	Sweetgale	Wildlife, fragrance, texture	Long leaves sweet scented, attracts birds
Myrica pensylvanica	Northern Bayberry	Props, collecting	Waxy grayish-white bery
Photinia melanocarpa	Black Chokeberry	Hiding,wildlife	White flowers with pink anthers May, blackish-purple berries persistent and eaten by birds
Rhus aromatica	Fragrant sumac	Props, color, collecting, wildlife, fragrant	Orange, red, purple, yellow fall color, make catkins as props, female berries as props, aromatic foliage, Yellow flowers april-June, berries serve as winter food for birds, attracts birds and butterflies, larval host for red-banded hairstreak, and Banded Hairstreak
Salix discolor	Pussy Willow	Props, collecting, wildlife	Fuzzy flower buds, white blooms feb-march, early season harvest for songbirds and waterfowl, attract butterflies, larval host for Mourning Cloak and Viceroy

Viburnum lentago	Nannyberry	Fragrance, collecting, wildlife, color	White fragrant flower clusters May, wine-red fall color, blue black berries persist through winter, attracts songbirds and gamebirds, larval host for the Spring Azure
Viburnum opulus	Cranberrybush	Hiding, props, collecting	Bright red berry, conspicuous flowers white april-may
Viburnum prunifolium	Blackhaw	Hiding, wildlife, fragrance, collecting, edible	White flower clusters april-may, blue black berries eaten by songbirds, gamebirds, and edible to humans
Perennials			
Allium cernuum	Nodding Wild Onion	Fragrance, wildlife, texture, color	Soft, grasslike leaves, Purple Flower nodding, edible leaves, bulbs, and bulblets, medicinal, attracts hairstreak butterfly, attracts hummingbirds and butterflies
Allium schoenoprasum	Wild Chives	Fragrance	Pink Globular Flower June-Aug
Equisetum fluviatile	Horsetail	Collecting, props, wildlife	Fish cover and habitat, primary food source for trumpeter swans, hollow plant can be used as straws, telescopes, or whistles
Impatiens capensis	Jewelweed	Wildlife, color, interaction	Important nectar source for hummingbirds, orioles, and bees, gamebirds and mice eat the seeds, cover for frogs and reptiles, Orange flowers June-Sept, seed pods 'burst' when touched
Monarda didyma	Bee Balm	Fragrance, color, wildlife, edible	Bright red tubular flowers May-Oct, minty fragrance leaves, attracts hummingbirds, butterflies, and bees, leaves edible
Onoclea sensibilis	Sensitive Fern	Texture, props, collecting	Cover for small mammals and songbirds, pale red fiddle-heads in spring, soft texture foliage
Physostegia virginiana	Obedient Plant	Wildlife, color, interaction	Nectar source for hummingbirds and butterflies, rosy-pink flowers July-Oct, flowers stay in the direction they are bent
Grasses			
Calamagrostis canadensis	Bluejoint	Props, Hiding	Grass grows 3-5', clump-forming, stands up well in winter
Calamagrostis purpurascens	Purple Reed Grass	Props, hiding, wildlife	Plume, Larval host to the Arctic Skipper
Panicum virgatum	Switchgrass	Hiding, texture, wildlife	Seed heads aug-oct, 3-6' tall, pale yellow fall color persistent through winter, seeds eaten by ground-feeding songbirds and game birds, cover and nesting material, attracts butterflies, larval host of the Delaware Skipper, nectar source for the Dotted Skipper
Spartina pectinata	Prairie Cord Grass	Hiding, wildlife, texture	Yellow fall color, 5-6' tall, Attracts birds
Groundcover			
Comptonia peregrina	Sweet Fern	Fragrance, wildlife, soft texture	Dark, olive leaves, soft groundcover
Gaultheria procumbens	Wintergreen	Fragrance, wildlife, collecting, edible, color	Evergreen foliage with wintergreen fragrance, small bell shaped white flowers June-Aug, followed by red berries, edible, attracts birds
Sedum glaucophyllum	Cliff Stonecrop	Texture, props, collecting	Leathery leaves, woody dried seed capsule

Teucrium canadense	American Germander	Fragrance, wildlife	White bloom May-Aug, aromatic foliage when bruised, attracts butterflies

Butterfly Gardens

Purpose

A butterfly garden provides habitat for butterflies, an integral part of Northern Michigan ecosystems. They are pollinators, a food resource for many other organisms, act as environmental indicators, and their beauty gains the attention of people, helping to promote wildlife value.

Like bees, butterflies pollinate plants, many of which rely solely on butterfly species for their annual reproduction. Pollinators are essential to plant reproduction and fruit production because they are responsible for **cross-fertilization**. Without pollinators, plants do not get fertilized, and cannot produce fruit, which is an important food source for many organisms. Boyne Mountain can provide habitat for pollinators and help keep their populations abundant and healthy to ensure the fertilization of Northern Michigan.

Butterflies have short generation times, and their population numbers tend to respond very quickly to environmental degradation. Therefore, their presence can often indicate ecological quality. Butterflies are also graceful and beautiful, and they are generally appreciated and desired in garden areas.

There are two different varieties of butterflies: specialists and generalists. Specialist butterflies rely on the presence of a single species or genus of host plant to complete the larval stage of their life cycle. Generalist butterflies can use a variety of plants as hosts. All adult butterflies are usually generalists, obtaining food and nectar from a variety of sources. A butterfly garden maximizes the amount of host plants and adult food sources available for butterfly habitat, while providing a constant supply of nectar sources throughout the season.

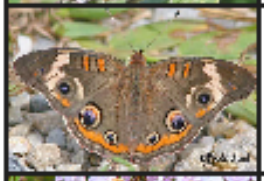
- *Aesthetics:* Butterflies are beautiful, graceful, and colorful, as are their host plants. Butterfly gardens can be designed to be beautiful through all 4 seasons.
- *Education:* Butterflies move through the landscape, and seeing them is a special occurrence. A garden can be used to attract butterflies so sightings are more common, and garden visitors can be educated on pollination, metamorphosis, life cycle changes, and life history strategies of different butterflies. They can also be given a checklist, with descriptions of butterflies, that they may see while at Boyne Mountain.
- *Habitat:* Providing habitat for butterflies allows them to be present at Boyne where they can be enjoyed by the guests, as well as provide a patch to help their populations survive in Northern Michigan.

- *Biodiversity:* A butterfly garden can help provide habitat for many different types of butterflies, which will increase the biodiversity on the site and provide pollination for many of the plants growing in the natural ecosystems and landscaped areas at Boyne Mountain.

Butterfly Profiles of Northern Michigan

There are many butterfly species native to Northern Michigan that rely on plants that are also native to Northern Michigan. These butterflies exist in varying population numbers, but are all important for biodiversity. Here we will consider their host plants, aesthetic properties, and range of habitat to determine the characteristics butterfly gardens at Boyne should display in order to be a viable habitat solution.

Table 4

	**Acadian Hairstreak** *Satyrium acadicum* **Family:** Lycaenidae **Color:** Brown-gray with blue marginal spot	**Larval Host Plant:** Black Willow **Adult Nectar Source:** Common Milkweed, New Jesey Tea **Habitat:** Willow lined streams, marshes, moist woodlands
	**American Painted Lady** *Vanessa virginiensis* **Family:** Nymphalidae **Color:** Brown, yellow, orange pattern, white, 2 large eyespots	**Larval Host Plant:** Asters, Plantain-leaved Pussytoes **Adult Nectar Source:** Milkweeds, Composites **Habitat:** Open places, low vegetation, forest edges
	**Atlantis Fritillary** *Speyeria atlantis* **Family:** Nymphalidae **Color:** Orange-brown, black outer margins, silvered spots	**Larval Host Plant:** Northern Blue Violet **Adult Nectar Source:** Milkweeds, Vetches, Mints, Composites **Habitat:** Forest openings, upland pastures, meadows
	**Banded Hairstreak** *Satyrium calanus* **Family:** Lycaenidae **Color:** Dark brown, band of dark dashes edged in white	**Larval Host Plant:** Blackjack, Turkey Oak, Butternut, Hickories **Adult Nectar Source:** New Jersey Tea, Milkweeds **Habitat:** Forest areas, neighboring open fields
	**Buckeye** *Junonia coenia Hubner* **Family:** Nymphalidae **Color:** Brown, 2 orange bars, 2 eyespots, white, magenta, rose-red	**Larval Host Plant:** Snapdragon, False Foxglove **Adult Nectar Source:** Asters, Sunflowers **Habitat:** Open, sunny areas with low vegetation and some bare ground
	**Canadian Tiger Swallowtail** *Papilio canadensis* **Family:** Papillonidae **Color:** Yellow, Orange, Black	**Larval Host Plant:** Willow, Birch, Quaking Aspen **Adult Nectar Source:** Milkweeds **Habitat:** Northern Deciduous and Evergreen Deciduous woods and forest edges
	**Coral Hairstreak** *Satyrium titus* **Family:** Lycaenidae **Color:** Dark brown, light brown, row of coral spots some ringed with white	**Larval Host Plant:** Black Cherry, Chokecherry **Adult Nectar Source:** Common Milkweed **Habitat:** Shrubby areas, brushlands, openings in woodlands, streamsides
	**Eastern Tailed Blue** *Everes comyntas* **Family:** Lycaenidae **Color:** Males blue, females light blue to charcoa, black to orange spots	**Larval Host Plant:** Legumes, Vetches, Clovers **Adult Nectar Source:** Cinquefoils, Milkweeds, Asters **Habitat:** Roadsides, old fields, pastures, prairies, home gardens
	**Monarch** *Danaus plexippus* **Family:** Danidae **Color:** Orange, black veins, wide black borders, white spots	**Larval Host Plant:** Asclepias species **Adult Nectar Source:** Asclepias, lilac, red clover, goldenrod, blazing star, ironweed **Habitat:** Open, sunny locations including old fields, rroadsides, meadows, prairies, parks, and gardens

	**Mourning Cloak** *Nymphalis antiopa* **Family:** Nymphalidae **Color:** Purple-black, wide bright yellow boarder, row of iridescent blue spots	**Larval Host Plant:** Black Willow, Quaking Aspen, Cottonwood, American Elm, Paper Birch, Hackberry **Adult Nectar Source:** Milkweeds **Habitat:** Anywhere host plants occur
	**Northern Crescent** *Phyciodes cocyta* **Family:** Nymphalidae **Color:** Orange-brown, dark borders	**Larval Host Plant:** Panicled Aster **Adult Nectar Source:** Composites **Habitat:** Moist open areas in rocky places, wooded streams, marsh edges
	**Northern Pearly Eye** *Enodia anthedon* **Family:** Satyridae **Color:** Brown with dark eyespots	**Larval Host Plant:** Indian Woodoats, White Grass **Adult Nectar Source:** Sap flows from willows, poplars, and birch **Habitat:** Damp deciduous woods, usually near marshes or waterways
	**Northern Spring Azure** *Celastrina lucia* **Family:** Lycaenidae **Color:** Males blue, females with some black at outer edge, late spring and summer forms white, small blackor gray dots and blotches	**Larval Host Plant:** Black Cherry, Chokecherry, Blueberry, Labrador Tea, Dogwood **Adult Nectar Source:** Dogbane, New Jersey Tea, Blackberry, Milkweed **Habitat:** Openings and edges of deciduous woods, old fields
	**Pink-Edged Sulphur** *Colias interior* **Family:** Pieridae **Color:** Yellow, pink edges	**Larval Host Plant:** Blueberry **Adult Nectar Source:** Milkweeds **Habitat:** Shrubby openings in woods, bogs, or scrub areas
	**Purplish Copper** *Lycaena helloides* **Family:** Lycaenidae **Color:** Brown, purple iridescence, female has orange	**Larval Host Plant:** Docks, Knotweeds **Adult Nectar Source:** Clovers, Swamp Milkweed, Composites, New Jersey Tea **Habitat:** Roadsides, open fields, wet meadows, marshes, streamsides, valleys
	**Question Mark** *Polygonia interrogationis* **Family:** Nymphalidae **Color:** Red-orange, black spots	**Larval Host Plant:** American Elm, Red Elm, Hackberry **Adult Nectar Source:** Adults don't feed on nectar **Habitat:** Wooded areas with open space, city parks, suburbs, fencerows
	**Red-Spotted Purple** *Limenitis arthemis astyanax* **Family:** Nymphalidae **Color:** Blue to blue-green iridescence, 2 red-orange bars, 3 red-orange spots	**Larval Host Plant:** Black Cherry, Chokecherry, Poplars, Quaking Aspen, Black Oak **Adult Nectar Source:** Coneflowers, Asters **Habitat:** Deciduous or mixed forests, moist uplands, valley bottoms
	**Silvery Blue** *Glaucopsyche lygdamus* **Family:** Lycaenidae **Color:** Iridescent silvery blue, narrow dark boarders with white	**Larval Host Plant:** Vetch, Vetchling, Veiny Peavine, Clover **Adult Nectar Source:** Composites, Legumes, Blueberry, Black Cherry **Habitat:** Open woods, prairies, meadows, road edges, brushy fields

	**Silvery Checkerspot** *Chlosyne nycteis* **Family:** Nymphalidae **Color:** Yellow-orange, dark borders and markings, white spots	**Larval Host Plant:** Sunflowers, Purple-stemmed Aster, Black-eyed Susan, Crownbeard **Adult Nectar Source:** Milkweeds, Vetches **Habitat:** Moist, open places including streamsides, meadows, forest openings
	**West Virginia White** *Pieris virginiensis* **Family:** Pieridae **Color:** White	**Larval Host Plant:** Toothwort **Adult Nectar Source:** Toothwort, Trillium, Canada Violet **Habitat:** Moist deciduous woodlands or mixed woods
	**White Admiral** *Limenitis arthemis arthemis* **Family:** Nymphalidae **Color:** Black, broad white median bands, blue dashes	**Larval Host Plant:** Black Birch, Yellow Birch, Hawthorn, Basswood, Hop-hornbeam, Willow **Adult Nectar Source:** Adults don't feed on nectar **Habitat:** Deciduous broad-leaf or mixed evergreen forests dominated by aspen or birch

Suggested Butterfly Garden Plant Characteristics

- *Type:* A variety of plant types should be used to provide a variety of habitat for different types of butterflies as well as structure below, at, and above eye level for the garden visitor.
- *Flowers:* Flowers not only provide an explosion of color in the spring, summer, and fall, but also provide nectar sources for butterflies.
- *Colors:* Red, orange, yellow, green, blue, indigo, and violet colors are used by various native Michigan plants to attract different butterflies for pollination. All of these colors can be represented in a garden setting using native plants.
- *Bark:* Given that Boyne is a four-season resort, the bark of trees and shrubs is extremely important. Barks have different textures and colors, and could provide a very different winter experience in the garden.
- *Branching Patterns:* Branching patterns are also much more noticeable in the winter than in the summer, and are greatly responsible for the winter form of the garden. Shrubby branching patterns should be juxtaposed with strong, clean branching patterns to prevent the garden from looking messy in the winter.
- *Fruit:* The fruit of trees and shrubs provides additional interest during late summer, and often these fruits persist into the winter for additional winter interest, color, and form.
- *Leaf Size:* Providing a variety of large and small leaf sizes allows for the presence of different textures within the green areas of the garden, and can provide interest when a plant is not in bloom.
- *Leaf Surface:* Another way to provide a variety in green texture is by varying the types of leaf surfaces in the chosen plants. This will prevent all the green from

appearing shiny and smooth. If some leaves are downy, some shiny, and some dull green, while others are bright green, a variety of resting places are provided for the butterflies and a variety of textures are provided for visual interest.

Suggested Butterfly Garden Plant Profiles

These plants are suggested for the butterfly gardens throughout the Boyne property. Each plant is listed with the butterflies to which it is a host plant, butterflies to which it is a nectar source or a food source for generalist butterflies are not listed here. These plants will attract a larger diversity of butterflies than those listed here.

Table 5

Botanical Name	Common Name	Bloom Time	Winter Interest	Host Plant
Trees				
Betula alleghaniensis	Yellow Birch	Yellow/green, April-May	Winter form, bark	Canadian Tiger Swallowtail, White Admiral
Betula papyrifera	Paper Birch	Yellow/green, April	Winter form, Bark	Canadian Tiger Swallowtail, Mourning Cloak
Carpinus caroliniana	Hop-hornbeam	Green, March-May	Winter form, bark, fruit	White Admiral
Carya cordiformis	Bitternut Hickory	Yellow, April	Winter form, fruit	Banded Hairstreak
Carya ovata	Shagbark Hickory	White, March-april	Winter form, bark, fruit	Banded Hairstreak
Celtis occidentalis	Hackberry	Green, April	Winter form, berries	Mourning Cloak, Question Mark
Cercis canadensis	Redbud	Pink, March-May	Winter form, legumes	Nectar source only for listed butterflies
Crataegus crus-galli	Cockspur Hawthorn	White, May-June	Winter form, pome	White Admiral
Hamamelis virginiana	Witch Hazel	Orange/yellow, Sept-Dec	Winter form, flowers	Nectar source only for listed butterflies
Populus deltoides	Cottonwood	Yellow, Feb-April	Winter form	Mourning Cloak, Red-spotted Purple
Populus tremuloides	Quaking Aspen	Yellow, April-May	Winter form, white bark	Canadian Tiger Swallowtail, Mourning Cloak, Red-spotted Purple
Prunus virginiana	Chokecherry	White, April-July	Winter form, fruit	Coral Hairstreak, Northern Spring Azure, Red-spotted Purple
Quercus velutina	Black Oak	Yellow/green, March-April	Winter form	Red-spotted Purple
Salix nigra	Black Willow	Yellow, April-May	Winter Form	Acadian Hairstreak, Canadian Tiger Swallowtail, Mourning Cloak, White Admiral
Shrubs				
Ceanothus americanus	New Jersey Tea	white, march-april	Winter form	Nectar source only for listed butterflies
Dalea purpurea	Purple Prairie Clover	Purple, Jun-Sept	None	Eastern Tailed Blue, Silvery Blue

Vaccinium corymbosum	Highbush Blueberry	White, May-June	Winter form, fall color, berries	Northern Spring Azure, Pink-edged Sulphur
Viburnum prunifolium	Black Haw Viburnum	White, April-May	Winter form, fall color, berries	Nectar source only for listed butterflies
Vines				
Vicia americana	American Vetch	Purple, May-July	None	Eastern Tailed Blue, Silvery Blue
Perennials				
Anaphalis margaritacea	Pearly Everlasting Aster	White, Jun-Oct	None	American Painted Lady
Asclepias purpurascens	Purple Milkweed	Pink/Red,	None	Monarch
Asclepias syriaca	Common Milkweed	Purple, Jun-Aug	None	Monarch
Asclepias tuberosa	Butterfly Weed	Orange, May-Sep	None	Monarch
Aster novae-angliae	New England Aster	Purple, Aug-Sept	Persistent seed heads	American Painted Lady
Aster puniceus	Purple-stemmed Aster	Light Blue, Aug-Oct	Persistent seed heads	American Painted Lady, Silvery Checkerspot
Aster simplex	Panicled Aster	White, Aug-Oct	Persistent seed heads	American Painted Lady, Northern Crescent
Echinacea purpurea	Purple Coneflower	Purple, April-Sept	Persistent seed heads	Nectar source only for listed butterflies
Eupatorium purpureum	Sweet Joe-pye Weed	Pink, Jul-Sept	Persistent seed heads	Nectar source only for listed butterflies
Helianthus giganteus	Giant Sunflower	yellow, Jul-Sept	Persistent seed heads	Silvery Checkerspot
Helianthus mollis	Downy Sunflower	Yellow, Jun-Sept	Persistent seed heads	Silvery Checkerspot
Lathyrus ochroleucus	Cream-colored Vetchling	White, June-July	None	Eastern Tailed Blue, Silvery Blue
Lathyrus venosus	Veiny Peavine	Purple, Jun-July	None	Eastern Tailed Blue, Silvery Blue
Liatris aspera	Rough Blazing Star	Purple, Aug-Sept	None	Monarch adult nectar source
Ratibida pinnata	Yellow Coneflower	Yellow, May-Sept	Persistent seed heads	Nectar source only for listed butterflies
Rudbeckia hirta	Black-eyed Susan	Yellow, June-Oct	Persistent seed heads	Silvery Checkerspot
Silphium terebinthinaceum	Prairie Dock	Yellow, July-Sept	None	Purplish Copper
Verbesina virginica	White Crownbeard	White, Aug-Nov	None	American Painted Lady, American Painted Lady American Painted Lady, Atlantis Fritillary, Buckeye, Silvery Checkerspot
Viola septentrionalis	Northern Blue Violet	Blue, April-June	None	Atlantis Fritillary
Annuals				
Agalinis purpurea	Purple False Foxglove	Pink, July-Nov	None	Buckeye, Eastern Tailed Blue
Grasses				
Chasmanthium latifolium	Indian Woodoats	Green, Jun-Sept	Attractive through winter	Northern Pearly Eye
Leersia virginica	White Grass	Green, July-Aug	None	Northern Pearly Eye

Groundcover				
Antennaria rosea	Rosy Pussytoes	Pink,	None	Nectar source only for listed butterflies
Arctostaphylos uva-ursi	Bearberry	Pink, March-Jun	Evergreen, red berries	Nectar source only for listed butterflies
Dentaria diphylla	Toothwort	White, May-June	None	West Virginia White
Dentaria laciniata	Cut-leaved Toothwort	White, April-May	None	West Virginia White
Ledum groenlandicum	Labrador Tea	White, May-Aug	Evergreen	Northern Spring Azure

Songbird Gardens

Purpose

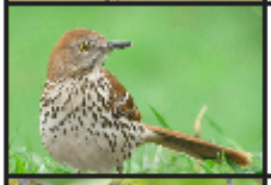
A songbird garden provides habitat for songbirds. Songbirds need a food source, and native plants can provide a more sustainable and less expensive food source than bird feeders. Bird seed often contains seeds of non-native plants, is ravaged by squirrels and other undesirable rodents, is expensive, and bird feeders are often unsightly and messy looking. A songbird garden can provide all of the benefits of a series of bird feeders with additional benefits, to the birds, to guests of Boyne Mountain, and to the maintenance crew.

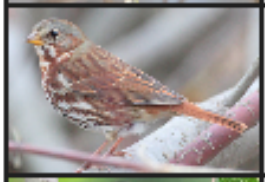
- *Aesthetics:* As in any garden design, aesthetics and beauty of the garden is of paramount importance to the choice of plants for birds.
- *Education:* Attracting song birds to Boyne Mountain provides an educational opportunity to learn about birds, their nesting and mating behaviors, their habitat needs, and food sources. It can also provide innovative ideas for how Boyne guests can sustainably attract birds to their own yards at home.
- *Songbird Habitat:* In order to attract songbirds and have them remain in the garden for any length of time, the garden needs to provide either nesting or roosting habitat, or a food source.
- *Biodiversity:* By increasing the biodiversity of plant food sources for the birds in the songbird garden, the diversity of songbirds attracted to the garden also goes up. There are many benefits to having an increase of songbird diversity at Boyne, the most important of which is guest environmental education.

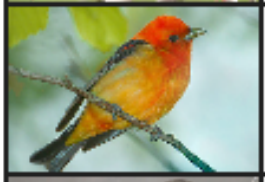
Songbird Profiles of Northern Michigan

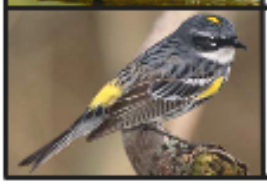
There are many species of songbirds native to Northern Michigan that rely on plants that are also native to Northern Michigan for food and shelter. They may use different plants for food than they do for nesting sites, but these are both important parts of their habitat. A songbird garden at Boyne Mountain will probably be less appropriate for nesting, but we can provide a food source for these birds that sustains through the winter for those birds that do not migrate.

Table 6

	**American Robin** *Turdus migratorius* **Diet:** Insects, soft foods, berries and fruits **Group:** Thrush Family **Season:** Summer	**Plants:** Highbush Blueberry, Eastern Red Cedar, American Elder, Nannyberry, Staghorn Sumac, Wild Strawberry, Dogwoods, Winterberry, Spicebush, Sugar Maple, Coralberry, Brambles, Arrowwood **Habitat:** Fields and woods' edges, gardens
	**American Tree Sparrow** *Spizella arborea* **Diet:** Seeds in winter, insects during nesting season, some berries **Group:** Small Finch Family **Season:** Winter	**Plants:** Paper Birch, River Birch, Asters, Sunflowers, Black-eyed Susans, Coneflowers, Little Bluestem, Speckled Alder, Swamp Rose, Blueberry **Habitat:** Brushy thickets, shrubs, semi-open fields
	**Baltimore Oriole** *Icterus galbula* **Diet:** Insects, some fruit and nectar **Group:** Blackbird and Oriole Family **Season:** Summer	**Plants:** Maples, Birches, Black Cherry, Oaks, River-bank Grape, Chokecherry, Wild Strawberry, Brambles **Habitat:** Deciduous and mixed forest, natural openings, shorelines, gardens, and parklands
	**Black-Capped Chickadee** *Poecile atricapilla* **Diet:** Insects, spiders, conifer seeds, invertebrate eggs, nuts, fruits, and berries **Group:** Chickadee and Titmouse Family **Season:** Year-round	**Plants:** Asters, Sunflowers, Black-eyed Susans, Birch, Redbud, Cinnamon Fern, Royal Fern, Spruce, Oak, Hemlock, Serviceberry, Bayberry, Winterberry, Viburnums, Pines **Habitat:** Deciduous and coniferous woods, Wooded urban parks
	**Blackburnian Warbler** *Dendroica fusca* **Diet:** Budworms, flies, beetles, and other insects **Group:** Wood-warbler Family **Season:** Summer	**Plants:** Sugar Maple, White Pine, Eastern Hemlock, **Habitat:** Woodlands and areas with tall shrubs
	**Blue Jay** *Cyanocitta cristata* **Diet:** Seeds, nuts, fruits, eggs, insects, carrion **Group:** Crow and Jay Family **Season:** Year-round	**Plants:** Firs, Sunflower, Pines, White Oak, Blueberry, Winterberry, Red Mulberry, Sumac, Wild Cherrys, River-bank Grape, Brambles, Elder **Habitat:** Mixed deciduous forests, scrubby fields and yards
	**Bobolink** *Dolichonyx oryzivorus* **Diet:** Adult and larval invertebrates, seeds **Group:** Blackbird and Oriole Family **Season:** Summer	**Plants:** Sunflowers, River-bank Grape, Chokecherry **Habitat:** Tall, grassy meadows and ditches
	**Brown Thrasher** *Toxostoma rufum* **Diet:** Half insects, half seeds and berries **Group:** Mimic Thrush Family **Season:** Summer	**Plants:** Blueberrys, Eastern Red Cedar, Mountain Ash, Dogwoods, Prairie Wild Rose, Wild Strawberry, Bayberry, Downy Serviceberry, Hackberry, Coralberry, Brambles, Elder, Viburnums **Habitat:** Dense shrubs and thickets, woodland edges
	**Cedar Waxwing** *Bombycilla cedrorum* **Diet:** Flying insects, fruit and berries in fall and winter **Group:** Waxwing Family **Season:** Year-round	**Plants:** Eastern Red Cedar, Mountain Ash, Hawthorns, Pagoda Dogwood, Nannyberry, Swamp Rose, Common Juniper, Wild Strawberry, Downy serviceberry, Cherries, Coralberry, Brambles, Elder **Habitat:** Forest edges, wooded parks, gardens

	**Eastern Bluebird** *Sialia sialis* **Diet:** Flying insects and ground invertebrates, fruit **Group:** Thrush Family **Season:** Summer	**Plants:** Blueberry, Eastern Red Cedar, Cherrys, Mountain Ash, Elder, Dogwoods, Nannyberry, Smooth Sumac, Common Juniper, Winterberry, Spicebush, Bayberry, Brambles **Habitat:** Fields and woods' edges
	**Eastern Meadowlark** *Sturnella magna* **Diet:** Insects and Seeds **Group:** Blackbird and Oriole Family **Season:** Summer	**Plants:** Sunflowers, River-bank Grape, Choke-cherry, Bayberry **Habitat:** Open woods, grassy meadows, city parks, backyards
	**Eastern Towhee** *Pipilo erythrophthalmus* **Diet:** Seeds, insects during nesting season, berries **Group:** Small Finch Family **Season:** Summer	**Plants:** Blueberry, Asters, Wild Strawberry, Black-eyed Susan, Coneflowers, Mountain Ash, Elder, Bayberry, Brambles **Habitat:** Woodland edges, shrubby abandoned fields
	**Evening Grosbeak** *Coccothraustes vespertinus* **Diet:** Seeds, tree buds, insects, fruits, and berries **Group:** Large Finch Family **Season:** Year-round	**Plants:** Eastern Red Cedar, Maples, Alder, Birches, Tulip Tree, Sunflowers, Flowering Dogwood, Cherries, Coralberry, Brambles **Habitat:** Forests and thickets
	**Fox Sparrow** *Passerella iliaca* **Diet:** Seeds, insects, berries **Group:** Small Finch Family **Season:** Migrates	**Plants:** Hawthorns, Birches, Asters, Sunflowers, Black-eyed Susans, Coneflowers, Bearberry, Brambles **Habitat:** Riparian thickets, brushy woodland clearings, edges, and parklands
	**Gray Catbird** *Dumetella carolinensis* **Diet:** Ants, beetles, grasshoppers, caterpillars, moths, spiders, and berries **Group:** Mimic Thrush Family **Season:** Summer	**Plants:** Blueberrys, Eastern Red Cedar, Mountain Ash, Nannyberry, Sumacs, Wild Strawberry, Dogwoods, Prairie Wild Rose, Bayberry, Serviceberry, Hackberry, Brambles, Red Mulberry, Spicebush, Elder, Arrowwood **Habitat:** Dense thickets, hedgerows
	**Great Crested Flycatcher** *Myiarchus crinitus* **Diet:** Insects, caterpillars, and fruit **Group:** Flycatcher Family **Season:** Summer	**Plants:** Red Mulberry, Cherries, River-bank Grape, Sassafras, Elder, Blueberry, Spicebush **Habitat:** Deciduous and mixed woodlands and forests, usually near openings or edges
	**Indigo Bunting** *Passerina cyanea* **Diet:** Grasshoppers, beetles, weevils, flies, and larvae, thistle, dandelions, and others **Group:** Small Finch Family **Season:** Summer	**Plants:** Asters, Coneflowers, Thistle, Dandilion, Brambles, Elder, Grasses **Habitat:** Deciduous forest and woodland edges, shrubby fields, and hedgerows
	**Northern Cardinal** *Cardinalis cardinalis* **Diet:** Seeds, tree buds, insects, fruits, and berries **Group:** Large Finch Family **Season:** Year-round	**Plants:** Blueberry, Hackberry, Elder, Gray Dogwood, Asters, Black-eyed Susans, Red Maple, Birches, Alder, Smooth Sumac, Coralberry, Spicebush, Brambles **Habitat:** Brushy thickets along woodland edges, parks

