
A guide to
**environmental
stewardship**
on the
golf course



Second edition

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Acknowledgements

This newly revised guide book incorporates knowledge gained through Audubon International's 10 years of work to help golf courses serve as ecologically valuable green spaces throughout North America, while reducing potential environmental impacts associated with golf course operations. It reflects the expertise and experiences of the thousands of golf course superintendents, as well as golf industry professionals, environmental organizations, university researchers, and others, who have participated in the Audubon Cooperative Sanctuary Program for Golf Courses since 1991. The cooperative nature of the program has enabled us to learn much from each other and to draw upon innovative ideas, successes, struggles, and day-to-day experiences to strengthen the program and help thousands of golf courses achieve tangible environmental results.

We especially thank the individuals and organizations who reviewed this text and offered suggestions and insights to improve it. Their expertise and assistance have been invaluable.

Contributing Individuals and Organizations

David Bishop, Director of Environmental Stewardship,

Golf Course Superintendents Association of America, KS

Patrick Blum, Superintendent, Colonial Acres Golf Course,
NY

Patricia Cobb, Ph.D., Emeritus Professor of Entomology, Auburn University, AL

Ron Conard, Superintendent, City of Cheyenne Golf Department, WY

F. Daniel Dinelli, CGCS, North Shore Country Club, IL

Kimberly Erusha, Ph.D., Director of Education,

United States Golf Association Green Section, NJ

Shelly Foy, Office Coordinator, United States Golf Association,
Green Section, Florida Office

Todd Lowe, Agronomist, United States Golf Association,

Turf Advisory Service, Florida Office

Peter Salinetti, CGCS, Schuyler Meadows Golf Club, NY

James T. Snow, National Director, United States Golf Association Green Section, NJ

Patricia Vittum, Ph.D., Associate Professor of Entomology, University of
Massachusetts

Audubon International

Jean Mackay, Director of Educational Services

Principle Author and Editor

Ronald Dodson, President and CEO

Mary Jack, Executive Assistant to the President

Miles (Bud) Smart, Ph.D., Director, Environmental Planning Department

Carol Thompson, Staff Ecologist, Audubon Cooperative Sanctuary System

Larry Woolbright, Ph.D., Director, Research Department

Joellen Zeh, Staff Ecologist, Audubon Cooperative Sanctuary System

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Introduction

What can you do, right now, to be the best environmental steward you can be?

For people who manage and maintain golf courses, environmental responsibility includes using appropriate cultural and integrated pest management methods, monitoring water quality, and conserving golf course wildlife and their habitats. But these activities must take place within the context of *managing a golf course* and meeting expectations for playability, aesthetics, maintainability, and fiscal responsibility.

This guidebook is designed to help you blend environmentally responsible practices into the day-to-day operations of golf course management. From evaluating your resources to developing an environmental plan and taking action, it will give you pertinent information, direction, and concrete instructions for creating a successful Audubon Cooperative Sanctuary golf course.

What's Inside

Inside this guidebook you'll find information and resources to help you implement a variety of environmental management strategies and achieve certification as an Audubon Cooperative Sanctuary. The book is comprised of six chapters that cover each environmental component of the Audubon Cooperative Sanctuary Program. A Self-Assessment Checklist is provided at the end of each chapter to help you check your knowledge and assess current management practices. The Appendix includes a variety of resources, such as nest box construction plans, wildlife inventories, and sample IPM scouting records.

This guidebook is designed to help you blend environmentally responsible practices into the day-to-day operations of golf course management.

Chapter 1: Environmental Planning
Chapter 2: Wildlife and Habitat Management
Chapter 3: Chemical Use Reduction and Safety
Chapter 4: Water Conservation
Chapter 5: Water Quality Management
Chapter 6: Outreach and Education

Audubon International Support and Guidance

Audubon staff members are available to help you every step of the way. Think of us as resource people whom you can call upon when you need information, have a question, or just want to talk about one of your projects. We are available weekdays from 9 a.m. to 5 p.m. EST. Or if you prefer, contact us via email.

The Audubon Cooperative Sanctuary Program for Golf Courses

The Audubon Cooperative Sanctuary Program for Golf Courses helps golf courses to enhance wildlife habitats and protect natural resources for the benefit of people, wildlife, and the game of golf. The program is designed to give golf course managers the information and guidance they need to implement stewardship projects and receive recognition for their efforts.

The Golf Program is part of the Audubon Cooperative Sanctuary System, a nationwide network of conservation partnerships that includes backyards, schools, corporate and business properties, and golf courses. It is administered by Audubon International, a non-profit environmental organization that spearheads education and conservation assistance programs that promote environmental stewardship and sustainability.



Funding support for the Audubon Cooperative Sanctuary Program for Golf Courses comes from memberships, donations, and program sponsorship provided by the **United States Golf Association** since 1991.

Achieving certification as an Audubon Cooperative Sanctuary demonstrates your leadership, commitment, and high standards of environmental management. Your first step toward receiving this high honor is to fill out and return your completed *Site Assessment and Environmental Plan* in the *Certification Handbook* to Audubon International. Upon acceptance of your plan, your golf course will achieve a *Certificate of Recognition in Environmental Planning*. In addition, the person principally responsible for developing the plan will receive a Certificate of Recognition.

Your *Certification Handbook* provides all necessary details about gaining certification in each of the remaining environmental components of the program. Once you have implemented your environmental plan and documented your stewardship activities, your golf course will achieve national recognition as a *Certified Audubon Cooperative Sanctuary*. An additional *Certificate of Recognition in Environmental Stewardship* will be awarded to the person who is principally responsible for completing all components of certification at a single golf course. This recognition may be used to promote your commitment to stewardship and competency in implementing a comprehensive environmental management program.

Audubon Cooperative Sanctuary Program
Audubon International
120 Defreest Drive
Troy, NY 12180

Telephone: (518) 767-9051
Fax: (518) 767-9076
E-mail: acsp@auduboninternational.org
Website: www.auduboninternational.org

Chapter I

Environmental Planning



Tiara Rado Golf Course, Grand Junction, Colorado

A successful environmental plan balances the needs of golfers with the course's responsibility to care for the environment.

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“The principles of the Audubon Cooperative Sanctuary Program have improved the aesthetics of Tiara Rado Golf Course and reduced the use of pesticides to near nil. Concurrently, the quality of playing surfaces also improved as a natural balance was allowed to develop.

The certification of Tiara Rado is just the starting point in a continual quest for complete natural balance on the golf course.”
—Doug Jones, CGCS

FOCUS ON:

- Assessing resources
- Setting goals
- Getting people involved

Overview

The purpose of Environmental Planning is to balance the demands of golf with your responsibility to the natural environment. Your plan will help you safeguard the quality of the environment and responsibly care for the water, land, and wildlife habitats upon which your course is sustained.

There are many conservation projects you can pursue that will benefit wildlife, protect natural resources, and yet allow you to manage your golf course with a high degree of playability. These include managing woodlands, ponds, and golf play areas with the needs of wildlife in mind, implementing integrated pest management techniques and best management practices, conserving water, and keeping your maintenance facility environmentally sound.

The best way to get started is to develop an environmental plan to direct your efforts. This section provides an overview of how to assess the resources available to you and create and implement a successful environmental plan.



Stonington Country Club, Stonington, Connecticut

Environmental planning involves assessing your course's natural resources, formulating strategies for environmental improvement, and identifying people who can advance your stewardship efforts. Aerial photographs aided Superintendent Dean O'Lari at Stonington Country Club gain perspective on how the 156-acre golf course compliments surrounding woods and wetlands.



Tartan Park Golf Course, Lake Elmo, Minnesota

Getting people involved in environmental stewardship projects is a great way to put your environmental plan into action. At Tartan Park Golf Course, Superintendent Joe Moris enlisted the help of local Cooperative Extension offices, the Minnesota Department of Natural Resources, and the University of Minnesota Raptor Center and Wildlife Rehabilitation Clinic to provide assistance with various projects on the course.



Jackson Park Golf Course, Chicago, Illinois

There are many easy starter projects that can kick off your involvement in the Audubon Cooperative Sanctuary Program. At Jackson Park Golf Course, Superintendent Tom Tully used bird nest boxes as a way to educate junior golfers about the benefits of good stewardship.

General Knowledge

By their very nature, golf courses provide significant open spaces and opportunities to provide needed wildlife habitat in increasingly urbanized communities across North America. The average course covers 150 acres, yet just 30% is generally used for greens, tees, fairways, and buildings, leaving 70% as rough, woods, water, and other habitats (*source*: United States Golf Association Green Section). These non-play areas provide significant opportunities to enhance and protect wildlife and native habitats, provide corridors that link to other natural areas, filter pollutants, produce oxygen, and stabilize soils.

At the same time, golf courses are called to address environmental concerns related to the potential and actual impacts of water consumption and chemical use on local water sources, wildlife species, and native habitats. New golf course developments raise additional land use concerns, but also present excellent opportunities to showcase sustainable design and development.

Your environmental plan will serve as a blueprint for maximizing environmental assets and minimizing environmental problems on the golf course. This involves determining what resources and opportunities for environmental improvement exist on your course, evaluating current management practices and any liabilities, and outlining a plan of action based on realistic goals and objectives.

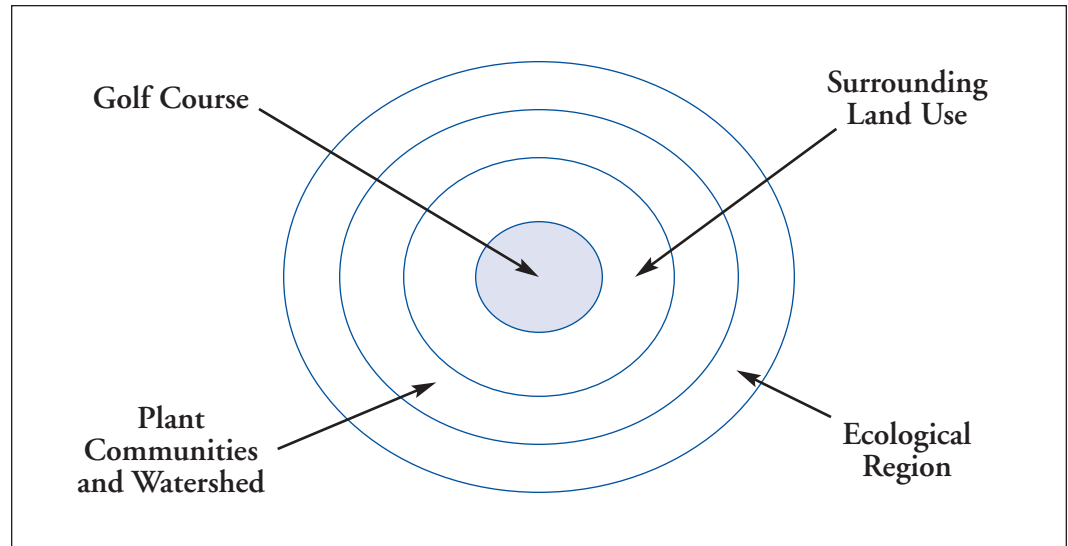
The Management Context

Every golf course is unique in terms of its setting, but also in terms of its organizational structure, policies, golfers or members, staff, and budget. This management context provides a backdrop for all golf course maintenance decisions and activities. In addition, every golf course operates with an environmental management context that includes the course's landscape features, such as trees, shrubs, water features, and terrain, as well as the surrounding landscape and ecological region.

For management decisions and practices to have the greatest benefit for golf and the environment, they must take place not only within the context of the course itself, but also within the broader landscape in which the golf course is connected. Your environmental plan will help you account for the needs of your staff, the needs of golfers, and the needs of wildlife and the environment before you implement specific projects.

Your environmental plan will serve as a blueprint for maximizing environmental assets and minimizing environmental problems on the golf course.

The Management Context



- **Golf Course**—The location, style, and layout of the course itself, combined with the quality and quantity of natural habitats, such as woods or open fields, constitute the primary site features that influence the environmental context in which you are working. The golf course management context also includes golf activity, traffic, speed of play, golfer expectations, and club politics.
- **Surrounding Land Use**—Urban, suburban, or rural characteristics, plus actual neighboring land uses have a strong influence on plant communities, wildlife species, water, and other environmental aspects of the golf course.
- **Natural Plant Communities**—Natural plant communities, such as forests, grasslands, and wetlands, are made up of distinct *native*, or indigenous, plant species. These are species that originated in your region, rather than being introduced from Europe, Asia, or other continents. Native plants are part of complex communities of plants and animals that thrive together and give each region its unique character and biological diversity.
- **Watershed**—The specific *watershed* in which your course is located affects drainage patterns, aquatic communities, and potential water pollution. A watershed is defined as the entire drainage area that feeds into a particular stream or river, and eventually, into the ocean. It is important to define your watershed since upstream events, such as discharges of pollutants, can have adverse effects on water quality far downstream.
- **Ecological Region**—An ecological region, or ecoregion, is defined as a relatively large area of land or water that contains geographically distinct natural communities. Natural features, such as geologic history, soils, landforms, topography, vegetation, and climate, define ecoregions. The ACSP membership packet contains information regarding the ecoregion in which your golf course is located.

Managing for Golf and the Environment

To maximize environmentally sensitive management, key staff members, including the superintendent, assistant superintendent, golf pro, club manager, and green committee must work with golfers to accomplish what is good for both the game of golf and the environment. Developing an environmental plan and participating in the Audubon Cooperative Sanctuary Program paves the way for dialog, policies, and practices that support sound environmental management. The following chart illustrates how golf and environmental concerns can be resolved via various environmental management strategies.

ENVIRONMENTAL PLANNING CHART

Management Area	Golf Concerns	Environmental Concerns	Environmental Management Strategies
Greens, Tees, Fairways, Roughs	Quality Turfgrass Green Speed Playability Consistency Financial	Adverse affects of chemical use on water sources and non-target wildlife species Water consumption	Chemical Use, Reduction & Safety through IPM and BMPs Water Conservation Water Quality Management
Facility and Equipment	Financial State/Local Regulations Functionality	Potential contamination of water sources from spills, improper chemical handling, or unsafe storage Hazardous waste generation and disposal Fuel consumption	Water Quality Management Chemical Use Reduction and Safety
Irrigation System	Sufficient Irrigation and Supply to Ensure Playability and Aesthetics	High water consumption	Water Conservation Water Quality Management
Landscaping	Aesthetics Maintainability	Use of non-native, exotic plants that have no wildlife or nature conservation value Loss of biodiversity Highly manicured conditions that require intensive inputs and maintenance	Wildlife and Habitat Management Chemical Use Reduction and Safety
Water Features	Playability Maintainability Aesthetics	Potential water quality degradation or contamination Aquatic habitat degradation	Water Quality Management Wildlife and Habitat Management
Natural Areas	Aesthetics Speed of Play	Need to protect local wildlife habitats and native plant communities	Wildlife and Habitat Management

Step-by-Step Environmental Planning

1. Evaluate resources, strengths, and weaknesses.
2. Define goals.
3. Choose projects to meet your goals.
4. Assign tasks.
5. Develop a time frame for implementation.
6. Evaluate your success.

Developing a Plan

Preparing an environmental plan has multiple benefits. It will help you coordinate your environmental activities, illustrate how environmental conservation activities complement one another, and pave the way for greater efficiency. Your plan also will help you better communicate your stewardship efforts to fellow employees, management, and the public. Further, you will have written documentation of your environmental accomplishments and goals and a means by which you can evaluate your progress.

Although your plan can be relatively simple or very complex, it should include environmental management strategies in five key areas:

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

Developing a plan involves a step-by-step approach that will take you from evaluating your resources to implementing projects and evaluating your success.

Evaluating Resources, Strengths, and Weaknesses

To set realistic goals and outline a plan for achieving them, it is wise first to determine your key resources and any site constraints, as well as management strengths and weak points. In addition, it helps to visually identify and record your resources by sketching a map and taking photographs of your golf course. Together, a site assessment, map, and photographs will serve as valuable baseline information and help you effectively communicate with others about the basis of your plan.

- **Conducting a Site Assessment**—The *ACSP Certification Handbook* includes a *Site Assessment* form to guide you in evaluating your site. The *Site Assessment* asks for general information about the golf course and management context, as well as information about key landscape features, such as turf surfaces, gardens, natural plant communities, and water sources. These site features along with golf course facilities, finances, equipment, and personnel represent your primary resource base.