	**Northern Mockingbird** *Mimus polyglottos* **Diet:** Beetles, ants, wasps, grasshoppers, berries adn wild fruit **Group:** Mimic Thrush Family **Season:** Summer	**Plants:** Blueberry, Eastern Red Cedar, Black Cherry, Hackberry, Mountain Ash, Dogwoods, Wild Strawberry, Bayberry, Serviceberry, Hackberry, Elder, Brambles **Habitat:** Hedges, gardens, and orchard margins
	**Pine Siskin** *Carduelis pinus* **Diet:** Seeds, buds, and some insects **Group:** Small Finch Family **Season:** Year-round resident	**Plants:** Birches, Coneflowers, Pines, Alder **Habitat:** Coniferous and mixed forests, urban and rural ornamental and shade trees, forest edges, meadows
	**Purple Finch** *Carpodacus purpureus* **Diet:** Seeds, buds, berries, and insects **Group:** Small Finch Family **Season:** Year-round resident	**Plants:** Eastern Red Cedar, Common Juniper, Sunflowers, Black-eyed Susan, Prairie Dock, Coneflowers, Smooth Sumac, Coralberry, Nannyberry **Habitat:** Coniferous, mixed and deciduous forests, shrubby open areas
	**Red-eyed Vireo** *Vireo olivaceus* **Diet:** Mainly insects, especially caterpillars, also berries **Group:** Vireo Family **Season:** Summer	**Plants:** Bayberry, Roses, Viburnums, River-bank Grape, Staghorn Sumac, Virginia Creeper, Serviceberry, Brambles, Spicebush **Habitat:** Deciduous forests with shrubby understory
	**Rose-breasted Grosbeak** *Pheucticus ludovicianus* **Diet:** Insects, seeds, tree buds, berries, and some fruit **Group:** Large Finch Family **Season:** Summer	**Plants:** Cherries, Mountain Ash, Wild Strawberry, Maples, Alder, Birches, Dogwoods, Hawthorn, Virginia Creeper, Elder, Red Mulberry, River-bank Grape, Serviceberry, Nannyberry, Arrowwood, Brambles **Habitat:** Deciduous and mixed forests
	**Scarlet Tanager** *Piranga olivacea* **Diet:** Large-bodied insects, seasonally available berries **Group:** Tanager Family **Season:** Summer	**Plants:** Blueberry, Red Mulberry, Flowering Dogwood, Cherries, Oaks, Bayberry, Brambles **Habitat:** Fairly mature upland mixed deciduous forests
	**Swainson's Thrush** *Catharus ustulatus* **Diet:** Insects, soft foods, berries and fruits **Group:** Thrush Family **Season:** Summer	**Plants:** Hackberry, Swamp Rose, Virginia Creeper, Elder, Nannyberry, Wild Strawberry, Dogwoods, Winterberry, Spicebush, Spruce, Fir, Elder, Brambles **Habitat:** Edges of coniferous and mixed forests
	**White-breasted Nuthatch** *Sitta carolinensis* **Diet:** Pry insects out of deep bark crevices, nuts, and conifer seeds **Group:** Nuthatch Family **Season:** Year-round Resident	**Plants:** Firs, Maples, Sunflowers, Pines, Oaks, Hemlocks, Black-eyed Susans, Spruce **Habitat:** Mixedwood forests, woodlots, and backyards
	**White-throated Sparrow** *Zonotrichia albicollis* **Diet:** Seeds, insects, and berries **Group:** Small Finch Family **Season:** Summer	**Plants:** Black Cherry, Asters, Sunflowers, Black-eyed Susans, Coneflowers, Wild Strawberry, Elder, River-bank Grape, Spicebush, Brambles **Habitat:** Woodlots, wooded parks, semi-open coniferous and mixed forests

	**Wood Thrush** *Hylocichla mustelina* **Diet:** Insects, berries, and fruits **Group:** Thrush Family **Season:** Summer	**Plants:** Downy Serviceberry, Dogwoods, Sumacs, Virginia Creeper, Wild Strawberry, Elder, Nanny-berry, Wild Strawberry, Winterberry, Spicebush, Brambles **Habitat:** Moist, mature deciduous woodlands
	**Yellow-Rumped Warbler** *Dendroica coronata* **Diet:** Beetles, flies, wasps, caterpillars, moths, and berries **Group:** Wood-warblers Family **Season:** Summer	**Plants:** Common Juniper, Northern Bayberry, Smooth Sumac, Virginia Creeper, Flowering Dog-wood, Eastern Red Cedar, White Spruce, White Pine **Habitat:** Coniferous and mixed forests, shrubby areas

Suggested Songbird Garden Plant Characteristics

- *Fruit:* Berries and nuts are common food sources for songbirds, and many plants rely on birds for seed dispersal. Fruit that persists through the winter provides a winter food source, as well as winter color and interest.
- *Nesting/Roosting Value:* Some birds nest and roost in garden plants, while others take parts of the plants to use in their nests elsewhere. Providing shelter and materials is a key component of garden plants used by birds.
- *Winter Interest:* Persistent fruit, colored branches, interesting branching patterns, and grasses that keep their form all contribute to a garden that acts as bird habitat through all four seasons.
- *Planting Patterns:* Plants should be planted with multiple individuals of each species close together or in clumps. This increases fertility, and therefore, fruit yield. Many bird garden plants are dioecious, meaning they have male and female flowers on separate plants. In this case, not only should plants be planted in clumps, but also both male and female plants should be present to ensure fertility.
- *Vines:* Vines play an important role for birds in providing nesting places, perches, and leaf surfaces. Vines that also produce fruit have additional food value.
- *Water Source:* Although birds get water from foods, if they are provided open water, they will readily use it for both drinking, bathing, and to cool themselves from the heat of the summer. Birds are especially attracted to pools that have flowing water or dripping like small fountains. Provided water is especially important in the winter when most natural sources of fresh shallow water are frozen.
- *Nest Boxes:* Many birds use tree cavities for nesting, and these nest sites may be in short supply in the garden and developed setting. Few people want dead standing trees in their gardens for both safety and aesthetic reasons. An

alternative is to provide nest boxes, which simulate tree cavity nesting sites. Forty-eight bird species are known to raise young in nest boxes, which can be made of any wood. In order to attract the Eastern Bluebird, the nest boxes should be located in an open portion of the garden, simulating an open field. Nest boxes can be built in different sizes to attract different species of birds, so a variety of sizes should be provided to ensure nesting opportunities for a variety of songbird species.

Suggested Songbird Garden Plant Profiles

Table 7

Botanical Name	Common Name	Bird Value	Birds
Trees			
Abies balsamea	Balsam Fir	Seeds Aug-Sept, cover, nesting	Blue Jay, White-breasted Nuthatch, Black-capped Chickadee, American Robin, Swainson's Thrush, Evening Grosbeak, Purple Finch
Acer rubrum	Red Maple	Seeds March-July, sap, buds, cover, nesting	Baltimore Oriole, White-breasted Nuthatch, Rose-breasted Grosbeak, American Robin, Northern Cardinal, Evening Grosbeak
Acer saccharinum	Silver Maple	Seeds April-June, Buds, Cover, Nesting	Baltimore Oriole, White-breasted Nuthatch, Red-breasted Grosbeak, Northern Cardinal, Evening Grosbeak
Acer saccharum	Sugar Maple	Seeds June-October, buds, cover, host for insects, nesting	Baltimore Oriole, White-breasted Nuthatch, Rose-breasted Grosbeak, American Robin, Blackburnian Warbler, Golden-winged Warbler, Red-eyed Vireo, Northern Cardinal, Evening Grosbeak
Amelanchier arborea	Downy Serviceberry	Fruit June-Aug	Wood Thrush, Black-capped Chickadee, Red-eyed Vireo, Rose-breasted Grosbeak, Gray Catbird, Northern Mockingbird, Brown Thrasher, American Robin, Cedar Waxwing, Scarlet Tanager, Northern Cardinal
Betula alleghaniensis	Yellow birch	Seeds Aug-Oct, buds, sap, cover, nesting	American Tree Sparrow, Fox Sparrow, Black-capped Chickadee, Rose-breasted Grosbeak, Pine Siskin, Blue Jay
Betula nigra	River Birch	Seeds Aug-Oct, buds, sap, cover, nesting	American Tree Sparrow, Fox Sparrow, Black-capped Chickadee, Rose-breasted Grosbeak, Pine Siskin
Betula papyrifera	Paper Birch	Seeds Aug-Sept, sap, cover, cavity	American Tree Sparrow, Fox Sparrow, Pine Siskin, Black-capped Chickadee, Rose-breasted Grosbeak, Blue Jay
Celtis occidentalis	Hackberry	Fruit Sept-Nov persistent through winter, sap	Northern Cardinal, Northern Mockingbird, Swainson's Thrush, Gray Catbird, Brown Thrasher, American Robin, Swainson's Thrush, Eastern Bluebird, Cedar Waxwing, Evening Grosbeak, Fox Sparrow

Cornus florida	Flowering Dogwood	Fruit Aug-Nov	Rose-breasted Grosbeak, Scarlet Tanager, Evening Grosbeak, Wood Thrush, Swainson's Thrush, Northern Mockingbird, Gray Catbird, Brown Thrasher, American Robin, Eastern Bluebird, Cedar Waxwing, Red-eyed Vireo, Northern Cardinal, Purple Finch, White-throated Sparrow, Yellow-rumped Warbler
Crataegus crus-galli	Cockspur Hawthorn	Fruit Aug-Feb, cover, nesting	Cedar Waxwing, Fox Sparrow, Blue Jay, Gray Catbird, Northern Mockingbird, Brown Thrasher, American Robin, Northern Cardinal, Evening Grosbeak, Purple Finch
Crataegus flabellata	Hawthorn	Fruit Aug-Sept persistent through winter, cover, nesting	Cedar Waxwing, Fox Sparrow, Rose-breasted Grosbeak, Blue Jay, Gray Catbird, Northern Mockingbird, Brown Thrasher, American Robin, Northern Cardinal, Evening Grosbeak, Purple Finch
Juniperus virginiana	Eastern Red Cedar	Shelter, fruit Sept-Nov persistent through March, nesting	American Robin, Brown Thrasher, Cedar Waxwing, Eastern Bluebird, Evening Grosbeak, Gray Catbird, Northern Mockingbird, Purple Finch, Swainson's Thrush, Northern Cardinal, Fox Sparrow, Yellow-rumped Warbler
Morus rubra	Red Mulberry	Fruit June-Aug	Scarlet Tanager, Blue Jay, Rose-breasted Grosbeak, Great Crested Flycatcher, Northern Mockingbird, Gray Catbird, Brown Thrasher, American Robin, Wood Thrush, Swainson's Thrush, Eastern Bluebird, Cedar Waxwing, Red-eyed Vireo, Northern Cardinal, Indigo Bunting, Purple Finch, White-throated Sparrow
Picea glauca	White Spruce	Shelter, seeds Aug-Nov, needles, cavity	Black-capped Chickadee, White-breasted Nuthatch, Blue Jay, Northern Mockingbird, American Robin, Wood Thrush, Swainson's Thrush, Cedar Waxwing, Blackburnian Warbler, Evening Grosbeak, Purple Finch, Pine Siskin, White-throated Sparrow, Yellow-rumped Warbler
Pinus strobus	Eastern White Pine	Seeds Aug-Sept, needles, cover, nesting, cavity	Blue Jay, White-breasted Nuthatch, Black-capped Chickadee, Pine Siskin, Brown Thrasher, Wood Thrush, American Robin, Cedar Waxwing, Blackburnian Warbler, Eastern Meadowlark, Northern Cardinal, Evening Grosbeak, Purple Finch, White-throated Sparrow, Yellow-rumped Warbler
Prunus pensylvanica	Pin Cherry	Fruit July-Sept persistent into winter	Eastern Bluebird, Blue Jay, Rose-breasted Grosbeak, Scarlet Tanager, Great Crested Flycatcher, Northern Mockingbird, Gray Catbird, Brown Thrasher, American Robin, Wood Thrush, Swainson's Thrush, Cedar Waxwing, Red-eyed Vireo, Northern Cardinal, Evening Grosbeak, White-throated Sparrow

Prunus serotina	Black Cherry	Fruit June-Oct, cover, nesting	Baltimore Oriole, Northern Mockingbird, Rose-breasted Grosbeak, White-throated Sparrow, Blue Jay, Scarlet Tanager, Great Crested Flycatcher, Gray Catbird, Brown Thrasher, American Robin, Wood Thrush, Swainson's Thrush, Eastern Bluebird, Cedar Waxwing, Red-eyed Vireo, Northern Cardinal, Evening Grosbeak, White-throated Sparrow
Quercus alba	White Oak	Fruit Sept-Nov, cover, nesting	Baltimore Oriole, Blue Jay, Scarlet Tanager, Black-capped Chickadee, White-breasted Nuthatch, Brown Thrasher, American Robin, Eastern Meadowlark, Rose-breasted Grosbeak
Quercus macrocarpa	Bur Oak	Cavity Tree, nuts	Baltimore Oriole, Blue Jay, Scarlet Tanager, Black-capped Chickadee, White-breasted Nuthatch, Brown Thrasher, American Robin, Eastern Meadowlark, Rose-breasted Grosbeak
Quercus rubra	Northern Red Oak	Fruit Sept-Oct persistent to Dec, cover, nesting	Baltimore Oriole, Blue Jay, Scarlet Tanager, Black-capped Chickadee, White-breasted Nuthatch, Brown Thrasher, American Robin, Eastern Meadowlark, Rose-breasted Grosbeak
Sorbus americana	American Mountain Ash	Fruit Aug-Oct persistent to March	Brown Thrasher, Cedar Waxwing, Eastern Bluebird, Gray Catbird, Rose-breasted Grosbeak, Evening Grosbeak, American Robin, Wood Thrush, Swainson's Thrush
Tsuga canadensis	Eastern hemlock	Seeds Sept-Oct persistent through winter, needles, cover, nesting	Black-capped Chickadee, White-breasted Nuthatch, Blue Jay, Gray Catbird, Brown Thrasher, American Robin, Wood Thrush, Blackburnian Warbler, Pine Siskin, White-throated Sparrow, Fox Sparrow
Shrubs			
Alnus rugosa	Speckled Alder	Seeds Aug-Oct persistent to Dec, buds, cover, nesting	Rose-breasted Grosbeak, Pine Siskin, Purple Finch, American Tree Sparrow, Fox Sparrow
Cornus alternifolia	Pagoda Dogwood	Fruit late July-Sept, buds, cover, nesting	Brown Thrasher, Cedar Waxwing, Eastern Bluebird, Wood Thrush, Swainson's Thrush, Rose-breasted Grosbeak, Great Crested Flycatcher, Northern Mockingbird, Gray Catbird, American Robin, Red-eyed Vireo, Scarlet Tanager, Northern Cardinal, Evening Grosbeak, Purple Finch, White-throated Sparrow
Cornus amomum	Silky Dogwood	Fruit Aug-Oct, cover, nesting	Wood Thrush, Swainson's Thrush, Eastern Bluebird, American Robin, Gray Catbird, Brown Thrasher, Cedar Waxwing, Purple Finch
Cornus racemosa	Gray Dogwood	Fruit July-Oct persistent to early winter, cover, nesting	Eastern Bluebird, Northern Cardinal, Wood Thrush, Swainson's Thrush, Rose-breasted Grosbeak, Gray Catbird, American Robin, Cedar Waxwing
Cornus stolonifera	Red-osier dogwood	Fruit July-Oct, dense cover, nesting	Gray Catbird, Brown Thrasher, American Robin, Swainson's Thrush, Eastern Bluebird, Cedar Waxwing, Purple Finch, White-throated Sparrow

Ilex verticillata	Winterberry	Fruit Aug-Oct persistent into winter, cover, nesting	American Robin, Wood Thrush, Swainson's Thrush, Eastern Bluebird, Black-capped Chickadee, Blue Jay, Northern Mockingbird, Gray Catbird, Brown Thrasher, Cedar Waxwing
Juniperus communis	Common Juniper	Fruit Sept-Nov, cover	Cedar Waxwing, Eastern Bluebird, Purple Finch, Northern Mockingbird, Gray Catbird, American Robin, Evening Grosbeak, Yellow-rumped Warbler
Lindera benzoin	Spicebush	Fruit July-Oct	American Robin, Eastern Bluebird, Swainson's Thrush, Wood Thrush, Red-eyed Vireo, Northern Cardinal, White-throated Sparrow, Gray Catbird, Great Crested Flycatcher
Myrica pensylvanica	Northern Bayberry	Fruit June-April very persistent	Black-capped Chickadee, Northern Mockingbird, Gray Catbird, Brown Thrasher, Eastern Bluebird, Scarlet Tanager, Eastern Towhee, Eastern Meadowlark, Yellow-rumped Warbler
Prunus virginiana	Chokecherry	Fruit July-Oct	Eastern Bluebird, Blue Jay, Rose-breasted Grosbeak, Scarlet Tanager, Great Crested Flycatcher, Northern Mockingbird, Gray Catbird, Brown Thrasher, American Robin, Wood Thrush, Swainson's Thrush, Cedar Waxwing, Red-eyed Vireo, Northern Cardinal, Evening Grosbeak, White-throated Sparrow
Rhus glabra	Smooth Sumac	Fruit Aug-Oct persistent to following summer	Eastern Bluebird, Gray Catbird, Wood Thrush, Swainson's Thrush, Blue Jay, Purple Finch, Northern Cardinal, Northern Mockingbird, Brown Thrasher, American Robin, Red-eyed Vireo, Yellow-rumped Warbler
Rhus typhina	Staghorn Sumac	Fruit Aug-Sept persistent through winter	American Robin, Red-eyed Vireo, Eastern Bluebird, Blue Jay, Black-capped Chickadee, Northern Mockingbird, Gray Catbird, Brown Thrasher, Cedar Waxwing, Northern Cardinal
Rosa palustris	Swamp Rose	Fruit Aug-Sept persistent through winter, cover, nesting	Cedar Waxwing, Swainson's Thrush, Northern Mockingbird, Gray Catbird, Brown Thrasher, American Robin, Wood Thrush, Eastern Bluebird, Northern Cardinal, Evening Grosbeak, American Tree Sparrow, Fox Sparrow
Rubus allegheniensis	Common Blackberry	Brambles, fruit July-Sept, dense cover, nesting	Blue Jay, Gray Catbird, Cedar Waxwing, Baltimore Oriole, Northern Mockingbird, Brown Thrasher, American Robin, Wood Thrush, Swainson's Thrush, Eastern Bluebird, Red-eyed Vireo, Scarlet Tanager, Northern Cardinal, Rose-breasted Grosbeak, Evening Grosbeak, Indigo Bunting, Eastern Towhee, White-throated Sparrow, Fox Sparrow, Great Crested Flycatcher

Rubus occidentalis	Black Raspberry	Brambles, fruit July-Aug, dense cover, nesting	Blue Jay, Gray Catbird, Cedar Waxwing, Baltimore Oriole, Northern Mockingbird, Brown Thrasher, American Robin, Wood Thrush, Swainson's Thrush, Eastern Bluebird, Red-eyed Vireo, Scarlet Tanager, Northern Cardinal, Rose-breasted Grosbeak, Evening Grosbeak, Indigo Bunting, Eastern Towhee, White-throated Sparrow, Fox Sparrow, Great Crested Flycatcher
Salix discolor	Pussy Willow	Catkins April-May, buds, twigs	Northern Cardinal, Purple Finch, Evening Grosbeak
Sambucus canadensis	American Elder	Fruit July-Sept, cover, nesting	American Robin, Eastern Bluebird, Northern Cardinal, Rose-breasted Grosbeak, Great Crested Flycatcher, Blue Jay, Northern Mockingbird, Gray Catbird, Brown Thrasher, Wood Thrush, Swainson's Thrush, Cedar Waxwing, Indigo Bunting, Eastern Towhee, White-throated Sparrow
Symphoricarpos orbiculatus	Coralberry	Fruit Sept-Dec or longer	Evening Grosbeak, American Robin, Brown Thrasher, Wood Thrush, Cedar Waxwing, Northern Cardinal, Purple Finch
Vaccinium corymbosum	Highbsh Blueberry	Fruit June-Sept	American Robin, Brown Thrasher, Eastern Bluebird, Eastern Towhee, Gray Catbird, Northern Cardinal, Northern Mockingbird, Scarlet Tanager, Blue Jay, Great Crested Flycatcher, Black-capped Chickadee, Cedar Waxwing, Baltimore Oriole, American Tree Sparrow, White-throated Sparrow, Wood Thrush
Viburnum lentago	Nannyberry	Fruit Aug-Oct, cover, nesting	American Robin, Cedar Waxwing, Eastern Bluebird, Gray Catbird, Black-capped Chickadee, Rose-breasted Grosbeak, Purple Finch
Viburnum rafinesquianum	Downy arrowwood	Fruit late Aug-Nov	Black-capped Chickadee, Gray Catbird, Brown Thrasher, American Robin, Eastern Bluebird, Red-eyed Vireo, Rose-breasted Grosbeak
Viburnum trilobum	Highbush Cranberry	Fruit Aug-Oct persistent throughout winter	Brown Thrasher, Cedar Waxwing, Black-capped Chickadee, Eastern Bluebird, Northern Cardinal, Great Crested Flycatcher, Northern Mockingbird, Gray Catbird, American Robin, Wood Thrush, Swainson's Thrush, Cedar Waxwing, Rose-breasted Grosbeak, Purple Finch, White-throated Sparrow
Vines			
Celastrus scandens	American Bittersweet	Fruit Aug-Dec or longer	Northern Mockingbird, Gray Catbird, American Robin, Eastern Bluebird, Cedar Waxwing, Red-eyed Vireo, Northern Cardinal
Parthenocissus quinquefolia	Virginia Creeper	Fruit Aug-Feb	Red-eyed Vireo, Swainson's Thrush, Wood Thrush, Rose-breasted Grosbeak, Great Crested Flycatcher, Black-capped Chickadee, White-breasted Nuthatch, Northern Mockingbird, Gray Catbird, Brown Thrasher, American Robin, Eastern Bluebird, Yellow-rumped Warbler, Scarlet Tanager, Purple Finch, Fox Sparrow

Vitis riparia	Riverbank Grape	Fruit Aug-Sept, cover, nesting	Blue Jay, Rose-breasted Grosbeak, Great Crested Flycatcher, Northern Mockingbird, Gray Catbird, Brown Thrasher, American Robin, Wood Thrush, Swainson's Thrush, Eastern Bluebird, Cedar Waxwing, Red-eyed Vireo, Scarlet Tanager, Baltimore Oriole, Northern Cardinal, Purple Finch, Fox Sparrow
Perennials			
Aster puniceus	Purple-stemmed Aster	Wildflowers, seeds	American Tree Sparrow, Black-capped Chickadee, Eastern Towhee, Fox Sparrow, Indigo Bunting, Northern Cardinal, White-throated Sparrow
Aster novae-angliae	New England Aster	Wildflowers, seeds	American Tree Sparrow, Black-capped Chickadee, Eastern Towhee, Fox Sparrow, Indigo Bunting, Northern Cardinal, White-throated Sparrow
Aster simplex	Panicled Aster	Wildflowers, seeds	American Tree Sparrow, Black-capped Chickadee, Eastern Towhee, Fox Sparrow, Indigo Bunting, Northern Cardinal, White-throated Sparrow
Echinacea purpurea	Purple Coneflower	Wildflowers	American Tree Sparrow, Pine Siskin
Fragaria virginiana	Wild strawberry	Wildflowers	American Robin, Brown Thrasher, Cedar Waxwing, Eastern Towhee, Gray Catbird, Rose-breasted Grosbeak, Wood Thrush, Swainson's Thrush, Eastern Bluebird
Helianthus spp	Sunflowers	Wildflowers	American Tree Sparrow, Black-capped Chickadee, Eastern Meadowlark, Fox Sparrow, Purple Finch, White-breasted Nuthatch, Blue Jay
Rudbeckia hirta	Black-eyed Susans	Wildflowers	American Tree Sparrow, Black-capped Chickadee, Eastern Towhee, Fox Sparrow, Northern Cardinal, Purple Finch, White-breasted Nuthatch, White-throated Sparrow
Grasses			
Schizachyrium scoparium	Little Bluestem	Seeds	American Tree Sparrow, Fox Sparrow, White-throated Sparrow
Groundcover			
Arctostaphylos uva-ursi	Bearberry	Evergreen cover and shelter, berries July-Oct persistent to March	Fox Sparrow
Vaccinium angustifolium	Low-sweet blueberry	Fruit July-Sept	American Robin, Brown Thrasher, Eastern Bluebird, Eastern Towhee, Gray Catbird, Northern Cardinal, Northern Mockingbird, Scarlet Tanager, Blue Jay, Swainson's Thrush, Wood Thrush

Stormwater Gardens

Purpose

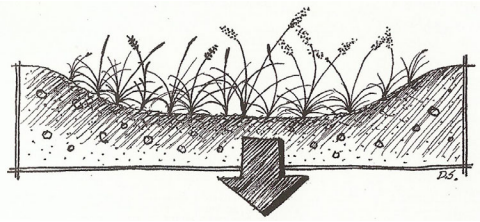
A stormwater garden is used to improve the quality of stormwater. They are generally used in places of high runoff to intercept, slow, and clean stormwater before it can return to natural aquatic ecosystems. However, they can also be placed in areas of high pedestrian traffic as a showcase for educational purposes. The goals of sustainable stormwater management are to slow water, clean water, and keep water. Slowing water allows infiltration to occur and prevents runoff from being whisked away to storm drains. This also keeps the water cooler, and the soils and microclimate of the ecosystem cooler. Pollutants can be removed from water through sustainable stormwater management, to prevent causing harm in natural aquatic ecosystems. Keeping the water in the soil keeps the water in the terrestrial ecosystem, allowing it to be available to plants and wildlife, and reducing drought conditions between storms.

- *Aesthetics:* Stormwater gardens can often support wetland species that normally cannot survive in the average garden. This provides a new variety of plants, colors, and flowers that are unique. Also, people are fascinated with water and a stormwater garden can incorporate flowing water into a beautiful design.
- *Education:* Stormwater goes mostly unnoticed until a drainage system fails. Most people do not consider where it goes, as it is out of sight, out of mind. The reality is that most of it flows into a storm sewer and is directed to the nearest river. This prevents the water from being used by plants and animals that rely on rain for subsistence. Rain gardens can help educate people about the importance of water in the terrestrial ecosystem and in the soil.
- *Contamination Treatment:* The stormwater that falls into the sewers flows over surfaces and picks up contaminants including petroleum, oils, fertilizer, feces, and other unpleasantries that make the water high in nutrients and toxins. Stormwater gardens can allow the water to slow down so plants can remediate some of these toxins before it enters the natural river system. Phytoremediation is the process by which contaminants are taken up or broken down by plants. Choosing plants that are particularly good at phytoremediation is especially important for a garden to provide this important service.
- *Wildlife and Biodiversity:* Stormwater gardens are planted with a high diversity of moisture-tolerant plants. This high diversity of plantings is more efficient at taking up water and treating the contaminants there in, and also improves the habitat value of the garden. Stems of perennials left standing over the winter provide homes for many invertebrates and seeds for birds.
- *Bioretention:* Bioretention is a land-based practice that uses the chemical, biological, and physical properties of plants, microbes, and soils to control both

the quality of water and the quantity of water within a landscape.[viii] Holding water in the land and in plants essentially keeps it available to the terrestrial ecosystem and prevents drought conditions between rainfalls.

Raingardens

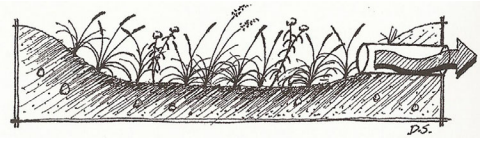
Raingardens are very shallow planted depressions that encourage surface run-off to infiltrate into the soil and promote bioretention. In cases where the soil is relatively impervious, 4'-6' of sandy soil may be substituted under the garden. Raingardens are no more than 1' deep in the center, and are not meant to hold or transport water. They allow for water to infiltrate back into the ground, be held in the plants, and slowly return to the water table or the natural river system. Raingardens also allow for suspended solids and particles to settle or be filtered out of suspension, nutrients or heavy metals assimilated into plant material, dissolved pollutants can adhere to plant roots, soil particles, or other organic matter and be pulled out of the water, and decomposition of chemicals and organic matter. At Boyne Mountain, a raingarden could exist anywhere that runoff could feed it. Specific areas to look for are where runoff from large impervious areas such as parking lots or roofs drain. Raingardens can be inconspicuous plantings alongside a parking lot, or beautiful showy educational gardens to help guests learn about the importance of stormwater in the landscape.



Source: Shaw and Schmidt, 2003

Bioswales

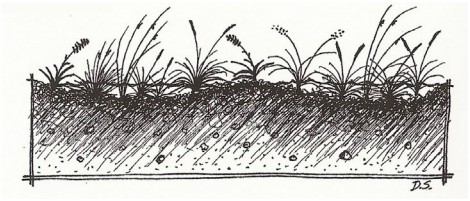
Bioswales are long linear depressions used to move stormwater to a desired destination. A traditional swale is simply a trench planted with turf or other monoculture. A bioswale is different in that it is planted with a large diversity wetland plants that act to slow the water and clean it as it moves it to a desired destination. Bioswales also promote bioretention, but their main purpose is to move water, in a manner that is sensitive to the needs of the terrestrial ecosystem. They usually are graded at a maximum slope of 2%, and their bottoms are typically moist long after a storm because they do not have supplemental drainage material under them. Bioswales would be appropriate at Boyne Mountain along roads, in parking lots, along trails, or along any linear design feature such as a building or tennis court.



Source: Shaw and Schmidt, 2003

Constructed Wetlands

Constructed wetlands are larger systems meant to treat larger amounts of stormwater before it moves into a natural aquatic ecosystem. They do not work as well as natural wetlands for water quality control, but in areas where natural wetlands are no longer present, they are the most appropriate way to sustainably improve water quality. Constructed wetlands usually have a large input of water, like a stream or a river, that brings a consistent flow to the wetland. They are perpetually wet, and depending on the wetland design, can hold as much as 6' of water. In developed areas, constructed wetlands usually have to be set aside with a fence to keep exploring children out of them. At Boyne Mountain, a constructed wetland would be appropriate between the golf course and Deer Lake to treat the runoff water, rich in nutrients from the fertilizer and pollutants on the golf course, before it enters the lake.



Source: Shaw and Schmidt, 2003

Retention Ponds

Retention ponds are basins that permanently hold water. Water is lost from these ponds if it is pumped out or evaporates. Retention ponds can play an important role in removing pollution from water if they are vegetated and are able to mimic a natural aquatic ecosystem. Pollutants can settle out of water as it slows down in the pond, or be phytoremediated by plants. These plantings should be able to withstand periodic flooding as well as times of drought when the water levels are low. Planting a high diversity of plants provides habitat value on the edges of the ponds that can sustain insects, butterflies, dragonflies, amphibians, reptiles, and birds which can greatly increase the biodiversity of the area. Vegetating the edges of the pond can also make the pond much more attractive as many wetland plant species have beautiful blooms throughout the season. Plants should vary from upland plants, marginal plants, emergents, floating-leaved aquatics, and submerged aquatics, shown as zones 5 through 1 on Figure 3 to the right, providing a variety of habitat as well as aesthetic variety. The retention ponds at Boyne Mountain could easily be planted and become very valuable wildlife habitat, as well as more visually interesting for the guests. Also, providing more diverse habitat will attract a larger variety of waterfowl, which could provide some competition for the Canadian geese, and keep them to lower levels.

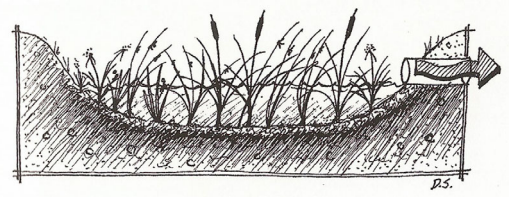


Figure 2

Source: Shaw and Schmidt, 2003

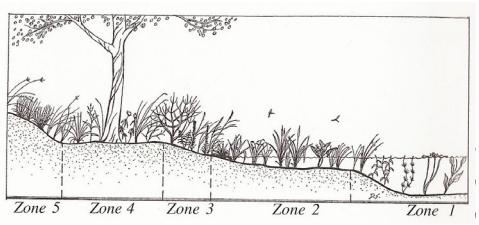


Figure 3

Source: Shaw and Schmidt, 2003

Permeable Paving

Although permeable paving is not a stormwater garden type, it is included here because paving is often a major characteristic of the developed landscape, and is a large barrier to the goals of sustainable stormwater management. Impermeable pavement does not allow water to infiltrate through it, is often warmer than the soil and warms the stormwater, and holds pollutants until the water washes it off into the storm drain. A variety of permeable paving alternatives exist varying from permeable asphalt to be used on roads and parking areas, to permeable bricks for patios and pedestrian walks. These permeable pavings allow the water to infiltrate through the paving into the soil below. The infiltrated water is slowed, and it moves through subsurface flow either to the water table or to the natural river system without ever entering a sewer. At Boyne Mountain, when repair or replacement is needed, any of the outdoor patio areas can be replaced with permeable pavers or permeable bricks and the parking areas and roads can be replaced with permeable asphalt. New development and garden design should consider permeable alternatives to conventional paving methods.

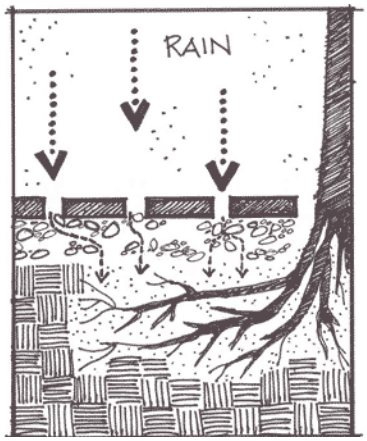


Figure 4

Source: <www.cityfarmer.org>

Stormwater Garden Plant Characteristics

Different plant types play different, vital roles in a stormwater garden. Depending on the main roles a property owner wants the stormwater garden to play in the landscape, different proportions of each plant type may be chosen for garden function.

- *Trees and Shrubs:* Significant influence on evapotranspiration and high capacity for nutrient uptake, roots aid infiltration, roots absorb large amounts of water, provide vertical structure in the landscape and provide winter form for gardens, and important habitat for many wildlife species.
- *Grasses, Sedges, and Rushes:* Roots of prairie grasses extend deep into the ground aiding in infiltration and evapotranspiration, dense roots stabilize soil, wetland sedges and bulrushes have shallow roots but aid in evapotranspiration, grasses generally have many stems and produce thatch that slows water flow and facilitates filtration, efficient at nutrient uptake, add winter form and interest to the landscape, and have high wildlife value.
- *Forbs and Ferns:* Roots of prairie forbs can extend deep into the ground and aid in infiltration and evapotranspiration, wetland forbs generally have shallow roots

but aid in evapotranspiration, native forbs add aesthetic appeal to the landscape, and have high wildlife value. [ix]

Suggested Stormwater Garden Plant Characteristics

Plants used in stromwater gardens must exhibit certain characteristics in order to be successful. Depending on the location and purpose of a garden, some of these characteristics may have variable priority in plant choice.

- *Inundation and Drought Tolerance:* Stormwater gardens vary from flooded to dry on a regular basis. Plants chosen should be able to tolerate and thrive on a range of moisture conditions.
- *Habitat Value:* Wildlife is an important asset to a stormwater garden, and should be accommodated in the choices of plants. Fruits, flowers, and structure are all habitat factors to consider, and a variety should be provided.
- *Phytoremediation Capabilities:* The ability of the chosen plants to phytoremediate is especially important if the runoff entering the garden is contaminated, or the soil around the garden is contaminated. Certain plants do much better at assimilating and breaking down toxins than others.
- *Blooms:* Flowers provide color and aesthetic quality to a stormwater garden, and plants should be chosen so there are always active blooms throughout the season, both for beauty and habitat value.
- *Winter Interest:* Many wetland perennials that look bright and colorful in the summer melt down into brown mats in the winter. Providing woody plants and grasses that hold their form through the winter is very important to maintaining a cared-for garden through all four seasons.

Suggested Raingarden Plant Profiles

Table 8

Botanical Name	Common Name	Bloom Time	Habitat Value
Base Trees and Shrubs			
Aronia melanocarpa	Black Chokeberry	White, May	Fruit persistent through winter and eaten by gamebirds, songbirds, large and small mammals
Cephalanthus occidentalis	Buttonbush	White, June-Aug	Nectar source and habitat for insects and hummingbirds, waterfowl eat its seeds as well as beaver and muskrats, habitat for birds and reptiles
Cornus stolonifera	Red-osier Dogwood	White, May-June	Flowers attract common blue butterflies, fruit and buds used by wood ducks, marsh birds, shorebirds, songbirds, and gamebirds, excellent warbler and American goldfinch habitat.
Ilex verticillata	Winterberry	Greenish-white, June	Fruit extensively eaten by songbirds, ruffed grouse, turkeys, pheasants, yellow-bellied sapsuckers, and

			mammals
Viburnum trilobum	Highbush Cranberry	White, June	Fruit eaten by many gamebirds and songbirds, and also by chipmunks, white-footed mice, beaver, rabbits, and skunks
Base Forbs and Ferns			
Agastache foeniculum	Giant Hyssop	Blue, June-Oct	Flowers attract bees and butterflies
Angelica atropurpurea	Angelica	White, June	Habitat for upland gamebirds and songbird, bee and butterfly attractant
Asclepias incarnata	Marsh Milkweed	Pink, June-August	Host and nectar plant for monarch butterflies, fibers from old stems used by birds for nests, bees and butterfly attractant
Aster novae-angliae	New England Aster	Purple, July-Frost	Great nectar source, visited by migrating monarch butterflies, waterfowl cover
Aster puniceus	Red-stemmed Aster	Lavender, Aug-Oct	Waterfowl cover, butterfly and bee attractant
Boltonia asteroides	Boltonia	White, Aug-Oct	Bee and butterfly attractant
Chelone glabra	Turtlehead	White, July-Oct	Host plant for several butterflies, attracts hummingbirds and other insects, host plant for threatened Baltimore Butterfly
Eupatorium maculatum	Joe-pye-weed	Pink, July-Sept	Attracts butterflies, bees, and many other insects, cover for small mammals, amphibians, and reptiles, swamp sparrows and turkeys eat the seeds
Eupatorium perfoliatum	Boneset	White, July-Sept	Excellent nectar provider from bronze copper, monarch, crescent, and fritillary butterflies, turkeys, swamp sparrows, and some waterfowl eat the fruit, mallards and ruffed grouse eat the leaves, cover for small mammals, reptiles, and amphibians
Iris versicolor	Blueflag	Purplish-blue, May-July	Nectar for hummingbirds and butterflies, waterfowl and other birds eat the seeds, cover for marsh birds, fish, and amphibians, habitat for many insects
Liatris ligulistylis	Meadow blazingstar	Rosy-purple, July-Aug	Butterfly attractant and birds eat the seeds
Liatris pychnostyachya	Prairie blazingstar	Purple, July-Sept	Nectar source and butterfly attractant
Lilium superbum	Turk's-cap Lily	Orange, June-Aug	Nectar for hummingbirds and orioles
Lobelia cardinalis	Cardinal Flower	Red, July-Sept	Great nectar source for hummingbirds, orioles, and butterflies, pollinated by hummingbirds
Lobelia siphilitica	Blue Lobelia	Blue, July-Oct	Nectar source and songbirds eat seeds
Onoclea sensibilis	Sensitive Fern	Pale red fiddle-heads in spring	Cover for small mammals and songbirds
Osmunda regalis	Royal Fern	N/A	Cover for small mammals and songbirds
Physostegia virginiana	Obedient Plant	Rosy-pink, July-Oct	Nectar source for hummingbirds and butterflies
Pteridium aquilinum	Bracken Fern	N/A	Cover for small mammals and songbirds
Rudbeckia subtomentosa	Brown-eyed Susan	Yellow, July-Sept	Food and habitat for birds and butterflies
Silphium perfoliatum	Cup Plant	Yellow, July-Sept	Seeds eaten by meadow mice, goldfinches, and sharp-tailed grouse, butterfly and hummingbird attractant, cups hold water for wildlife after storms
Base Grasses, Sedges, and Rushes			
Equisetum fluviatile	Horsetail	N/A	Fish cover and habitat, primary food source for trumpeter swans

Sides Trees and Shrubs			
Aronia melanocarpa	Black Chokeberry	White, May	Fruit persistent through winter and eaten by gamebirds, songbirds, large and small mammals
Cornus racemosa	Gray Dogwood	White, May-July	Flowers attract the common blue butterfly, fruit and buds are used by wood ducks, marsh birds, shorebirds, songbirds, and game birds, habitat for large and small mammals
Viburnum trilobum	Highbush Cranberry	White, June	Fruit eaten by many gamebirds and songbirds, and also by chipmunks, white-footed mice, beaver, rabbits, and skunks
Sides Forbs and Ferns			
Arisaema triphyllum	Jank-in-the-pulpit	Green, April-May	Fruit and leaves eaten by gamebirds, wood thrushes, wood ducks, and mammals
Artemisia ludoviciana	Prairie Sedge	Not showy	Habitat and cover for small birds and mammals
Asclepias tuberosa	Butterfly Milkweed	Orange, June-Sept	Host plant for gray hairstreak and monarch butterfly caterpillars, excellent nectar source for all butterflies
Aster laevis	Smooth Aster	Lavender-blue, Aug-Oct	Attracts the orange sulphur butterfly
Aster macrophyllus	Bigleaf Aster	Lilac, Aug-Oct	Cover and nesting habitat for songbirds of the forest floor
Aster pilosus	Frost Aster	White, Aug-Nov	Waterfowl cover, butterfly and bee attractant
Epilobium angustifolium	Fireweed	Rose-purple, June-Aug	Good nectar source for butterflies, bees, insects, and hummingbirds
Liatris ligulistylis	Meadow blazingstar	Rosy-purple, July-Aug	Butterfly attractant and birds eat the seeds
Liatris pychnostyachya	Prairie blazingstar	Purple, July-Sept	Nectar source and butterfly attractant
Lilium superbum	Turk's-cap Lily	Orange, June-Aug	Nectar for hummingbirds and orioles
Matteuccia struthiopteris	Ostrich Fern	N/A	Cover for small mammals and songbirds
Monarda fistulosa	Wild bergamot	Lavender, July-Aug	Nectar source for butterflies, bees, and hummingbirds
Osmunda regalis	Royal Fern	N/A	Cover for small mammals and songbirds
Pteridium aquilinum	Bracken Fern	N/A	Cover for small mammals and songbirds
Ratibida pinnata	Yellow Coneflower	Yellow, July-Oct	Provides seed for the American goldfinch and other songbirds and gamebirds, attracts butterflies and other insects
Rudbeckia subtomentosa	Brown-eyed Susan	Yellow, July-Sept	Food and habitat for birds and butterflies
Sides Grasses, Sedges, and Rushes			
Andropogon gerardii	Big Bluestem	Bronze, July	Food for delaware skipper, cover and food for gamebirds and songbirds
Bromus ciliatus	Fringed Brome	June-July	Seeds eaten by a number of birds and rodents
Panicum virgatum	Switchgrass	Beige, July-Oct	Food source for ground-feeding songbirds and gamebirds, good cover, food source for muskrats and rabbit
Schizachyrium scoparium	Little Bluestem	Reddish-brown, July-Sept	Principle wildlife food for songbirds in open and prairie areas
Sorghastrum nutans	Indian Grass	Golden-brown, Aug-Sept	Seeds for gamebirds and songbirds, good winter cover, butterfly attractant

Suggested Bioswale Plant Profiles

Table 9

Botanical Name	Common Name	Bloom Time	Habitat Value
Forbs and Ferns			
Artemisia ludoviciana	Prairie Sedge	Not showy	Habitat and cover for small birds and mammals
Asclepias incarnata	Marsh Milkweed	Pink, June-August	Host and nectar plant for monarch butterflies, fibers from old stems used by birds for nests, bees and butterfly attractant
Aster puniceus	Red-stemmed Aster	Lavender, Aug-Oct	Waterfowl cover, butterfly and bee attractant
Lobelia siphilitica	Blue Lobelia	Blue, July-Oct	Nectar source and songbirds eat seeds
Verbena hastata	Blue Vervain	Purplish-blue, July-Aug	Sandpipers, lark buntings, cardinals, juncos, and sparrows eat the seeds, rabbits and other small mammals eat the shoots and plants, nectar source for bees and butterflies
Grasses, Sedges, and Rushes			
Andropogon gerardii	Big Bluestem	Bronze, July	Food for delaware skipper, cover and food for gamebirds and songbirds
Bromus ciliatus	Fringed Brome	June-July	Seeds eaten by a number of birds and rodents
Calamagrostis canadensis	Canada blue-joint Grass	Brown, May-Aug	Songbirds and waterfowl eat the seeds, stands up well in winter making it a good source of food and cover for songbirds
Carex bebbii	Bebb's Sedge	Green, May-June	Fruits eaten by many birds including songbirds, cover for ducks
Elymus virginicus	Virginia Wild Rye	Tan, June-Oct	Palatable for many browsers, blackbirds, and quail
Glyceria striata	Fowl Manna Grass	Purplish-green, June-Aug	Cover and food for waterfowl and muskrats
Juncus effusus	Soft Rush	Green, July-Aug	Roots occasionally provide food for muskrats, deer, rodents, rabbits, waterfowl, upland gamebirds, marsh birds, and songbirds eat the seeds, nesting habitat for rails, ducks, and insects
Panicum virgatum	Switchgrass	Beige, July-Oct	Food source for ground-feeding songbirds and gamebirds, good cover, food source for muskrats and rabbit
Spartina pectinata	Prairie Cord Grass	Greenish-yellow, July-Aug	Food source for ducks, habitat for marsh wrens and muskrats

Suggested Wetland Plant Profiles

Table 10

Botanical Name	Common Name	Bloom Time	Habitat Value
Trees and Shrubs			
Alnus rugosa	Speckled Alder	Not showy, March	High value for songbirds, gamebirds, waterbirds, small mammals, and cover for many animals

Aronia melanocarpa	Black Chokeberry	White, May	Fruit persistent through winter and eaten by gamebirds, songbirds, large and small mammals
Betula nigra	River Birch	Yellowish, April-May	Seeds and nesting for songbirds and upland gamebirds
Cephalanthus occidentalis	Buttonbush	White, June-Aug	Nectar source and habitat for insects and hummingbirds, waterfowl eat its seeds as well as beaver and muskrats, habitat for birds and reptiles
Cornus amomum	Silky Dogwood	White, May-July	Fruit and buds used by wood ducks, marsh birds, shorebirds, songbirds, and gamebirds
Cornus racemosa	Gray Dogwood	White, May-July	Flowers attract the common blue butterfly, fruit and buds are used by wood ducks, marsh birds, shorebirds, songbirds, and game birds, habitat for large and small mammals
Cornus stolonifera	Red-osier Dogwood	White, May-June	Flowers attract common blue butterflies, fruit and buds used by wood ducks, marsh birds, shorebirds, songbirds, and gamebirds, excellent warbler and American goldfinch habitat
Ilex verticillata	Winterberry	Greenish-white, June	Fruit extensively eaten by songbirds, ruffed grouse, turkeys, pheasants, yellow-bellied sapsuckers, and mammals
Salix discolor	Pussy Willow	Silky catkins, May-June	Buds are staples for ruffed and sharp-tailed grouse, songbirds, waterfowl, and marsh birds, rabbits, squirrels, porcupines, muskrats, beavers, elk, moose, and deer eat the twigs, foliage, and bark
Sambucus pubens	Red-berried Elder	White, April-May	Important food source for songbirds and gamebirds in summer, rabbits eat fruit and bark
Viburnum lentago	Nannyberry	White, May-June	Fruit eaten by many gamebirds and songbirds, and also by chipmunks, white-footed mice, beaver, rabbits, and skunks
Viburnum trilobum	Highbush Cranberry	White, June	Fruit eaten by many gamebirds and songbirds, and also by chipmunks, white-footed mice, beaver, rabbits, and skunks
Forbs and Ferns			
Agastache foeniculum	Giant Hyssop	Blue, June-Oct	Flowers attract bees and butterflies
Angelica atropurpurea	Angelica	White, June	Habitat for upland gamebirds and songbird, bee and butterfly attractant
Artemisia ludoviciana	Prairie Sedge	Not showy	Habitat and cover for small birds and mammals
Asclepias incarnata	Marsh Milkweed	Pink, June-August	Host and nectar plant for monarch butterflies, fibers from old stems used by birds for nests, bees and butterfly attractant
Aster novae-angliae	New England Aster	Purple, July-Frost	Great nectar source, visited by migrating monarch butterflies, waterfowl cover
Aster puniceus	Red-stemmed Aster	Lavender, Aug-Oct	Waterfowl cover, butterfly and bee attractant
Aster simplex	Panicle Aster	White, Aug-Oct	Bee and butterfly attractant, waterfowl cover
Boltonia asteroides	Boltonia	White, Aug-Oct	Bee and butterfly attractant

Caltha palustris	Marsh marigold	Yelow, April-May	Seeds eaten by game birds, used by frogs and insects as well
Chelone glabra	Turtlehead	White, July-Oct	Host plant for several butterflies, attracts hummingbirds and other insects, host plant for threatened Baltimore Butterfly
Eupatorium maculatum	Joe-pye-weed	Pink, July-Sept	Attracts butterflies, bees, and many other insects, cover for small mammals, amphibians, and reptiles, swamp sparrows and turkeys eat the seeds
Eupatorium perfoliatum	Boneset	White, July-Sept	Excellent nectar provider from bronze copper, monarch, crescent, and fritillary butterflies, turkeys, swamp sparrows, and some waterfowl eat the fruit, mallards and ruffed grouse eat the leaves, cover for small mammals, reptiles, and amphibians
Impatiens capensis	Jewelweed	Orange, June-Sept	Important nectar source for hummingbirds, orioles, and bees, gamebirds and mice eat the seeds, cover for frogs and reptiles
Iris versicolor	Blueflag	Purplish-blue, May-July	Nectar for hummingbirds and butterflies, waterfowl and other birds eat the seeds, cover for marsh birds, fish, and amphibians, habitat for many insects
Liatris ligulistylis	Meadow blazingstar	Rosy-purple, July-Aug	Butterfly attractant and birds eat the seeds
Liatris pychnostyachya	Prairie blazingstar	Purple, July-Sept	Nectar source and butterfly attractant
Lilium superbum	Turk's-cap Lily	Orange, June-Aug	Nectar for hummingbirds and orioles
Lobelia cardinalis	Cardinal Flower	Red, July-Sept	Great nectar source for hummingbirds, orioles, and butterflies, pollinated by hummingbirds
Lobelia siphilitica	Blue Lobelia	Blue, July-Oct	Nectar source and songbirds eat seeds
Monarda fistulosa	Wild bergamot	Lavender, July-Aug	Nectar source for butterflies, bees, and hummingbirds
Onoclea sensibilis	Sensitive Fern	Pale red fiddle-heads in spring	Cover for small mammals and songbirds
Osmunda regalis	Royal Fern	N/A	Cover for small mammals and songbirds
Physostegia virginiana	Obedient Plant	Rosy-pink, July-Oct	Nectar source for hummingbirds and butterflies
Polygonum amphibium	Water Smartweed	Red-pink, June-Aug	Popular with waterfowl and songbirds, major food source for purplish copper butterfly, cover for fish
Pontederia cordata	Pickerelweed	Violet-blue, June-Aug	Seeds for waterfowl, muskrats, cover for frogs and fish, small solitary bee (Halictoides novae-angliae) visits plant exclusively for nectar and pollen
Rudbeckia subtomentosa	Brown-eyed Susan	Yellow, July-Sept	Food and habitat for birds and butterflies
Sagittaria latifolia	Broadleaved arrowhead	White, July-Aug	Waterfowl food and habitat, seeds and tubers food sources for waterfowl, muskrats, beavers, and porcupines, also habitat for insects, reptiles, amphibians, and gamefish
Silphium perfoliatum	Cup Plant	Yellow, July-Sept	Seeds eaten by meadow mice, goldfinches, and sharp-tailed grouse, butterfly and hummingbird attractant, cups hold water for wildlife after storms

Spirea alba	Meadowsweet	White, June-Aug	Valuable to deer, songbirds, and gamebirds, attracts butterflies, moths, and other insects
Verbena hastata	Blue Vervain	Purplish-blue, July-Aug	Sandpipers, lark buntings, cardinals, juncos, and sparrows eat the seeds, rabbits and other small mammals eat the shoots and plants, nectar source for bees and butterflies
Grasses, Sedges, and Rushes			
Andropogon gerardii	Big Bluestem	Bronze, July	Food for delaware skipper, cover and food for gamebirds and songbirds
Bromus ciliatus	Fringed Brome	June-July	Seeds eaten by a number of birds and rodents
Calamagrostis canadensis	Canada blue-joint Grass	Brown, May-Aug	Songbirds and waterfowl eat the seeds, stands up well in winter making it a good source of food and cover for songbirds
Carex aquatilis	Water Sedge	Reddish-brown, June-Aug	Fruits eaten by many birds including songbirds, cover for ducks
Carex bebbii	Bebb's Sedge	Green, May-June	Fruits eaten by many birds including songbirds, cover for ducks
Carex comosa	Bottlebrush Sedge	Green, May-July	Fruits eaten by many birds including songbirds, cover for ducks
Carex languinosa	Wooly Sedg	Green, April-July	Fruits eaten by many birds including songbirds, cover for ducks
Carex stipata	Awl-fruited Sedge	Green, May-July	Fruits eaten by many birds including songbirds, cover for ducks
Carex stricta	Tussock Sedge	Green, April-June	Fruits eaten by many birds including songbirds, cover for ducks
Elymus virginicus	Virginia Wild Rye	Tan, June-Oct	Palatable for many browsers, blackbirds, and quail
Equisetum fluviatile	Horsetail	N/A	Fish cover and habitat, primary food source for trumpeter swans
Glyceria striata	Fowl Manna Grass	Purplish-green, June-Aug	Cover and food for waterfowl and muskrats
Juncus balticus	Baltic Rush	Greenish, May-Aug	Waterfowl, upland gamebirds, marsh birds, and songbirds eat the seeds
Juncus effusus	Soft Rush	Greenish, July-Aug	Waterfowl, upland gamebirds, marsh birds, and songbirds eat the seeds, nesting habitat for rails, ducks, and insects
Leersia oryzoides	Rice-cut Grass	Greenish-white, June-Oct	Seeds eaten by ducks, swamp and tree sparrows, and sora rails, food and cover for invertebrates, reptiles, amphibians, and fish
Panicum virgatum	Switchgrass	Beige, July-Oct	Food source for ground-feeding songbirds and gamebirds, good cover, food source for muskrat and rabbit

Suggested Retention Pond Plant Profiles

Table 11

Botanical Name	Common Name	Bloom Time	Habitat Value
Emergent Trees and Shrubs			

Cephalanthus occidentalis	Buttonbush	White, June-Aug	Nectar source and habitat for insects and hummingbirds, waterfowl eat its seeds as well as beaver and muskrats, habitat for birds and reptiles
Emergent Forbs and Ferns			
Caltha palustris	Marsh marigold	Yelow, April-May	Seeds eaten by game birds, used by frogs and insects as well
Polygonum amphibium	Water Smartweed	Red-pink, June-Aug	Popular with waterfowl and songbirds, major food source for purplish copper butterfly, cover for fish
Pontederia cordata	Pickerelweed	Violet-blue, June-Aug	Seeds for waterfowl, muskrats, cover for frogs and fish, small solitary bee (Halictoides novae-angliae) visits plant exclusively for nectar and pollen
Sagittaria latifolia	Broadleaved arrowhead	White, July-Aug	Waterfowl food and habitat, seeds and tubers food sources for waterfowl, muskrats, beavers, and porcupines, also habitat for insects, reptiles, amphibians, and gamefish
Emergent Grasses, Sedges, and Rushes			
Carex aquatilis	Water Sedge	Reddish-brown, ??	Fruits eaten by many birds including songbirds, cover for ducks
Carex stricta	Tussock Sedge	Green, April-June	Fruits eaten by many birds including songbirds, cover for ducks
Juncus balticus	Baltic Rush	Greenish, May-Aug	Waterfowl, upland gamebirds, marsh birds, and songbirds eat the seeds
Juncus effusus	Soft Rush	Greenish, July-Aug	Waterfowl, upland gamebirds, marsh birds, and songbirds eat the seeds, nesting habitat for rails, ducks, and insects
Wet Meadow Trees and Shrubs			
Sambucus pubens	Red-berried Elder	White, April-May	Important food source for songbirds and gamebirds in summer, rabbits eat fruit and bark
Salix nigra	Black Willow	Yellow-green, April-May	Buds staples for ruffed and sharp-tailed grouse, songbirds, waterfowl, and marsh birds, rabbits, squirrels, porcupine, muskrats, beaver eat twigs, food source for mourning cloak butterfly
Wet Meadow Forbs and Ferns			
Angelica atropurpurea	Angelica	White, June	Habitat for upland gamebirds and songbird, bee and butterfly attractant
Asclepias incarnata	Marsh Milkweed	Pink, June-August	Host and nectar plant for monarch butterflies, fibers from old stems used by birds for nests, bees and butterfly attractant
Aster novae-angliae	New England Aster	Purple, July-Frost	Great nectar source, visited by migrating monarch butterflies, waterfowl cover
Aster simplex	Panicle Aster	White, Aug-Oct	Bee and butterfly attractant, waterfowl cover
Chelone glabra	Turtlehead	White, July-Oct	Host plant for several butterflies, attracts hummingbirds and other insects, host plant for threatened Baltimore Butterfly
Eupatorium maculatum	Joe-pye-weed	Pink, July-Sept	Attracts butterflies, bees, and many other insects, cover for small mammals, amphibians, and reptiles, swamp sparrows and turkeys eat the seeds