As you consider your environmental plan, think about your property, its specific characteristics, and how much time and money you have to invest. You also may wish to draw upon information from the golf course architect, irrigation engineer, or USGA Turf Advisory Service reports. The strengths, weaknesses, and unique qualities of your property highlighted in your *Site Assessment* need to be factored into your plan.

- **Creating a Map**—An important part of assessing your golf course is to draw a property map to highlight existing resources and project opportunities. Use your map as a baseline from which to work. It should serve as a record of what currently exists and be used to sketch plans for habitat enhancement or other environmental improvement projects.

Over time, update your map as needed, but be sure to keep a copy of your original so that you have a record of what you've accomplished. Your map can be a useful tool for visually communicating your plans and charting your progress.

Step 1: Use an 8 1/2 x 11 sheet of paper (or larger) to sketch your map.

You may use an existing site map (an irrigation map or scorecard can work very well) or sketch a map that includes the major features of your site. Include the following components:

- Property boundaries;
- Buildings and other permanent structures;

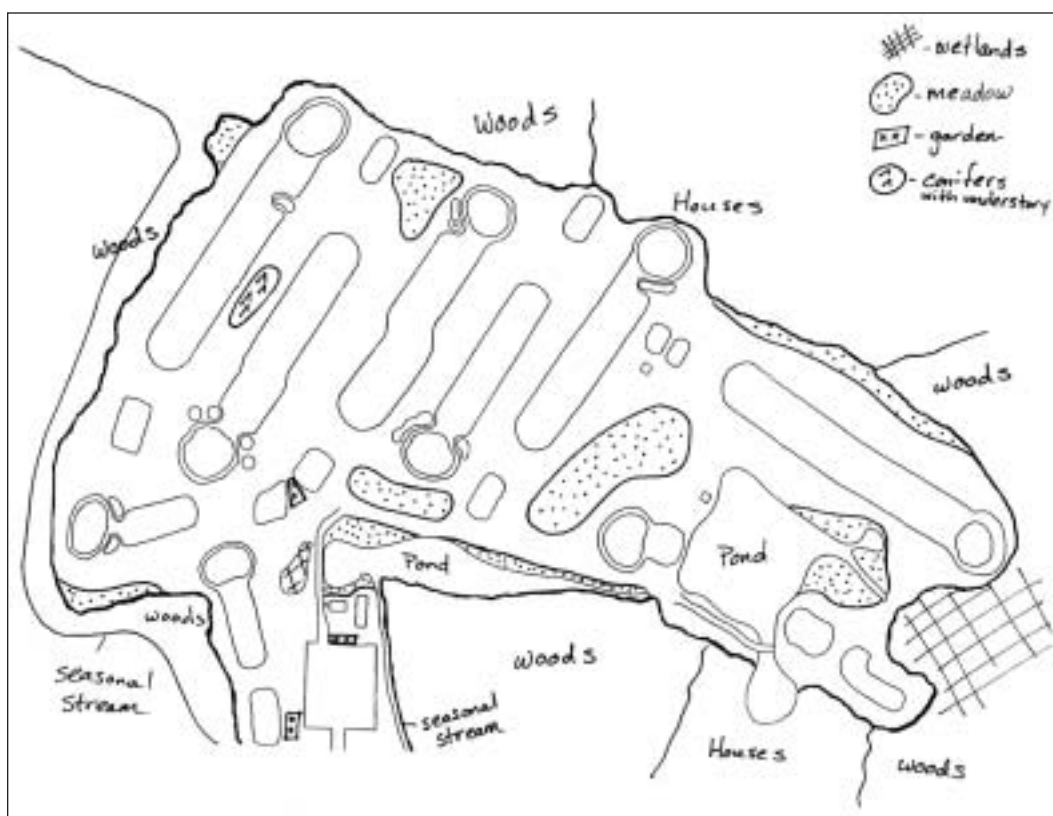
- Existing turfgrass and major habitat areas, such as woods, meadows, water bodies, and other natural features. If the property is relatively small, sketch and label existing trees and shrubs;
- Roads, walkways, or service corridors;
- Above and belowground utility rights-of-way and irrigation lines, if applicable.

Step 2: Label each of these features and indicate north-south orientation.

You may also want to note existing drainage patterns on your baseline map, especially if seasonal drainage will affect naturalization plans.

Step 3: Check your map.

Walk your property to be sure that your map is accurate. You may note things that need to be added. Make adjustments as needed, so that your map provides a good visual record and reference for your work.



- **Taking Photographs**—Photographs provide excellent documentation of your stewardship activities and can be used as an educational tool for both your members and the general public. The most effective photographs are *before* and *after* pictures, taken from the same vantage point, of various projects, such as naturalization, garden improvements, water enhancements, or turf renovation. Photographs of people in action working on various projects will also help you tell your story in a personable way. Photographs allow you to show others not only the progress you have made, but also the aesthetic value of stewardship projects.

Defining Goals and Objectives

A goal is a statement of what you ultimately want and value most. It expresses the reasons you're doing what you're doing and what you want to accomplish. A goal is a reflection of what motivates you.

Sample Goals

- Balance the needs of golfers with our responsibility to the environment.
- Improve wildlife habitat in non-play areas of the property.
- Reduce chemical use by 20%.
- Inform the public of our commitment to environmental stewardship.

This guidebook and the *Certification Handbook* set forth goals for each environmental component of the ACSP to guide you toward implementing sound environmental management practices. You also may choose to develop specific goals for your golf course or for yourself personally.

A golf course may choose to develop an environmental policy as a club in order to clarify and publicly state its aims and principles of action in relation to the environment. Setting an environmental policy involves active discussion with club members and employees and becomes a foundation for setting environmental objectives.

An environmental policy may include a stated commitment to:

- Continually improve environmental performance;
- Comply with relevant regulations;
- Minimize the impact on the environment of all activities within the golf club by using Best Management Practices;
- Optimize efficiency of resource use;
- Facilitate communication at all levels within the course;
- Increase environmental awareness among the users of the golf club and the wider community.

Choosing Projects

Each section of this guidebook, along with the *Environmental Planning Form* in your Certification Handbook, suggests conservation activities and environmental management strategies that provide a benchmark for environmental management on the golf course. These projects and practices will help you to meet the goals set forth for each environmental component of the program. Review the checklists in the *Environmental Plan*, or at the end of each section of this guidebook, and choose projects to extend your current stewardship efforts.

As you develop your plan, remember that all of the environmental quality areas addressed in your plan are interrelated. For instance, water quality will affect the types of wildlife that are able to thrive in ponds, lakes, and streams; birds that you attract in nest boxes can reduce insect activity and be part of your integrated pest management strategy; the pesticides you use may affect the wildlife you attract; and educating people about your efforts can create support for increasing the scope of your environmental program. The more comprehensive and carefully thought-out your plan, the greater the benefit for wildlife, the environment, and your golf course.

Assigning Tasks

Keep in mind that environmental projects are most successful when many people support them. Involve fellow employees, regular golfers or members, or neighboring homeowners when possible. Though one person may be the driving force behind developing and implementing an environmental plan, the work involved in maintaining an environmentally sensitive golf course cannot be born by one person alone. The plan must have broad support to be sustained for the long term. Assigning tasks to various staff or members of a Resource Advisory Group is an effective way to share the responsibility and the enjoyment of environmental management projects.

Developing a Timeframe

Look at your schedule and the yearly calendar and develop a realistic time frame for implementing projects. Use winter months for planning, research, indoor conservation activities, and documentation. Concentrate planting projects, water quality activities, and outdoor conservation during spring and summer. Fall is an excellent time for planting projects, waste management, end-of-season wrap-up, and evaluation.

Evaluating Your Success

Whether you are just getting started or are actively involved in environmental management, review your Environmental Plan and progress on implementing it on a yearly basis. This will ensure your success and guide your stewardship efforts. Many golf courses arrange a meeting at the end of the season to formally evaluate what worked, what got accomplished, what didn't go well, and why. This is the time to develop new goals and plan new projects or strategies for the coming year.

Encouraging Involvement

Forming a Resource Advisory Group

To help you get started and share the work involved in participating in the ACSF, gather a group of people who can help you implement projects or provide technical advice along the way. This "resource team" should be a group of people who will volunteer their time and energies to develop and implement projects. Your group could include employees, managers, board members, and at least one person from the local community with expertise in the types of projects you wish to pursue.

Your resource group may want to meet on a regular basis to organize and plan projects, or they may simply be available via telephone to answer questions and serve as a reference for technical information. Think of it as a resource for information and support for your efforts.

Many golf courses arrange a meeting at the end of the season to formally evaluate what worked, what got accomplished, what didn't go well, and why. This is the time to develop new goals and plan new projects or strategies for the coming year.

Potential Resource People

- Club members and employees
- Property neighbors
- Cooperative Extension agent
- Local nature center staff
- Local Audubon society member
- Ducks Unlimited member
- Wildlife rehabilitator
- Local nursery owner
- School teacher
- Bird or garden club member
- Soil and Water Conservation District employee
- University or college professor or students
- Federal, state, or local conservation officer
- Scouts

Whoever you select, the group should have several functions or purposes.

- **Planning**—With staff guidance, the resource team members can help determine short and long-term goals. Share your environmental plan with them and ask for suggestions. Determine what can be accomplished in logical steps and in a manageable time frame.
- **Technical knowledge**—Resource people can provide the technical knowledge needed to develop species lists, provide wildlife information specific to your area, consult on chemical reduction strategies, or provide on-site consultation with other projects. Reaching out to local experts is an excellent way to expand your knowledge and meet people from your community who support conservation.
- **Volunteer work**—Resource people may volunteer time and help to implement and monitor specific projects. They can check nest boxes, record wildlife species, or develop an informative brochure that describes your work. The more people involved, the more quickly your projects will take shape.
- **Publicity**—Sometimes it is awkward for you to take credit for positive projects by writing press releases and advertising the good things you are doing. Resource advisory members can help to publicize your environmental efforts.
- **Continuity**—Though staff assignments may change, the commitment to the environment at your golf course should remain constant. Your Resource Advisory Group will provide continuity and ensure that you achieve your long-term goals.

Getting People Involved

You can involve golf course employees, including maintenance staff and club personnel, and Resource Advisory Group members every step of the way from environmental planning to project implementation. Here's a simple outline of how to get people involved:

Step 1: Provide information and invite participation.

Inform employees and potential Resource Advisory Group members of your participation in the ACSP. Tell them that you are going to be reviewing environmental practices and expanding environmental programs in five primary areas:

- Wildlife and Habitat Management—natural areas and outdoor landscaping
- Chemical Use Reduction and Safety—turf health and management, chemical use and storage
- Water Conservation—water use efficiency
- Water Quality Management—water quality and water features
- Outreach & Education—employee and community participation and public relations

This section includes a sample memo you can use to inform people of your involvement and invite their participation. Interested staff can help complete the *Site Assessment and Environmental Plan*. You can seek out people with specialized skills to contribute to specific projects, such as conducting a wildlife inventory or water quality testing.

Step 2: Ask for input and list strengths.

As you plan projects in each environmental component, ask employees for their suggestions. List things that are in place, can be built upon, and will serve as positive models.

Step 3: Assign tasks and implement projects.

Inform employees and members of your Resource Advisory Group of all projects you are initiating and be specific about how you want them to participate. You can distribute a copy of your environmental plan and assign specific tasks. Rather than take the lead role in implementing

all ACSP projects, many superintendents serve as facilitators who get the ball rolling and coordinate tasks. This eases work involved and spreads ownership and enjoyment of participating in the ACSP.

SAMPLE MEMO

To: All staff
From: Project Manager
RE: Participation in Audubon Cooperative Sanctuary Program for Golf Courses

We have recently decided to get involved in an exciting environmental improvement program for our golf course. The *Audubon Cooperative Sanctuary Program* (ACSP) provides information, guidance, and support to help golf courses conduct proactive environmental projects that benefit people and the environment. We have many sound environmental practices in place already and this program will help us expand upon these and gain recognition for our efforts.

The program addresses five key environmental quality areas: Wildlife and Habitat Management, Chemical Use Safety and Reduction, Water Conservation, Water Quality Management, and Outreach & Education. Our first step is *Environmental Planning*. During the next month, we'll be filling out a *Site Assessment* and *Environmental Plan* to tell Audubon International staff about our organization and the types of projects we want to pursue. They will then have a better sense of who we are and what our goals are.

Once we have implemented a variety of projects in each environmental component, we can apply to become a *Certified Audubon Cooperative Sanctuary*. This exemplary distinction is a national recognition of environmental excellence bestowed on organizations that are taking a leadership role in conservation projects. We believe we can achieve certification within the next year—but we need everyone's involvement to achieve success!

As we begin this program and start the planning process, we welcome your input. We will be hosting a short information meeting on Date/Time for all interested employees. If you have ideas to share or just want to hear more about this program, please come!

Environmental quality is important to our golf course. We hope you'll support this effort every step of the way.

Self-Assessment Checklist

A comprehensive environmental plan is your road map to a successful environmental management program. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

- ☐ Fill out the *Site Assessment and Environmental Plan* from Audubon International and develop a map of the property that highlights wildlife habitat, water sources, and management zones to use for environmental planning and project implementation.
- ☐ Evaluate progress toward goals and objectives *at least once per year*.
- ☐ Train all employees regarding the importance of environmental performance and specific techniques for ensuring environmental quality.
- ☐ Regularly communicate to employees, customers, stakeholders, and community members about environmental goals, issues, project implementation, and progress.

Chapter 2

Wildlife and Habitat Management



Edgewood Country Club, River Vale, New Jersey

Non-play areas of the golf course can be managed to attract desirable species and provide needed habitats for local plants and wildlife. At Edgewood Country Club, Superintendent Paul Dotti naturalized nearly 20 acres of out-of-play areas with wildflowers and tall fescues. As a result, the course eliminated use of 250,000 gallons of water per year and saves about \$10,000 annually on pesticides, labor, and equipment use.

“Many golfers that are used to manicured turf may not like the look of naturalized areas or they may be concerned about slow play, unwanted wildlife, or deer ticks. I was faced with all these concerns and educating the membership through newsletters and the course bulletin board led to general acceptance of naturalization.”
—Paul Dotti, Superintendent

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FOCUS ON:

- Landscaped areas
- Gardens
- Non-play natural areas
- Points of interest—clubhouse, half-way house, entrance drive

Overview

The purpose of wildlife and habitat management is to enhance natural areas and landscaping on the golf course to protect and improve native habitats and the wildlife that depend on them for survival.

Successfully managing natural areas and wildlife species on the golf course is an important, yet sometimes challenging, part of creating an enjoyable golf course. Focusing on three primary goals will help you maximize the benefits of your efforts:

1. Continually expanding your knowledge of the plants, wildlife species, and habitats found on the golf course.
2. Providing habitat for a variety of wildlife species in non-play and landscaped areas.
3. Preserving the rich biological diversity of your region by protecting existing native habitats and species and landscaping primarily with native plants.

Whether you are beginning with a tight layout or many acres of natural areas, a restricted budget or lots of money to invest, there are a variety of projects that can suit your site, budget, and maintenance needs. This section will help you understand the needs of wildlife, identify the places on your course that currently provide the best habitat, and choose appropriate projects for your site.



Commonwealth National Golf Club, Horsham, Pennsylvania

Water features, woodlands, and meadows are just a few of the natural habitats available on many golf courses. Commonwealth National Golf Club naturalized out-of-play turfgrass areas and shorelines to improve food and cover sources for wildlife and link larger natural habitats together.



Blue Heron Pines Golf Club, Cologne, New Jersey

Wetlands, threatened and endangered species, rare natural communities, and pristine ecosystems on or near a golf course can require special protection. Erecting signs, designating “environmentally-sensitive areas,” and flagging nests or den sites are ways to ensure that special habitats receive the protection they need. Blue Heron Pines Golf Club, which sits within the New Jersey Pinelands environmentally-sensitive area, preserved 40 acres of woodland, protecting valuable habitat for a variety of wildlife species.



Warren Golf Course at the University of Notre Dame, Indiana

Maintenance staff at Warren Golf Course at the University of Notre Dame constructed 45 bat boxes and bird nest boxes and mounted them throughout the course. Tree swallows and bluebirds were absent from the property before the project. Just one year later, Warren Golf Course hosted 17 families of bluebirds and tree swallows that fledged a total of 61 birds.