Eupatorium perfoliatum	Boneset	White, July-Sept	Excellent nectar provider from bronze copper, monarch, crescent, and fritillary butterflies, turkeys, swamp sparrows, and some waterfowl eat the fruit, mallards and ruffed grouse eat the leaves, cover for small mammals, reptiles, and amphibians
Impatiens capensis	Jewelweed	Orange, June-Sept	Important nectar source for hummingbirds, orioles, and bees, gamebirds and mice eat the seeds, cover for frogs and reptiles
Iris versicolor	Blueflag	Purplish-blue, May-July	nectar for hummingbirds and butterflies, waterfowl and other birds eat the seeds, cover for marsh birds, fish, and amphibians, habitat for many insects
Liatris ligulistylis	Meadow blazingstar	Rosy-purple, July-Aug	Butterfly attractant and birds eat the seeds
Liatris pychnostyachya	Prairie blazingstar	Purple, July-Sept	Nectar source and butterfly attractant
Lilium superbum	Turk's-cap Lily	Orange, June-Aug	Nectar for hummingbirds and orioles
Lobelia cardinalis	Cardinal Flower	Red, July-Sept	Great nectar source for hummingbirds, orioles, and butterflies, pollinated by hummingbirds
Lobelia siphilitica	Blue Lobelia	Blue, July-Oct	Nectar source and songbirds eat seeds
Monarda fistulosa	Wild bergamot	Lavender, July-Aug	Nectar source for butterflies, bees, and hummingbirds
Onoclea sensibilis	Sensitive Fern	Pale red fiddle-heads in spring	Cover for small mammals and songbirds
Osmunda regalis	Royal Fern	N/A	Cover for small mammals and songbirds
Spirea alba	Meadowsweet	White, June-Aug	Valuable to deer, songbirds, and gamebirds, attracts butterflies, moths, and other insects
Verbena hastata	Blue Vervain	Purplish-blue, July-Aug	Sandpipers, lark buntings, cardinals, juncos, and sparrows eat the seeds, rabbits and other small mammals eat the shoots and plants, nectar source for bees and butterflies
Wet Meadow Grasses, Sedges,	and Rushes		
Andropogon gerardii	Big Bluestem	Bronze, July	Food for delaware skipper, cover and food for gamebirds and songbirds
Bromus ciliatus	Fringed Brome	June-July	Seeds eaten by a number of birds and rodents
Calamagrostis canadensis	Canada blue-joint Grass	Brown, May-Aug	Songbirds and waterfowl eat the seeds, stands up well in winter making it a good source of food and cover for songbirds
Carex comosa	Bottlebrush Sedge	Green, May-July	Fruits eaten by many birds including songbirds, cover for ducks
Carex languinosa	Wooly Sedg	Green, April-July	Fruits eaten by many birds including songbirds, cover for ducks
Carex stipata	Awl-fruited Sedge	Green, May-July	Fruits eaten by many birds including songbirds, cover for ducks
Equisetum fluviatile	Horsetail	N/A	Fish cover and habitat, primary food source for trumpeter swans
Panicum virgatum	Switchgrass	Beige, July-Oct	Food source for ground-feeding songbirds and gamebirds, good cover, food source for muskrats and rabbit
Spartina pectinata	Prairie Cord Grass	Greenish-yellow, July-Aug	Food source for ducks, habitat for marsh wrens and muskrats
Floodplain Trees and Shrubs			

Acer saccharinum	Silver Maple	Not showy, Feb-March	Seeds and nesting cover for gamebirds, songbirds, waterbirds, and waterfowl, porcupine, raccoon, squirrel, chipmunk, mice, beaver, deer
Alnus rugosa	Speckled Alder	Not showy, March	High value for songbirds, gamebirds, waterbirds, small mammals, and cover for many animals
Aronia melanocarpa	Black Chokeberry	White, May	Fruit persistent through winter and eaten by gamebirds, songbirds, large and small mammals
Betula nigra	River Birch	Yellowish, April-May	Seeds and nesting for songbirds and upland gamebirds
Celtis occidentalis	Hackberry	Greenish-yellow, April-May	Fruit persistent through winter and eaten by birds, exclusive food source for the hackberry and snout butterflies
Cornus amomum	Silky Dogwood	White, May-July	Fruit and buds used by wood ducks, marsh birds, shorebirds, songbirds, and gamebirds
Cornus stolonifera	Red-osier Dogwood	White, May-June	Flowers attract common blue butterflies, fruit and buds used by wood ducks, marsh birds, shorebirds, songbirds, and gamebirds, excellent warbler and American goldfinch habitat.
Quercus bicolor	Swamp White Oak	Not showy, May	Acorns important food source for wildlife, including songbirds, woodpeckers, and small mammals
Salix discolor	Pussy Willow	Silky catkins, May-June	Buds are staples for ruffed and sharp-tailed grouse, songbirds, waterfowl, and marsh birds, rabbits, squirrels, porcupines, muskrats, beavers, elk, moose, and deer eat the twigs, foliage, and bark
Viburnum lentago	Nannyberry	White, May-June	Fruit eaten by many gamebirds and songbirds, and also by chipmunks, white-footed mice, beaver, rabbits, and skunks
Viburnum trilobum	Highbush Cranberry	White, June	Fruit eaten by many gamebirds and songbirds, and also by chipmunks, white-footed mice, beaver, rabbits, and skunks
Floodplain Forbs and Ferns			
Aster puniceus	Red-stemmed Aster	Lavender, Aug-Oct	Waterfowl cover, butterfly and bee attractant
Boltonia asteroides	Boltonia	White, Aug-Oct	Bee and butterfly attractant
Physostegia virginiana	Obedient Plant	Rosy-pink, July-Oct	Nectar source for hummingbirds and butterflies
Silphium perfoliatum	Cup Plant	Yellow, July-Sept	Seeds eaten by meadow mice, goldfinches, and sharp-tailed grouse, butterfly and hummingbird attractant, cups hold water for wildlife after storms
Floodplain Grasses, Sedges, and Rushes			
Elymus virginicus	Virginia Wild Rye	Tan, June-Oct	Palatable for many browsers, blackbirds, and quail
Leersia oryzoides	Rice-cut Grass	Greenish-white, June-Oct	Seeds eaten by ducks, swamp and tree sparrows, and sora rails, food and cover for invertebrates, reptiles, amphibians, and fish

Functional Design

Determining where on the Boyne Mountain property each garden theme should be located, and to what extent these gardens are initially implemented should respond to the layout and use of space already defined at Boyne, and work within those constraints. We do not suggest ripping out all the existing landscaping and replacing it entirely with educational native gardens at one time. However, having a master plan in mind can help shape a goal for the future. Five factors were considered when locating the educational gardens: high pedestrian traffic nodes on the main lodge area of the resort, visibility from outdoor seating areas and inside buildings, ample sunlight, suitable soil, and respecting the masterplan goals that Boyne Mountain has already accepted and maintained as a part of their current landscaping maintenance plan. These factors resulted in the Mountain Grand Lodge being the priority location for educational gardens.

Helga House: View from West

Since the Helga House Children's center currently has no landscaping, these plant choices and purchases can be focused on native plants that provide interest for children, such as the ones suggested earlier in this chapter. These initial plantings can be the beginning of a children's garden where more and more plants are added each year. If a plan and a design for a children's garden is set beforehand, then which plants to purchase next, and where they should be located is predetermined, and the design can be implemented in phases.

Such is also the case with the other garden themes. Boyne can begin by installing one bioswale adjacent to a parking area. In following years, they can install more bioswales that lead to raingardens or constructed wetlands. Likewise, as plants in existing beds need replaced, choosing to replace them with butterfly host plants such as the ones suggested earlier in this chapter will result in a gradual turnover resulting in complete butterfly gardens.

Mountain Grand Lodge: View from Northeast

The first step is locating the appropriate areas on Boyne's property for each garden theme. The second step is prioritizing these garden themes, and making a commitment to implement them in predetermined phases. The

third step is to have detailed garden designs and plant lists so these gardens are ready for implementation as the funding becomes available or as plants need replaced.

This chapter will provide the first step, a conceptual design suggesting locations for each garden theme around the Mountain Grand Lodge base area. Figure 5 below shows a plan-view of the Mountain Grand Lodge base area with appropriate garden locations highlighted.

Figure 5

Butterfly gardens do not need to be large, and so are appropriate anywhere that butterfly host plants and nectar sources can grow. Figure 5 above shows in pink the small areas throughout the site that can be designed as habitat patches. This patchy layout gives butterflies a series of habitat stepping-stones allowing them to find habitat throughout the site. Providing many small patches of habitat will also encourage butterflies to remain on the site for longer than if only one large habitat patch was provided.

Songbird gardens, however, need to be larger in size and in closer proximity to wooded areas. Most of the plants that provide habitat and food to birds are woody trees and

shrubs, contrasting butterflies, which mostly rely on perennial plants. There are many bird species that are edge-habitat species, meaning that they primarily nest and roost on the edges of wooded areas, coming out only to look for food. Songbird gardens that are larger in size can provide a variety of these larger woody species, which provide a food source for songbirds throughout the year. Locating these gardens on the edges of wooded areas allow these garden to be used by edge-habitat bird species as well as open habitat or prairie grassland bird species.

The proposed Helga House Children's Garden is located around the new Helga House. The main entrance to the garden should be related to the main entrance of the Helga House, and circulation through the garden should relate to the circulation into and out of the Helga House, as well as to the Mountain Villa Condominiums to the east of the garden. Once a detailed survey is created including the exact location and footprint of the Helga House, the design of the children's garden should include the forms and planting suggestions discussed earlier in this chapter.

The stormwater gardens are most appropriately located where they treat stormwater before it runs off the site or into the storm sewer. In Figure 5, the bioswales are located in long, narrow areas along parking areas and roads to treat the runoff as it moves to a raingarden or retention area. The raingardens are located in low areas where stormwater naturally flows. These raingarden sites are meant to infiltrate water back into the ground. The wetland plantings are located around existing retention ponds. These ponds provide an opportunity for wetland habitat if plantings are provided to create habitat opportunities. These planting should not look messy, and should be trimmed and landscaped along with the rest of the grounds. The plantings should also be low to provide views of the fountains and capacity of these ponds.

Existing Clocktower retention pond from North

The Mountain Grand Lodge base area is one small portion of Boyne Mountain's property, covering approximately 68 acres. Implementing the suggested educational garden plan will convert 15 of the 68 acres into viable wildlife habitat, increasing by 22% the area of ecosystem services in the built landscape of Boyne Mountain. The same garden themes that are appropriate in this area have potential throughout the entire Boyne Mountain property. The Mountain Grand Lodge was chosen in this project component because of the heavy traffic it receives from guests. Educational gardens will have the most benefits for education in areas that are most populated by guests and employees. Following the Mountain Grand Lodge base area landscaping, we suggest Boyne next focuses on the landscaping on and around the golf course.

Mountain Grand Lodge from Northwest

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Chapter 7:
Golf Course Audubon Cooperative Sanctuary Certification

Table of Contents

Abstract

The purpose of this chapter is to determine where Boyne Mountain is in accordance with the guidelines required by Audubon International in order to attain the Audubon Cooperative Sanctuary Program's certification for golf courses. The environmental management requirements for certification are extensive, but many of them are already fulfilled by the project components suggested in this sustainable management plan for Boyne Mountain. Included in this chapter are the guidelines for the certification that overlap with our other suggested project components, or with our initial best practices analysis of Boyne Mountain. Suggestions on how to meet these guidelines are listed, as are the next steps Boyne should take to begin the certification process.

Spotlight on: **Aspen Snowmass Golf Course**

The Aspen Snowmass golf course uses recycled water for all of its irrigation, and 100% organic fertilizer on its golf course and landscaping. Golf carts are 100% all-electric. The batteries off-gas only hydrogen, and the fans are only triggered when hydrogen reaches a certain level to save energy on the use of the fans.

Source: Interview with Auden Schendler 5/20/08

Purpose & Scope

The purpose of this chapter is to provide an assessment of the Audubon Cooperative Sanctuary Program's certification for golf courses, and to outline how Boyne Mountain can gain this certification within three years.

> "Drawing upon the expertise and experience of golf course superintendents, golf industry experts, university researchers, and environmental professionals from diverse backgrounds, Audubon International has developed Standard Environmental Management Practices that are generally applicable to all golf courses."
>
> *Source: Audubon International Golf and Environment Fact Sheet(include web address and date accessed)*

Golf courses are energy and resource intensive. They require ample irrigation, fertilization, and mowing, and often result in a monoculture of landcover that is unsuitable as any form of habitat. Their irrigation needs can put stresses on natural freshwater sources. Fertilizer can dissolve in stormwater and run into natural aquatic ecosystems causing nutrient loading, algal blooms, and decreased oxygen availability for fish and macroinvertebrates. This greatly reduces the biodiversity in these ecosystems. Mowing burns fossil fuels and releases carbon dioxide into the atmosphere adding to the problem of global warming. However, these environmental harms are not necessary compromises for golf lovers. With changes to golf course management, courses can become much more environmentally sustainable.

Audubon International is a non-profit company that specializes in helping companies become more sustainable through good stewardship of natural environments where people live, work, and recreate.[1] They partner with landowners of all varieties with the goal of enhancing wildlife habitat, protecting water quality, and building a network of lands that would complement the "conservation landscape" of traditional sanctuaries. By helping individual landowners manage their land in an environmentally sustainable way, they increase a number of high quality habitat patches available and therefore sustain wildlife at a larger scale than any single wildlife sanctuary could. The landowners they have worked with include developers, government agencies, municipal officials, individual citizens, university leaders, businesses, and ski resorts. They have over 150 projects in the United States, and have also worked in eight other countries.[1] They focus on multi-disciplinary teamwork to help landowners meet their own environmental, financial, and

AUDUBON INTERNATIONAL
Gold Signature Member

marketing goals, while meeting the program guidelines necessary to gain certification. Properties that have gained certification include cemeteries, corporate parks, community colleges, churches, manufacturing facilities, municipal and state parks, resorts, residential developments, and retail stores.

The Audubon Cooperative Sanctuary Program (ACSP) for Golf Courses has members that encompass every variety of golf course, including:

- Daily Fee Courses
- Golf Community Courses
- Military Courses
- Private Courses
- Resort Courses
- Semi-Private Courses
- State and Federal Park Courses
- University Courses

One of Audubon International's main goals is education. They work, therefore, not only with the resort, but also with resort guests. They offer incentives to help golfers make more environmentally conscious choices in their travels and golf outings. Some of the environmental promotions they run are:

- North American Birdwatching Open
- Green Golfers Pledge Drive
- Jr. Green Golfers
- Outreach Invitational

The North American Birdwatching Open is a nation-wide event in which golfers, over the span of 24 hours, make a list of each bird species they see or hear within the boundaries of their golf course. The Green Golfer Pledge Drive allows participating golf courses to compete for the greatest amount of golfers to pledge to environmental sustainability in their golf courses. Educational materials are given out to the golfers, serving as a marketing campaign to increase the demand for golf course environmental stewardship. Jr. Green Golfers is a program to help younger golfers build environmental awareness. Audubon International applauds programs such as golf lessons and workshops that include an environmental education component. Outreach Invitational is a competition among environmentally sustainable golf courses where each course submits case studies of how they have led environmental outreach and education efforts aimed at their golfers. Audubon International, after reviewing the case studies, chooses winners who are eligible for sweepstake prizes.

The ACSP does provide certifications for land cover types other than golf courses, and Boyne may be eligible for one of these other certifications as well. However, given the

large environmental impact that golf courses have on the surrounding landscape, they are a priority for management change, and could greatly improve Boyne Mountain's sustainability. Therefore, only the golf course certification is discussed here. For information on additional certification programs, and more information about the organization, see the Audubon International website at <www.audubooninternational.org>.
The guidelines for golf course certification span the areas of:

- Environmental Planning
- Wildlife and Habitat Management
- Chemical Use Reduction and Safety
- Water Conservation
- Water Quality Management
- Outreach and Education

A portion of these certification guidelines are discussed in this chapter, with specific information and suggestions on how Boyne Mountain's current golf course management plan compares to the best practices identified by Audubon International, and what steps Boyne can start taking today to work towards the goal of being certified within three years. The full certification program provides extensive guidelines; the ones discussed here are those either already being fulfilled by Boyne's current management practices, or those can be met by our other proposed project components, or extensions thereof. We have not included those guidelines which Boyne has not made progress towards or which our project components will not influence, because Audubon International will work with Boyne on these guidelines once Boyne signs up for certification. They will develop a comprehensive plan on the remaining steps Boyne should take to become an official Sanctuary. Our intent in this chapter is to illustrate that Boyne is on the right track towards eventual certification.

Boyne Mountain has two award-winning 18-hole golf courses on its property: the Alpine Golf Course, and the Monument Golf Course. These two golf courses cover a total of 607 acres. This area consists of 208 acres of wooded habitat, 347 acres of rough and grasslands, 8 acres of ponds, and 44 acres of intensely-managed turf, which covers the tees, fairways, and greens of the two golf courses. An illustration of the golf courses' layout is shown in Appendix A below.

Boyne Mountain Golf Center

Wildlife and Habitat Management

Golf courses provide opportunities for wildlife habitat. They are large, open spaces, usually surrounded by

woodlands. They contain trees, fresh water sources, and usually some sort of scrubby groundcover that is suitable for many birds and wildlife. Understanding how Boyne's specific golf course size, layout, and proximity to prime habitat affect its suitability as a certified wildlife sanctuary is important. Audubon International will help Boyne identify core habitat areas, and special habitat concerns located on the property. They will spend time training Boyne staff on how different management practices positively or negatively affect wildlife species and habitats. They will identify the dominant native plant community and ecological region of the golf course, and maintain an on-going written inventory of bird and mammal species to track through the process of management changes. Appendix B shows an aerial photograph of the Boyne property with the dominant native plant communities existing in 1800 highlighted. The majority of the property originally was covered with a beech, sugar maple, and hemlock forest, and the land surrounding Deer Lake was a cedar swamp. Although some of the land has been cleared since then, the soils to support such plant communities still exists. An on-ground floristic inventory should be completed by Boyne to determine where these dominant plant communities still exist on the site.

ACSP Guidelines to Enhance Wildlife

- **Maintain natural wildlife habitat in at least 50% of all minimally used portions of property**. This includes minimizing mowing, planting native plants, and managing for a native prairie ecosystem in field areas. Currently at Boyne, most of the minimally used portions of the property are wooded habitat, which would fulfill this guideline. Also, implementing the educational gardens and native plantings suggested in Chapter 6 would increase the amount of wildlife habitat by 15 acres, just surrounding the Mountain Grand Lodge, so it is possible to maintain natural wildlife habitat in maximally used portions of the property as well.
- **Connect habitat patches as much as possible to improve wildlife dispersal throughout the golf course and surrounding habitat patches**. At Boyne, the forest habitat is relatively connected due to the wooded areas remaining throughout the site, which cover 34% of the golf course. The educational gardens proposed in Chapter 6 for the Mountain Grand Lodge (MGL) area will include additional patches of habitat throughout the site.
- **Maintain or plant plants of varying heights and types, and maintain a heterogeneous patchwork of habitat**. This is already the case in the natural areas, and Boyne should focus on bringing some of the shrubby and tree sized plants onto the golf course area to maximize habitat availability on the course.
- **Leave dead trees standing where they do not pose a safety hazard**. Boyne is already doing this in the wooded areas, and should highlight as a sustainability measure.
- **Maintain a fresh water source with aquatic plants and native landscaping along the shoreline**. Boyne has several fresh water sources between Deer Lake and their 17 retention ponds on the golf course; however, none of them are planted

with vegetation. By vegetating them with native plants, they could provide an additional 8 acres of habitat to aquatic wildlife such as frogs and dragonflies. For planting suggestions, see the Stormwater Garden portion of Chapter 6.

- **Naturalize at least 50% of out-of-play shorelines with emergent-aquatic and shoreline plants, paying special attention to shallow water areas**. For planting suggestions, see the Stormwater Garden portion of Chapter 6.
- **Choose flowers for landscaped areas based on their value for hummingbirds and butterflies**. The proposed songbird and butterfly gardens in the MGL base area described in Chapter 6 suggest how landscaping can be used for butterfly and songbird habitat. Bringing some of these plantings to the other side of the resort would provide additional patches and improve chances of colonization of the educational gardens, as well as improve the quality of habitat surrounding the golf course. For a list of suggested plants for butterflies and songbirds, see the Butterfly Garden portion of Chapter 6.
- **Maintain nesting boxes to enhance nesting sites for birds and bats**. Nesting boxes have already been proposed for the MGL area, and placing them consistently throughout the property can promote further habitat opportunities. See Chapter 6 for further explanation of nesting boxes.

ACSP Guidelines for Habitat Protection and Biodiversity Conservation

- **Establish and maintain at least 80% of the landscaped trees, shrubs, and flowers, excluding turfgrass, with plants that are indigenous to the native plant community of the ecological region of the property**. Native plants have been proposed for all of the educational gardens around the MGL, and extending that planting palette to the golf course can help sustain quality habitat throughout the resort. For suggestions of native plants, see Chapter 6.
- **Purchase landscape plants from locally-grown sources, whenever possible, to support the genetic integrity of local native plant communities**. This principle is incorporated in our sustainable purchasing guidelines described in Chapter 8. These guidelines described for sustainable purchases should be extended to every resort purchase including plants, soil, and mulch.

Chemical Use Reduction and Safety

Chemicals that are used on Boyne Mountain's golf courses include inorganic fertilizers, pesticides, and chemicals used for maintenance of machinery and golf carts. All of these chemicals can be toxic to natural environments and wildlife. Understanding how to minimize their use, and minimize their

Boyne Mountain Golf Course from Northwest

impact on natural systems is necessary for increasing the sustainability of the resort. Audubon International can give Boyne suggestions that combine pesticide reduction and the use of integrated pest management (IPM) techniques.

ACSP Guidelines for Cultural Practices and IPM Techniques

- **Inventory soil types for all playing surfaces and assess conditions such as soils structure, nutrient levels, organic content, compaction, and water infiltration**. A preliminary soil type analysis is provided in Appendix C, which shows the variety of different soil textures located under the Boyne Mountain golf course. This preliminary analysis was based on Charlevoix County GIS soils data. Although soils GIS data is a useful tool to get an idea of what to look for in the field, it does not replace the need to inventory the actual soil on the ground. Soil borings should be done on-site to determine a more exact inventory of soil conditions including nutrient levels, organic matter content, and the amount of topsoil available throughout the golf course.
- **Regularly work to improve soil health including amending organic content, aerating, and improving water infiltration to cultivate a diverse, living biotic soil community**. This guideline can be accomplished by maintaining an on-site compost pile, which is discussed in Chapter 4, and regularly applying compost to the soil. Understanding the stormwater runoff patterns on the golf course can show high priority areas for stormwater gardens that help promote infiltration and prevent contaminated water from entering Deer Lake. Appendix D shows a drainage study, locating where stormwater drains off the golf course based on its topography. Appendix E shows prime locations for stormwater gardens and areas for wetland restoration based on the wetland soils remaining in those areas. For a more complete discussion on stormwater gardens, and their benefits to aquatic ecosystems, see the stormwater garden section of Chapter 6.

ACSP Guidelines for Maintenance Facility and Equipment

- **Prevent gasoline, motor oil, brake and transmission fluid, solvents, and other chemicals used to operate and maintain equipment and vehicles from contaminating soils, surface waters, or ground water**. The golf course maintenance area is near the shore of Deer Lake. Preventing this kind of runoff contamination is very important, and a stormwater garden located between the facility and the lake may help treat any contaminated water that does escape the maintenance area before it enters Deer Lake. Appendix E shows the locations on the golf course where a stormwater garden or constructed wetland is appropriate

Golf Maintenance Area

based on remaining wetland soils. One such appropriate location is between the maintenance area and Deer Lake.

- **Clean and maintain equipment in ways that prevent wash water from draining directly into surface waters**. As with the previous guideline, a stormwater garden located between the maintenance facility and Deer Lake can minimize the contamination of the lake from maintenance pollution.

Water Conservation

Water conservation is an issue not represented by any project components in this report, given that conserving water is a relatively low priority for Boyne. However, it is an important issue, and an entire section of the Audubon certification guidelines is focused on water conservation. The guidelines that coincide with our project components are included here.

ACSP General Water Conservation Guidelines

- **Identify water sources used for irrigation and drinking water**. Retention areas provide the irrigation for the top half of the golf course, which are pumped from wells when they run low. The bottom half of the golf course is irrigated by water pumped from Deer Lake.
- **Prioritize water conservation and train employees to employ conservation techniques**. As of now, water conservation is not a priority at Boyne, as there are few marginal costs associated with water use. Water conservation needs to be made a priority based on the goal of sustainability rather than reducing business expenses.

ACSP Guidelines for Proper Watering Practices and Turf Care

- **Incorporate evapotranspiration rates or weather data into daily irrigation decisions**. This can be accomplished most easily through implementing an area-wide central monitoring system, like the one we propose in Chapter 3 for energy monitoring. The same system can be used to monitor irrigation based on high evapotranspiration and precipitation times from a single computer.
- **Avoid running the irrigation system at peak evapotranspiration times**. On the golf course itself, this is less of an issue because the golf course is in use during peak evapotranspiration times. However, this policy should be incorporated on the grounds surrounding the golf course, and around the rest of the resort. If the amount of irrigation needed exceeds what is possible during the night, then replacing conventional landscaping plants and lawn with drought-resistant native plants and native lawn alternatives may accomplish this guideline.

- **Water "hot spots" to target needed areas only, rather than running the entire irrigation system during the peak of the day**. An area-wide central monitoring system would allow an employee to determine where on the golf course the soil is getting dry, and turn on irrigation only in that immediate area.
- **Maintain soils and turf grass to maximize water absorption and reduce runoff and evaporation including: maintain soil cover, improve soil structure, add or maintain natural organic matter in the soil, and improve drainage**. By increasing biodiversity of plants in the rough and surrounding areas, the soil biota will also experience an increase in biodiversity and fertility. Implementing an on-site composting system as suggested in Chapter 4 will provide an ample, inexpensive, sustainable supply of nutrient-rich organic matter that can be used to improve soil structure on the turf.
- **Reduce or eliminate irrigation on all unused or minimally used portions of the property**. Native plants have lower water needs than conventional non-native garden plants. Planting native plants that are suited to the dry Northern Michigan climate will reduce the needs for fertilization in both used and minimally used parts of the resort.
- **Monitor daily water use, tally monthly usage, and set targets for yearly improvement**. Again, this would be most easily done by implementing an area-wide central monitoring system.
- **Use turf grass on greens, tees, and fairways that is appropriate for the local climate and growing conditions**. No alternatives have been used nor native plants selected for turf on the golf course. The greens, tees, and fairways cover 45 acres of the golf course. If a turf grass was used that had lower irrigation and fertilization needs, 45 acres of water and chemical golf course inputs would be reduced.

Water Quality Management

Water quality is an extremely important issue for aquatic ecosystems. Water quality across the entire state is being degraded due to pollution inputs, higher rates of runoff, higher temperatures, and greater stormwater loads reaching natural streams, rivers, and lakes at unsurpassed speeds. These high rates of warm, contaminated water put a stress on natural aquatic ecosystems, and in extreme cases, can cause major disruption and death of fish, macroinvertebrates, and aquatic plants. The importance of managing for water quality is discussed in detail in the stormwater gardens section of Chapter 6.

Wastewater in Golf Maintenance Area

ACSP General Water Quality Management Guidelines

Deer Lake Villas from East

- **Prioritize the protection of water quality, both on and off the golf course, and train staff to use best management practices (BMPs) to prevent pollution**. This can most easily be accomplished by minimizing the use of inorganic fertilizers through use of on-site compost amended with organic fertilizers, minimizing the need for pesticides by increasing the biodiversity of plants surrounding the golf course to maintain habitat for natural enemies of pests, and installing stormwater gardens between the golf course and any natural water habitats to prevent runoff of chemicals to these natural systems.
- **Identify the specific watershed in which the property is located, including where wastewater and runoff go after leaving the property**. Boyne Mountain is located in the Boyne River Watershed. Opportunities exist for Boyne to partner with the Friends of the Boyne River, a non-profit organization whose sole purpose is protecting the water quality of the Boyne River, which runs through downtown Boyne City. Appendix D shows a runoff study of the Boyne Mountain golf course, which diagrams the path stormwater follows based on the topography of the golf course.

ACSP Guidelines for Best Management Practices (BMPs) and Structural Controls

- **Employ environmentally-sensitive plant management techniques within 25 feet of all water bodies and well heads to minimize nutrient and chemical inputs.** This can be done by buffering Deer Lake with plantings to help filter and treat the stormwater before it is released to the lake. Stormwater gardens are perfect for this purpose. Also, eliminating fertilizer, herbicide, and pesticide use within 25 feet of Deer Lake will fulfill this guideline.
- **Raise mowing heights along in-play shorelines to slow and filter runoff**. Turf itself can minimally help treat stormwater if it is allowed to grow to a slightly higher length. Boyne should allow turf to grow slightly longer around the lake and retention areas can to improve water quality.
- **Reduce the potential for nutrient loading to water bodies by employing BMPs such as: using slow-release fertilizers, filtering drainage through vegetative or mechanical filters prior to entering water bodies**. This guideline would be completely fulfilled by implementing stormwater gardens around high discharge areas into the lake.