General Knowledge

While golf course personnel are thoroughly trained in agronomics, many have never had the opportunity to formally study the natural habitats that often make up more than half of the golf course property. Yet managing these areas well is vital to the game of golf and to maintaining a healthy environment—two key concerns for golf courses.

Golf courses have tremendous opportunities to provide valuable open space for people and wildlife and become part of local green spaces within their communities. Equipping yourself with some basic knowledge of the needs of wildlife and how natural communities function will help you manage habitat areas with confidence.

Understanding the Needs of Wildlife

In order for all kinds of wildlife to survive, they must be able to find suitable food, ample water, and safe cover within the overall space they occupy. An animal or plant's particular preferences for food, water, and cover are known as its *habitat*.

- **Space**—The amount of space required by wildlife varies greatly. The layout of your course, size of existing natural areas, and surrounding land uses determines how much space your golf course provides for wildlife.
- **Food**—Plants are the primary source of food for the vast majority of wildlife species. Nuts, berries, and seeds are especially valued food sources for many birds and small mammals. A diversity of plants and animals, including insects, birds, amphibians, small and large mammals, and species that decompose dead plants and animals, all eating and being eaten, make up complex *food webs*.
- **Water**—Water is the sustenance of all life. Relied upon by many creatures for drinking, bathing, and cooling off, water sources, such as ponds, wetlands, and streams, also serve as a vital habitat for fish, salamanders, frogs, and aquatic insects.
- **Cover**—This general term includes places that provide protection for animals to carry out life functions, such as breeding, nesting, sleeping, resting, feeding, and travel.

There are many different types of habitats, such as wetlands, woods, open fields, deserts, and ponds, and each contains species that are especially adapted to live within them. On a golf course, these non-play natural areas, combined with water features, gardens, and landscaped areas, usually provide the primary food, cover, and water sources that sustain wildlife.

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Identifying Core Habitats

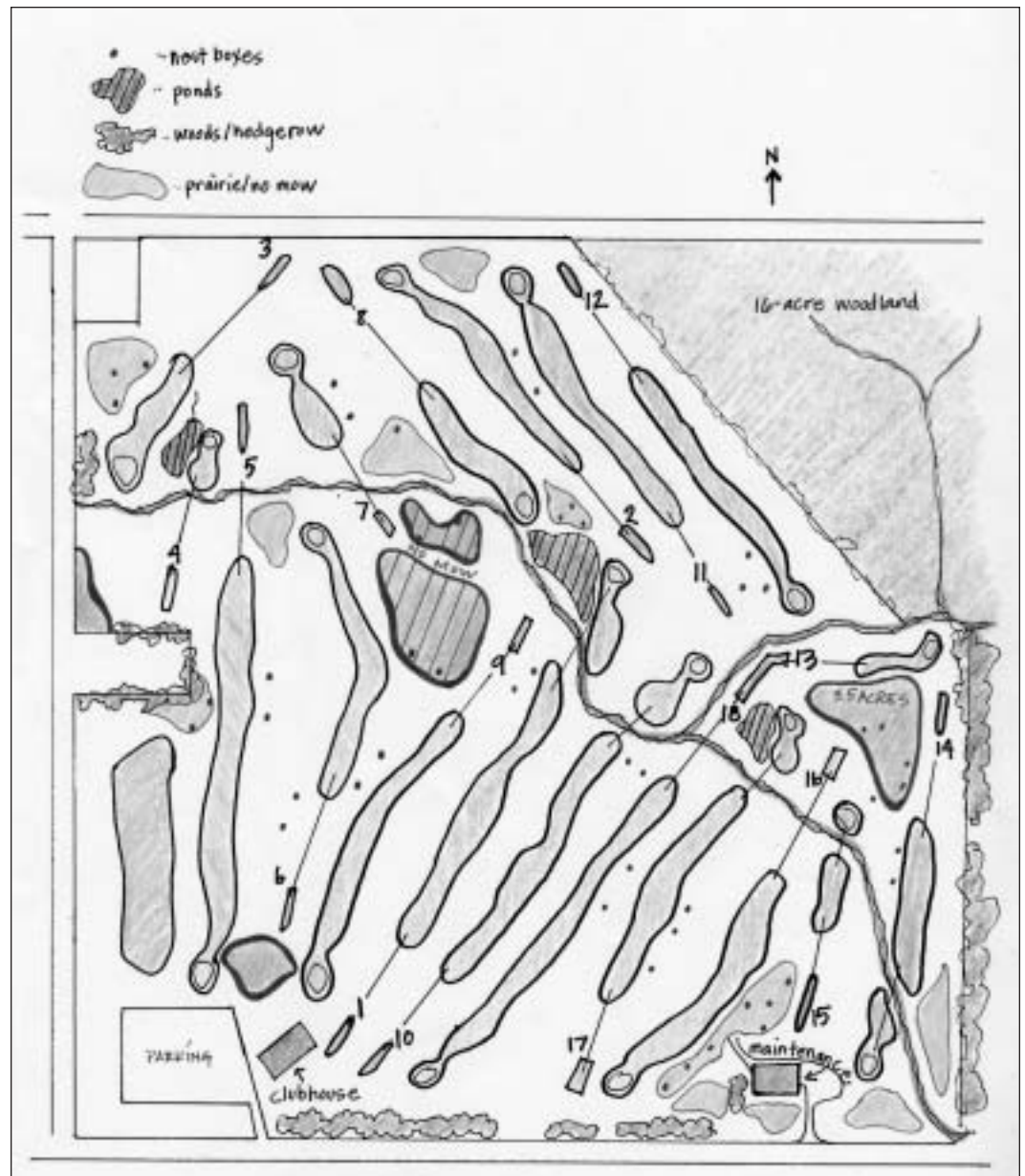
What are the best habitat areas present right now on your golf course? Do you have some acreage of woods, tall grasses or prairie, desert, or wetland? Consider these areas to be your *core habitats*. By protecting these areas from disturbance, you will go a long way toward supporting wildlife on your course. Second, projects that enhance, expand, or connect these areas will increase the quality and quantity of wildlife habitat available.

In addition, when you consider the kinds of wildlife you might attract to your grounds, remember to think beyond the boundaries of your property. Surrounding land use will have an impact on the types of wildlife you can attract. Even though you may not manage large acreage, the combination of your property and adjacent natural areas may add up to sizable habitat. In some cases, a core habitat may be connected to or part of an adjacent property, such as a forest preserve or large marsh.

Conversely, if you are surrounded by housing or commercial development, certain species will not be attracted to your property no matter what you do. You will only be able to attract those wildlife species that can meet their needs within the available space and habitat types present on your golf course and any surrounding natural areas.

Keeping in mind this *big picture*, the key to successful management for wildlife is properly using and enhancing the space you have. The greater the variety of plants and habitats on your course, the more species of wildlife you will attract. Ultimately, the key to managing a property for wildlife is *diversity*.

Core habitats include all large blocks of natural area on the property that provide significant wildlife habitat. Core habitats may include woods, wetlands, prairie areas, desert, or stream corridors.



Developing a Wildlife Inventory

Gathering baseline data about your property resources includes inventorying the wildlife species that inhabit it. You don't need to be an expert to begin; a good field guide, binoculars, and an eye for observing the wildlife around you will help you get started.

You'll be surprised how many species you see once you actually start to list them. This record will not only increase your knowledge, it will provide important documentation of common and unusual species that inhabit your area. Post your inventory in a central location, such as your pro-shop, clubhouse, or break room, so that people can easily see and add to it.

Your inventory should include:

- **Species Name**—Group the different species of wildlife you see according to general categories, *i.e.*, mammals, birds, insects, amphibians, and reptiles.
- **Location**—Noting the location where a species is seen will help you identify the preferred habitat of each species and “track” the range of wildlife on the property.
- **Date, Time, and Special Comments**—Recording information relevant to the sighting, such as feeding, nesting, or migration, will tell you more about how your property is being used by wildlife and whether changes in wildlife populations are occurring from year to year.
- **Seasonal Variation**—You can begin your inventory at any time, but be sure to record species throughout the year to note seasonal variation.

Refer to the Appendix for wildlife inventory checklists you can use to record species on your course.

SAMPLE WILDLIFE INVENTORY

Species: Birds	Date	Location—Habitat	Comments
Robin	5/10/02	Maple tree by front entrance	Carrying nesting material
Cardinal	5/14/02	Cluster of pine trees by rear parking lot	Year round
Chipping sparrow	5/21/02	Left side of building	Nesting in cedar shrubbery

Involving Staff

Just as the golf course crew is trained to cut the grass, aerify turf, and maintain equipment, your crew needs to know what areas on the course are considered most valuable for wildlife and how they can participate in efforts to protect them. During training sessions or staff meetings, provide examples of management practices that positively enhance or adversely impact wildlife species and habitats on the property.

Involve employees in developing and carrying out your habitat management plan so that they are familiar with your goals and priority management practices. Many superintendents have found that getting their maintenance crew involved in wildlife management activities improves their overall job satisfaction since it heightens the value of their work.

Habitat Enhancement Strategies

Once you have assessed the general amount and condition of wildlife habitat available on your golf course, your next step is to plan activities that can protect, improve, or expand upon these areas. A variety of general management strategies can help you enhance wildlife habitat with little or no effort or cost. There are a variety of projects and management practices from which to

Need help with
an inventory?

Solicit assistance
from:

- Golfers
- Employees
- Local bird club
- College or high school biology class
- Local nature center

Select activities that are appropriate for your site, clientele, budget, and maintenance routine.

choose—it's essential that you select activities that are appropriate for your site, clientele, budget, and maintenance routine. Review the information provided on the following pages to learn more about these strategies and their benefits and determine which ones might be best suited for your golf course.

Landscaped Areas and Gardens

Landscaped areas and gardens at the golf course entrance, clubhouse, halfway house, or on the course itself can easily be enhanced to attract desirable wildlife species and showcase some of the native flowers and shrubs that are unique to your region. Strategies to enhance these areas can be employed on any golf course, but are especially valuable for courses with tight layouts or little natural habitat.

- **Landscape With Native Plants**—Superintendents faced with tight layouts, slow play, or highly manicured aesthetics that cannot be changed may find that the best option for making their courses more natural is to landscape primarily with native plant species. This involves identifying trees, shrubs, and flowers native to your area and making a master list of those species that would be most attractive and grow best given on-site conditions. This list then becomes the key reference for all new tree, shrub, and flower selections for the course landscape.

While some non-native ornamentals may continue to be grown, we encourage courses to strive for 80% of all new landscape plants to be native to the local region. In this way, a course that is not able to expand habitats *per se* is able to increase food and cover sources for wildlife and contribute to its region's unique plant diversity. The Audubon International *New Member Packet* provides a regional native plant list and native plant source list to all ACSP members. (Refer to the Habitat Protection section later in this chapter for more information on using native plants.)

- **Plant nectar producing flowers for hummingbirds**—To attract hummingbirds, plant flowers with a tubular shape, such as beebalm (*Monarda sp.*), columbine, and cardinal flower, in clubhouse gardens, containers, hanging baskets, and other landscaped areas. The hummingbird's slender, pointed bill is especially adapted for probing tubular-shaped flowers for nectar. Though many of the hummingbird's preferred flowers are red, hummingbirds will come to flowers of many colors. Hummingbird feeders containing a mixture of one part sugar to four parts boiled water will provide a steady supply of nectar solution between blooms. Feeders should be cleaned between each filling, or every two to three days in hot weather, to prevent bacteria or fermentation from spoiling the solution.
- **Plant flowers for butterflies and other native pollinators**—To entice butterflies to your property, plan to grow nectar-producing flowers for adult butterflies and *host plants* that provide food for their caterpillars. Bright colored flowers with numerous flower heads and large petals to land on are most attractive. Composites—flowers that have a center surrounded by a ray of petals, such as asters, purple coneflower, and black-eyed Susan—are good choices. Butterflies also prefer flowers with small clusters of blossoms on strong stems, such as butterfly weed, lantana, and mints. Because butterflies are cold-blooded insects, they rely on the sun to keep warm and raise their metabolism so that they can fly. Choose a sunny location for your butterfly garden. You can also add stones for sunning and a shallow source of water or mud for drinking.

Host plants for butterfly caterpillars can be quite specific to each butterfly species. Select several host plants from the list provided in the Appendix, or identify the butterflies you see in your area and provide their preferred host plants. Because butterflies are insects, it is essential to avoid insecticide use in your butterfly garden.

Butterflies are just one of many insect species that pollinate a variety of plants, including 80% of the world's food crops. Nectar-producing flowers also will attract and help to sustain native bees and other pollinating insects. In contrast to wasps and non-native honeybees, native bee species are generally solitary, not prone to sting, and harmless—there is no need to fear them in garden areas.

- **Plant shrubs and trees that produce food for songbirds**—Enhance songbird populations by planting a variety of shrubs that produce berries, seeds, or nuts in landscaped areas. The selection of attractive shrubs is many and varied. Choose varieties that are native to your region, since these have evolved in tandem with the birds that live in your area.

Another vital part of a bird's diet is insects. During the spring, especially, spiders, aphids, flies, and beetles are just a few of the insects that birds need to feed both themselves and their young. By controlling insects naturally, a healthy bird population can become an integral part of your overall integrated pest management program.

- **Begin a tree management and replacement program**—Mature trees have many scenic and natural benefits. It's important to think about and plan for the loss of specimen trees and trees in general throughout the property. Conduct a tree inventory, evaluate the health of what you have, and schedule appropriate tree planting each year. Again, choose native trees when making additions and replacements.

A list of flowers that attract hummingbirds, butterflies, and songbirds is provided in the Appendix.

Woodlands

Woodlands are composed of both trees and *understory*, which includes shrubs, non-woody plants, ground covers, and leaf litter. The understory is extremely important for providing both food and cover for a host of wildlife species. Removing woodland understory diminishes wildlife diversity and abundance. While there may be limited areas on the course where lower tree limbs need to be pruned and the shrub layer removed to improve air circulation, in general try to practice the following management strategies to maximize the value of woods on the course:

- **Maintain a shrub layer**—In woodland areas or under clumps of trees, add or leave in place a variety of shrubs, small trees, and vines. Varying heights and types of vegetation add *structural diversity* that provides places for birds and other wildlife to nest, rest, and feed.
- **Leave dead and dying trees when they pose no safety hazard**—They provide excellent food and cover sources for cavity nesting species, such as woodpeckers, flycatchers, bats, and beneficial insects.
- **Keep fallen leaves on the ground**—Resist the urge to “clean up” woods. Fallen leaves and limbs return valuable nutrients to the soil and provide ground nesting sites for birds and moist cover for amphibians.
- **Build a brush pile**—Stack fallen limbs and debris to offer cover for small mammals and birds. Leave an entryway at the base by using larger logs at the bottom and piling smaller limbs on top.
- **Limit trails to edges**—The nesting success of many songbird species is adversely impacted by common predators, such as crows and raccoons. Further, many songbirds require larger interior woodland habitat. Because trails open up pathways for predators and break up intact interior areas, they are best kept to the edges of woodlands.

Greater plant
diversity increases
wildlife diversity.

- **Naturalize along the edge with taller grasses or shrubs**—If there is room between the rough or fairway edge and woods, allow taller grasses to grow. This strategy protects the woodland edge and interior from disturbance and weather extremes and increases plant and wildlife diversity.
- **Connect larger woods with smaller “islands” of trees**—Connecting habitat areas increases the overall availability of food, cover, and space for wildlife. It also facilitates wildlife movement and the flow of genetic diversity within species. (Refer to *Creating Wildlife Corridors* later in this section for more information.)

Prairies/Grasslands/Fields

North America’s once vast grasslands have largely been converted to agriculture. Thus, remaining remnants of prairie and recreated grasslands—including those on golf courses—are critical to the survival of species that are adapted to prairie life. In the east, smaller meadows are also valuable wildlife habitats. The height of various grasses within a meadow or prairie is dependent upon rainfall and climate, with short grasses dominating in the rain shadow of the Rocky Mountains and increasingly taller grasses predominating as one moves east. A variety of simple management strategies will help you enhance prairie or open field habitat.

- **Mix grasses and forbs (broad-leaved flowering plants). Avoid single species plant communities**—Planting a mix of grasses and forbs creates a diverse plant community, which, in turn, adds more food sources at the primary level of the food chain. You can make up your own seed mix of grasses and wildflowers or order a pre-made mix from a variety of seed companies. The advantage of mixing your own is in choosing plants that will grow best given the soil and moisture conditions on site. Several ACSP member courses have experimented with planting a prairie by growing a single plant species, such as little blue stem or switchgrass, to gain experience in plant establishment and maintenance. After several seasons, they then plant additional prairie species to diversify the area.
- **Provide song posts and nest boxes or snags**—Perches will be used by birds, such as bluebirds and hawks, while scouting for a meal. Nest boxes provide valued nesting sites in otherwise open areas.
- **Mow after the nesting season**—Many birds nest right on the ground, hidden in the tall grass of open fields and prairies. Mowing after the young have left the nest—July 31 is safe for most areas—protects ground nests from disturbance during the critical nesting season.
- **Mow or burn every three years to increase diversity in the plant community**—Mowing or burning on a three year cycle maximizes diversity in the grassland community, yet prevents woody plants from invading. Many courses prefer to mow more frequently. Experiment with different mowing regimes to see what works best for you.
- **Implement a prescribed burn plan**—Burning releases valuable nutrients into the soil, helps many seeds germinate, warms the soil, and removes woody growth. A local permit is usually required. Audubon International can provide additional details upon request for developing a burn plan.

Wetlands

By definition wetlands must have three basic attributes:

1. Surface water or water in the root zone at some time during the growing season,
2. Wet (hydric) soils or undrained soils,
3. Vegetation that is predominantly adapted to wet conditions (hydrophytes).

Wetlands play an integral role in providing wildlife habitat and ensuring water quality for essential ground water supplies and downstream water resources. Golf courses should give high priority to wetland protection.

- **Protect from disturbance and trash dumping**—“*Wetlands are the marrow of nature*,” said Thoreau. Keep them functional as breeding habitats, spawning areas, and water sources and for water filtering, recharge, and flood control. Use signage, if needed, to keep people out.
- **Designate a vegetated buffer along wetland margins**—Raising the mowing height for turf or allowing taller grasses and wildflowers to grow helps to protect water quality and wildlife habitat.
- **Mount a nest box for wood ducks**—Wood ducks find few large tree cavities in which to nest. If you have a large wetland, especially one that is wooded or borders woods, erecting a wood duck box will provide a nesting site.

Water Features: Ponds, Lakes, and Streams

Birds and mammals rely on various water sources to drink, bathe, and cool off, while numerous species of fish, salamanders, frogs, and aquatic insects live or fulfill vital aspects of their life cycle in the water. There are a number of things you can do to maximize the habitat potential of a pond, lake, or stream, no matter what its size. A water feature’s attractiveness to wildlife is largely dependent upon the number and variety of aquatic and shoreline plants surrounding it and the depth of the water.

- **Create a vegetated buffer or “no spray” zone or spot treat problem areas along pond, lake, and stream margins**—A vegetated buffer is an area around the edge of a water body specifically maintained with plants that will reduce storm water flow and potential pollution from runoff. On sites where pesticides and fertilizers are routinely used, a buffer zone will protect water quality and aquatic species. (For more information about creating a vegetated buffer, refer to the Water Quality Management section of this guide.)
- **Stabilize banks; eliminate erosion**—Stabilizing shorelines with plants, riprap, or rocks improves water quality and fish habitat by reducing sediment loads. Installing vegetated fiber logs or shoreline plants has an added benefit of providing excellent wildlife habitat and is the preferred method of stabilizing banks.
- **Sink a tree or log**—Place used Christmas trees or dead trees weighted with a rock or concrete block in the middle of a pond during the winter when ice covers the surface. When the ice melts, the tree will sink to provide shelter for fish. Or simply place a fallen branch or log along the shoreline to improve cover and nesting sites for turtles, fish, and amphibians.
- **Maintain or increase shallow water areas (less than 2 feet)**—Shallow water areas provide ideal habitat for frogs and salamanders, especially in ponds without fish, a primary predator of amphibians.
- **Connect with woods or fields**—Connected habitats increase the movement of wildlife species and are especially needed by amphibians for movement between breeding and wintering sites. (Refer to *Creating Wildlife Corridors* later in this section for more information.)
- **Take out invasive species, such as purple loosestrife**—Don’t let invasive plants get a foothold. They will out-compete more desirable native plants.

The Appendix includes a list of aquatic and shoreline plants suitable for planting along pond, lake, stream, or wetland margins.

- **Use IPM strategies to control algae and other weed species**—Grass carp, aerators, barley straw, and filters are a few of the available methods for reducing aquatic weeds. Be sure that you or your lake management company employ IPM strategies to reduce or eliminate chemical use in ponds.
- **Leave submergent vegetation in ponds**—There is no need to remove underwater plants unless they become a problem. Leave submergent plants to help maintain healthy oxygen levels, water quality, and wildlife habitat in the pond.
- **Plant emergent and shoreline plants**—Numerous plant species prefer shallow water and wet growing conditions. Such plants provide nesting habitat, cover, and food sources for a variety of birds, mammals, amphibians, and insects. Floating plants take up nutrients, maintain good oxygen levels, and naturally reduce the chance of algal blooms. Shoreline vegetation also provides shade, which keeps water temperatures cool—an important factor for many aquatic species. Both emergent and floating plants can make pond, lake, and stream shorelines more attractive. See *Special Considerations for Naturalizing Golf Course Water Features* for additional information on planting along a shoreline margin.

Special Considerations For Naturalizing Golf Course Water Features

While you may be familiar with planting trees, shrubs, or flowers to attract wildlife, planting vegetation in a pond requires a few special considerations. To get started, you need to gather some basic information about your pond so that you can choose plants that are best suited for your site. Your initial assessment should include:

1. **Size**—Make an estimate of the size of your pond. In large ponds with little or no natural vegetation, you may want to select a small portion for naturalization. This will allow you to experiment with pond planting and expand over time as your experience grows.
2. **Use**—Consider how you use the pond. Is it in play? Does it provide irrigation water? Do you want to reserve part of it for fishing or boating? Defining how you use the pond will help you determine how much and what type of access you need and which parts of the edge can be enhanced with shoreline plants.
3. **Sunlight and water depth**—Use a yard stick to measure the depth to the bottom along the edge of the pond. Also note how many hours of sunlight the pond receives each day. This information will help you decide what plants will grow best in and around the pond.
4. **Existing vegetation**—Take stock of the existing plants in and around your pond. This will give you valuable information about what types of plants seem to grow well. In some cases, you may choose to expand existing natural areas or add to their diversity by introducing different types of emergent plants.
5. **Wildlife value and aesthetics**—Choosing native plants with high wildlife value will help attract the greatest diversity of species. At the same time, you also may want to choose a few plants simply for their aesthetic value. For example, blue flag iris and marsh marigold can provide beautiful ornamental interest along the shoreline of your pond.

Maintaining Shoreline Plants

Superintendents often express concern about how to maintain naturalized shorelines. During the initial establishment period, naturalized shorelines do need to be monitored and managed to remove invasive weeds, such as purple loosestrife.

During the first two years of establishment, check shoreline plantings at least every other week. Remove unwanted plants. It may also help to rope or mark these areas to keep golfers from trampling through them. Based on golfing activity, you also may choose to reduce or expand the margin of a shoreline buffer. Once established, naturalized shorelines require minimal maintenance, especially compared with the routine maintenance required to manicure a shoreline.

Consider your current maintenance regime for shorelines: are there slopes that are time consuming and difficult to manicure? Are there areas where erosion has become a problem? Are there areas that do not come into play or places that could benefit from having greater definition? These areas make good candidates for shoreline naturalization and generally result in decreased regular maintenance and improved water quality and aesthetics.

Special Habitats

Many golf courses are home to endangered or threatened species of plants or animals. These courses must manage habitat areas to ensure their survival on the golf course property. Yet even without the official label of endangered or threatened, most courses include unique and valuable wildlife habitats or species. These may include plant communities that are unique to your region, such as prairies, wetlands, deserts, or woodlands, or species found only in very specialized habitats.

Take a look at your golf course with an eye toward what makes it unique. Make a list of wildlife species, unique native plants, or natural habitats that should receive special attention in your habitat management plan. Label the location of habitats on a map, so that you can clearly communicate with staff how they are to be managed. In general, there are three major actions that may need to be taken to protect special habitats on the golf course.

- **Protect From Disturbance by Golfers and Maintenance Activities**—Core wildlife habitats and unique plant communities or wildlife species should receive the highest status in your habitat management plan. These areas should be considered “conservation areas” where disturbance from golfing and maintenance activities should be avoided. USGA rules allow *Environmentally Sensitive Areas* to be designated on the course so that golfers are warned to keep out while not being penalized for errant shots.
- **Remove exotic invasive species**—Some properties suffer from invasive plants that have crowded out native plant communities. Kudzu, purple loosestrife, Japanese honeysuckle, and melaleuca are just a few common examples of invasive plants that overwhelm native plant communities. If you have invasive plants on your property, your habitat management plan should include ongoing actions to cut back or eliminate them.
- **Restore degraded habitat**—Restoring degraded habitat by planting native species encourages wildlife to move back into the area. Expertise on the plant community and long-term planning are essential elements in restoring degraded habitats.

Naturalizing Lawns and Large Non-Play Turf Areas

Large lawns, expanses of non-play turf, and hard to maintain slopes or mounds may be good candidates for naturalization. Naturalization simply means making the landscape *more natural*. Not every golf course has room for large-scale naturalization, but many courses find that they do have space—between golf holes, along the edges of rough, near woodland edges, on steep slopes, under clumps of trees—that can be improved to provide better habitat.

When thinking about making your course more natural, consider potential locations and types of projects you want to pursue. If you are new to naturalization, it may be wise to start slowly, learn from any initial mistakes, and gain approval prior to undertaking large-scale enhancement or restoration projects.

Endangered species—
Species of plants or animals whose populations are so low that they are in danger of becoming extinct. Loss of habitat is one of the primary causes of species endangerment.

Threatened species—
Plants or animals that are in jeopardy of becoming endangered.

Location is the most important consideration in terms of plant selection, visual appeal, and acceptance by golfers, employees, and surrounding property owners.

The Benefits of Naturalization

Environmental Benefits

- Maintains a diversity of plants and animals
- Improves water quality
- Minimizes erosion
- Protects ecosystems and ecological communities
- Maintains the gene pool of particular plant and animal species, promoting hardiness, disease resistance, and adaptability
- Supports an aesthetic appreciation of natural beauty
- Creates positive, progressive, and constructive attitudes about the natural world

Maintenance Benefits

- Lowers maintenance costs and reduces the need for high-intensity maintenance
- Reduces equipment wear and maintenance
- Reduces the need for gasoline, pesticides, fertilizers, and water

Golfing Benefits

- Adds distinctive contrast and natural beauty
- Increases wildlife sightings for golfers
- Defines play and non-play areas

No matter what type of naturalization project you choose, there are several factors you must keep in mind:

- **Location**—Location is the most important consideration in terms of plant selection, visual appeal, and acceptance by golfers, employees, and surrounding property owners. Look for areas that you currently maintain with mowed grass or that are visually unappealing and target them for naturalization. Areas under small stands of trees, near wooded edges, or along the property border may be suitable. These areas do not have to be large—you can start small and expand over time where possible.
- **Plant Selection**—Take into account that most native species evolved to thrive under specific growing conditions. Survey your property and learn more about the native plant communities in your area to determine which species will grow best on your site.

In addition, you can attract more wildlife species sooner by selecting plants that produce both food and cover. Locating plants near water sources will further extend their habitat potential.

- **Site Preparation and Plant Care**—Another important point to consider is that, while native species are extremely tough and hardy and will eventually thrive better without inputs at all, they do benefit and establish faster with some site preparation and post-planting care. Mulching, weed barriers, and supplemental irrigation will increase shrub survival rates. Seeding native grasses just prior to or during the most likely time for precipitation usually will be enough to ensure good germination. Then, by providing some form of mechanical weed control and exercising patience, a naturalized wildlife habitat can be sustained for years.
- **Communication**—Changes to the golf course landscape generally require approval by various committees before being implemented. Communicating goals and site plans with golfers and committee members is often key to the success and acceptance of such projects. Be prepared to respond to questions about project costs, benefits, and effects on the game of golf.

Addressing Common Concerns

Slow Play—Naturalized areas, such as long native grasses or shrub plantings, can be potential sources for slow play. You can address this concern by properly locating naturalized areas and, if necessary, employing a well-trained and persistent marshal staff.

Conflicting Aesthetics—Some golfers perceive naturalized areas as unkempt and unsightly. Most golfers are won over, however, when they understand the many reasons for and benefits of a naturalized landscape.

Golfer Expectations—Naturalization doesn't mean poor playing conditions. In fact, you may find that you have *more* time to devote to maintaining playing surfaces when you take non-play areas out of routine maintenance.

Your no-mow area will need to be maintained. However, it will not require regular, weekly inputs to mow, fertilize, or control weeds.

Naturalization Projects

There are many ways to enhance wildlife habitat on your golf course, some are easy and some quite involved. Here, we present a variety of options. Choose what will work best for you, given your unique landscape conditions, maintenance needs, and budget.

- **Designating No Mow Areas**—Many golf courses have successfully created habitat and eliminated high intensity maintenance by simply not mowing in designated, non-play areas. Taller grasses and wildflowers soon grow to replace the close-cropped turfgrass monoculture. Such areas improve habitat diversity and provide a more natural aesthetic.

When designating no-mow areas, look for places where taller grasses will complement existing habitat, such as along woodland edges or pond shorelines. You can also use tall grasses to create corridors that connect isolated habitat areas. This will increase the overall space that is available for wildlife.

Most courses simply stop mowing to begin the naturalization process. This is easy and inexpensive, but may look unsightly for a few weeks while growing in. Use signage or rope off areas to keep people out and inform them that the area has not been neglected.

Another strategy is to add plugs of wildflowers into the no-mow area. This increases color and diversity, while not requiring major site preparation or plant care.

Your no-mow area *will* need to be maintained—it's not a no work zone. However, it will not require regular, weekly inputs to mow, fertilize, or control weeds. Many superintendents report that these areas are less stressful to maintain, since thresholds are much higher and they do not demand attention during the height of the golf season. At least once during a three-year growing cycle, naturalized areas will need to be mown or burned to prevent woody growth from establishing. More frequent mowing—once a year—favors grass species and gives the area an even appearance, while a three year cycle diversifies the number of plant species in the no-mow area. You may choose to experiment with different mowing regimes (*e.g.*, every fall, spring, every other year, *etc.*) to determine what works best for you and your golf course, or different naturalized areas of the course.

- **Planting Wildflowers**—Meadow flowers add beauty to the golf course that appeals to golfers, birds, and butterflies. While a wildflower meadow rarely provides a full season of multi-colored blooms and is not as easy or maintenance free as is often advertised, a successful wildflower planting interspersed with native grasses can add subtle beauty and a changing mosaic of color to the golf course landscape.

Habitat corridors, sections of undisturbed habitat that connect two or more larger natural areas, are crucial for enabling many wildlife species to access food, water, and shelter.

There are several methods for establishing wildflowers. When planting directly from seed, choose seed that is at least regionally adapted. Native wildflower seed mixes are more costly than generic mixes, but contain plant species that will preserve the natural history of your region. You can also purchase or grow wildflower plants and add them to no-mow areas or prepared beds. This method often results in greater plant survival and quicker establishment.

It's *very important* to prepare your seedbed carefully prior to planting to reduce weed competition and ensure the survival of your wildflower plants. Existing vegetation can be removed with a non-selective herbicide or via mechanical means. Temporary irrigation can be installed during the establishment of the planting and then removed after the first season.

Wildflower areas are not maintenance free, but they do not require the daily maintenance, or stress, that manicured turf areas do. During establishment, and for the first two to three years, you will need to remove weeds so that they do not take hold and spread through the planting. Like no-mow areas, wildflowers will need to be mown or burned every few years to keep perennial plants thriving.

- **Creating Wildlife Corridors**— Among the problems facing wildlife today is the fact that so much of our existing habitat is cut into small fragments and isolated parcels. This is the case on the regional level as well as on individual properties, where woods, fields, and water sources are often disconnected. Habitat corridors, sections of undisturbed or restored habitat that connect two or more larger natural areas are crucial for enabling many wildlife species to have access to food, water, and shelter.