Outreach and Education

Education is a major goal of every project component presented in this management plan. Gaining customer support for environmental initiatives is imperative for Boyne Mountain's success, as well as the environmental movement as a whole. With "green" support coming from the federal government, industry, and consumers, it is only a matter of time before sustainable management becomes the norm rather than the exception. It is important for Boyne Mountain to communicate its dedication to sustainability early in the process to maintain marketability as a leader and an ecologically, socially, and financially sustainable resort.

Informational Sign at Boyne Golf Center

ACSP General Outreach and Education Guidelines

- **Communicate environmental goals, objectives, and projects to patrons, staff, and company decision makers. Provide regular updates about progress and accomplishments**. This guideline is completely fulfilled by our internal communication plan described in Chapter 10.
- **Invite employees, patrons, and community members to help with stewardship projects, as appropriate**. This opportunity is briefly described in our best practices in Chapter 2. Boy Scout groups, churches, and volunteer organizations can provide volunteer workers to help manage natural areas. Boyne Mountain could provide environmental education to the community, and get community support for their environmental endeavors.
- **Communicate with neighboring property owners, homeowners' associations, and community groups to inform them of the course's involvement with various environmental stewardship projects**. This guideline stresses the importance of a local green marketing campaign. Chapter 9 includes suggestions for a green marketing campaign for Boyne, and making sure the local community is a prime target would fulfill this guideline.

Although this is not a comprehensive list of the guidelines required by Audubon International for a successful certification application for the golf course, it shows that implementing the various project components suggested in this management plan will put Boyne Mountain in a position to easily acquire third-party certifications in multiple areas of their resort.

Reducing fertilizer use on the fairways, tees, and greens or switching to organic fertilizer or compost would prevent 45 acres of polluted runoff from entering Deer Lake.

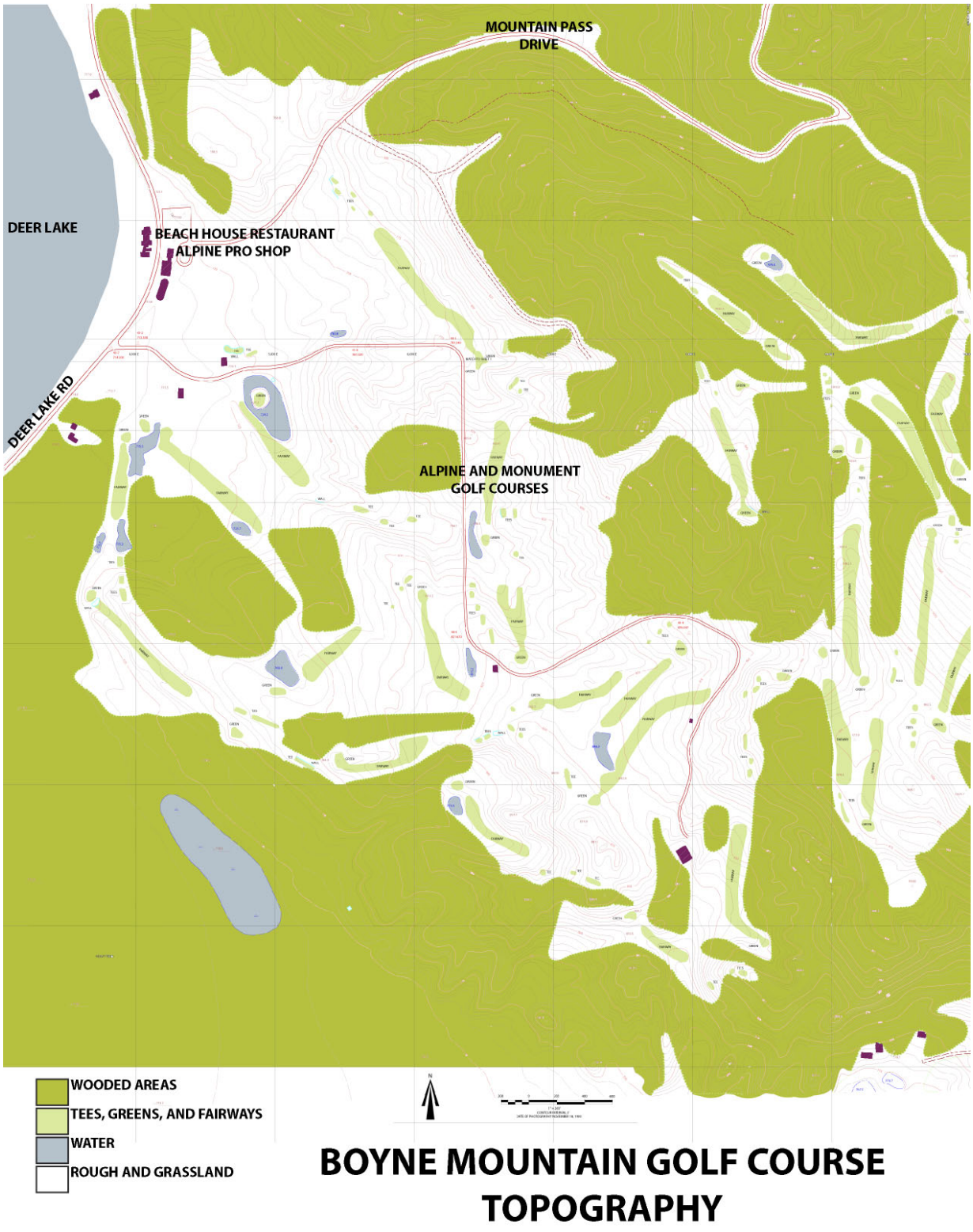
Reducing mowing on the rough, planting native grasses and prairie plants, and minimizing pesticide use would allow for an additional 347 acres of habitat availability. This represents a habitat quality increase of 57% from current management practices.

Next Steps

In order for Boyne's golf courses to gain designation as Certified Audubon Cooperative Sanctuaries, Boyne Mountain has to register and enroll in the Audubon Cooperative Sanctuary Program. The annual registration fee is $200, which includes certification materials and review. Audubon International will work with Boyne to compose a specific golf course management plan that will allow Boyne to gain certification within one and three years, depending on how long it takes Boyne to assess, implement, and document their environmental practices.

Boyne Mountain Golf Course from Northwest

Appendix A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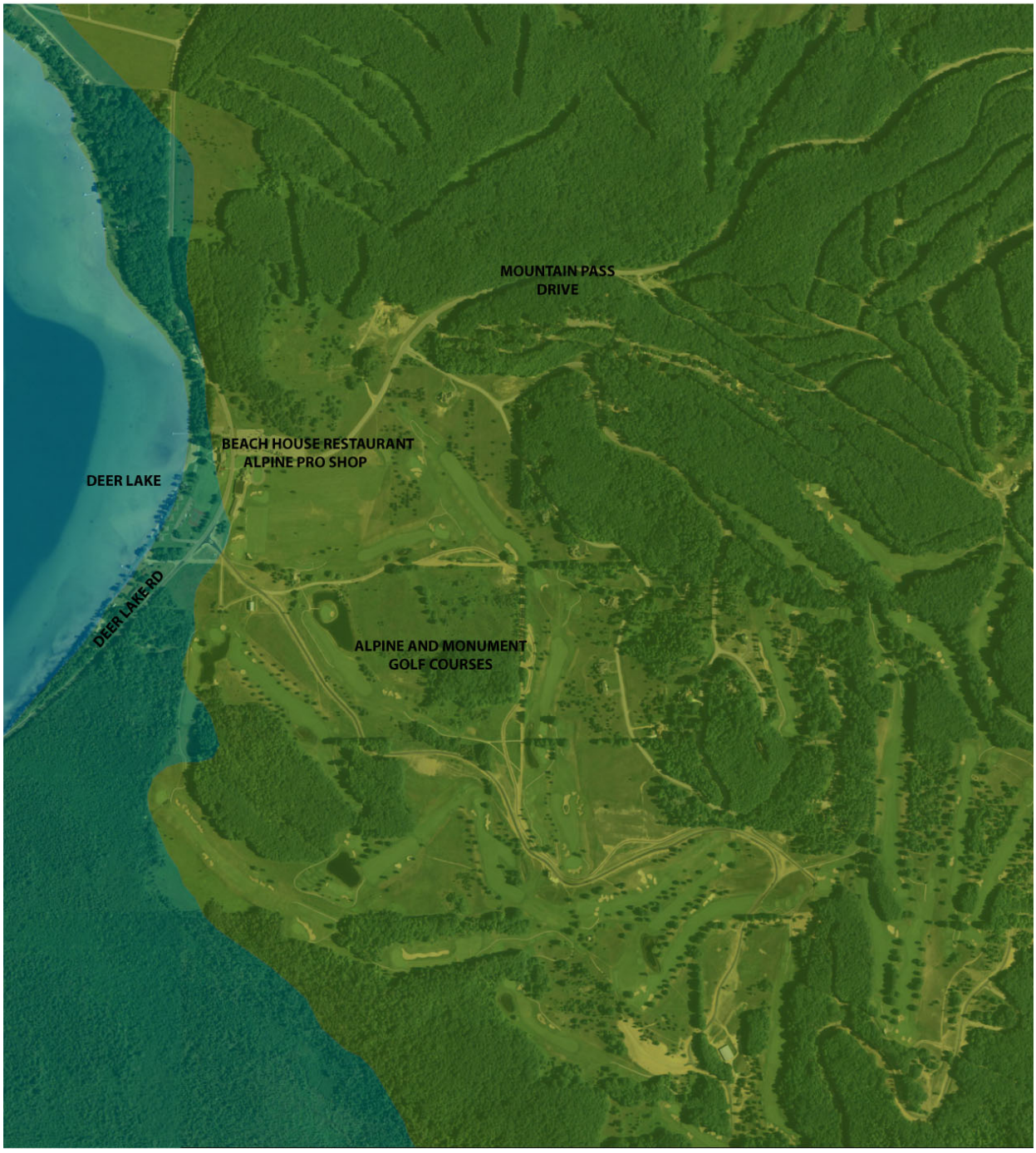
DEER LAKE RD
ALPINE AND MONUMENT GOLF COURSES
WOODED AREAS
TEES, GREENS, AND FAIRWAYS
WATER
ROUGH AND GRASSLAND
BOYNE MOUNTAIN GOLF COURSE
TOPOGRAPHY

Appendix B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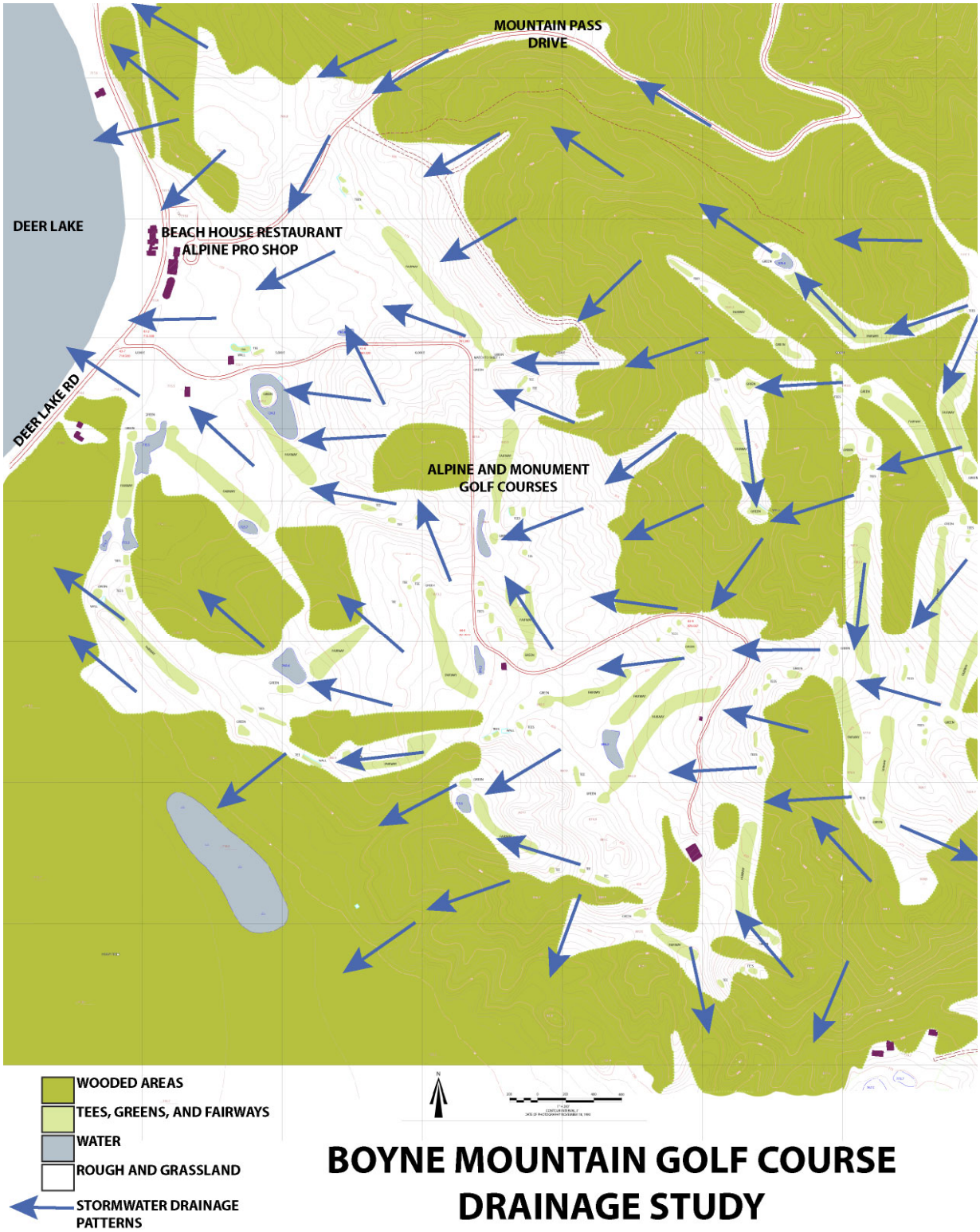
ALPINE PRO SHOP
DEER LAKE
DEER LAKE RD
ALPINE AND MONUMENT
GOLF COURSES
BEECH SUGAR MAPLE HEMLOCK FOREST
CEDAR SWAMP
WATER
BOYNE MOUNTAIN GOLF COURSE
1800 NATIVE VEGETATION

Appendix C

BOYNE MOUNTAIN GOLF COURSE
SOIL STUDY

Appendix D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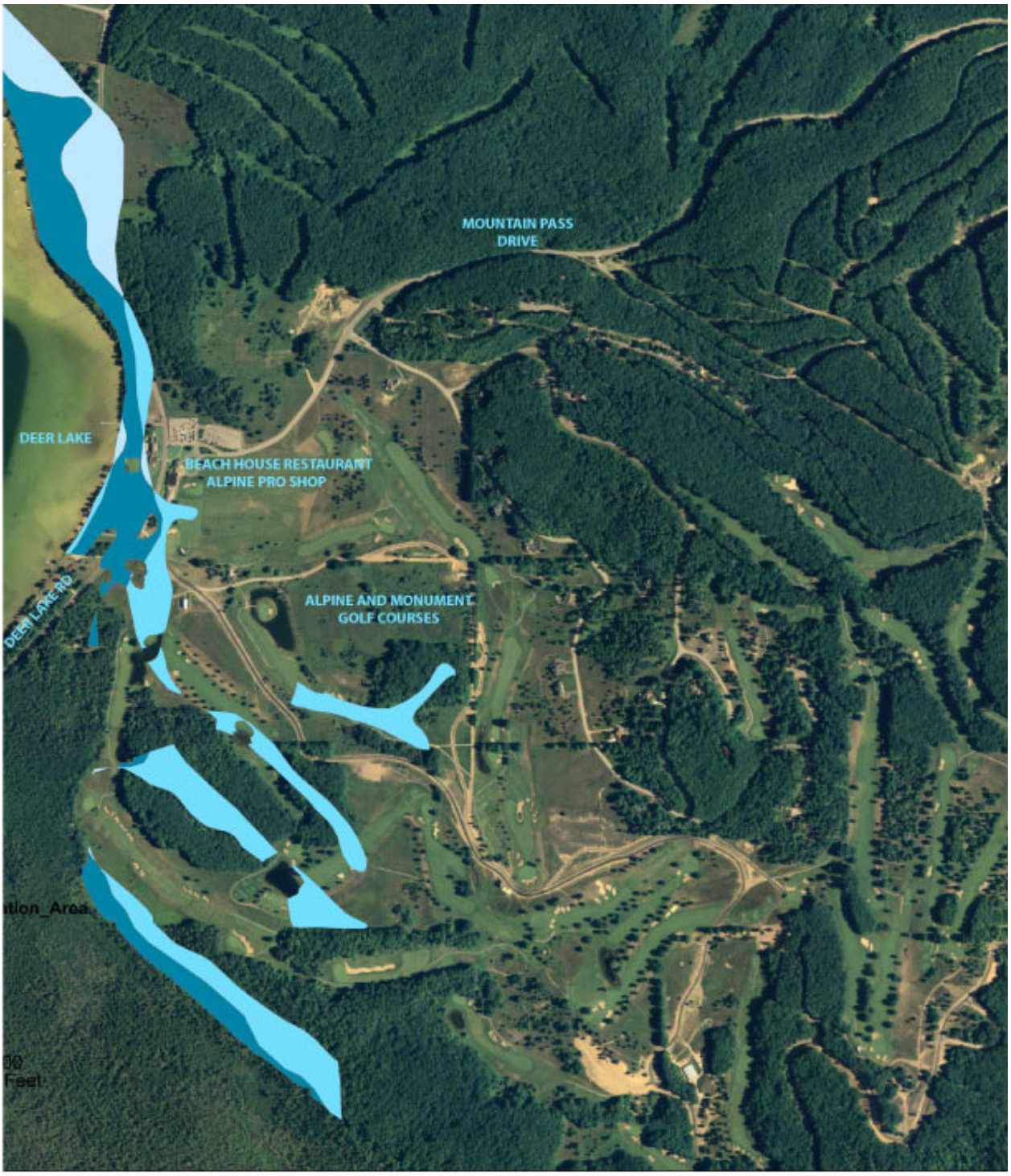
DEER LAKE RD
ALPINE AND MONUMENT GOLF COURSES
WOODED AREAS
TEES, GREENS, AND FAIRWAYS
WATER
ROUGH AND GRASSLAND
STORMWATER DRAINAGE PATTERNS
BOYNE MOUNTAIN GOLF COURSE
DRAINAGE STUDY

Appendix E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DRIVE
DEER LAKE
BEACH HOUSE RESTAURANT
ALPINE PRO SHOP
DEER LAKE RD
ALPINE AND MONUMENT
GOLF COURSES
BEST WETLAND SOILS
GOOD WETLAND SOILS
FAIR WETLAND SOILS
BOYNE MOUNTAIN GOLF COURSE
WETLAND RESTORATION

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Chapter 8:
Sustainable Purchasing Guidelines

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Abstract

This chapter sets forth guidelines for purchasing more environmentally preferable products to supply Boyne Mountain's lodging and recreational operations. For each type of product, it details the environmental harms associated with "traditional" versions of the product. It then recommends criteria or third-party labels purchasers can look for to find comparable products that are better for the environment. While we recognize that no product can be deemed "green" or "sustainable," the criteria herein seek to reduce the water, waste, fuel, pollutants, and resource depletion associated with these products. The guide should be used by purchasers at Boyne Mountain as part of the decision-making process for sourcing a range of products.

Spotlight on: **Kimpton Hotels**

Kimpton Hotels, with 50 properties throughout North America, follows rigorous environmental purchasing guidelines as part of its EarthCare program. This program has helped the hospitality company reduce its environmental impact. For example, it replaced 50,000 gallons of cleaning chemicals with non-toxic alternatives in just one year.

Source: Kimpton Hotels' green initiatives earn governor's environmental and economic leadership award, Press Release, 12/17/07.

Purpose & Scope

The purpose of this document is to provide Boyne Mountain team members with purchasing guidelines that incorporate environmental sustainability. Any team member involved in making purchasing decisions should consider the environmental implications of their purchase. Each of these decisions might seem small on its own, but the truth is the environmental impact of purchased items adds up very quickly. While there are no hard rules that must be followed, this guide provides information on the environmental impact of several types of products, and the best way to mitigate that impact so purchased items are more "environmentally friendly." This is consistent with Boyne Mountain management's desire to improve the environmental sustainability of Boyne Mountain's operations.

> "Sustainable procurement is the process by which organizations buy supplies and services taking into consideration the best value for money and the environmental and social aspects that the product/service has over its whole life cycle"
>
> *Source: Environmentally and Socially Responsible Procurement Working Group*

This guide applies to purchases made for:

- Lodging
- Restaurants
- Maintenance (Ski and Golf)
- Retail

Because it pertains to Boyne Mountain only, Boyne Design is excluded.

Product-specific guidelines have been developed for the following categories:

- Paper & wood products
- Food & beverage
- Cleaning supplies
- Large appliances
- Maintenance supplies
- Packaging

For items that do not fall into these categories, follow the general guidelines at the end of this document, which can be applied to all types of purchases.

Paper & Wood Products

Products in this category include lumber, furniture, bath tissue, paper towels, facial tissue, paper cups, food packaging, and office paper. These guidelines will therefore be helpful for team members in housekeeping, restaurant operations, and office managers, as well as those involved in developing specifications for new development.

Environmental impact of paper & wood products

Paper and wood products can contribute to the following environmental problems:

- *Deforestation:* Paper and wood products come from trees, which are important vehicles for carbon sequestration and soil stabilization. While trees are a renewable resource, harvesting them in certain ways can destroy these benefits. For instance, when forests are clear-cut, it is more difficult for the area to recover because all vegetation has been removed. Furthermore, old growth or "virgin" forest is particularly valuable because older, larger trees sequester more carbon than younger ones, provide a rich habitat for other flora and fauna, take hundreds of years to grow back, and are considered a part of human heritage for their aesthetic value. Finally, some paper and wood products are supplied by illegal means from forests that are supposed to be protected; this is most prevalent in developing countries like Indonesia and Brazil where authorities have been unable to control rampant deforestation.[1]
- *Pollution:* Paper processing and lumber treatment employ various chemicals to render trees into useful products. Some of these substances are highly toxic, and poison local water supplies or escape into the air in the form of noxious fumes and particulates. For instance, chlorine is frequently used to bleach paper products so they appear bright white. However, this process releases the toxic chemical dioxin; this is an incredibly harmful substance, known to cause certain types of cancer, developmental problems in children, nervous system disorders, and immune system damage.[2]
- *Water use:* The manufacturing of pulp and paper products is one of the most water-intensive industries. Fresh water, though a renewable resource like trees, is being depleted faster than the earth can recharge it.

Reducing environmental impact through smart purchasing

Unfortunately, the supply chain for most paper products is long and complex, with several steps in between the forest and the ultimate consumer. To avoid the above problems, paper and wood products should be of legal origin, be harvested and manufactured sustainably, contain a high percentage of recycled fiber content, and

avoid using various harmful ingredients. It would be far too complicated and cost-prohibitive to perform extensive research every time a new order for something as simple as printer paper is made; fortunately, the most important criteria fall under a handful of labels. Look for the following when purchasing paper and wood products:

- *Forest Stewardship Council (FSC):* The FSC is an independent organization that promotes responsible management of the world's forests through a rigorous inspection program. Chain-of-custody certification ensures that each step of the supply chain, from forest management to manufacturing and distribution, adheres to the FSC's Principles of Responsible Forest Management.[3] FSC is recognized above other forestry labels such as the Sustainable Forestry Initiative and Programme for the Endorsement of Forest Certification as more enforceable and environmentally beneficial; according to the World Wildlife Fund, "the only certification scheme currently recognized as credible by industry, NGOs and indigenous peoples groups alike is the scheme operated by the Forest Stewardship Council (FSC)."[4]

  FSC-certified wood and paper products, while adhering to the highest standards of environmental responsibility, are still somewhat limited in availability. For particular types of products, FSC-certified versions can be difficult to find. If this is the case, the "next best" solutions are recycled and chlorine-free products, especially for paper-based goods.

- *Recycled:* Recycled products reduce the amount of virgin wood that must be harvested. Look for paper-based products with a high percentage of recycled fiber. More specifically, check to find the product with the highest percentage of *post-consumer* recycled fiber; this is material that was previously a paper product, and was recycled by a consumer or business. ("Pre-consumer" recycled fiber, which is never explicitly labeled as such is simply the scrap paper left over from traditional manufacturing processes.) High-quality office paper, notebooks, and binders, to name a few examples, can be made with 100% post-consumer recycled fiber. Office Max is a great resource for such products.
- *Chlorine-free or unbleached:* To avoid dioxin pollution, look for paper products that have not been bleached. "Unbleached" versions of most paper products, from office paper to coffee filters, are easy to find from mainstream suppliers. The most environmentally friendly label is "Process chlorine free," which is for recycled paper that has been processed into new products without chlorine derivatives.[5] This label is often not readily apparent; if you are unsure, ask the supplier if you can review a material list.

Suppliers to look for

While purchasers should still check the specific labeling on each item, the following brands / suppliers typically offer environmentally preferable paper and lumber products:

- Ambrose International
- Central Michigan Paper Company
- Home Depot
- IKEA
- Lowes
- The Millcraft Group (and Millcraft Paper Stores)
- RIS
- Seventh Generation (bath tissue, facial tissue for guest-facing purposes)
- Unisource Worldwide
- Xerox Corporation
- Xpedx

Food & Beverage

Products in this category include food and beverage items purchased for Boyne Mountain's restaurants and snack shops. These guidelines will therefore be helpful for team members in restaurant operations and retail.

Environmental impact of food & beverage products

Food and beverage products can contribute to the following environmental problems:

- *Waterway pollution:* Modern industrial agriculture is built on the intensive use of fertilizers, pesticides, and herbicides to improve crop productivity. While such innovations have allowed farmers to increase yields, feeding many more people with the same plot of land, they have also caused dire environmental problems. All of these additives contain chemicals, the residues of which are washed off of fields and end up contaminating waterways. The two most devastating elements are excess nitrogen and phosphorus from fertilizers. When runoff reaches large waterways like rivers and oceans, these nutrients accumulate, causing algal blooms through a process called eutrophication. These are sometimes toxic in themselves; but the more serious problem is that when they die, they consume oxygen, leading to a state of depleted oxygen known as "hypoxia."[6] Fish and other marine life no longer have enough oxygen to survive, so entire swaths of marine habitat can become dead zones.
- *Fossil fuel consumption:* The majority of fresh produce, dairy, and meat is sold far from where it was grown. Large farms sell to wholesalers who aggregate food in warehouses and sell it on to grocery retailers, food service companies, and institutions throughout the country. Furthermore, the US imports about $72B in agricultural products every year from abroad.[7] All told, this means your average vegetable or fruit travels 1,300 – 2,000 miles to reach the restaurant you eat it in.[8] This has negative environmental consequences because each of those miles requires fuel and refrigeration, which are typically powered by non-renewable, petroleum-based resources that release greenhouse gasses (GHGs) and pollutants into the atmosphere. Agricultural fuel use has risen by 400% since 1950.[9]
- *Water use:* In addition to fertilizers and pesticides, modern high-yield agriculture relies on the consumption of large amounts of water, typically enabled by irrigation. In many fertile regions, water resources are being depleted faster than the earth's natural ability to recharge them, leading to a permanent decrease in fresh water availability. For example, water from the Ogallala aquifer in the US Southeast (which supplies a vast swath of fertile land from Texas to Nebraska) is being extracted at *8 times* its regeneration rate.[10] This is equivalent to drawing

down capital vs. living off of annual income: at some point, the aquifer will run dry. In addition to watering the land itself, food processing (particularly for beverages) is also water-intensive. For example, it takes around 5 bottles of water to manufacture 1 bottle of beer.[11]

- *Habitat encroachment:* As the global population rises and increasing affluence leads to changing dietary patterns, demand for food is ever-increasing. Despite productivity improvements, more and more land area is being converted to agricultural use; approximately one quarter of the earth's terrestrial surface is now under cultivation.[12] Particularly in developing countries, new cropland is often created by clearing natural areas like tropical forests. Such natural areas support biodiversity by providing habitat for flora and fauna; prevent soil erosion and water depletion; and serve as a sink for carbon dioxide. Often, they are ruthlessly cleared through slash-and-burn techniques that degrade soil nutrients. After a few years of farming, the land is depleted and abandoned, no longer useful for farming or as natural habitat.
- *Fisheries exploitation:* Years of rampant overfishing have led to the collapse of many of the world's major fisheries, such as North Atlantic cod. Approximately "one quarter of important commercial fish stocks are overexploited or significantly depleted."[13] Humans are simply taking more out of the ocean than its capacity to reproduce. Some scientists are now estimating that by about 2050, there will be no more fish in the sea.[14] While aquaculture (fish farming) has been touted as a potential solution, it brings a host of problems on its own: farm-raised fish are typically fed wild fish, and antibiotics, artificial hormones, and waste from the farm-raised fish can pollute surrounding ecosystems. Furthermore, when farm-raised fish escape, they frequently outcompete wild fish or alter the genetic pool.

Reducing environmental impact through smart purchasing

The issue of feeding a growing population with a finite planet has no easy solution. However, certain types of foods have a lower environmental impact than others. Look for foods with one or more of the following characteristics.