As much as possible, connect isolated habitat areas with natural corridors. This will allow wildlife to safely travel throughout the property or from your property to neighboring habitat by minimizing their exposure to predators. It will also help to increase the number of available breeding sites. When smaller habitats are linked, previously isolated wildlife populations may interbreed, thereby increasing the flow of genes between populations and facilitating healthier and more stable wildlife populations. Ideally, all natural features would be incorporated into a coherent network on the property, as well as connected to surrounding natural areas.

One group of wildlife species that is especially dependent upon wildlife corridors that connect different habitats is amphibians. Each year, frogs and salamanders migrate between breeding ponds and upland wooded areas where they spend most of their lives. Connecting wetland and wooded habitats via corridors of protected vegetation is key to the survival of amphibian populations.

Survey your golf course layout on a map or aerial photo. Are there isolated “islands” of habitat? How can these areas be connected to adjoining blocks of habitat? You may be able to connect areas by extending trees or shrubs, or by leaving unmown areas between stands of trees. Streams make good corridors, too. Property borders may also benefit from naturalization to improve travel between your land and neighboring habitats. Likewise, buffers of aquatic and shoreline vegetation around pond margins and other natural vegetation that connects aquatic habitats with upland woods is vital to facilitating safe wildlife movement on the golf course.

Mounting Nest Boxes

Nest boxes are birdhouses that are specifically tailored for cavity-nesting birds. The size of the opening and the dimensions of the box are specifically calculated to fit the size of the bird and its nest. The standard songbird box is sized to fit a number of small birds, including bluebirds, swallows, chickadees, and wrens.

To begin a nest box project, you must determine how many boxes you want to put up, what types of birds you are likely to attract, and who will build, monitor, and maintain the boxes.

Step 1: Survey habitat.

Start by surveying the types of *habitat* available on your property. Different habitats will attract different species of birds to nest. Use the chart to identify which birds are likely to take up residence.

HABITAT PREFERENCES OF NESTING BIRDS

Habitat Type	Bird Species
Open areas—lawn or field	Bluebirds Tree Swallows Kestrels
Wooded sites or edges	Wrens Chickadees Tufted Titmice Nuthatches
Areas with water—pond, stream, or wetland	Tree Swallows Violet-Green Swallows Purple Martin Wood Ducks (<i>wetland preferred</i>)

Step 2: Choose the correct nest box.

A basic songbird nest box will house all of the birds listed here except Wood Ducks and Kestrels. These larger birds need bigger boxes (See the Appendix for construction plans).

If you choose to purchase a nest box, check the dimensions carefully to make sure it is built for the birds you want to attract. Often, birdhouses sold in department stores are simply not built for birds. Many lawn and garden stores sell suitable nest boxes, as do bird specialty stores and mail order businesses.

In addition, be sure that you can *open the box easily*. This is essential for cleaning out old nests and monitoring the nesting birds. Nest boxes should be hinged on one side or on the top to facilitate opening, cleaning, and closing.

Step 3: Mount your nest boxes.

Follow these tips for successful nest box placement:

- Mount nest boxes on metal poles, trees, or fence posts. A metal post will discourage predators such as raccoons, cats, and snakes from climbing to the nest.
- Mount the boxes four to five feet above the ground. Keeping the boxes within easy reach will make checking and cleaning them much easier.
- The nest box opening may face in any direction, but positioning the entrance hole away from prevailing winds will help keep the nest dry.

- Most birds begin searching for nesting sites in February in the South and March in the North, so boxes should be up by early spring. Boxes that are placed by late spring are also valuable and may attract birds ready to begin their second brood.
- Consider the first year of your nest box project an experiment. Some boxes may go unused while other boxes may be eagerly sought out by several birds. Try placing your boxes in a variety of locations to see which ones are most successful. As a general rule, place boxes away from areas of high traffic.
- Keep in mind that birds have different territorial requirements that affect how many birds of the same species will use a given area.
- Boxes can be placed in pairs, ten to twenty feet apart, to reduce nest site competition between different species.

TERRITORY SIZE OF NESTING BIRDS

Bird Species	Nesting Territory
Bluebird	100 to 150 yards
Chickadee	10 acres
Wren	½ to 1 acre
Tufted Titmouse	2 to 5 acres
Nuthatch	20 to 40 acres
Tree Swallow	nest site only

Step 4: Monitor your nest boxes.

Once you put up nest boxes, it is important to monitor them on a regular basis to help ensure nesting success. During the breeding season, from mid-March through August, open the box once a week or every two weeks. When you open the box, you can count the number of eggs or young, detect predator problems, and discard old nests once each group of young has left the box.

Opening the boxes will *not* frighten the birds into abandoning the nest. Just open the box, take a quick look inside to count the number of eggs or young, check for disturbance, and close it again.

The only time to refrain from checking the boxes is after the young are about 12 days old. Opening the box during the 12- to 18-day period after birth may provoke the young to leave the box too early.

If you're not sure how old the young birds are, play it safe and refrain from checking the box for two weeks. Then look inside and remove the old nest if it is empty. Cleaning out the box will prevent a buildup of mites and other parasites that prey upon birds.

Record information about your nest boxes to learn more about the birds using them and keep track of the number of birds successfully fledged. Copy the *Nest Box Survey* included in the Appendix or use a 5x7 note card for each box to record information about bird activity.

Dealing With Wildlife Problems

Dealing with wildlife problems comes with the turf of successful wildlife management on a golf course. From time to time, most superintendents struggle with wildlife species doing things or entering places we would prefer they did not. When a wildlife species causes damage or becomes a significant nuisance, it's time to take action. But effective action and long-term solutions require not just knowledge of control measures, but a good understanding of why the species has become a problem in the first place.

Understanding the Cause

If you are experiencing problems with a particular wildlife species around your golf course, your first concern may be: *What can I do to solve it?* But before choosing a solution, it's worth asking a few additional questions:

What are the conditions and natural life supports that are sustaining the wildlife species?

Why is the problem occurring now?

How might current management practices or landscape conditions actually be contributing to the problem?

Every species is connected to a life support system made up of food, cover, and water sources, and exists within a complex food web that includes natural enemies and predators. Your job is to find out more about the habitat and life habits of your “problem” wildlife species so that you better understand why the species is causing you trouble. For instance, is there an over abundance of food, lack of predators, or lack of suitable habitat?

It is also important to look for underlying conditions or management practices that are causing or exacerbating a problem. Once you have identified the root cause, you'll be able to identify a variety of control options, such as altering food, cover, or water sources that sustain the species, increasing natural predators, or altering management practices.

In addition, keep in mind that human values, needs, and perceptions provide a context for all wildlife conflicts. Indeed, there would be no wildlife problems without people. As you try to solve wildlife problems, evaluate your own needs and goals, and define your tolerance for living with various species. Striking a workable balance, rather than totally eradicating a particular species, is often a preferred and more achievable solution.

A Step-by-Step Approach

The following step-by-step approach to dealing with problems works with wildlife species great and small. It will help you effectively deal with rodents, birds, deer, mosquitoes, houseflies, grubs or other problem species you encounter. When you take the time to ask the right questions, you'll find solutions that really work.

Step 1: Understand the species and its habitat.

Find out about the species' preferences for food, cover, and water sources, as well as breeding requirements and territory size. An Audubon International staff ecologist can provide species information if you need help.

Step 2: Evaluate and define the problem specifically.

What *exactly* is the problem? The more specific you can be, the easier it will be to narrow down solutions. Try to define *what*, *where*, and *when*, as well as *why* the problem is occurring.

Effective action and long-term solutions require not just knowledge of control measures, but a good understanding of why the species has become a problem in the first place.

For example, “*Canada Geese on the property*” is not a very informative problem definition. “*Canada Geese are eating turf grass and leaving a substantial mess during March and April*” is much more specific.

Step 3: Survey your property & determine how you contribute to the problem.

Review your landscape management practices to determine whether something you or your golfers are doing causes or exacerbates the problem.

For example, *people feeding geese* would be an obvious contributing factor. Landscape management practices such as *removing shoreline vegetation around ponds* or *eliminating understory vegetation that may support natural predators* would be additional practices that favor geese.

Step 4: Review solutions and choose the most effective.

Evaluate a variety of control options. Consider your needs, the nature of the wildlife species and your property, along with short and long-term effectiveness when choosing your response to the problem.

For example, you might choose to *increase pond vegetation* to deter geese, *enhance habitat overall*, and *get a dog* to discourage geese from breeding on the property.

Step 5: Communicate about the species and your actions.

Share your knowledge about the wildlife species and the nature of the problem. This will provide a valuable context for the control measures you choose. People are apt to support you when they know you fully understand the problem and are taking action to solve it.

Habitat Protection

Habitat loss and degradation are two critical factors impacting the health and diversity of wildlife species throughout North America and around the world. Golf courses are often criticized for simplifying, and therefore degrading, wildlife habitats or for inadequately protecting natural areas on site. By implementing management practices that protect habitat areas, you will ensure that your course is providing sanctuary for wildlife in your vicinity.

Preventing Disturbance

Wildlife, water, and natural systems can be adversely affected when golfers inadvertently traipse through natural areas, maintenance practices are done carelessly, or improperly trained golf course personnel, managers, or owners fail to implement proper safeguards or sound management practices. It is the job of the golf course superintendent, working together with employees, owners, and golfers to protect natural areas on the golf course responsibly.

There are a variety of effective means to educate people about habitat protection. Choosing a combination of strategies and repeatedly following up may be necessary to raise awareness and promote actions that do not harm the environment.

Strategies

- **Mount signage**—One of the most effective ways to protect special habitats is to mount signs. In certain areas you may choose to use the official USGA designation, *Environmentally Sensitive Area*. Other areas may simply warrant an explanation of your expectations (e.g., No Carts—Keep Out), a statement of why the area is significant (e.g., Wildlife Habitat; Nesting Area; Native Prairie), or both.

Golf Course Activities That Can Damage Natural Habitats

- Golfers trampling native plants while searching for balls
 - Carts straying into naturalized areas
 - Weed trimming or mowing too close to tree trunks
 - Dumping debris or leaves into ravines or wooded streams
 - Removing shrub layers or leaf litter in woods
 - Removing wetland, streamside, or pond vegetation
 - Ignoring eroding stream banks
 - Planting exotic plant species
 - Removing trees from streamside habitats (alters water temperatures and streamside habitat)
 - Improperly using or storing chemicals
 - Mowing fields prior to the end of nesting season for ground nesting birds
- **Rope off areas**—Sensitive habitat areas may need to be roped off to discourage golfers or maintenance staff from intruding. When roping off areas, make sure to inform both employees and golfers why access is being restricted.
 - **Communicate with golfers and homeowners**—Look for ways to inform people in greater detail about sensitive habitats or species in need of protection. Many courses have successfully educated golfers via newsletter articles, bulletin board notices, meetings, and seasonal site tours. If a homeowner association is involved, communicate in writing or in person so that neighbors have an opportunity to ask questions, express concerns, and remain informed and involved.
 - **Educate maintenance workers**—Routinely review environmentally sound maintenance practices with the maintenance crew. Set high expectations and follow up on careless or inappropriate practices.
 - **Avoid disturbance to known nest or den sites**—Since all wildlife species must successfully breed and raise young to survive, it is important for golf course personnel to avoid disturbing nests, den sites, or other breeding habitat—especially during the spring when breeding activity peaks. In fact, it is illegal under the Migratory Bird Treaty Act to “take” native bird nests, eggs, or young without a permit. You may choose to flag or stake ground nests (*e.g.*, killdeer nests) or avoid thinning woods during the spring. In tall grass areas, do not mow until after young birds have left nests—around July 31 for most parts of the country.
 - **Minimize traffic**—Limiting traffic in habitat areas minimizes habitat disturbance and fragmentation. Route vehicular and foot traffic away from any environmentally sensitive areas. If necessary, confine cart paths to the edges of core habitats, rather than cutting paths through the interior.

Using Native Plants

Another key management strategy for preserving the rich biological diversity of your region is to landscape primarily with *native* plants. Native plants *originated* and *grow naturally* in a particular region or habitat. Landscaping with native plants can be done on any golf course, regardless of size. They can be planted in flower gardens, natural habitats, and landscaped areas around buildings, entry roads, or property borders. Unlike many non-natives, these plants are well adapted to local climate and soils and provide good sources of food and cover for wildlife.

The Benefits of Landscaping With Native Plants:

- Maximizes the effectiveness of habitat management efforts
- Provides food and cover for native wildlife species
- Provides a full compliment of species in the plant communities on the course
- Reduces water, fertilizer, and chemical inputs
- Reduces the need for high intensity maintenance
- Preserves the unique biological diversity of your region
- Helps the golf course become a valued part of local green space networks

Landscaping with native plants is not much different from landscaping with common naturalized or exotic garden trees, shrubs, and flowers. But your success with natural landscaping and native plant gardening may depend upon thoughtful planning and landscape design.

Consider the full spectrum of landscaping as a continuum from highly artificial designs to those that carefully recreate an ecological community. The choice of plant material, design, and purpose of each varies widely and each carries a distinct aesthetic appeal.

LANDSCAPE DESIGN CONSIDERATIONS

	<i>Plant Type</i>	<i>Design Considerations</i>	<i>Plant Selection</i>
<i>Traditional Landscaping</i>	Use of non-native and possibly native species	Arrangement in formal or informal designs	Plants chosen for aesthetic value only
<i>Natural Landscaping</i>	Use of native plants	Designed to simulate natural areas and enhance wildlife habitat	Plants chosen for aesthetic and wildlife value and to preserve natural integrity of the site
<i>Ecological Restoration</i>	Use of full complement of native plants	Designed to recreate a natural community and stimulate ecological processes	Plants chosen to maximize ecological community structure and functioning

When you plan additions to your landscape this year, let the following questions guide your overall design and plant selections:

- What type of landscape design do you prefer?
- What is the current landscape aesthetic of your property—*Traditional, Formal, Informal, Natural*?
- What are some of the areas on your property that would lend themselves to natural landscaping?
- Are there areas that could shift from high intensity management to lower intensity management?
- What are some of the native trees, shrubs, and flowers on your property that have the greatest aesthetic appeal?
- What native plants could be added that would fit well with the current landscape design and add to the property’s structural diversity and overall wildlife habitat?
- Do your landscape or naturalization plans fit with existing site conditions, such as climate, topography, hydrology, soils, and vegetation?

Audubon International recommends that 80% of golf course plantings be native. However, we recognize that native plants may not always match the aesthetics you are trying to create. Alternatives to native plants come in two forms: naturalized plants and ornamental plants. Naturalized plants are those that have established themselves in an area distant from their origin. Many of North America's non-native, naturalized plants came on the boots and cargo of immigrants and have successfully established themselves throughout the country. Ornamental plants are those that have been bred throughout the years, usually from non-native stock, for aesthetic appeal. Ornamentals are commonly found in nurseries and, if chosen wisely, can be used as both food sources and aesthetically pleasing landscape plants.

When buying ornamentals, you should be sure that they are not classified as exotic/invasive plants, since these plants are growing *outside of their place of origin* and are *interfering with* the growth of native species in that location. For example, the sale of purple loosestrife, Japanese honeysuckle, and Russian olive is still widespread despite the invasive and destructive nature of these plants. Audubon International or your local native plant council can provide you with a list of plants to avoid for your specific location.

Restoring Degraded Habitat

Occasionally, a golf course may find itself in a position of needing to repair damaged or disturbed natural areas, or correct serious habitat management problems. Though such repairs may be costly or time consuming, investing sooner rather than later prevents increased damage and expense.

For instance, one of the most common problems for golf courses is eroding stream or pond banks resulting in degraded water quality, wildlife habitat, and aesthetics. Erosion problems often stem from improper design or management of lake, pond, and stream margins. When short mown turf is maintained to the edge of the water source, its roots often are not strong enough to hold the soil in place. Stabilizing shorelines, via either re-vegetation or structural supports, is necessary to prevent further damage.

Restoration projects generally require technical expertise and site specific planning, as well as capital expenditures. Specific recommendations are beyond the scope of this guidebook. However, there are a number of general considerations to keep in mind that will help you undertake a successful restoration project.

Restoration Tip:

When possible, combine restoration projects with other types of golf course renovation work. The availability of equipment and labor, combined with a disruption in golf play, often presents an ideal situation in which habitat restoration can be accomplished.

General Guidelines

- Clearly define your goals. If the restoration project will require a large capital expenditure or will alter the game of golf, seek the input of key stakeholders, such as members, owners, or local officials, before proceeding.
- Seek help from experts.
- Review the hydrology and geology of the site.
- Identify the wildlife that live on the site, the wildlife species you would like to attract, and the natural history of both.

- Develop a site plan based on the natural history of your region and the species you are trying to protect.
- Determine the native plants appropriate to your ecoregion and find a source for those plants. (This information is included in the *ACSP New Member Packet*.)
- Prepare the site. This is one of the most important steps in insuring that desirable plants become established and invasive weeds are controlled.
- Supervise project implementation.
- Control any weed or exotic species.
- Monitor and maintain the site as appropriate.

Self-Assessment Checklist

Proper wildlife habitat management has dramatic consequences for maintaining an enjoyable, environmentally friendly golf course. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- ☐ Identify core habitats, such as mature woodlands, wetlands, or stream corridors, and special habitat concerns, such as endangered or threatened species on the property.
- ☐ Train staff to understand that management practices may positively enhance or adversely impact wildlife species and habitats on the property.
- ☐ Identify the dominant indigenous (native) plant community and ecological region in which the golf course is located.
- ☐ Maintain an on-going written inventory of at least bird and mammal species to document and track wildlife use of the property. Additional inventories may include amphibians, reptiles, fish, and other wildlife, and plants, such as trees, shrubs, and herbaceous species (non-woody plants).

Wildlife Habitat: Space, Food, Cover, and Water Enhancements

- ☐ Maintain natural wildlife habitat in at least 50% of all unused or minimally used portions of the property.
- ☐ Connect wildlife habitat areas, such as woods, meadows, stream corridors, and ponds, to facilitate wildlife movement through the property.
- ☐ Maintain or plant varying *heights* and *types* of plants, from ground cover to shrub and tree layers, in habitat areas such as woods, desert, or prairie (*e.g.*, in woodlands, leave understory, including shrubs, herbaceous (non-woody) plants, debris, and leaf litter intact).
- ☐ Leave dead trees standing when they do not pose a safety hazard.
- ☐ Maintain a water source for wildlife *with aquatic plants and shrubbery or native landscaping along the shoreline (i.e., not turfgrass)*. This could be a pond, stream, wetland, or river corridor. On smaller properties, this may also include a birdbath or created “backyard” pool.
- ☐ Naturalize at least 50% of *out-of-play* shorelines with emergent-aquatic and shoreline plants. Special attention should be given to shallow water areas (<2ft. deep) since wildlife is most abundant when shallow water includes emergent aquatic vegetation.
- ☐ Choose flowers for gardens or container plants that will provide nectar for hummingbirds, butterflies, and other native pollinators.
- ☐ Maintain nesting boxes or other structures to enhance nesting sites for birds or bats.

Habitat Protection and Biodiversity Conservation

- ☐ Protect wildlife habitats, and any endangered or threatened wildlife or plant species, from disturbance by golfers and maintenance activities. Mount signs or designate “environmentally-sensitive zones” as per USGA rules, if appropriate.
- ☐ 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.
- ☐ Purchase landscape plants from locally grown sources, whenever possible, to support the genetic integrity of local native plant communities.
- ☐ Avoid disturbing known bird nests or den sites until after young have dispersed. Stake or flag such areas when needed (*e.g.*, roping killdeer nests; not mowing fields until after bird nesting season—July 31).
- ☐ Avoid removing shrubs or trees during bird nesting season if nests are present.
- ☐ Restore degraded habitats, such as eroded slopes, compacted soils, and polluted water sources.
- ☐ Clean up trash from habitat areas when necessary.
- ☐ Where possible, confine roads, cart paths, trails, and necessary vegetation removal to the edges of existing habitats to minimize habitat disturbance and fragmentation.

Chapter 3

Chemical Use Reduction and Safety



Schuyler Meadows Country Club, Loudonville, New York

Maintaining optimal turf health, while reducing risks associated with chemical storage, application, and disposal are keys to a golf course environmental management program. At Schuyler Meadows Country Club, Superintendent Peter Salinetti reduced pesticide use by more than 50% by spot-treating problem areas. The Club reduced fertilizer use by 60% by converting fairways from *poa annua* to bentgrass.

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“We believe that a well executed IPM plan not only makes good environmental sense, but is cost effective as well. Our IPM plan involves daily scouting, minimum pesticide use, water conservation, and a constant effort to encourage establishment of grasses that require less water and pesticides.”
—Peter Salinetti, CGCS

FOCUS ON:

- Turf surfaces
- Ornamental Landscaping
- Maintenance Facility

Overview

The purpose of Chemical Use Reduction and Safety is to ensure safe storage, application, and handling of chemicals and reduce actual and potential environmental contamination associated with chemical use.

Pesticides and fertilizers can have significant adverse impacts on surface and ground water, people, wildlife, and other organisms. The environmental impacts of pesticides and fertilizers are often a focus of concern from regulatory agencies and the public. It is essential that golf course personnel understand and address the environmental and safety issues associated with chemical use. This section focuses on helping you achieve five key goals:

1. Expand your knowledge of chemical use issues, integrated pest management, best management practices, and alternative pest control measures.
2. Maintain turfgrass in a vigorous and healthy state through sound cultural practices and integrated pest management techniques.
3. Apply and store all chemical products in a manner that minimizes harmful environmental impacts.
4. Ensure that maintenance staff is properly trained and supervised.
5. Ensure that chemicals are properly stored and handled and equipment is properly maintained to reduce the potential for negative environmental impacts.

Careful attention to safe storage, application, and handling of chemicals will help you achieve both healthy turf and a healthy environment.



Saucon Valley Country Club, Bethlehem, Pennsylvania

Regular scouting and monitoring help golf course employees become familiar with pests and address problems once threshold levels have been exceeded. Maintenance staff at Saucon Valley Country Club regularly scout for pests, identify hot spots, and map problem areas as part of their IPM program.



North Shore Country Club, Glenview, Illinois

Implementing a comprehensive IPM program is one way to foster optimal turf health and reduce chemical use. At North Shore Country Club, Superintendent Dan Dinelli takes a holistic approach to turf management, using his IPM toolbox to incorporate cultural, mechanical, biological, and chemical controls to improve and maintain healthy turf.

Please note: Audubon International is not a regulatory agency. The Audubon Cooperative Sanctuary Program is an education and conservation assistance program. It expects members to comply with all local, state, and federal regulations, as the foundation for the Chemical Use Reduction and Safety part of the program, which builds upon that foundation.



United States Golf Association Green Section, Turf Advisory Service

Employing available experts and taking advantage of continuing education programs will continually improve your knowledge of turfgrass systems. Likewise, communicating about IPM efforts with golfers and the general public fosters understanding and support for IPM strategies.

General Knowledge

Chemical use has dramatically altered maintenance practices in the golf industry, allowing superintendents to meet the rising aesthetic and playability expectations of golfers and continually increase those standards. However, the widespread use of chemicals has not come without a price. Risks associated with chemical use threaten human health and the environment and negatively influence the public's perception of golf courses.

Reducing reliance on chemicals, employing best management practices, and seeking least toxic products while balancing the demands of golfers is a worthy goal—from both an environmental and an economic point-of-view. In fact, it is one of the most important ways that golf course personnel can showcase their commitment to environmental stewardship.

Understanding Risks

When most people think of risks associated with chemical use, they primarily think about the risks to water, wildlife, or human health associated with the chemical application itself. Yet threats to human health and the environment can result from chemical manufacture, transportation, storage, application, and waste management. Ground and surface water contamination, soil contamination, and direct and indirect negative impacts on people and other living organisms are among the many risks associated with chemical use.

Chemical use on the golf course has resulted in water and soil contamination—sometimes persisting long after a particular chemical is no longer in use. Though today's products are less persistent, they still *must be stored and applied properly* to ensure worker and environmental safety. Herein lies one of the greatest risks associated with pesticide and fertilizer use: serious liabilities continue to be posed by inadequate supervision and training, insufficient financing for proper storage facilities, mismanagement, product application under the wrong conditions, and simple carelessness.

When golf course personnel, club green committees, or management companies understand the potential risks inherent with using chemicals, they are better equipped to make wise management decisions, adequately invest in storage and handling facilities, and improve accident response protocols. Likewise, employee training, especially for seasonal employees and pesticide applicators, must pay proper attention to chemical safety and environmental issues. Employees should understand potential risks to workers, the golf course, and its guests, as well as the local environment.

OSHA Regulations

OSHA has created Hazard Communication Standards (HCS) in order to deal with the potential hazards of working with chemicals. These standards need to be followed in your maintenance facility. The purpose of the HCS is to ensure that information about the chemicals used and the protective measures associated with them is disseminated to your employees.

OSHA regulations include:

- Keeping MSDS sheets accessible;
- Informing employees of the risks they are being exposed to;
- Training employees how to use the chemicals safely;
- Creating protocols to deal with potential accidents.

The Audubon Cooperative Sanctuary Program expects its members to comply with all OSHA, state, and local regulations.

Though today's products are less persistent, they still must be stored and applied properly to ensure worker and environmental safety.

Risks Associated With Chemicals

Improper chemical use can have serious consequences for people, the environment, and the game of golf. Risks are not only limited to chemicals in their liquid, gas, or particulate form, but also in the form of dust, fumes, fibers, mists, and vapors.

Human Risks

- Physical hazards—Chemical reactions can result in fire, explosion, or toxic gas release, which cause physical trauma if chemicals are handled or stored improperly.
- Health hazards—Harmful health effects (illness, chronic disease, sub-lethal impacts) can be caused directly from chemicals.

Environmental Risks

- Diminished water quality—The likelihood of pesticide contamination of ground water and water wells depends partly on the geologic and hydrologic characteristics of the site, as well as on pesticide characteristics. Contamination is usually the result of improper application or careless handling, storage, or disposal of unused pesticides and pesticide containers.
- Detrimental effects on non-target species—Chemical drift or runoff may impact wildlife species in the vicinity of the chemical application.
- Poor soil structure—Disturbance to soil structure and organisms from chemical use negatively impacts nutrient cycling and plant growth.

Golf Risks

- Liability—Improper storage or handling of chemicals increases golf course liability. Contamination can result in costly environmental cleanup and fines.
- Poor public opinion—The public has repeatedly voiced concern regarding chemical use on golf courses and its environmental and health effects.
- Pest resistance—Target pests can develop resistance to a chemical that is used repeatedly, resulting in the need to use increasingly toxic chemicals to control the pest.

Cultural Practices and Integrated Pest Management

Sound cultural practices and integrated pest management techniques are key to maintaining healthy, vigorous turfgrass. Making a commitment to both helps to ensure favorable playing conditions and good environmental quality.

Using an Integrated Pest Management Approach

Integrated pest management involves using a variety of management measures to keep turfgrass pest populations below levels that are economically and aesthetically damaging, without creating a hazard to people and the environment. The basic components of IPM include:

- Employing sound cultural practices to promote plant health;
- Scouting and monitoring potential pest populations and their environment;
- Selecting thresholds for acceptable and unacceptable levels of pest injury;

- Accurately identifying the problem and choosing the best management strategies;
- Educating personnel about various management strategies;
- Proper timing and spot treatment for cultural, biological, or chemical methods;
- Evaluating the results and keeping records.

Employing an IPM program necessitates that the superintendent and key maintenance staff have a thorough knowledge of turf and its pest problems, that there be a structured monitoring or scouting program, and that detailed records be kept to measure the effectiveness of the program.

Employing Sound Cultural Practices

Sound cultural practices are at the root of every good integrated pest management program. Indeed, using common sense and doing your best to ensure healthy soils, good drainage, and healthy turf that can resist and recuperate successfully from environmental stresses, pest damage, weed infestation, and golfing activity should be your number one priority.

- **Plant Selection and Care**—Turfgrass species and cultivars must be selected to match local environmental and playing conditions. Introducing a species outside its range of adaptation increases its susceptibility to stresses and pests. Where possible, select adapted species and cultivars that minimize water and pesticide use.
- **Mowing Heights**—One of the most important changes that can be made in the maintenance of turf areas is the heights at which they are mown. Mowing height and frequency are directly related to the turfgrass species and growth rate of the plant. To minimize stress on the plant, no more than one third of the leaf blade should be removed with any one mowing. On greens, cutting heights consistently 1/8" or less can place the turf under severe stress during weather extremes.

Increasing the mowing heights slightly will also create a better filter for water that moves through the course. Creating a 15- to 30-foot buffer of turfgrass mown at a height of three inches, or as high as possible for the particular turf species, is especially important for reducing and filtering runoff which can lead to algae or other nuisance plant problems in water bodies. In addition, using lightweight mowers on greens and fairways tremendously reduces the effects of soil compaction on turf growth.

- **Irrigation Practices**—If properly watered, turf is more resistant to insects and diseases. Since excessive irrigation is one of the most common problems observed in the field, it is important to survey the irrigation system to ensure that all irrigation heads are working and set properly to obtain uniform coverage.

Irrigation frequency should be dictated by the evapotranspiration (ET) requirements of the plant. Irrigating deeply and less frequently produces turf with a deeper root system and improved overall turf health. Monitor root depth, soil moisture, and ET conditions and use visual inspection to determine turf irrigation needs.

- **Fertility and pH Management**—Fertilization should be scheduled to meet the nutritional and growth requirements of the plant. No one fertilizer program or fertilizer can suit all situations. The frequency of fertilizer application will vary depending on the turfgrass species and the type of fertilizer. Slow release fertilizers, such as IBDU, coated urea, or natural organic materials, should be used on the golf course whenever possible. Use low rates of inorganic fertilizers with any one application. Tissue tests and soil tests are good diagnostic tools for assessing soil pH, phosphorus, potassium, and other nutrient needs of the turf plant.
- **Soil Testing and Root Zone Management**—Improving soil characteristics can have a positive impact on turfgrass health and decrease the need for chemical inputs. The type of soil particles (*e.g.*, sand, silt, clay), the amount and flow of water, and the amount and type of carbon

Integrated pest management involves using a variety of management measures to keep turfgrass pest populations below levels that are economically and aesthetically damaging, without creating a hazard to people and the environment.

Excessive irrigation is one of the most common problems observed in the field.

Before implementing any control strategy, it is important to determine the cause of the problem and then select the best corrective measures.

found in roots or dead organic matter affect soil organisms. Disturbance to soils and sediments can disrupt biological and chemical cycles, destroy soil organisms, and alter subsurface food webs. Conversely, improving soils can enhance underground habitats for beneficial organisms that stimulate plant growth and help plants resist disease. Knowing your soils and working to enhance them will prove a worthwhile investment.

Regularly test for nutrients, cation-exchange capacity, and pH of your soils. Add compost or other soil amendments as needed to improve the structure and fertility of your soil. Testing irrigation water may prove useful because the quality of irrigation water may also impact soil balance.

- **Drainage**—An important aspect of soil health is the proper movement of surface and sub-surface water, which is critical for root growth and overall turf health. Good surface drainage through surface contouring alleviates ponding of water created from runoff, although it does not correct underlying soil problems. Properly installed subsurface drainage is an effective way of avoiding turf damage.

Water movement through the soil is disrupted when layering occurs within the soil profile or when compacted soil conditions exist. Though there is no single solution to this soil problem, core cultivation, deep tine aeration, and high-pressure injection aeration are possible control methods. Before implementing any control, however, it is important to determine the cause of the problem and then select the best corrective measures.

- **Tissue Tests**—Soil testing does not always give you the full story about plant health, since nutrients in the soil can be present but not readily available to plants. If you want to completely understand turfgrass health, conduct leaf tissue tests since they will inform you of the nutrient status of the plant.
- **Thatch Control**—The potential for thatch problems varies with turfgrass species, intensity of culture, and traffic. Thatch becomes a problem on fairways and greens when it accumulates to a depth that increases potential for puffiness, mower scalping, disease development, and localized dry spot formation.

Avoid excessive fertilization in order to prevent excessive thatch formation. For greens, light vertical mowing at intervals dependent on the growth rate of the plant and topdressing, which helps enhance the rate of biological degradation, can be effective in controlling thatch formation.

On fairways, excessive thatch can be avoided by preventive cultural practices. Such practices include: using appropriate turfgrass cultivars, maintaining appropriate soil pH, utilizing soil cultivation techniques to enhance soil oxygen levels, properly irrigating, moderately applying nitrogen fertilizers, and using pesticides only as needed.