- *Local:* Foods produced within a 150-mile radius of consumption are typically considered "local." Such foods have a drastically reduced "carbon footprint" because they have not been shipped or trucked over great distances with fossil fuels. Furthermore, given the natural fertility and frequent rainfalls of Michigan and surrounding states, food grown here is much less likely to deplete soil and water resources or encroach on ecologically sensitive areas. From a business perspective, working with local farmers can boost Boyne's standing within the community by supporting regional economic activity. Consumers are also likely to respond positively: a 2004 Roper poll of 1,000 adults found that 73% of

consumers believed it was important to know whether their food was produced locally.[15]

- *Organic:* While the USDA organic label has recently come under fire for certifying industrial-scale organic farms, it is still the only enforceable label for foods grown without non-natural fertilizers, pesticides, and herbicides. By avoiding chemicals, organic farms do not contribute to watershed pollution and hypoxia. Furthermore, consumers are increasingly drawn to organic foods because they are viewed as healthier: "A 2004 survey by Whole Foods Market, the largest natural foods supermarket chain in the country, found that 54% of Americans believe that organic foods are better for their health, 32% believe that organic foods taste better, and 42% believe organic foods are better in quality."[16]

- *Fair trade:* Transfair-certified Fair Trade goods meet criteria on a fair price for producers, fair labor conditions for workers, transparency throughout the supply chain, community development, and environmental sustainability. For imported agricultural products, this is the most highly regarded and rigorously enforced standard. The most widely available fair trade goods include tea and coffee, but increasingly one can find sugar, chocolate, rice, and spices with the Transfair logo.

- *Marine Stewardship Council-certified:* In order to obtain MSC certification, fisheries must adhere to strict rules of management, including sustainable catch sizes that do not deplete fish stocks; ecosystem maintenance; and respect for national and international laws. This is the only globally recognized standard for sustainable seafood, endorsed by non-governmental organizations including the World Wildlife Fund.

- *Animal treatment:* There are a host of labels associated with animal welfare. Unfortunately, none of them are third-party certified as are the preceding 3 schemes. However, that should not deter one from seeking out "hormone-free" dairy products, "free-range" or "cage-free" poultry and eggs, and "grass-fed" beef. Such attributes are not only better for the animals, but also for the environment. While they do not carry the weight of external certification, it is technically illegal to market such products falsely. Be wary of "natural" claims, as there are absolutely no standards (enforced or not) underpinning this label.

Suppliers to look for

- Cherry Capital Foods (Traverse City-based aggregator / distributor of locally grown food products)
- Any farmer, fishery, or producer within 150 miles of Boyne City, MI
- National organic labels include Horizon Dairy, Organic Valley, Maggie's Organics, Annie's Naturals, and Earthbound Farms; numerous smaller producers exist, just look for the "USDA Organic" seal
- Most major food producers offer a Fair Trade line of coffee, tea, and sugar
- A complete list of MSC-certified seafood suppliers can be found at http://www.msc.org/where-to-buy/find-a-supplier/united-states.

Cleaning Supplies

The main products in this category are the cleaning fluids used in Boyne's hotel and condominium operations, including laundry detergent, dishwashing fluids, and general disinfectants. These guidelines will therefore be helpful for team members in housekeeping and hotel management.

Environmental impact of cleaning supplies

Cleaning products can contribute to the following environmental problems:

- *Toxic chemicals:* According to the Responsible Purchasing Network, "1 out of 3 commercial cleaning products are potentially harmful" to human health and the environment because of the toxic chemicals they contain.[17] Such toxins can be breathed in by employees and guests upon use, causing problems ranging from liver damage to asthma. Residues from dishwashing or laundry can also pollute water bodies if sewer systems overflow or are leaky. Moreover, manufacturing such products often creates harmful byproducts that can end up in the air or in water bodies, where they can poison any organism that ingests or breathes them.
- *Waste & fuel:* Cleaning products typically require large amounts of water to work. When products come pre-mixed with this water, they become much bulkier and heavier, requiring more fuel to transport them from the manufacturer to user. Furthermore, the larger bottles needed to contain them contribute to landfill waste.

Reducing environmental impact through smart purchasing

Scientific breakthroughs have led to the development of safe, effective cleaning products that perform well with minimal risk to human health and the environment. Follow these guidelines to choose eco-friendlier cleaning products.

- *Avoid or minimize use of these chemicals:*
    - Alkylphenol ethoxylates (APEs): human endocrine disruptors; toxic in aquatic environments
    - Volatile organic compounds (VOCs): gasses that can damage soil, groundwater, and air quality; some are also greenhouse gasses
    - Phosphates: contribute to eutrophication and hypoxia in water bodies
    - Chlorine: contains and is made by using toxic pollutants dangerous to human health and ecosystems

- *Biodegradable:* Such products break down naturally over time, rather than accumulating where they end up (be it a natural water body or a sewage system).
- *Concentrated:* Cleaning solutions that come in concentrated formulas requiring the user to add water are less bulky and heavy than solutions that are ready to use. Therefore, they require less packaging and less fuel to transport them.
- *Plastic #1 or #2:* Look for cleaning solutions packaged in containers made from #1 or #2 plastics. These materials are typically accepted by municipal recycling services, whereas other types are not.

Suppliers to look for

- "Green Seal" certified products (a complete list of suppliers and products can be found at http://www.responsiblepurchasing.org/purchasing_guides/cleaners/products/?show=records&table=cleaners&page=all&rc_sp=1&rc_ep=5&prevpage=1#rc_top)

Appliances

Products in this category include dishwashers, laundry machines, kitchen mixers, etc. These guidelines will therefore be helpful for team members in housekeeping, restaurant operations, and hotel operations.

Environmental impact of large appliances

Appliances can contribute to the following environmental problems:

- *Energy use:* Large appliances require considerable energy to operate. Such energy is typically generated by dirty sources like coal, which emit particulates, air pollutants, and greenhouse gasses that contribute to global warming.
- *Water use:* Many large appliances also consume large amounts of water. While fresh water is a renewable resource, its use must be moderated to ensure withdrawals do not exceed the local water system's ability to recharge.

Reducing environmental impact through smart purchasing

Fortunately, public attention on the above issues and the cost savings that can be reaped through the use of more efficient appliances have led to a mature market in water- and energy-saving appliances, including commercial strength choices.

- *Energy Star®:* The Environmental Protection Agency's Energy Star® program is a well-developed certification program and labeling system that makes finding efficient products easy. However, such a great proportion of appliances meet these standards now that it is important to not just look for the logo, but to find the most energy- and water-efficient products available for a given need. Energy Star® appliances can range from 10-50% less energy and water use than their traditional counterparts.[18] Look at the Energy Star® labels to compare kilowatt and gallons of comparable products, and choose the option with the lowest requirements; it will save you money in the long run through reduced utility bills. You can calculate just how much by using Energy Star®'s savings calculators, available at http://www.energystar.gov/index.cfm?c=bulk_purchasing.bus_purchasing#comapp.
- *Take-back or Recycling programs:* Many brands offer take-back programs for appliances when they reach their end of life. Such products are disassembled and the useful parts are reused in new machines, rather than being thrown away. This is particularly important for appliances with heavy metals that often

leach toxins into the ground when left in landfills. Ask the manufacturer if they have a take-back program – and remember to participate in it when replacing appliances.

Suppliers to look for

- Continental
- Huebsch
- Maytag
- Speed Queen
- Unimac

Maintenance Supplies

Products in this category include motor oil, antifreeze, paint, sealants, fertilizers, and pesticides. These guidelines will therefore be helpful for team members in grounds operations and maintenance.

Environmental impact of maintenance supplies

Maintenance supplies can contribute to the following environmental problems:

- *Toxic chemicals:* Most maintenance fluids are made with synthetic chemicals that are harmful to living organisms. These substances can harm the people who inhale or touch them while working with them. Frequently, improperly stored fluids leak (or are simply washed off a surface, as in the case of pesticides and fertilizers), contaminating nearby natural ecosystems. This can harm the animals and plants that come in contact with the substance, and can pollute the air. Furthermore, VOCs are often found in paints and sealants (see Cleaning Supplies section above), and nutrients in fertilizers can lead to aquatic dead zones (see Food & Beverage section above).
- *Fossil fuel consumption:* Many maintenance fluids, including most fertilizers and all motor oils, are made with petroleum. This is a non-renewable resource. Just as it does when you fuel your car with it, petroleum used in maintenance activities releases GHGs and other pollutants into the air. GHGs aid global climate change by absorbing the back radiation from the Earth's surface, effectively "trapping" heat in the atmosphere and causing global temperatures to rise. This not only means warmer winters, but also more erratic and unreliable precipitation, and extreme weather events like hurricanes and droughts.

Reducing environmental impact through smart purchasing

Maintenance remains a fairly "dirty" realm since there are often no available substitutes to toxic chemicals. A best practice for reducing the environmental impact of maintenance fluids is to store them very carefully, and dispose of them properly according to hazardous waste guidelines (these can be found at http://www.epa.gov/osw/hazard/index.htm). However, certain formulations are better than others. These include the following:

- *"Low-VOC" and "Non-toxic":* Look for paints, adhesives, finishers, and sealants with a low-VOC, non-toxic formula. Unfortunately, there is no threshold for what qualifies as "low", nor even an enforceable definition of what "non-toxic" means. You can examine labels of comparable products to compare VOC levels, which are expressed in pounds per gallon (lbs/gal) or grams per liter (g/l). If this

information is unavailable, it is advisable to also try to find an EcoLogo^{M} or Green Seal™ certified product (see below) that carries these taglines. Both programs have standards for toxics they don't allow, and low permissible VOC levels.

- *EcoLogo^{M}:* EcoLogo is a third-party certifier of environmentally-preferable products. There are a host of "green" certifiers out there, but EcoLogo (along with Green Seal) is one of the most robust:[19] Its product certification criteria are developed by a stakeholder engagement process including scientific review, and its certification process requires a third-party on-site audit to ensure suppliers actually meet their "green" claims. Each product sub-category (e.g. "Sealants and Caulking Compounds") has specific, detailed requirements, so purchasers need not research individual ingredients.
- *Green Seal™:* Green Seal is an independent non-profit that "provides science-based environmental certification standards that are credible [and] transparent."[20] Like EcoLabel, product criteria follow a rigorous scientific evaluation, and all products are tested and manufacturing facilities audited. Products vary from floor finishers to wall paint to window panes. The organization has specifically worked with hospitality companies on a 'greening the lodging industry' initiative, so you can trust that its products meet commercial performance levels. Both EcoLogo and Green Seal's standards are more rigorous than the EPA's guidelines.
- *"Rerefined" and "Extended Life":* Vehicle maintenance fluids like motor oils are available in rerefined formulas. These are fluids that have essentially been recycled and cleaned, and perform just as well as their virgin counterparts. Furthermore, rerefined motor oil requires "50 to 85 percent less energy to produce than virgin motor oil,"[21] reducing fossil fuel consumption. Extended life versions of some products such as antifreeze reduce the frequency of replacement, cutting down on overall material volumes. These can also be recycled an unlimited number of times.
- *Organic:* Look for pesticides and fertilizers that do not contain synthetic chemicals. By using natural materials, such substances do not contain the high levels of nitrogen and phosphorus that petro-chemical based ones do, thus reducing watershed pollution and the likelihood of hypoxia. Organic fertilizers include food waste, animal meal, guano, and soy meal. Unfortunately, there is no USDA certification of such products. Look at the ingredients list to ensure no chemicals are used.

Suppliers to look for

- A complete list of EcoLogo certified products can be found online at: http://www.ecologo.org/en/greenproducts/professional/.
- A complete list of Green Seal certified products can be found online at: http://www.greenseal.org/findaproduct/index.cfm.

- Converted Organics (Organic fertilizers and garden products)
- Organic Growing Systems (Organic fertilizers and garden products)

General

In lieu of detailed purchasing guidelines for every other potential product type, we have developed general guidelines that purchasers should look for in all products, including those explicitly outlined above. These fall primarily into the categories of supplier practices, product attributes, and packaging attributes.

- *Supplier practices:* Boyne Mountain has tried hard to improve its own environmental footprint, and should look for the same resolve from suppliers. Many suppliers are public companies that produce annual corporate responsibility or sustainability reports from which this information can be gleaned. Private companies interested in maintaining a relationship with Boyne as a key customer should be able to provide similar information upon request. Check suppliers':
    - *Compliance with environmental regulations:* This is the most basic requirement, and should absolutely not be negotiable. Make sure your suppliers are following all applicable environmental laws and have not received any major fines or lawsuits from violations.
    - *Involvement in voluntary programs:* Many industries have voluntary programs that outline sustainability goals for companies who choose to participate in them. For example, the Cement Sustainability Initiative is a group of cement producers who have publicly committed to taking action to reduce their environmental impact.[22] Furthermore, several groups and certification programs exist that any company can join. For instance, companies can achieve ISO 14001 certification by implementing an environmental management system.[23] US EPA Climate Leaders is another option, where partner companies adopt comprehensive climate change strategies.[24]
    - *Environmental goals:* Look for companies who have declared – and are making progress towards achieving – environmental goals. These typically include reduction targets for energy, water, and waste. Absolute goals have a greater impact than relative goals (e.g. 10% less energy *per unit* of production is not meaningful when production is growing by around 10%!). Qualitative goals like initiating employee carpooling programs also demonstrate commitment to improving environmental impact.
    - *Transparency:* Several sets of guidelines exist for disclosing environmental and social progress through regularly published reports. The Global Reporting Initiative and CERES Principles are the two best known and highly respected. While these don't contain standards for

what suppliers should be *doing*, they do require transparency – which typically induces better behavior.

- *Third-party certification:* Look for credible third-party endorsement of environmental initiatives. Several have already been mentioned above (Green Seal, Energy Star, and the USDA Organic label are great examples), but countless others exist. Before trusting a label, make sure to research the criteria and enforcement mechanisms it employs.

- *Product attributes:* Two different products that meet comparable end-user needs can have very different environmental impacts. In addition to performance, quality, and price, consider the following product attributes when choosing between product options:
  - *Material composition:* Where possible, choose renewable materials (e.g. bamboo) over non-renewable (e.g. aluminum) or chemically-based (e.g. PVC) materials.
  - *Coatings & finishes:* Look for products with low-VOC, non-toxic coatings (see "Maintenance Supplies", above).
  - *Manufacturing process:* If possible, consider the energy and water used and waste and toxic pollutants created in the process of manufacturing the product. This information can be hard to find, but some do publish information on the energy-, water-, and waste-intensity of particular products. Where unavailable, examine company-level data for comparable suppliers.
  - *Efficiency:* For any product that uses water or electricity, find the one with the lowest water and energy requirements per unit of performance.
  - *Recyclability / reusability:* If available, choose a recyclable or reusable version of a product. For instance, certain vehicle treads can be returned to the manufacturer once worn out and melted down to make new ones. Ask potential suppliers whether they have such programs in place. For consumer products, look for recyclable packaging (see below).

- *Packaging attributes:* This information can be difficult to obtain since it relates to the package, not the product itself. However, many suppliers are starting to treat their packaging as a serious part of their environmental strategy. This movement has been boosted by Wal-Mart's "Packaging Scorecard", launched in 2006. The scorecard has rigorous requirements, for instance on GHGs per ton of production. While such detailed information is typically not publically available, purchasers should strive to order products in packages that fit the following criteria:
  - *Smaller packages:* Look for the lowest packaging-to-product ratio. Less volume of packaging means less trash for the landfill.

- *Lighter materials:* Lighter materials require less fuel to transport, so produce less GHGs and air pollutants throughout the shipping and distribution phases.
- *Recycled content:* seek recyclable cardboards and plastics over packaging materials that cannot be recycled. This will reduce the amount of packaging waste that ends up in the landfill.
- *Bulk purchases:* Buying in volume typically results in less packaging per amount of product.
- *Square packaging:* Square packages take up less room in shipping containers and delivery trucks because they can be stacked closer together. This means fewer trips, again saving fuel.
- *Recyclable materials:* Cardboard, paper, glass, tin / aluminum cans, foil, and #1 and #2 plastics can be recycled in Boyne Falls. Other types of plastic (#3 - #7), polystyrene (Styrofoam), manila envelopes, padded envelopes, and paperboard coated in metallic finishes cannot.

Suppliers to look for

Individual suppliers are too numerous to mention. Find suppliers for a range of different items on the following green product search sites:

- https://www.gsaadvantage.gov/advgsa/advantage/search/specialCategory.do?cat=ADV.ENV
- http://www.responsiblepurchasing.org/
- http://www.buygreen.com/

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Chapter 9:
Green Marketing Plan

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Abstract

This chapter analyzes third-party research and sets forth recommendations on how Boyne should market its environmental initiatives to customers. It explores customer segmentation, demographics, beliefs, and behaviors related to green purchasing decisions. Then, we apply these findings to Boyne's unique customer demographics and array of environmental projects to recommend potential marketing messages, channels, and promotional ideas. We also suggest which projects Boyne should focus its communications around. Finally, we have developed a survey Boyne Mountain's marketing personnel should issue to its customer base to determine the specific attitudes and perceptions of its guests. This will help Boyne tailor its positioning and tactics to a more specific audience.

Spotlight on: **Aspen Skiing Company**

Aspen integrates "green" messages into its mainstream marketing materials, including magazine ads and its website. The company partners with recognizable campaigns and brands such as "Keep Winter Cool" and the Winter X-Games to cross-promote its environmental position.

Source: Auden Schendler, Personal Communication.

Purpose & Scope

The purpose of this document is two-fold:

1. Provide Boyne Mountain's marketing staff with a summary analysis of market research findings on consumers' demographics, beliefs, and behaviors regarding "green" purchasing decisions, particularly with respect to travel.
2. Recommend the key messages and channels through which Boyne Mountain should market its own environmental initiatives to customers.

Marketing of environmental initiatives should adhere to the same principles of integrity necessary in traditional marketing activities. "Green" marketing by a broad array of corporations has come under fire in the past year, as consumers and the media have criticized companies for exaggerating claims. Boyne Mountain should take care to communicate environmental efforts honestly and openly to avoid accusations of greenwashing.

Boyne Mountain should also be aware that talking about its environmental initiatives publically will draw additional scrutiny of such efforts. We believe this is beneficial, as it will encourage the resort to live up to its goals, strive harder to reduce its environmental impact, and transparently disclose opportunities for further improvement.

Finally, Boyne Mountain should take steps to understand its own customer base's unique attitudes towards the environment and how they impact resort travel decisions. We have included a customer survey in

What does "green" mean?

We realize few business projects, products, or services are 100% environmentally benign or beneficial, and do not mean to imply that by the use of this term. This adjective has been widely used and abused, but for simplicity's sake we adopt the term most prevalent in the marketing literature. In this context, "green" refers broadly to environmental initiatives (e.g. energy efficiency projects) or environmentally preferable products (e.g. organic food served in restaurants) that *reduce* the impact of the firm on the environment as compared to "traditional" modes of business.

Appendix 1 that we recommend Boyne issue to its guests as soon as possible. The market research and recommendations in this document only reflect the general attitudes of the US population as a whole. To craft a more effective green marketing strategy, Boyne should tailor its approach to the viewpoint of its customer base as elicited from this survey.

Green Consumer Characteristics

Market Segmentation & Size

Considerable third-party market research has been conducted to determine the size, demographics, beliefs, and behaviors of the "green" consumer segment. While each survey differs on the exact definition of different customer segments, all agree that "green" consumers constitute a significant proportion of the population, rather than a fringe that can be ignored. For example, a recent survey by the Natural Marketing Institute showed 80% of the total US adult population demonstrates some type of "green motivation" when making purchasing decisions (as compared to 77% in 2005).[1] They segment the market into 5 groups:

- LOHAS (Lifestyles of Health and Sustainability): values-driven consumers who hold strong beliefs about personal and environmental health.
- Naturalites: driven by personal health and wellness; want to do more for the environment.
- Drifters: driven by trends, but currently consider sustainability when making purchasing decisions. More price-sensitive than naturalites.
- Conventionals: no deep-rooted environmental values, but will practice environmental behaviors that have additional benefits, such as conserving energy to reduce utility bills.
- Unconcerned: do not consider the environment in purchasing decisions.

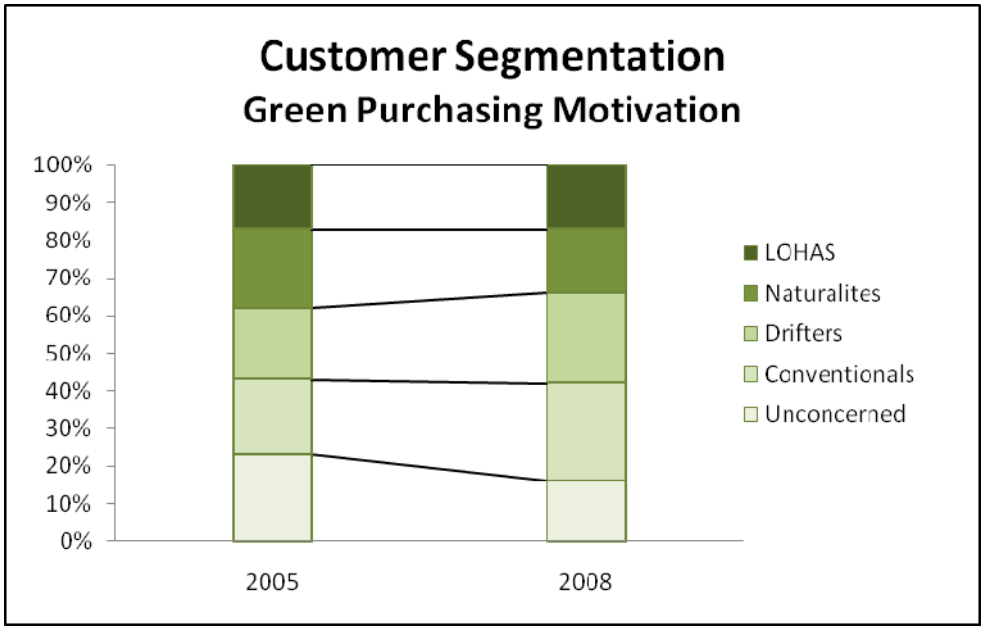


Figure 1: Customer segmentation (Source: 80% Of U.S. Adults Show Some Type Of Green Motivation, Environmental Leader, 11/4/2008).

Furthermore, concern for the environment is growing. According to Mintel, 56% of consumers are more concerned about the environment than they were 5 years ago.[2] Using their segmentation definitions, in a 16-month period the category of customers deemed "Never Green" shrunk by half, while the "True Green/Super Green" category tripled.

While many market-watchers speculated that the current recession would cause consumers to increasingly choose affordability over environmental attributes, evidence shows this has not actually happened. A study commissioned by Green Seal and EnviroMedia Social Marketing demonstrated that 82% of customers are still "buying green," despite the economic downturn.[3]

So who are these LOHAS or "super-green" consumers? While it is difficult to paint a discrete, defined picture of this segment, the following people tend to be the most environmentally conscious: [4]

- Age: 18-24 year olds are most likely to try new green products or services. They are also most susceptible to online marketing campaigns. However, 55 year olds and over tend to be most likely to make offline green purchases.
- Race: Asians tend to be the early adopters, while blacks are late adopters. Whites and Hispanics fall somewhere in between.
- Education: Current students and college graduates are more likely to purchase environmentally friendly products than people who have not attended college.

- Family: Families with children are less likely to make green purchases, particularly if efficacy or affordability is compromised. Convenience is essential for families.
- Religion: While no clear patterns currently exist, conservative Christians are expected to increasingly incorporate environmental considerations into their purchases given growing concern over serving as proper stewards of God's world.
- Activities: People who regularly engage in outdoor activities such as walking, hiking, biking, and skiing are more receptive to green marketing messages.

While these demographic characteristics pertain to all types of green product and service purchases, they are generally applicable to travel decisions. For instance, while more baby boomers travel than younger or older generations, 18-34 year olds and over 55s comprise a disproportionate number of ecotourists.[5]

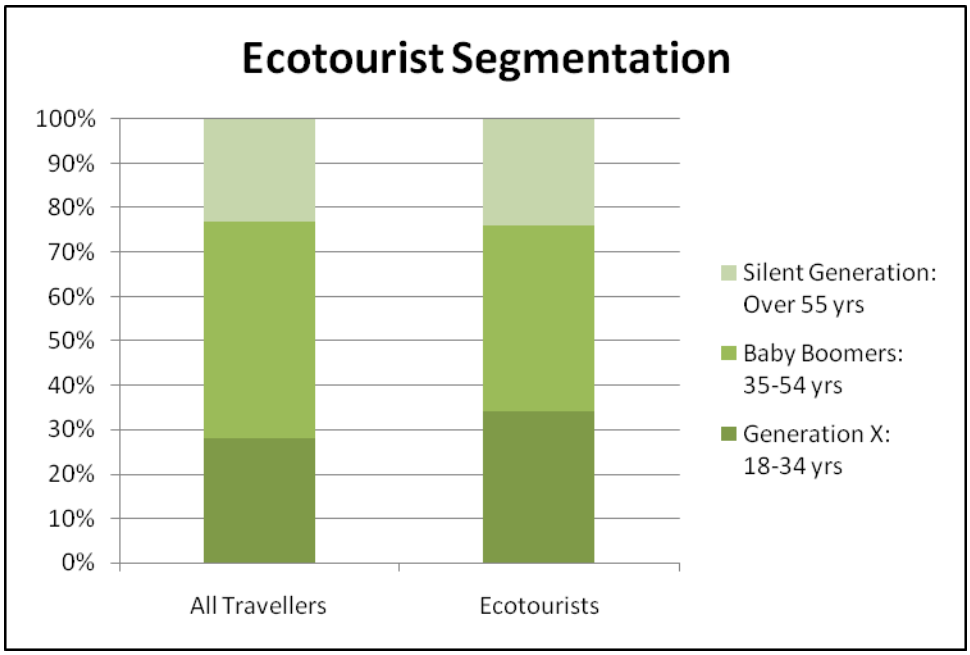


Figure 2: Ecotourist age segmentation (Source: Eco-Accommodation – International. Mintel, Nov. 2007).

Beliefs

Green consumers are not easy to define demographically. While they share certain outward characteristics as listed above, they are more united in their beliefs and values than in any tangible traits.[6] It is therefore more difficult to accurately target these customers; but once the message reaches them, their response rate may be higher given their deep resonance with environmental values.

More so than strictly environmental benefits, health and safety concerns are the biggest drivers in "green" purchases. In general, people believe products that are good for the

environment (such as cleaning products with reduced chemical content) are also safer and healthier for themselves. Consumers who value their own health are therefore more likely to purchase green products and services. Given the recent growth in health and wellness trends, this "common association between health and safety and environmental sustainability can only benefit 'green' products."[7]

Consumers are starting to expect more from companies. First, they want to know who made their products, where they came from, and what they're made of. The recent trend towards locally grown food is a fine example of this increased consumer scrutiny and awareness regarding the environmental impact of their purchases. Second, environmentally friendly behavior is becoming table stakes, not a competitive differentiator. Corporate social responsibility and environmental sustainability are increasingly seen as necessary components of good business practices, not rare achievements.[8] Jason Saul, President of Mission Measurement, predicts that in the near future, environmental sustainability will not be a tool for growing market share or charging premiums; it will be mandated by stakeholders as an entry requirement for doing business. Finally, customers are demanding more transparency and authenticity in communications about the environmental impacts of products. The mainstreaming of sustainability has increased customer awareness and acceptance of its importance; however, it has also bred skepticism. With nearly every company making splashy environmental claims, consumers have grown wary of the very word "green", and require more information and honesty to overcome their cynicism.[9]

Certain issues have greater resonance with consumers than others. Air and water pollution, toxic and other wastes, and extreme resource depletion were the original drivers behind the current environmental movement, because they are highly visible, affect human health, and are easy to connect with specific corporate actions.[10] It is therefore easy to communicate the benefit of reduced toxic emissions, chemical usage, and waste; however, such actions tend to be seen as necessary rather than differentiating conditions. Customers simply expect that companies are undertaking actions to clean up air and water, and preserve the natural environment around them, so are not impressed with the marketing of such initiatives (it is more appropriate to address such issues through public relations avenues, including annual sustainability reports). Wildlife conservation, biodiversity, and animal testing are also concerns, but tend to be thought of as purely "environmental" issues with little connection to human health and wellness. With the overwhelming scientific evidence and explosion in media coverage, the hottest (pardon the pun) issue currently on consumers' minds is global warming.[11] Energy conservation is closely associated with this. Consumers are generally aware of a link between conventional electricity generation and global warming, though they may not understand the exact science of this relationship. Water conservation is quickly becoming more front-of-mind as certain regions in the US are experiencing more frequent and severe droughts. Climate change avoidance (popularly referred to as carbon footprint reduction), energy efficiency, and water conservation are the primary issues around which marketing messages should revolve.

Consumers are more familiar with certain types of "green" products and services than others. "Natural and organic food and beverages are the most familiar"[12] of these, suggesting it would be prudent for Boyne to start marketing in natural and organic offerings in restaurants. Green buildings, particularly LEED certification and Energy Star appliances, are increasingly recognized by consumers and expected to become the standard rather than the exception. Solar and wind power are the most easily recognized forms of renewable energy, suggesting that even a small-scale demonstration project at Boyne would provide an image boost with customers. While they may seem easy and neat, carbon offset credits are widely distrusted since people are unsure whether their purchase leads to a net reduction in emissions.[13] Boyne Mountain has been wise to avoid such mechanisms.

Regardless of these specifics, green marketing campaigns "are more likely to be successful if they can link their environmental benefits to other benefits or ideals valued by their target consumers."[14] Boyne Mountain should identify the values of its own customer base – perhaps adventure, outdoor activity, or the health of family and friends – and link these to its environmental initiatives such that its marketing messages truly connect with the core beliefs of its guests.