Corrective measures for thatch control include verticutting, core aeration, and topdressing. It is best to perform these corrective measures when the turfgrass is actively growing.

- **Traffic Control Measures**—As the number of golfers on golf courses and the use of golf carts continues to increase, traffic must be carefully monitored to decrease potential wear and soil compaction problems. The easiest methods to control traffic problems are:
 - **Rotate traffic patterns** by planned movement of cup and tee markers.
 - **Distribute cart and foot traffic** over wide areas.
 - **Use cart paths** where traffic is highly concentrated.
 - **Institute a 90° rule.**
 - **Where chronic wear problems exist, employ an architect** in long-range planning for more than one way on and off playing areas.

- **Tree Management**—Trees play a strategic role in golf course design and are a valuable asset in the golf course landscape. However, tree placement should be carefully considered since shaded areas can often result in turfgrass that is weakened and more vulnerable to disease. In order to prevent shading problems:
 - **Increase light penetration** through the tree canopy by selectively thinning the crown and pruning lower tree limbs.
 - **Enhance air movement** in pocketed areas by judicious removal of shrubs and trees in the avenue of prevailing winds.
 - **Root prune trees** along fairways and greens that are competing excessively with the turfgrass for water and nutrients.

Regular scouting
is critical to a
successful IPM
program.

Scouting and Monitoring

An essential part of an IPM program is developing and maintaining a regular monitoring routine to collect information about pest activity occurring on your golf course. Regular monitoring provides an excellent record of active insect, weed, and disease populations; any resulting damage; and also provides follow-up information on the success of particular control measures.

When you spot a problem, ask: *What is the problem? Why is it occurring? Has the threshold for pest numbers or damage been exceeded? Is intervention necessary? What is the best method of control?* Over time, you'll get to know what pests occur when and where and identify "hot spots" that indicate when trouble is brewing.

The following actions are critical for developing a successful scouting program:

- **Determine who will monitor**—Monitoring can be done by a golf course employee who has formalized training in field identification of weeds, diseases, and insects and a thorough understanding of pests. This person must be a good observer, reliable, and able to communicate his or her findings. Though this person may have other duties to perform as a golf course employee, his or her primary responsibility is the IPM monitoring program.
- **Determine monitoring frequency**—Monitoring frequency varies for each portion of the golf course, depending on available time and operating budget. The greens and tees usually require the greatest attention and initially should be monitored daily or every other day. Fairways and roughs may be monitored less frequently if labor and time are a concern. The time spent monitoring will be reduced significantly once indicator areas, or "hot spots," for particular pests are identified. Such spots can be marked on golf course maps for future reference in scouting or treatment. Early morning monitoring is preferred, as disease symptoms and signs are most conspicuous prior to mowing and this time interferes least with play.
- **Keep records**—Keep accurate records when you scout your property. Scouting records can be used to find trends, help with early detection of problems, and make pest control decisions. Include the date, weather conditions, any problems observed, the method of treatment, and results. This will allow you to track season-to-season trends and modify treatment solutions as needed. (See the appendix for a sample scouting record.)

Setting Threshold Levels

Threshold setting is a necessary part of an IPM approach. Thresholds encourage the use of chemicals only when necessary—they are *action levels* that provide a tangible basis for pest management decisions. Most plants can tolerate some degree of damage from insects and disease. As part of your IPM plan, you'll need to determine what level of pest activity or damage you and the plant can tolerate before taking action (e.g., six to 10 white grubs found per square foot of

turf, five to 10 sod webworms per square foot). This will largely depend on your landscape, the type of pest or disease, the value of the area, the recuperative capacity of the turf, and your personal comfort level. The goal of corrective measures used is to bring the disease or insect below the threshold, not necessarily eliminate it. Audubon International staff, the USGA Turf Advisory Service, or your local Cooperative Extension service can provide you with additional information on setting threshold levels and can refer you to local experts to help you.

Identifying the Problem and Choosing Control Strategies

There are a variety of control strategies available and IPM involves evaluating various options in light of the specific pest problem at hand. In order to choose the best course of action, it is important to correctly identify the pest or disease.

- **Pest Forecasting Techniques and Equipment**—In addition to keeping reference books on hand to help you identify pests, many tools are now available to aid in forecasting potential problems on the golf course. Some examples include:
 - **Weather stations** help to monitor potential weather conditions that are conducive to disease development.
 - **Diagnostic kits** provide rapid, on-site tests for disease detection and monitoring pathogen levels.
 - **New computer forecasting models** aid in disease, insect, and weed management applications.
 - **Degree days** aid in generating a specific calendar of events for the stage of development of insect and weed activity.
- **Pest Management Measures**—Depending on the specific pest problem, time of year, and various environmental conditions, you may choose cultural, biological, chemical control, or a combination of these management measures. In some cases, a *wait and see* approach is warranted.

Cultural practices, such as those listed previously, often can be used effectively to address underlying conditions that cause disease, weed, or insect pests to reach problem levels. Raising the mowing height, altering irrigation, or improving soil health may adequately address certain problems.

Biological controls regulate pests by introducing natural enemies to the turf environment to combat turf pathogens. Some biological products are currently available for turf and research shows that the potential of such products is bright, at least for certain pests.

When chemical treatments are needed to control turf insects and diseases, choose the correct treatment for the specific problem. In some cases, spot treatments will be all that is needed to control a problem. Proper timing is essential for chemicals to work effectively given the life cycle of many insects and diseases.

Evaluating Results and Keeping Records

Keeping legible, regular records is crucial to a successful IPM program. Documentation is an important tool for recording the history of pest problems, cultural practices, weather, and the results of any action. Set up a clear, concise method of recording all pest information to which all staff involved with scouting can contribute. We recommend keeping three types of records:

- **Field data sheets**—These sheets serve as a tool to record what, where, and how many pests are present during scouting. This should include basic information, such as the scout's name, scouted location (a map works best), weather, and basic observations of turf growth and health.
- **Control information**—Similar to field data sheets, control information should include the date, control method used, pesticide application information (as needed), expected results, proposed date for scouting the area again, and summary of control method effectiveness.
- **Weekly summaries**—The results from the field data should be compiled on a weekly basis. The location of incidents and population of each type of disease, insect, or weed should be recorded. These weekly summaries can serve as a valuable reference for the course, helping you to detect trends and make sound management decisions.

When BMPs are followed, chemical use is more effective, limited, and safer.

Best Management Practices

Best Management Practices (BMPs) allow chemicals to be used with minimal impact on human and environmental health. BMPs always involve employing proper precautions before using a chemical and minimizing the amount of chemical used. When BMPs are followed, chemical use is more effective, limited, and safer.

Selecting a Treatment Approach

There are two main approaches to applying chemicals on the golf course: curative and preventive. Which strategy you choose depends on the type of pest or disease and the likelihood of its occurrence. By employing a comprehensive IPM program, many golf courses have moved away from using preventive treatments. A primarily curative approach, with preventive treatments only for those diseases that are more effectively controlled before an outbreak, has proven to be an effective management strategy.

- **Curative**—When chemicals are applied on a curative basis, they are used only to solve current pest problems. This approach often allows a golf course to reduce the amount of chemicals being used, since only damaged areas are sprayed. This limits the amount of chemical resistance any organism will acquire and limits the effect on non-target species. When using a curative approach to pest management, it is important to monitor the health of each playing surface, as well as conditions that favor the spread of disease. When damage

Preventive or Curative?

When making the decision to apply chemicals on a preventive basis, ask yourself the following questions:

- Can I realistically control this pest on a curative basis?
- Does previous experience tell me that the pest will get out of hand if it is not dealt with ahead of time?
- How much damage will the pest cause if it shows up on the course?
- What is the preventive chemicals' level of toxicity for this pest?
- What is the curative chemicals' level of toxicity for this pest?
- What effects will spraying preventively have?
- Will spraying preventively realistically reduce the amount of chemicals that are used?
- What are the pesticide's characteristics?

threshold levels are exceeded or weather conditions favor disease spread, the superintendent must take action to control further pest damage.

- **Preventive**—Applying chemicals on a preventive basis may be needed to control certain types of turf diseases and pest problems. For certain diseases, preventive treatment may reduce the amount of overall pesticides needed or the toxicity of products used on a course. When applying chemicals preventively, areas that have no current pest problems and *may not develop* problems are sprayed. Such broadcast spraying of chemicals not only increases the likelihood of chemical resistance, but also can harm non-target species. Chemical resistance may result in the use of more toxic pesticide products later. However, if spraying preventively will stop an outbreak or reduce the need for more hazardous chemical usage, it may be the preferred treatment option. Sites receiving preventive treatments would likely have a history of pest occurrence or exhibit conditions favorable for pest development.

Safely Storing and Applying Chemicals

When buying, storing, or using pesticides, there are a variety of BMPs that help golf courses minimize risks. We recommend that golf courses employ all of the following strategies:

- **Buy only what you need**—This minimizes the amount of chemical products that need to be stored, avoids waste, and increases the likelihood that each chemical application will be evaluated carefully.
- **Use older products first**—This will allow your inventory to be kept current and effective.
- **Train employees**—Training ensures the application of pesticides in the appropriate way. Pesticides must be applied by a trained, licensed applicator or as directed by law.
- **Apply pesticides only where and when needed**—When threshold levels have been exceeded and pesticide use is warranted, select a pesticide that provides the most effective control, while presenting the least possible hazard to people, wildlife, and the environment.
- **Maintain sprayers**—A properly maintained and calibrated sprayer with the proper nozzle will ensure the right amount of product is applied.
- **Apply chemicals under proper conditions**—Apply pesticides under appropriate weather conditions. Rainy conditions may cause the pesticide to leach through the soil, thus reducing effectiveness and increasing contamination. Excessive heat may cause chemical volatilization, thereby rendering it ineffective. Windy conditions may cause the pesticide to spread via drift to adjacent areas and endanger non-target organisms. Using a covered boom reduces drift.
- **Follow label instructions**—*The label is the law.* Read, understand, and follow label instructions, since labels hold the key to appropriate chemical application. Labels must be prominently displayed on the container and kept in good condition at all times. Should a label be removed or defaced, make sure that the required information is immediately marked on the container. Superintendents with employees who speak Spanish or other languages should add label information in this language as well.
- **Maintain no-spray zones and buffer areas**—No-spray zones and buffer areas around water features and other environmentally sensitive areas minimize the potential for chemical runoff and drift. Be sure to communicate the precise location of buffer areas with seasonal and full-time employees. Hand pulling, mechanical removal, or occasional spot treatment of weeds can be highly effective in buffer areas.
- **Keep records**—Knowing the effectiveness of past field applications will help you determine the most effective control measures for various turf problems. Control measures used should be evaluated periodically to determine if the desired results are being achieved, and the control

plan should be adjusted if necessary. Diagnosing, evaluating, and controlling a turf pest problem follows a logical sequence. Each situation is unique and adjustments should be made to the overall program as circumstances change on the golf course.

- **Make *Material Safety Data Sheets* accessible**—Each material safety data sheet must be in English (although you may maintain copies in other languages as well) and must contain the name, address, and telephone number of the chemical manufacturer or someone who can provide additional information on the hazardous chemical and appropriate emergency procedures. It is best to keep these sheets in a binder in an area that is easily accessible.

The MSDS is your primary tool to determine the physical and health hazards, routes of entry, toxicity, and other information about each chemical in your workplace. Use the MSDS binder to analyze the hazards presented by each chemical in your workplace.

Communication and Education

In an industry where employee turnover is high and seasonal staff may have minimal education in golf maintenance, ongoing employee education is imperative. Regular training, combined with continuing education for senior employees, including state licensing, professional association training, and IPM certification, increase the likelihood that sound BMPs and IPM practices will be carried out. This not only reduces liability, it cultivates a dedicated, knowledgeable workforce. In addition, communicating about turf conditions and pest management strategies with the green committee, club manager, and club pro, as well as golfers themselves, can coordinate and assure support for needed maintenance activities.

Training Employees

A fundamental component of employee training is the Hazard Communication Program. The goal of this program is to ensure that employers and employees know about workplace hazards and how to protect themselves. This reduces the incidence of chemical source illness and injuries, as well as golf course liabilities. Employers must provide employees with effective information and training on hazardous chemicals in their work areas at the time of their initial assignment and whenever a new physical or health hazard is introduced into their work areas.

Chemical-specific information must always be available through labels and material safety data sheets. In addition, training should involve the following topics:

- **Methods and observations**—Practices that may be used to detect the presence or release of a hazardous chemical in the work area, such as monitoring conducted by the employer, continuous monitoring devices, and visual appearance or odor of hazardous chemicals.
- **Physical and health hazards**—Training need not be conducted on each specific chemical found in the workplace, but may be conducted by categories of hazard (*e.g.*, carcinogens, acutely toxic agents) that are, or may be, encountered by an employee during the course of his or her duties. Training should include potential risks to both people and the environment.
- **Measures employees can take to protect themselves**—This includes specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.
- **Details of the hazard communication program**—These are developed by the employer and include an explanation of the labeling system, the material safety data sheet, and how employees can obtain and use appropriate hazard information.

- **An overview of the IPM program**—For an IPM program to work effectively, employees must understand the basic tenets of IPM and learn ways to reduce pest and disease problems via sound golf course maintenance strategies. Common problems, such as grounds employees mowing buffer areas or damaging trees with mowers or string trimmers, can be avoided with careful training and supervision. Likewise, crewmembers are more likely to be attentive to turf problems when they understand the value of their efforts. Acknowledge employees for good maintenance practices.
- **Pest ID and Monitoring**—Monitoring and identification practices should be explained to key employees, so that they can help during their normal rounds. This will also give employees a sense of ownership in the IPM program. One easy way to reinforce training is to mount a poster of the different pests commonly found on your golf course in the maintenance facility. This will help employees become more familiar with the appearance of specific pests and allow them to inform you of a problem on a timely basis.

An employer has a responsibility to evaluate an employee's level of knowledge with regard to hazards in the workplace, the employee's familiarity with the safety standards, and the hazard communication program. Ultimately, responsibility for chemical safety rests with the employer.

Increasing Support Via Communication

All too often, golfers forget that the sport they love is played on living plants. Demands for fast greens and perfect conditions, combined with carelessness in repairing ball marks, divots, and cart use, undermine sound maintenance strategies. Communication is essential for educating course officials, committees, and golfers about the impact of golfer demands on environmentally sound golf course maintenance.

Educate course officials and golfers about IPM strategies and explain why they are being undertaken. The club newsletter is a good forum for addressing pertinent issues. Likewise, posting information regarding course conditions in the pro shop or locker rooms has proven an effective communication strategy for many superintendents. Informing officials of sound management techniques can help promote your stewardship activities. Letting golfers know you practice IPM helps them better understand and accept management decisions.

IPM and BMPs have been employed successfully at thousands of golf courses around the world. Following proper cultural practices, carrying through with a well conceived maintenance plan, and communicating with golfers and maintenance staff will ensure quality golf course conditions with the least impact on people and the environment.

Effective Communication Strategies

- Signs
- Newsletter articles
- Presentations to golfers, garden clubs, community groups
- One-on-one conversations
- Bulletin board messages
- Communication with the golf pro

The Maintenance Facility

One of the most important aspects in maintaining chemical safety on a golf course is the maintenance facility. Whether you are working out of a low budget, no frills facility or a high-end natural resource management center, basic standards apply. The facility should be orderly and clean and any potentially hazardous substances must be safely stored, handled, and disposed of.

Evaluate your facility and potential workplace hazards using the following checklists. Conduct a walk-through inspection, check records, and determine what chemicals and practices could pose threats to worker health or environmental quality. For instance, higher toxicity chemicals could be re-evaluated and possibly replaced with lower toxicity chemicals. Identify problem areas and develop a plan to eliminate them.

Environmentally responsible chemical storage and handling not only require good management, but also depend on the infrastructure available at the golf facility. When expensive repairs or upgrades are needed, consider the cost of liability against the cost of investment in safer facilities. Such arguments are often the most persuasive in gaining approval for capital expenses for a better maintenance facility.