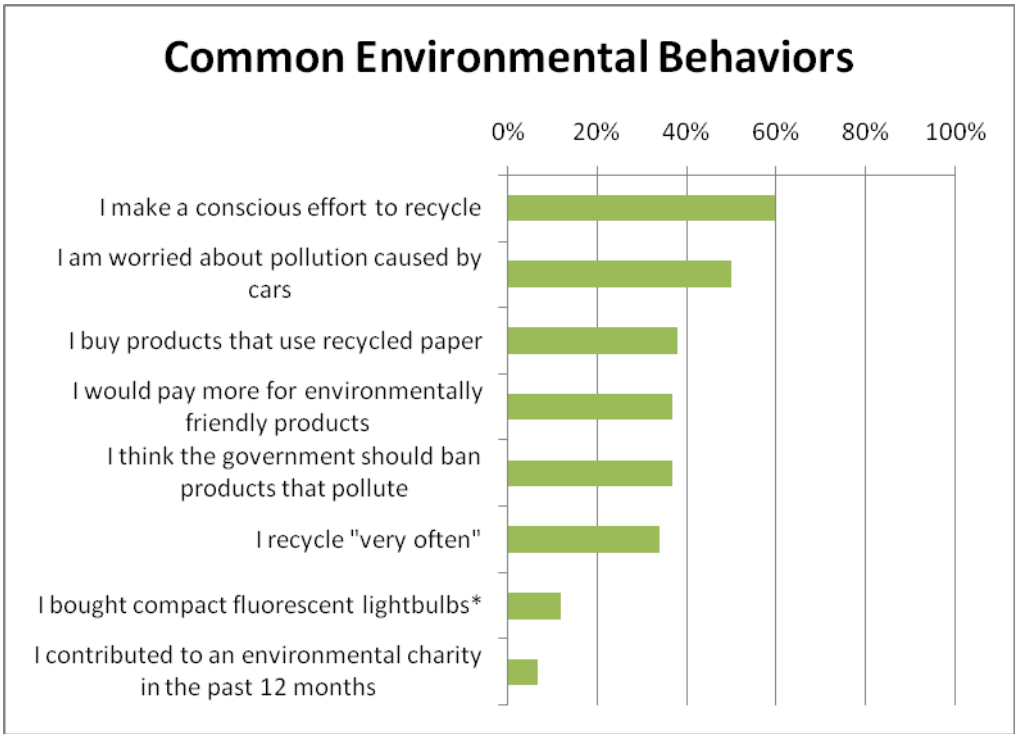
Behaviors

Green marketers are constantly frustrated with the apparent disconnect between people's stated support for a healthy environment and their actions when it comes time to choose one product over another. Until recently, "environmental" versions of products suffered from an image problem: if they were better for the environment, they must not be as effective. [15] However, more recent studies show that perceived quality of environmental products is now on par with or superior to conventional products. The main barrier to green purchasing now is price. 51% of consumers want to buy green products, but they are too expensive; most are "unwilling to pay more than 10% extra" for environmentally preferable products.[16] Boyne should resist the temptation to charge significant premiums for green services such as its natural food offerings or use of its "green room." Additional barriers include contentment with the current product (i.e. no motivation to try something new) and lack of awareness or availability. This suggests that trial products or discounted services could be effective, and that greater marketing efforts are needed to grow consumers' understanding of environmentally preferable alternatives.

Consumers are more likely to base purchasing decisions on green credentials if a product or service is third-party certified: "consumers will act on information about products' environmental impacts if that information is readily accessible (i.e., on the product label), easily understandable, and reliable."[17] Boyne can leverage third-party certifications such as LEED and the Green Hotels Association to help overcome consumers' skepticism (and hence inertia) regarding green purchases.

While “ecotourism” is generally associated with foreign travel to wilderness areas, the sheer size of the market, at $24.17B,[18] is evidence that many consumers do make travel decisions based on the environmental impact of their choice. They key to influencing consumer decisions is marketing environmental initiatives with personal benefit (or no personal sacrifice in comfort or convenience). For instance, natural and organic restaurant food is not only better for the environment, but healthier for the guest; low-VOC paints mean the air within the hotel is cleaner for guests to breathe; and key card activated lights, heat, and appliances make it effortless for the guest to conserve energy. This puts the customer at the center of green efforts: not only are environmental features beneficial to the guest, but the guest feels he/she is playing an active role in improving the environment (while still enjoying a relaxing, leisurely vacation).

Finally, some consumers exhibit green behavior at home that could translate to environmentally friendly behavior while on vacation. Recycling and pollution avoidance are the most prominent of these, suggesting that consumers would respond well to in-room and on-mountain recycling programs or discounts for carpooling.



**of those who bought lightbulbs in past month*

Figure 3: Common environmental behaviors (Source: Mintel Green Living Report).

Boyne Demographics

It is important to consider Boyne's demographic profile when choosing how to position its green marketing messages. The Boyne guest tends to be a baby-boomer from Michigan who is married, possibly with a family; he has likely graduated college.

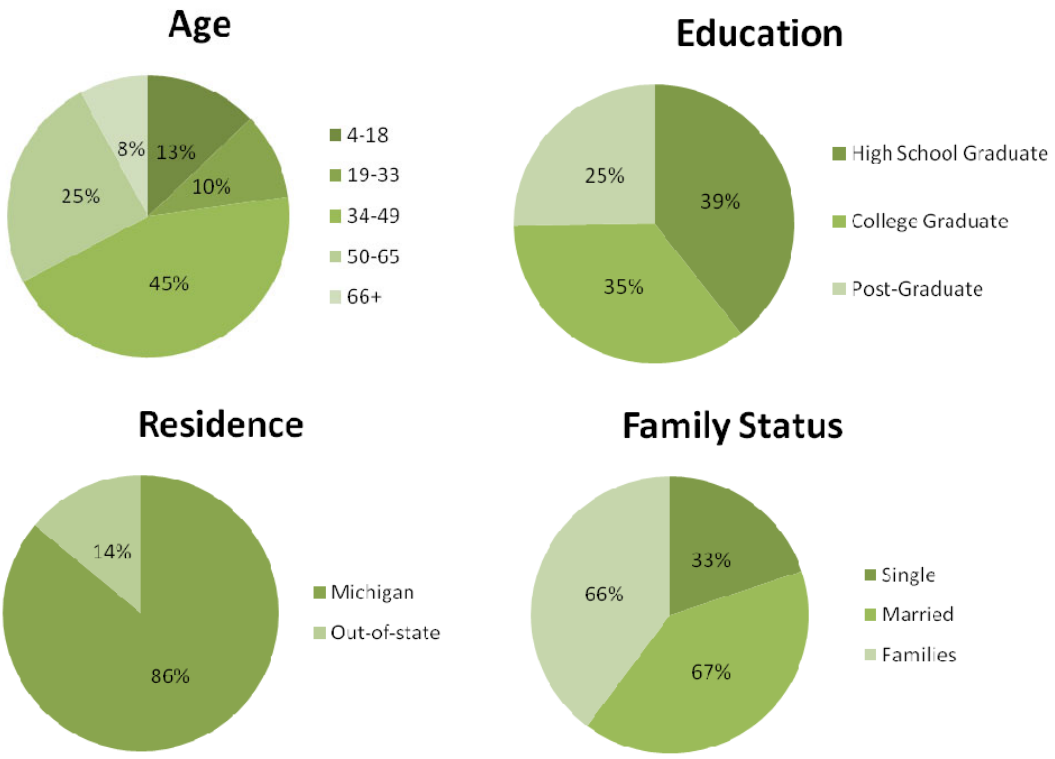


Figure 4: Boyne Demographics (Source: Julie Ard, Director of Resort Marketing and Communications, Boyne Mountain, 12/1/2008).

Boyne's demographics do not align with the "super-green" characteristics identified above. However, since we've demonstrated beliefs are more important than physical characteristics, this does not mean Boyne should keep quiet about its environmental efforts. Boyne's challenges will be to 1). raise awareness (but not alarm) about the environmental impact of ski and golf resorts, then 2). communicate the *guest benefit* of visiting a more environmentally friendly resort (see below for specific messaging recommendations). While Boyne's customers may not be at the forefront of the environmental movement, they are bound to exhibit growing concern for the environment as the general "green" consumer movement progresses. Boyne will be better off proactively leading the opinions of its customers by communicating its environmental stance now, rather than struggling to catch up once such sentiments become more widespread.

Recommended Marketing Plan

Messages

Since Boyne's demographics do not align with the traditional LOHAS or super-green segments, it will have to tap into customer values other than pure environmental benefit when positioning messages around its environmental initiatives. This would be best done by surveying customers to assess their perceptions of the environment and various other values. However, a couple of potential themes that could be effective, based on the research explained above, include:

- Skiing and golf are healthy, outdoor activities; they in turn rely on the health of the environment (e.g. low temperatures for adequate snow fall; pristine natural setting for golf course; ample water for snow-making and golf course irrigation)
- Visiting an environmentally-friendly resort is better for the health and safety of the guest and their family (e.g. reduced chemicals in cleaners, paints, and food)
- Visiting an environmentally-friendly resort helps guests do their part for the environment (e.g. conserving energy and recycling, just like they do at home)
- Traditionally-run ski and golf resorts contribute to global warming (e.g. through energy needed to run ski lifts, power golf carts, and light up hotel rooms); however, energy efficiency measures and the use of renewable energy sources can reduce this impact, thereby contributing to climate stability needed to keep ski and golf resorts running
- Traditionally-run ski and golf resorts use large quantities of fresh water (e.g. for snow-making, irrigation, and hotel laundry); however, water-efficiency and water quality measures like low-flow faucets and better stormwater management can help reduce this impact

In crafting the tone for these themes, remember that "positive, hopeful marketing messages that emphasize the power of individual and corporate commitments to the environment"[xix] are more likely to be successful.

Actions

Regardless of the specific messages and positioning chosen, Boyne should take steps to communicate its environmental initiatives. Of course, it wouldn't be a marketing plan without 4 Ps, those ours are not the typical "product, price, place, promotion":

- **Proclamation:** A green marketing campaign should be spearheaded by leadership at the top. Publically state Boyne's commitment to environmental improvement by articulating a succinct set of goals, and give the program a catchy name. Destination Hotels has dubbed its program "Destination Earth,"[xx]

providing a simple sound bite that can be associated with all other specific campaign activities. Furthermore, Boyne Mountain should officially join the Sustainable Slopes Initiative as a way to indicate its intentions.

- **Promotions:** Actively engage the customer in environmental efforts by providing promotions with other perks. For example, offer premier parking spaces for people carpooling or driving hybrid or electric vehicles. Have a resort-wide recycling day with greeters at prominent recycling stations who pass out small stickers (e.g. "I recycled!") to everyone who participates. On in-room cards explaining the towel reuse program, include statistics (e.g. "75% choose to reuse their towels, saving XX gallons of water per year) to motivate better behavior through the use of social norms. Host "local food nights" in Everett's Restaurant with special dishes showcasing a particular farm or ingredient (e.g. asparagus in spring, cherries in summer, apples in fall, butternut squash in winter) with discounted prix-fixe meals. The possibilities are endless when it comes to raising environmental awareness or encouraging environmentally friendly behavior through fun, participatory programs that are not costly to implement.

- **Partnerships:** Build relationships with third-parties to enable cross-promotion. Consumers may not know much about global warming, but could be familiar with the Keep Winter Cool campaign that some 70 ski resorts participate in. Many ski, clothing, and food companies such as Horny Toad and Clif Bar have environmental programs of their own and may be willing to co-sponsor events or gear giveaways that tie into environmental themes. Marketing third-party certifications like Energy Star appliances, LEED certified buildings, the Audubon-certified golf course, and Fair Trade coffee is another way to build credibility with consumers.

- **Projects:** Include basic environmental information in all traditional marketing materials. This need not be overwhelming – a short paragraph in a brochure, a logo link on the home page, or a one-phrase blurb at the bottom of a magazine ad will serve to notify customers that Boyne cares about the environment, and allow those who are interested to follow up in more detail by visiting the environmental pages of Boyne's website. Boyne is undertaking a wide variety of environmental initiatives, all of which will provide positive benefits. However, some of these are more likely than others to pique customers' interests. We recommend Boyne focus on the following. [Note: information on *all* environmental projects should be available to stakeholders through some public means like an annual sustainability report or website. The projects deemed "marketable" here are those which are best suited to customer facing promotional materials whose intent is to drive business to Boyne Mountain.]

	Timing	Marketable
Renewable energy efforts		
Operating hydro dam to supply 300 kW energy	Current	✓
Exploring possibility of solar-powered golf cart shed	Future	✓
Exploring possibility of on-mountain micro-hydro	Future	✓
Exploring possibility of using solar heat for pools	Future	✓
Energy efficiency / reduction measures		
Snowcats are turned off instead of idling	Current	
Golf cart fleet is battery-powered	Current	✓
Trialing Green Room with keycard-activated lighting and HVAC	Current	✓
Motion-sensor lighting throughout buildings	Current	✓
Replacing all lodge & restaurant lighting with CFLs	Current	✓
Redesigning slope lighting	Future	✓
Sourcing more water- and energy-efficient appliances	Future	✓
Switched to low-energy snow guns	Current	✓
Installed cooler curtains to keep the cold in	Current	
Planning on installing harmonic filters in Avalanche Bay	Future	
Exploring possibility of installing harmonic filters on ski lifts	Future	
Monitoring energy use to reduce peak usage	Future	
Water efficiency / water quality measures		
Capturing runoff from mountain in pools and reusing water for irrigation	Current	✓
Using dirt instead of man-made snow to shape half pipe	Current	✓
Running optional guest towel reuse program (to save on laundry)	Current	✓
Trialing Green Room with low-flow faucets	Current	✓
UV system for washing machines reduce water use	Current	✓
Redesigning stormwater management system to reduce natural system degradation	Future	
Recycling & waste reduction		
Reuse program for employees	Current	
Recycling in back-office (Clear glass and plastic from the spa #1 & #2)	Current	
Implementing recycling for guests	Future	✓
Compost food waste from kitchens	Future	✓
Pitchers of water in rooms instead of bottles	Current	✓
Newspapers at front desk instead of every room	Current	✓
Durable ceramic / metal tableware and biodegradable disposables	Current	✓
Environmentally-sensitive cleaning products	Current	✓
Recycles cardboard / packing materials	Current	
Relocated building from downtown instead of building new children's center	Current	✓
Cooking oil donated to people for biodeisel	Current	✓
Golf course		

Minimizing fertilizer & pesticide needs on golf course	Current	✓
Natural buffer zone between course and natural habitat	Current	
Audubon sanctuary certified	Future	✓
Restaurants & lodging		
Local seafood, produce, & breakfast meat	Current	✓
Fairtrade coffee	Current	✓
Low-VOC paints & sealants	Current	✓
Soy-based mattresses (instead of petroleum-based)	Current	✓
Implementing sustainable purchasing guidelines	Future	
Employee & guest involvement		
Carpooling & hybrid incentives	Future	✓
Ecology integrated in children's program (Fritz' Adventure Camp)	Current	✓
Volunteering / Community Involvement: Adopt-a-Highway program	Current	✓
Creating educational gardens	Future	✓

Future projects should only be marketed once a firm commitment is made to undertake them, and some reportable progress has been made towards implementation.

Marketing efforts should be accompanied by a public relations campaign that details the full extent of Boyne's impact on the environment, and detailed information on all of its initiatives. A public relations expert could provide guidance in this direction. We recommend at a minimum issuing a public statement of environmental values and goals, developing a more robust web page, and issuing annual sustainability reports.

Appendix 1: Boyne Mountain Green Marketing Survey

Attitudes:

- How important are the following attributes to you?
  - The health of the environment
  - My personal health
  - The safety and health of my family
  - Outdoor activities
  - Fun and adventure
  - Leisure and relaxation
- For all of the above, provide this answer matrix
  - Very important
  - Somewhat important, but not a top priority
  - Minimally important, but it still matters
  - Not important at all

Perceptions:

- How would you rate Boyne Mountain's environmental performance compared to other resorts you have visited or considered visiting?
  - Much better
  - Somewhat better
  - About the same
  - Somewhat worse
  - Much worse
  - Don't know
- Feel free to provide additional comments to explain your choice: [text box]

- How important do you think each of the following activities is to a resort's environmental performance?
  - Energy-efficiency (e.g. lower-energy lighting on slopes and in rooms)
  - Renewable energy (e.g. using wind power)
  - Water-saving measures (e.g. low-flow faucets)
  - Reuse programs (e.g. donating old furniture)
  - Recycling programs (e.g. collection containers for paper and containers)
  - Composting programs (e.g. collecting food scraps from restaurants)
  - Organic food served in restaurants
  - Locally-grown food served in restaurants
  - Environmentally-preferable furniture in hotel rooms (e.g. sustainably harvested wood furniture)
  - Community involvement (e.g. employees volunteering on a local environmental restoration project)

- For all of the above, provide this answer matrix:
    - Very important
    - Somewhat important
    - Not important

Behaviors:

- Why do you visit Boyne Mountain?
    - To relax and get away
    - To spend time with my family
    - To enjoy outdoor activities / adventure
    - Other (please describe)_____.
- To what extent do you consider the environmental performance of a resort when planning a vacation?
    - To a great extent; it is a primary selection criteria
    - To some extent; I take notice of a resort's environmental activities
    - I don't include it in my decision criteria, but it's a nice added bonus
    - Environmental performance has no bearing on my vacation decisions
- To what extent would a resort's environmental performance change your feelings towards that resort?
    - I would feel increased loyalty to the resort, and would be willing to pay more for the resort's services
    - I would feel increased loyalty to the resort, but would not be willing to pay more for the resort's services
    - I would appreciate the resort's environmental efforts, but it would not affect my loyalty
    - I would not pay much attention to the resort's environmental performance

Marketing Channels:

- How would you rate Boyne's current communication of its environmental performance?
    - Too much; I wish I heard less about Boyne's environmental performance
    - Just right; I know what I need to know about Boyne's environmental performance
    - Not enough; I wish I heard more about Boyne's environmental performance

- How do you gather information on Boyne Mountain when planning your visit?
    - Check the website
    - Call a customer service representative
    - Reference printed materials (e.g. brochures)

[1] "80 Percent Of U.S. Adults Show Some Type Of Green Motivation." Environmental Leader 4 Nov. 2008. <http://www.environmentalleader.com/2008/11/04/80-of-us-adults-show-some-type-of-green-motivation/>.
[2] Green Living. Rep. Mintel, 2008.
[3] "82 Percent of Consumers Buy Green, Despite Economy." Environmental Leader 5 Feb. 2009. <http://www.environmentalleader.com/2009/02/05/82-percent-of-consumers-buy-green-despite-economy/>.
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Chapter 10:
Internal Communications Plan

Table of Contents

Abstract

This document details the key messages and channels for communicating Boyne's environmental initiatives to its own employees. It explains how ski and golf resorts impact the environment, including energy usage, water consumption, and waste generation. This information should be used to provide employees with a basic understanding of the connection between Boyne's operations and the environment. It outlines Boyne's current and future environmental activities, to inform employees of the efforts Boyne is taking to improve its sustainability. It concludes with recommended channels and frequencies of employee communications regarding the environment. Boyne human resource employees can use this information to craft a detailed communication schedule and training curriculum.

Spotlight on: **Keystone Resort**

Keystone Resort in Colorado ensures its employees are well-versed in its environmental programs by including an environmental section in its new-hire training, and including pertinent environmental updates and an "Environmental Tip of the Week" in its weekly resort-wide email.

Source: National Ski Areas Association "Green Room", http://www.nsaa.org/nsaa/environment/the_greenroom/index.asp?mode=greenroom&group=G3, accessed 3/8/2009.

Purpose & Scope

The purpose of this chapter is to elaborate key environmental sustainability messages for Boyne Mountain's internal communication channels and training programs. We begin with an overview of the potential environmental impacts of the ski and golf industry, with some potential ways to mitigate those impacts. It is important for employees to understand this background so they know why the environment matters to Boyne. Then we detail Boyne's current environmental initiatives to build employees' understanding of what Boyne is doing to "Go Green." This will allow employees to speak knowledgeably to guests about Boyne's activities, as well as to support Boyne's goals through their own individual efforts. To provide insight on the future direction of this initiative, we outline some potential new projects Boyne Mountain is currently planning (which include all the recommended projects in this report). We then recommend some ways directors, managers, and team members can help support these various initiatives. All of the above messages should be included in Boyne's training and communication materials, which will be created by Boyne team members. The specific communication vehicles and recommended frequencies are detailed in the last section. This chapter should be used by Boyne's human resources group to craft a detailed communication schedule regarding the resort's environmental program, and to develop content for those communications.

The wording in the following sections is meant to portray the environmental impacts of resorts and what Boyne is doing about it in a straightforward way that every employee at Boyne can easily understand. We realize this information is not novel to the scientific community, but most Boyne team members do not have training in the environmental sciences. Our intent is to provide messaging that can be cut and pasted directly into Boyne's training and communication materials with minimal effort.

Environmental Impact of Ski & Golf Resorts

Ironically, while skiing and golfing provide opportunities for people to get outdoors and enjoy the natural world, traditionally-run ski and golf resorts can be environmentally destructive. They use large amounts of water, require considerable energy, and create substantial waste. Resorts across the country are taking steps to reduce these impacts, preserving the ecosystems upon which these recreational activities rely.

Water

Golf courses require water for irrigation to keep fairways and views moist and green. It is estimated that golf courses in the US use on average 762 billion gallons of water a year, or 0.5% of the US total.[1] An abundant supply of freshwater is crucial for the ongoing health of the golf industry. There are many measures that can be taken to reduce water consumption while maintaining the course's quality: Native grasses requiring less water and fertilizer can be planted in the rough; storm water retention can be maximized for irrigation; and watering can be performed at night to reduce evaporation. For a more detailed description and suggestions for golf course sustainability, see Chapter 7.

Ski areas rely on water for snowmaking to prolong the season and improve the "skiability" of runs which might otherwise not have enough snow cover in certain places. However, snow-making also requires significant fresh water: it takes 75,000 gallons of water to create a 6-inch layer of snow over a 200 ft by 200 ft area.[2] Ski areas can design terrain to reduce the need for snowmaking, for instance by using dirt rather than snow to form major contours. Furthermore, high-efficiency snow-guns that use less water and energy can be installed.

Hotels and restaurants require water for guest use (e.g. showers), food preparation, and sanitation (e.g. laundry). Various efficiency measures like low-flow faucets can reduce guests' water use with little noticeable difference to the guest. Furthermore, new technology for large appliances can drastically reduce the resort's water consumption; see Section III below for more on Boyne Mountain's successful solution to reducing water for laundering.

Resorts can also degrade water quality in local streams and lakes if runoff or effluent is allowed to reach these water bodies untreated. For instance, rain can wash toxic fertilizers and pesticides off golf courses and into natural waterways, causing nutrient-loading that disturbs the natural habitat and kills fish. Roads and parking areas pose a similar risk when oil residue and particulate matter run into natural waterways. For a further discussion of mitigation techniques, see the Stormwater Garden section of Chapter 6.

Energy

The livelihood of the ski and golf industry depends on a healthy environment and stable climate. For instance, consistent snowfall levels and low temperatures promote a long ski season. With climate change a real threat to our winter landscapes, the ski industry should be the first to embrace measures to reduce greenhouse gas emissions. However, ski areas are often major contributors to climate change because of their energy consumption. Energy consumption is linked to climate change because "traditional" forms of electricity (e.g. coal, natural gas) release greenhouse gasses (GHGs) into the atmosphere. GHGs absorb the back radiation from the Earth's surface, effectively "trapping" heat in the atmosphere and causing global temperatures to rise. This not only means warmer winters, but also more erratic and unreliable precipitation, and extreme weather events like hurricanes and droughts.

The largest sources of energy consumption for all-season resorts are typically snow-making and ski lift operations. Both can be made more efficient by employing various energy-saving technologies like the high-efficiency snow-guns mentioned above. Lodging and restaurants also suck up energy through lighting, heat, and appliances. Efficiency measures such as motion-sensored lighting, better insulation in walls, Energy Star® appliances, and programmable thermostats can reduce this impact.

While efficiency measures can reduce the overall *quantity* of energy consumed, using renewable energy sources can improve the *quality* of that energy by reducing GHG emissions. Renewable energy sources include wind, solar, hydro, and geothermal sources (using the natural heat from the earth). Many resorts have experimented with onsite renewable energy generation to reduce their reliance on dirtier electricity from coal or natural gas. For instance, Jiminy Peak in Massachusetts has a 1.5 megawatt wind turbine (providing 33% of its annual electricity demand), while Aspen in Colorado has a 150 kilowatt solar panel installation.

Waste

Resorts also generate considerable waste. Guests toss food scraps and water bottles, maintenance accumulates old paint and oil cans, and retail shops trash the plastic wrapping and cardboard boxes they receive merchandise in. The old "reduce, reuse, recycle" adage applies to resorts as well as homes. Waste can be reduced by better specifying requirements when purchasing goods; for instance, all those tiny shampoo and conditioner bottles could be eliminated if hotel rooms simply had bulk dispensers for such amenities. Large durable items can be reused; for example, ski lifts can be sold to other mountains and CAT engines can be remanufactured for a second "life". Finally, much of the remaining waste can be recycled. Many resorts have receptacles available for guests to deposit bottles and newspaper, sometimes even in each individual hotel room. Compacted cardboard and metal scraps can typically be sold for recycling. Food and garden waste can be composted to create rich, organic fertilizer.

Boyne's Current Environmental Sustainability Initiatives

Boyne Mountain has undertaken serious efforts to reduce its environmental impact. These efforts fall under water efficiency and quality, energy efficiency, renewable energy, waste reduction and recycling, restaurants and lodging, and guest-facing initiatives.

Water Efficiency and Water Quality

- *Water Reuse:* Boyne Mountain has retention ponds at both the top of the mountain to catch rainwater and the bottom of the mountain to capture runoff from snowmelt. This water is then reused for irrigation, pumped through pipes to water the grounds around the Mountain Grand Lodge and golf course.
- *Earthen Terrain Park:* Boyne Mountain's half pipe is shaped primarily with dirt, eliminating the need for a considerable portion of man-made snow each season.
- *Towel Reuse Program:* All guests at the Mountain Grand Lodge, BoyneHof Lodge, Clocktower Lodge, and Edelweiss Lodge have the option to reuse their towels, saving water by reducing laundry loads.
- *Laundry System:* Boyne Mountain's laundry equipment uses oxygen injection to zap linens clean, reducing water needs by per pound of laundry by 39%.
- *Natural Buffers:* Fairways are separated in some areas from natural habitat with buffer zones to reduce the runoff of fertilizers and pesticides into natural waterways.

Energy Efficiency

- *No Snowcat Idling:* Snowcats are turned off when not in use, rather than idling. At many resorts, snowcats are left idling in between jobs to keep the equipment warm. By not idling, Boyne Mountain saves fuel.
- *Electric Golf Carts:* The golf course uses electric, battery-powered golf carts, which reduce energy consumption and eliminate noxious fumes and particulates gasoline-powered engines release.
- *Motion-sensored Lighting:* All of Boyne Mountain's "backstage" areas (hallways, offices, etc.) are equipped with motion sensored-lighting. This ensures that lights are only on when people are present, reducing energy use.
- *Compact Fluorescent Lighting:* Boyne Mountain is replacing all lodging and restaurant lighting with CFLs, which consume 75% less energy than traditional incandescent bulbs.[3]

- *Low-Energy Snow Guns:* Traditional snow guns on the ski area are being phased out in favor of low-energy ones, which are 30% more energy efficient. Fifty-five new guns are in use now, and all remaining ones will eventually be replaced.
- *Cooler Curtains:* Restaurant kitchens' refrigerators and freezers are equipped with cooler curtains to keep cold air in, reducing energy requirements for cooling.
- *User-Powered Fitness Equipment:* Some treadmills in the Mountain Grand Lodge fitness center capture kinetic energy given off during exercise to help power the machine.

Renewable Energy

- *Hydro-Power:* Boyne Mountain operates a 300 kW dam on the Boyne River, 3 miles from the Mountain Grand Lodge. This power is used onsite at Boyne Mountain.

Waste Reduction & Recycling

- *Durable Tableware:* Many restaurants use durable ceramic plates, glasses, and silverware rather than disposable items. For those areas where disposability is necessary (e.g. the cafeteria), Boyne recently switched to biodegradable materials rather than plastic or paper. Furthermore, guests are offered pitchers of water in their rooms instead of bottles, reducing plastic bottle waste.
- *Cleaning Products:* Boyne Mountain housekeeping and kitchen staff use an environmentally sensitive cleaning solution that is less toxic than most commercial cleaners. This reduces the risk of harmful chemicals seeping from drainage pipes to groundwater. Furthermore, the solution comes in a concentrated format, reducing packaging needs.
- *Newspapers at Front Desk:* Rather than giving every guest a newspaper, many of whom may simply discard the paper before reading it, guests who wish to can pick up a copy of the newspaper at the front desk. This diverts excess papers from landfills.
- *Employee Reuse Program:* Employees can post ads for used durable items they no longer need to the Boyne intranet, passing them on to other employees rather than land-filling them.
- *Building Reuse:* Rather than building a new children's center, Boyne Mountain relocated an old building from downtown (the Helga House), eliminating the need for new building materials.
- *Employee Recycling:* Employees can recycle paper, clear glass, and #1 and #2 plastics in receptacles located throughout backstage areas.
- *Cardboard Recycling:* Boyne Mountain recycles large cardboard boxes, for instance from large shipments of food or skis.

- *Cooking Oil Recycling:* Used cooking oil is donated to local residents for biodiesel, who use this fuel instead of GHG-laden gasoline to power their cars.

Restaurants & Lodging

- *Locally-Grown Food:* Restaurants serve some seafood, produce, and breakfast meat from the Great Lakes region. By sourcing this food locally, Boyne Mountain reduces the "food miles" (which require fuel-burning transportation) required to procure food for guests. Boyne plans to continue seeking additional local options to add to its menus.
- *Fair Trade Coffee:* Boyne Mountain recently began sourcing Fair Trade coffee for its restaurants. Fair Trade coffee ensures growers receive a fair wage and adhere to certain farming standards which are better for the environment than traditionally-grown coffee.
- *Low-VOC Paints:* Boyne Design makes every effort to purchase low-VOC paints and sealants for lodging. Volatile organic compounds (VOCs) are gasses that can damage soil, groundwater, and air quality; some are also greenhouse gasses.
- *Soy-based Mattresses:* Boyne Design recently began purchasing mattresses for lodging that are 15% soy-based, instead of petroleum-based. Petroleum-based mattresses offgas harmful cancer-causing chemicals. While these are bad enough for people sleeping on them, they can cause acute lung damage and even death in the event of a fire, due to the highly potent toxic fumes released from the burning mattress.

Additional

- *Children's Program:* Ecological teachings are integrated into Fritz' Adventure Camp.
- *Adopt-a-Highway Program:* Employees are encouraged to volunteer in an Adopt-a-Highway program, keeping local roads free from litter.

Boyne's Planned Environmental Sustainability Initiatives

Boyne Mountain is currently investigating several additional projects to further reduce its environmental impact. While these are not yet implemented, it is important for team members to know what Boyne is doing to continuously improve its environmental sustainability.

Water Efficiency and Water Quality

- *Low-Flow Faucets:* The "Green Room" at Boyne Mountain is a trial room equipped with low-flow faucets in its shower and sinks. Pending guest satisfaction, these water-saving devices may be rolled out to the rest of Boyne lodging.
- *Stormwater Management:* Boyne Mountain is looking into ways that its storm water system could be redesigned to further reduce natural system degradation.

Energy Efficiency

- *Keycard-activated Electricity:* The "Green Room" at Boyne Mountain is a trial room equipped with keycard-activated lights, heating, and small appliances. These devices are either turned off or powered down when the guest is out of the room, and turned back on when the guest inserts his/her keycard to reenter. Pending guest satisfaction, these electricity-saving devices may be rolled out to the rest of Boyne lodging.
- *Upgraded Slope Lighting:* Boyne Mountain is researching alternative lighting solutions for its ski slopes. Potential energy-reducing options include LEDs (light-emitting diodes), switching the remaining incandescent bulbs to metal halide, and using carefully focused reflectors to provide effective lighting with less power.
- *More Efficient Appliances:* Boyne Mountain is soon adopting sustainable purchasing guidelines, which include standards for energy efficiency on large appliances, from kitchen mixers to clothes driers.
- *Harmonic Filtering Devices:* Avalanche Bay is planning on installing harmonic filters, which reduce voltage distortions caused by large, direct current (DC) drives and alternating current (AC) motors with adjustable-speed drives. These voltage distortions make the equipment less efficient. By smoothing out these distortions, harmonic filters are estimated to reduce energy consumption by about 5%. If these are successful, additional filters may be installed on ski lifts.
- *Energy Monitoring:* Boyne Mountain is considering implementing technology to allow it to better monitor its energy use. This will allow it to determine "peak" usage times, during which energy is most expensive, and make decisions about the best time to perform high-energy jobs.

Renewable Energy

- *Solar Power Demonstration:* Boyne Mountain is exploring the potential to create a demonstration-sized installation of solar power.
- *On-mountain Micro-hydro Power:* Boyne Mountain is exploring the possibility of using runoff from snow melt to power a small micro hydropower facility.
- *Solar Pool Heating:* Boyne Mountain is exploring the possibility of using heat from solar collectors mounted on the roof of an adjacent building to warm the pools in the Mountain Grand Lodge, Clock Tower, and condo area.

Waste Reduction & Recycling

- *Expanded Recycling:* Boyne Mountain is creating a guest-facing recycling program, so guests can responsibly dispose of common items like paper and bottles.
- *Composting:* Boyne Mountain is researching options for composting food scraps from kitchens as well as yard waste from maintenance work. This will divert such items from landfills, allowing them to break down naturally into fertilizer that can be used instead of petro-chemical based alternatives.

Additional

- *Audubon Certification:* The golf course is in the early stages of applying for Audubon sanctuary status. This would certify the Boyne Mountain's commitment to wildlife conservation and education in and around the golf course.
- *Sustainable Purchasing Guidelines:* Boyne Mountain plans to adopt sustainable purchasing guidelines, which will help it reduce its environmental impact by buying environmentally preferable products.
- *"Go Green" Incentives:* Boyne Mountain is evaluating various employee and guest incentives to encourage environmentally friendly behavior, from driving hybrid cars to recycling.
- *Educational Gardens:* Boyne Mountain is designing educational gardens to surround the new Children's Center and the Mountain Grand Lodge base area. These gardens will teach ski school and adventure camp participants as well as their parents about the natural ecology of the Boyne property and surrounding region.

How Employees Can Help

There are several ways employees can contribute to the success of Boyne Mountain's environmental sustainability program. First, each person should be familiar with the various environmental initiatives Boyne is undertaking. This will enable them to practice the programs themselves and answer guests' questions about these programs. For instance, they can promote reuse by advertising used items on Boyne's intranet. They can further reduce landfill waste by recycling paper, cans, and bottles while at work. They can help Boyne reduce its energy and water consumption by powering down computers and printers at night, turning off lights and faucets when not in use, postponing summer outdoor water use till evening, following Boyne Mountain's new sustainable purchasing guidelines, and carpooling to work.

Employees interested in becoming more involved should join Boyne's Green Team. They can find out how they can help plan or implement any of the above initiatives by calling Dave Newman at (231) 675-3262.

Channels and Frequency of Communications

Below are the various existing communication and training mechanisms used at Boyne Mountain. In the right hand column, we recommend which channels should be used for environmental messages, and how often.

Type	Frequency	Audience	Purpose	Environmental Messaging
Team Boyne Newsletter	Monthly	All team members in Michigan; distributed via email and printed for bulletin boards	General info	**Include quarterly environmental updates explaining recent successes, new projects, etc.**
Weekly Resort-Specific Newsletter	Weekly	Printed and given to guests (team members read it too)	Specific to Boyne Mountain; appropriate to communicate to guests	**Include environmental updates as needed, describing newly-made plans, success stories, or project updates for major environmental initiatives (especially those impacting guest experience)**
"Boyne Basic" Email	Daily	All team members at Boyne Mountain and sister resorts	Generic (non resort-specific) info	**Include environmental updates on a weekly basis; especially reminders for team members to contribute (e.g. how to participate in recycle & reuse programs)**

Type	Frequency	Audience	Purpose	Environmental Messaging
Boyne Mountain Staff Meeting	Weekly	Department heads (who then report to their managers)	Boyne-specific, particularly as it relates to people's jobs	**Include ad-hoc environmental messages here when needed to carry out a particular initiative; periodically seek feedback / ideas for environmental improvements**
"Stand-ups"	2 times a day	Managers talk to front line staff	10-15 minute meeting for every shift. Communicate Boyne Basic and staff meeting messages	**Not well suited for environmental messages, unless it relates directly to team members' work that day**
New Hire Orientation	Once (per employee)	New employees (same content for all Michigan resorts)	Employee on-boarding; already includes Boyne Going Green page on PowerPoint	**Frequently update content to reflect most current activities in summary format (like the information in this document)**
Back to Basics	Once (upon promotion or hiring)	Supervisors	Job-specific / management information	**Update to include more detailed explanation of Boyne's environmental activities, particularly as it relates to the team member's functional role**
Leadership Management Training	Monthly, 2 hours	Middle management	Topics rotate (e.g. "delivering better customer service")	**Develop and deliver entire 2-hour session on environmental impacts of ski / golf resorts and Boyne's efforts to improve its environmental impact (based on information in this chapter)**

[1] "Letter to the Directors, Officers, Owners, and Managers of Private Clubs." The Private Club Advisor. June 2008.
[2] "Greening Your Ski Area - A Pollution Prevention Handbook." Peaks to Prairies. Jan. 2002. Pollution Prevention Information Center. <http://peakstoprairies.org/p2bande/skigreen/>.
[3] "Frequently Asked Questions: Information on Compact Fluorescent Light Bulbs (CFLs) and Mercury." June 2008. Energy Star. <http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf>.

Chapter 11:
Employee Reward System

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Abstract

Adapting employee incentive programs to recognize sustainable behaviors is a key component to integrating sustainability throughout an organization. This chapter contains information on Boyne Mountain's current employee recognition programs as well as proposed modifications that will reflect Boyne's new commitment to sustainability and, more importantly, induce behavioral changes among Boyne team members.

Spotlight on: **Keystone Resort**

Keystone Resort in Colorado recognizes employees committed to the resort's environmental efforts through their GREENS incentive program (Good Recycling, Environmental Education, and Natural Sustainability). One recipient started an alternative transportation incentive program that has saved over 2,600 commuter days when employees take the bus, bike, or walk to work.

Source: National Ski Areas Association "Green Room", http://www.nsaa.org/nsaa/environment/the_greenroom/index.asp?mode=greenroom&group=G3, accessed 3/8/2009.

Purpose & Scope

The purpose of this chapter is to describe Boyne's current employee incentive programs and propose changes that will reflect Boyne's commitment to sustainability. Recognition of team members who contribute to Boyne's sustainability goals will demonstrate the sincerity of Boyne's commitment and motivate employees to practice sustainable behaviors. We begin with a complete description of the incentive mechanisms in place, including the Service Appreciation program, the Team Member of the Month program, and the Employee Referral program. For each, we propose changes and additions to these programs that will recognize team members who contribute to Boyne's environmental program. Our proposed changes do not require instituting a completely new incentive system, but are simple changes that are easy to implement and would achieve the desired results.

Incentive Programs at Boyne Mountain Resort

Employers use incentive programs to influence employee behavior. When a company reinforces its commitment to environmental sustainability, it may be necessary to use incentive programs to change employee habits and behaviors to reflect it. For instance, when Dupont embraced sustainability, the company started the Sustainable Growth Excellence Awards. Business units submit environmental projects for consideration for the top prize: dinner with the CEO, internal recognition, and $5,000 donated to the charity of the winner's choosing.[1] Boyne already has in place numerous incentive programs, and enhancing them to include sustainability would be a straightforward and effective means of encouraging sustainable employee behavior.

Service Appreciation Program (SAP)

Boyne guests who wish to recognize a team member[2] for outstanding service can fill out a ticket found in the guest room naming the employee. Managers can also complete these tickets. Once a team member has five tickets, s/he receives dinner for two at any Boyne restaurant. Ten tickets earn a team member a $100 gift certificate at Boyne Country Sports. Team members are limited to three dinners and one gift certificate per season. At the end of the season, all the tickets are put in a bin and one is drawn at random. The winner, as well as the Boyne guest who completed the ticket, both receive a week-long trip to Big Sky Montana, with lodging and airfare included for the team member and Boyne guest as well as one additional guest for each. The total cost for Boyne is $6,000 to $8,000 per couple, depending on the season of travel. Therefore the total cost to Boyne for all four recipients is about $16,000 per season, and $32,000 per year.

Adjusting the Service Appreciation Program to recognize sustainability efforts would be as simple as providing Boyne guests with not only the traditional SAP tickets but also "Green Tickets." These tickets would literally be colored green to stand out from the regular tickets, and would be earned when guests recognize team members who have shown a commitment to sustainability. The Green Tickets would be equivalent to regular SAP tickets in the rewards program. Any recipient of a Green Ticket would be recognized in Boyne communications.

Team Member of the Month

Each department at each Boyne resort recognizes one team member on a monthly basis as the Team Member of the Month. For each individual department, managers and fellow team members recognize the Team Member of the Month. In addition, Boyne places comments, letters, and "way to gos" in the monthly newsletter. The Team Member of the Month receives a basket of goods including a $50 gift certificate to Boyne Country Sports, a free night at any of the lodges, a two-day ski pass, and breakfast and dinner at a Boyne restaurant.

Boyne Mountain could add "Environmental Team Member of the Month" to its incentive programs. Managers would recognize those team members who showed a commitment to Boyne sustainability initiatives with a unique basket of goods including the same rewards as a traditional Team Member of the Month reward, as well as environmentally friendly projects such as an organic cotton polo shirt from Boyne Mountain Sports, a reusable water bottle, a pack of CFL lightbulbs, and some environmentally-friendly cleaning products. This would, however, double the cost of the Team Member of the Month reward program. A less costly option would be to require those recipients of Team Member of the Month rewards to have also demonstrated a commitment to sustainability, and simply maintain the one program.

Team Member Referral

Team members who refer a friend who works for at least 30 days receive $50. At this time we do not recommend any modifications to this incentive program.

Examples of Environmentally Friendly Behaviors

The following are examples of behaviors that can be recognized for a Green Ticket or for a Team Member of the Month reward. There are many other actions that would also merit a Green Ticket; managers should use their discretion.

- Printing documents on double-sided paper
- Turning off lights when leaving an office or room

- Questioning a vendor/supplier about their business's sustainability plan/effects on environment
- Arranging a carpool
- Informing guests on Boyne's environmental achievements and goals
- Making a habit of recycling
- Following sustainable purchasing guidelines
- Showing guests where the recycling containers are, including ski school students
- Pointing out Boyne's sustainable features to guests including native plants, permeable surfaces, CFL lightbulbs, for example
- Successfully promoting an action that will reduce Boyne's footprint through cost savings, waste reduction, or sustainability in general
- Publicizing Boyne's sustainability initiatives
- Demonstrating leadership in anything sustainable
- Kitchen staff: Creating new vegetarian or organic options or choosing local foodstuffs

[1] 2006. Hoffman, Andrew J. Getting Ahead of the Curve: Corporate Strategies That Address Climate Change. October.
[2] Team member refers to an employee of Boyne Mountain Resort.

Chapter 12:
Financing Sustainability

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Abstract

Traditional methods of corporate financing such as Internal Rate of Return (IRR) can often put projects focused on environmental sustainability at a disadvantage. Sustainability projects are often more long-term focused, while IRR points managers to short-term projects. Many businesses including ski resorts have successfully changed their method of choosing projects to accommodate sustainability projects while boosting their bottom lines. Boyne Mountain can achieve the same result through several possible modifications to its financing procedures.

Spotlight on: **Vail Mountain**

Vail Mountain in Colorado allows managers to fund sustainability projects using the "partnering concept:" if $10,000 is saved through energy efficiencies, for example, the manager can automatically use $10,000 toward another sustainability project.

Source: Luke Cartin, Vail Mountain Resort.

Purpose & Scope

The purpose of this chapter is to describe Boyne Mountain's current method of choosing which projects to fund and to demonstrate why this method puts sustainability projects at a disadvantage. We will then consider several alternatives including separate pools of capital and lower hurdle rates that will allow Boyne to fund more sustainable projects. This chapter should be adopted by Boyne Mountain's financial managers (with the support of senior leadership) to guide future budgeting and decision-making regarding project financing.

Financing Procedures at Boyne Mountain Resort

Boyne's current method of choosing projects

At Boyne Mountain, there is no protocol that explicitly states the requirements for getting a project approved for the budget, be it IRR, payback period, or net present value (NPV). Projects are presented to the management team, who reviews the return on investment (ROI) and the initial investment before forwarding it to the Executive Board for consideration.

Internal Rate of Return (IRR) / hurdle rate system

The internal rate of return is the rate of return offered by the project in question. It is the interest rate that sets the NPV equation equal to zero. Firms using this method of capital budgeting set a minimum and accept a project if it surpasses this minimum. The minimum rate to be surpassed is also called the firm's hurdle rate. The IRR rule may fail if a project entails multiple expenditures throughout the life of a project, such as maintenance costs beyond the initial investment expenditure. IRR is also biased toward short-term projects, as higher cash flows further in the future are discounted more. IRR also favors small projects. For instance, a project with an initial investment of $1,000 with a return of $1,500 has a 50% IRR while a project with an investment of $10,000 and a return of $12,500 has only a 25% return.

Return on Investment (ROI)

ROI is not a sustainable method for choosing projects to fund. It is calculated by the ratio of profit to initial investment and is equivalent to IRR in its drawbacks, namely, that it is biased toward smaller projects. A company which turns frequently to ROI to choose projects will turn down more capital-intensive projects which may be necessary for the company to remain competitive.

Payback

Payback is another faulty method for determining project financing. It looks at how long it takes for the cash flows of a project to pay back its investment, in nominal dollars. In choosing between projects, firms may set a time limit and then choose the project with the shortest payback as long as it is less than the limit. This method clearly discriminates against long-term projects, as a firm may choose a less profitable project over a more profitable one simply because the firm recoups its initial investment sooner. The payback method also ignores the time value of money, the simple concept that money today is worth more than the same amount of money in the future. This is because money received today can be invested for a positive return. In the payback method of comparing projects, one calculates how long it will take to "earn" back the initial investment. For example, if a project costs $2000, and leads to a savings of $200 per year, it has a 10 year payback. However, $200 10 years from now is worth less than $200 this year.

Alternative Financing Procedures

The financing methods below have proven successful at other businesses that have incorporated sustainability into their corporate finance procedures. Any of the three would be effective.

Lower hurdle rate

At Aspen Ski Resort in Colorado, projects deemed sustainable face a lower hurdle rate (6%) than do traditional, non-environmental projects (10%).[1] According to Auden Schendler of Aspen, this modification has led to the funding of several profitable environmental projects that would not have been funded before including a $1.1M solar farm.

Special pool of capital

Setting aside a special pool of capital for sustainability projects would be as effective as setting a lower hurdle rate for such projects. As we do not have specifics regarding Boyne Mountain's budget, we cannot recommend a certain amount for a pool of capital; instead we advise Boyne to start with what it can set aside. Aspen Ski Resort, for instance, recently set aside $300,000 for efficiency and renewable projects.

Constrained optimization with NPV

[1] The hurdle rate is another word for return-on-investment: it is the return that projects must generate in order to be "accepted" and implemented.

Net Present Value, or NPV, is the optimal method for choosing projects. It is equal to the present value of the cash flows from the project minus the initial investment. It represents the addition to the market value of the firm from undertaking the project. In choosing between projects, firms should accept the project with the highest NPV provided the NPV is greater than zero.

"Constrained optimization" with NPV refers to considering a project's NPV while also looking at non-financial metrics that meet sustainability criteria determined by the organization. For example, a project that may have a positive NPV but substantially increases nonrenewable energy use may be rejected under a constrained optimization method. The organization can also consider indirect but tough-to-measure benefits to the local community, customers, or the organization itself. For instance, an organization that establishes a recycling center that allows it to reduce the amount of garbage it produces may generate enough recycling to boost the market for recyclable materials. Then the project may facilitate recycling for other community members as well. Good public relations is a common unquantifiable benefit to sustainability projects.

Boyne could easily adopt any of the three methods described above. However, we recommend the last, constrained optimization with NPV, as this is the most accurate method of choosing projects. The "constrained optimization" criteria for Boyne would include adhering to the recommended purchasing guidelines described in Chapter 8 for example. Or, if Boyne decides to install an educational garden as described in Chapter 6, and were forced to choose between a native species which is more expensive and an invasive species that is cheaper, Boyne would choose the native species because it is better for the environment.

Chapter 13:
Conclusions

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Implementation

We have outlined a comprehensive set of projects that, if implemented, will launch Boyne towards becoming a leading resort in environmental sustainability. We have sought to provide as much detail as possible for Boyne to execute these recommendations, including specific policies, designs, and next steps. However, we recognize that there is a significant gap between the words in this document and action on the ground. To turn these recommendations into reality, an organizational shift is necessary transform the culture at Boyne to one that consistently values sustainability and incorporates consideration of the environment into every decision.

This transformation must start with the CEO of the company. We recommend issuing a public declaration to "launch" the newly revamped environmental program (see Figure 1). This will raise public awareness about Boyne's intentions; more importantly, it will signify to management and staff that the environment is a high-level corporate value on par with providing a fun recreational experience to guests. This broad statement of intention should be followed by specific environmental targets, which we have outlined in the section below. Having these numbers to aim for, management will be empowered to make decisions that promote environmental sustainability. Through the communications and incentives programs outlined in Chapters 10 and 11, team members will have the necessary knowledge and tools to pursue environmentally friendly behaviors in their daily activities. Most of the staff members we spoke with are concerned about the environment and sustainability; many have already initiated practices to improve Boyne Mountain's environmental impact. However, like any large institution, making significant changes in daily practices without reshaping the high level goals can be nearly impossible to achieve.

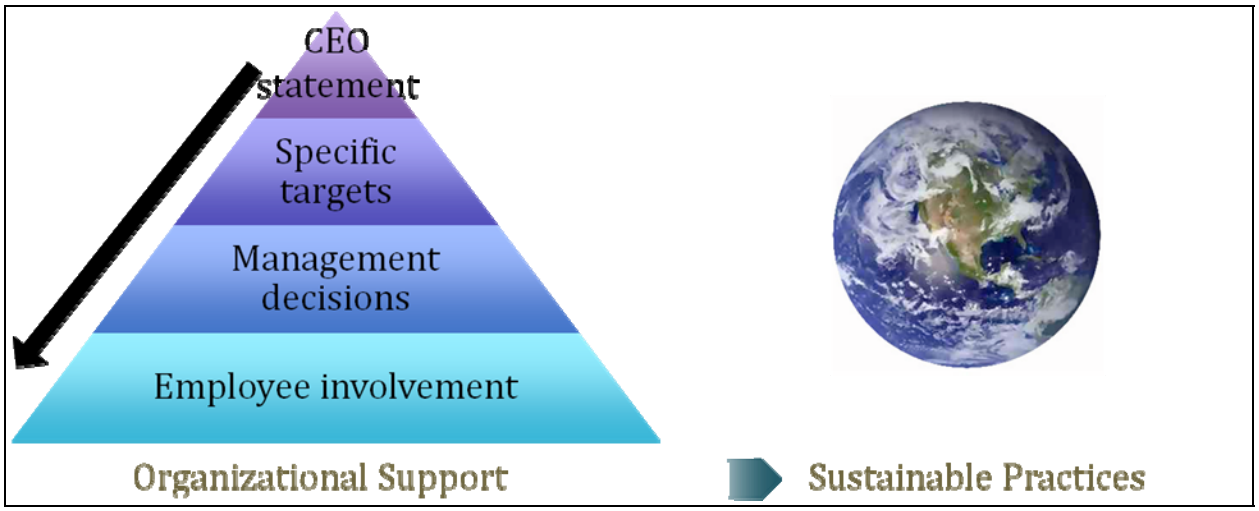

Figure 1: Organizational support drives sustainable practices

The premise for the management plan herein is: In order to continue to be a successful resort over the long run, Boyne Mountain needs to become more environmentally

sustainable. To do this, sustainability must become a high level goal, on par with profitability. Integrating sustainability at such a high level will expand management objectives – extend the ski season *and* reduce electricity use, provide great food *and* reduce waste, provide beautiful garden spaces and landscaping *and* provide native plants and wildlife habitat. Just as tracking costs and benefits is key to making profitable decisions, putting sustainability goals into practice will require informed decision-making based on monitoring energy use, material use, and environmental impacts, rather than just their dollar costs.

To ensure that these goals translate into actions, we propose adopting financing procedures to accommodate more sustainable projects through a special pool of capital or lower hurdle rate for projects geared toward sustainability (see Chapter 12). At the very least, Net Present Value (NPV) should be used for economic feasibility analyses of programs. NPV places more value on the benefits of programs in future years, making many of the proposed changes more feasible. The combination of dedicated capital and the specific benchmarks listed below will start Boyne Mountain on a path to becoming a leader in four-season resort sustainability.

Targets

The policies that make Boyne Mountain a great four-season resort are driven, in the end, by the bottom line. Targets like a long ski season, satisfied guests, and reducing costs all stem from the goal of profitability. Combining these targets with the realities of running the resort is the basis for the daily decisions and practices at Boyne. To really influence the decision-making and daily practices at Boyne, sustainability must become part of the bottom line, with specific targets as well. We recommend that Boyne Mountain adopt the following targets, which we believe are realistic outcomes of the recommendations in Chapters 3-12.

Energy

We believe that the 2008 "Self directed energy optimization" (EO) requirements for Michigan provide an opportunity to begin to incorporate sustainability as a high level goal. Instead of viewing the EO as yet another obligation detracting from Boyne Mountain's objectives, management should adopt the approach of many successful Fortune 500 companies and plan to well exceed the current minimum requirements. We feel confident in assuming that the future will bring more stringent sustainability regulations; the sooner sustainability is integrated into the core goals and structure, the smoother the transition will be to a more sustainable resort.

Where the EO plan requires a 0.3%, 0.5%, and 0.75% electrical efficiency improvement in 2010, 2011, and 2012 respectively, we suggest Boyne Mountain adopt a goal of 1% per year electricity efficiency improvements. A goal of 1% per year will lead to energy

use reductions in line with global energy reduction targets for 2020, necessary to avoid serious climate change impacts.

The improvements should come from a combination of:

- Purchasing only Energy Star® certified products when buying new appliances
- Implementing energy efficiency technologies like the harmonic filter project
- Reducing unnecessary energy use, e.g. adopting the automatic room key shutoff system throughout the resort

Environment

Boyne Mountain affects the natural environment in two ways: directly from resort activities, and indirectly from the choice of purchases. To reduce direct impact, we suggest an ongoing goal of improving biodiversity and reducing the impact on natural ecosystems both on Boyne property and surrounding areas. Some metrics to support these goals include:

- Increase the amount of native plants in landscaped areas to 95%
- Increase the amount of area available for native wildlife habitat and ecosystem function
- Reduce the amount of untreated stormwater runoff reaching natural waterways to 5%

To improve the impact from purchased goods, the environmental implications for all purchasing decisions should be considered, following the recommended guidelines in Chapter 8 of this document. Policies that can be implemented now include:

- Purchase only low-VOC paints, finishes, and sealants (preferably EcoLogo or Green Seal certified)
- Source 100% of paper products (bath tissue, paper towels, office paper, etc.) from recycled fibers
- Decrease reliance on external resources for landscaping (water, fertilizer, mowing)

Food, Recycling, and Waste

Like the ecosystem impacts above, Boyne Mountain can have a positive impact on sustainable food production through purchasing choices and reduce waste by improved recycling and composting. Initial benchmarks should include:

- Source 15% of food and beverages from local sources

- Source 20% of food and beverages from USDA organic sources
- Reduce waste sent to landfill by 30% in 2010

Education and Marketing

Being a socially responsible company includes showing guests what can be done to improve sustainability. However, we recognize that the first priority is to provide a resort experience, not to overload the guest with signs and "preachy" information. The education projects we've proposed here are fun or interesting, enhancing the guest experience.

A reasonable goal is that an average guest will see at least one "green" educational project by 2011, and that at least one new project will be started each subsequent year. For example, a child might walk through the educational gardens, or a golfer might ride in a solar powered golf cart. Attractive recycling containers, or small notes informing diners of local food sourcing, are all part of guest education. From a marketing standpoint, starting new projects each year increases public awareness of Boyne Mountain's commitment to sustainability.

Keeping environmental sustainability a priority requires setting goals for employee involvement, which should be done initially by:

- Increasing Green Team membership by 50%
- Launching new Leadership Management Training focused entirely on environmental sustainability
- Training 100% of new employees on Boyne's environmental initiatives
- Modifying employee incentive programs to include recognition for adherence to sustainability initiatives

Setting goals in these four areas (energy, environment, food and waste, and education and marketing) is the first step to becoming a leader in sustainability.

Conclusion

Boyne Mountain has been a leader and innovator in outdoor recreation in northern Michigan for the past 60 years. To help maintain this valuable reputation for the next 60 years and beyond, Boyne Mountain should establish itself as a leader in environmental sustainability. This comprehensive management plan should be used by Boyne Mountain personnel to begin the resort's emergence as a steward to the very environment that allows its operation to flourish.

Resorts have serious negative environmental impacts, from waste generation to energy consumption to natural habitat degradation; however, these impacts can be mitigated through concerted actions to improve. In the past two decades, many companies such as Dow Chemical and BP have transformed themselves from habitual degraders of the environment to serious stewards of the environment. While Boyne does not need to turn 180 degrees to become an environmental steward as other companies have required, it does need to pay more attention to its effects on the natural environment. If resorts such as Boyne do not, the environment that they rely on will no longer be able to support their businesses.

As an added incentive, external pressures are providing both the opportunity and the need to act quickly. Many consumers are becoming more demanding when it comes to the environmental stance of the resorts they visit. It is only a matter of time before Boyne Mountain guests incorporate environmental sustainability into their vacation choice, and Boyne would be better served preempting criticism by acting ahead of this trend curve rather than waiting. Finally, environmental regulations on both a state and federal level are expected to support greater use of renewable energy and higher energy efficiency standards. We could see a price on carbon in as little as 3 years if President Obama's current cap-and-trade proposals become legislation. It is therefore not only environmentally beneficial but financially wise for Boyne to take measures now to reduce its reliance on fossil fuels.

Looking ahead, we are excited to see how Boyne's environmental program evolves. It has been a pleasure working with Boyne Mountain personnel throughout the past 14 months. Future advice regarding the tactical implementation of the programs recommended herein, or regarding the "next phase" of Boyne's environmental program, could be developed as part of a second masters project between Boyne Mountain and the School of Natural Resources and Environment.