Storage

If stored safely in a secure location, pesticides pose no danger to humans or the environment. With this in mind the following should be practiced:

- ☐ Pesticides should be stored away from fertilizers and in an area with proper ventilation.
- ☐ The chemical storage structure should be fire proof and have explosion proof lights.
- ☐ Pesticides should be kept dry and out of the way of activities that might knock over a container or rip open a bag.
- ☐ Liquid pesticides should be stored below dry pesticides.
- ☐ Pesticides should be stored on metal or plastic shelves.
- ☐ Storage of liquid pesticides in cold weather should be considered as you improve your pesticide storage practices. Usually, when a liquid pesticide freezes, the only risk is separation of the active ingredient from the solvents or emulsifiers. This can lead to crystallization of the pesticide. However, if the liquid expands upon freezing, the container holding the pesticide may crack or rupture. The simplest solution to this problem is to avoid having excess pesticides that require winter storage. Should winter storage be necessary, a well-designed storage facility is the best defense against accidental leakage due to ruptured containers.
- ☐ Spills should be planned for; if a spill does occur, an impermeable floor (such as concrete sealed with impenetrable paint or other sealant) should virtually eliminate any seepage of pesticides into the ground. Putting a curb around the floor will prevent pesticides from spreading to other areas, including the unprotected ground, and having a spill containment kit readily available will make cleaning the spill fast and easy.

Mix/Load Area

Ground water contamination can result even from small spills in the mixing and loading area. Small quantities spilled regularly in the same place can go unnoticed, but pesticides can build up in the soil and eventually reach ground water. Mixing and loading on an impermeable surface, such as concrete, makes it possible to contain and reuse most spilled pesticides.

The two best ways to improve pesticide mixing and loading are to build a mixing and loading pad or to better manage your existing mixing and loading site. If you do not have, or are not able to construct, a mixing and loading pad, here are a few suggestions for better managing your mixing and loading site:

- ☐ Avoid mixing and loading pesticides near your water source. One way to do this is to use a nurse tank to transport water to the mixing and loading site.

- ☐ Avoid mixing and loading on gravel driveways or other surfaces that allow spills to sink quickly through the soil. A clay surface is better than a sand surface.
- ☐ Any materials involved with spills need to be handled according to label instructions.
- ☐ Install a back-siphon prevention device on the well or hydrants. Never put the hose in the sprayer tank; always keep the hose well above the water line. Provide an air gap between the hose and the top of the sprayer tank.
- ☐ Always supervise sprayer filling. For restricted-use pesticides, a trained and certified applicator must supervise operations.
- ☐ Use rinse water for mixing subsequent loads of the same pesticide. Spray the last rinse load on the field.
- ☐ Report spills of any amount in streams or lakes. On soil or a pad, report concentrated spills greater than one quart; dilute solutions greater than five gallons. Report spills of smaller quantities if they may cause damage to surface or ground water because of the specific compound or spill location. Remove the spilled material and contaminated soil no matter what the quantity and dispose of it according to recommendations you receive when you report the spill.
- ☐ Have an emergency response plan for the site. Know where the runoff water will go, how to handle your particular pesticides, and who to call for help.
- ☐ Under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), rinsing empty pesticide containers is mandatory. Triple-rinse or pressure-rinse plastic, metal, and glass containers immediately after use, since residue can be difficult to remove after it dries. Pour rinse water into the spray tank. Puncture metal and plastic containers and store them in a covered barrel until you can take them to an approved public landfill or condition the plastic containers and take them, along with any metal and glass containers, to a container recycling location.

Note: The maintenance facility specifications in the following two sections are considered standard for environmentally responsible chemical storage and handling. Because they involve *infrastructure* standards, we strongly recommend them to all golf courses, but do not require them for certification in the ACSP for Golf Courses. Use the following information to audit your facility.

Fuel Storage Area

Ideally the fuel storage area should have the following features:

- ☐ An impermeable surface (*e.g.*, concrete with a sealant), with a lip to minimize leaching and contain spills;
- ☐ Above ground tanks to minimize the potential of subsurface contamination;
- ☐ A containment dike surrounding the tanks that will catch any spills;
- ☐ Sensors to detect any leaks in the gas tanks;
- ☐ A spill containment kit readily available to clean up any spills;
- ☐ A roof over the tanks to increase the longevity of the tanks.

Wash Pad

When evaluating your wash pad area, the following should be considered:

- ☐ Several air hoses attached to posts in proximity to the wash area can be used to remove excessive grass clippings prior to cleaning equipment.
- ☐ The pad should have triple screen baskets to prevent an excess of grass clippings from entering the drain.
- ☐ The wash pad should be made of concrete and sealed, so that the impermeable surface will prevent leaching of any contaminants.
- ☐ Pesticide equipment should not be washed off in this area. Ideally, pesticide equipment is washed in a closed system where rinse water can be reused.
- ☐ Wash water from this area should not be discharged to surface water either directly or through ditches, storm drains, or canals. Equipment wash water can contain soaps, fertilizer residues, solids, and lubricating oil residues, which can contaminate water sources.
- ☐ Wash water should be recycled with contaminating materials, such as grease, oil, and gasoline, filtered from this recycled water.
- ☐ If no recycling system is available, then wash water should drain into a grassed retention area or swale at least 25 feet wide, but again there should be no direct contact with a surface water body. Discharge to a septic system may be illegal in your area.
- ☐ A roof to cover the wash pad area keeps rain off the pad and prevents excessive water from going into the recycling storage tanks.

Self-Assessment Checklist

Minimizing the use of chemicals and safely storing, applying, and handling the chemicals you use will reduce actual and potential environmental contamination associated with chemical use. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- ☐ Comply with all local, state and OSHA regulations that apply to storage and handling of chemicals used on the property.
- ☐ Train all key maintenance staff in the basic tenets of integrated pest management, including: (1) scouting and monitoring; (2) selecting thresholds; (3) making decisions based on treatment options; (4) proper timing and spot treatment; (5) documenting and evaluating results.
- ☐ Train all key maintenance staff to recognize that chemical manufacturing, use, storage, and disposal may pose risks to human health and the environment.
- ☐ Train all key maintenance staff to understand that poor management practices may adversely impact worker health, on- and off-site water quality, local soil health, and wildlife species and their habitats.

Cultural Practices and IPM Techniques

- ☐ Maintain green, tee, and fairway mowing heights at levels that can be reasonably maintained on a day-to-day basis without continually stressing turf or maximizing chemical inputs.
- ☐ Inventory soil types for all playing surfaces and assess conditions such as soil structure, nutrient levels, organic content, compaction, and water infiltration.
- ☐ Work to improve soil health. This may include: amending organic content, aerating, and improving water infiltration. Work to cultivate a diverse, living biotic soil community (*i.e.*, encourage soil microorganisms).
- ☐ Strive to maximize turf health and minimize resource inputs by improving turf conditions.
- ☐ Plant more pest-resistant or stress-tolerant cultivars on playing surfaces and in landscaping. Select plant species/cultivars best suited for your location.
- ☐ Continually improve and manage plant materials for landscaped areas, gardens, and larger wildlife habitats to maximize health and minimize resource inputs.
- ☐ Designate and train scouts to monitor plant health and pest populations as part of the IPM program.
- ☐ Identify, record, and map turf “hot spots” where disease or insect outbreaks routinely occur first. Identify other problem areas where poor growing conditions often lead to problems.
- ☐ Use scouting forms to record the type, severity, location, and treatment of pest problems.
- ☐ Establish aesthetic and functional thresholds for *insects* for all managed areas to manage pest populations precisely and efficiently and reduce chemical inputs.

- ☐ Establish aesthetic and functional thresholds for *fungal diseases* for all managed areas to manage pest populations precisely and efficiently and reduce chemical inputs.
- ☐ Establish aesthetic and functional thresholds for *weeds* for all managed areas to precisely and efficiently manage pest populations and reduce chemical inputs.

Best Management Practices For Chemical Use

- ☐ Evaluate potential control measures, including alterations in cultural management, biological, physical, and mechanical controls, and chemical methods.
- ☐ Consider the environmental impact of pest control measures (*e.g.*, leaching and runoff potential, toxicity to non-target organisms, soil absorption capacity, pesticide persistence, water solubility, effects on soil microorganisms and non-target species).
- ☐ Actively work to change turf stresses, cultural practices, or other conditions to prevent or discourage recurrence of problems.
- ☐ Maintain records of treatments employed *and their effectiveness* and use them to guide future pest control decisions.
- ☐ Read and follow label directions when using chemical products.
- ☐ Maintain a current MSDS (Material Safety Data Sheet) for each chemical at the facility.
- ☐ Apply pesticides only when and where scouting indicates that pest threshold levels have been exceeded.
- ☐ Strive to treat problems at the proper time and under the proper weather conditions to maximize effectiveness and minimize harmful environmental impacts.
- ☐ Employ practices and use products that reduce the potential for contamination of ground and surface water (*e.g.*, spoon-feeding, slow-release products, selected natural organic products).
- ☐ Apply pesticides by a trained, licensed applicator or as directed by law.
- ☐ Establish “no spray zones” and buffer areas, particularly around water features and other environmentally sensitive areas. Communicate these areas via map or site tour to all staff that apply fertilizers or pesticides.

Communication and Education

- ☐ Regularly train and encourage continuing education for maintenance staff, including state licensing, professional association training, and IPM certification. *If applicable*, provide non-English speaking employees with training in their native languages.
- ☐ Communicate with employees and clientele regarding the IPM program to maintain a dialogue regarding thresholds, epidemics, and control measures in relation to environmental quality.
- ☐ Communicate with the green committee, club manager, and club pro, as appropriate, to coordinate and assure support for needed golf maintenance activities.

Maintenance Facility, Chemical Storage, and Wash Pad

- ☐ Chemical storage structure should be secure and well ventilated. Personnel access should be limited.
- ☐ 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.
- ☐ When cleaning and maintaining equipment, no direct contact of wash/waste water with surface water should occur.
- ☐ Properly store all chemicals. Store pesticides and fertilizers on plastic or metal shelving to keep them off the floor. Store liquid products *below* dry materials.
- ☐ Handle all pesticides over an impermeable surface. A spill containment kit should be readily available and spill containment procedures should be in place.

Additional Maintenance Facility Standards

The following maintenance facility specs are considered standard for environmentally responsible chemical storage and handling. Because they involve *infrastructure* standards, we strongly recommend them to all golf courses, but do not require them for certification in the ACSP for Golf Courses. Use this information to self-audit your maintenance facility, anticipate problems or liability areas, and address concerns.

- ☐ Fuel is stored on an impervious surface that has spill containment and a roof.
- ☐ Explosion proof lights are used in chemical storage and maintenance areas.
- ☐ Chemical storage structure is fire proof.
- ☐ Chemical storage area has a sealed metal or concrete floor, and spills are contained by a sump located near the middle of the floor, and a lip along the edges.
- ☐ A catch basin to collect grass clippings, grease, and oils is installed and maintained.
- ☐ Grass clippings are blown off equipment with compressed air instead of, or prior to, washing with water.

Chapter 4

Water Conservation



The Den, Bloomington, Illinois

Conserving water has a positive affect on water sources, such as creeks, ponds, lakes, and ground water. Daily monitoring of the irrigation system, combined with charting of water flow and pump performance are two ways staff at The Den maximize irrigation efficiency and conserve groundwater that feeds the course's irrigation pond.

“Water conservation is an integral part of our IPM program. My belief is that a lot of disease problems are created by overwatering. Like many of my other management strategies, we push the threshold on holding back water.”
—Kerry Satterwhite, CGCS

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FOCUS ON:

- Irrigation Equipment
- Turf Surfaces
- Landscaping
- Indoor Plumbing

Overview

The purpose of water conservation is to ensure adequate water supplies not only for irrigation, but also for the healthy ecological functioning of water bodies, such as rivers, streams, wetlands, lakes, and ponds.

Water consumption is a key environmental concern for golf courses across the country. Having a comprehensive water conservation program in place helps to show your course's commitment to judicious water use and environmental stewardship. This section reviews water saving strategies that you can employ as part of your ongoing maintenance routine. These practices will help you meet three key goals:

1. Identify water sources of the golf course and make a commitment to judicious water use.
2. Maintain irrigation equipment for maximum efficiency and minimal water waste.
3. Implement water conservation practices. Maintain soil and turf health that maximizes water absorption and minimizes water loss to evaporation and runoff.



The Woodlands of Van Buren Wayne, Michigan

More than 15 acres of naturalized areas at The Woodlands of Van Buren reduce the need for irrigation in non-play areas. Water management practices, such as checking irrigation system distribution, probing for soil moisture, and using wetting agents, also help the course conserve water.

Photo © Gregg Ross

Saucon Valley Country Club, Bethlehem, Pennsylvania

Regular inspection and maintenance is important for ensuring optimal irrigation system efficiency. By installing a new irrigation system and incorporating weather data into the irrigation schedule, Saucon Valley Country Club is minimizing its impact on Saucon Creek, its principal source of irrigation water.



General Knowledge

One of the greatest environmental concerns facing golf courses is their use of water. Though water use on golf courses varies widely depending on climate and other factors, an average golf course may use 10 to 30 million gallons of water per year, with substantially higher water use rates in the arid Southwest. Golf course superintendents also continually rank securing adequate irrigation water among their top concerns. Given recent droughts and erratic weather patterns throughout much of North America, adopting water conservation measures is essential for addressing public concerns, securing irrigation supplies, and saving this essential natural resource.

Golf course irrigation practices can positively or negatively impact local water supplies, including: the amount of surface runoff, plants and wildlife species that rely on local water sources, and groundwater recharge rates. Water conservation and water quality management are critical for ensuring adequate irrigation supplies, without taxing or degrading vital water sources. Developing a conservation ethic in yourself and your fellow employees is the cornerstone of a successful environmental management program.

Identifying Water Sources

Knowing about the quality and quantity of your primary water source and potential backup supplies is essential to golf course operations. An understanding of water resources can help you make sound irrigation decisions and help employees remain mindful of potential golf course impacts to water supplies.

Across the country increasing demand for water has led to stream and river impoundments, the drilling of more and deeper wells, and water withdrawals from most natural water bodies. The high demand for and overuse of water can degrade wildlife habitats and contribute to water pollution in various forms: altered stream flows due to surface withdrawals, saltwater intrusion due to excessive withdrawals, and polluted runoff that carries sediments, nutrients, salts, and other pollutants.

Be sure that you and other golf course employees know where your water comes from and are aware of local issues regarding water consumption. Seek alternatives to potable water sources, such as municipal sources or on-site wells, when possible.

Issues Related to Consumption of Various Water Sources

- **Public or municipal water supplies**—In many areas of the country, the use of potable water to irrigate recreational facilities, such as golf courses, is an issue since it is considered “non-essential.” Since a municipality must ensure sufficient water supplies for current and future public, commercial, industrial, and agricultural users, recreational users may receive low priority, especially during drought conditions.
- **Private wells**—Removing more water from aquifers than is replaced by natural processes is a significant concern for many areas of the country and can result in dry aquifers that no longer provide reliable water supplies.
- **Ponds and reservoirs**—Storage ponds that collect storm runoff water that might otherwise be lost are an excellent alternative irrigation supply. Diverting water from streams into ponds and reservoirs also can provide quality irrigation water while not drawing from municipal supplies or aquifers. Diverting surface waters for irrigation may, however, reduce the natural flows needed to retain good water quality and wildlife habitat in streams and negatively impact downstream properties.
- **Treated effluent**—Wastewater supplied from municipal sewage treatment facilities or private sewage treatment plants may be an excellent source of irrigation water. Golf course turf filters nutrients and breaks down various chemicals and biological contaminants in the water.

However, water quality testing, soil monitoring, and tissue analyses must be regularly conducted to regulate the nutritional needs of the turf and prevent buildup of salts and other chemicals in golf course soils.

- **Brackish water**—Brackish waters or even ocean water to supplement other water sources is now a possibility for some golf courses. Bermudagrass is quite tolerant and seashore paspalum is very tolerant of high salt content water. However, soil containing high amounts of clay or organic matter may limit its use. A state-of-the-art irrigation system must be used to allow precise application of salt water so as not to affect native plants in the surrounding landscape.
- **Recycled runoff water**—Water saved from other uses, such as water from air conditioners, showers, pools, or the maintenance facility wash rack area, should be analyzed for water quality prior to use. Making use of “gray water” can be a valuable part of a water conservation program.

Key Aspects of a Water Conservation Program

To save water, look for ways to:

- Install and maintain an efficient irrigation system;
- Apply water efficiently;
- Eliminate unnecessary water use;
- Maximize ground water infiltration;
- Minimize water loss from runoff, evaporation, and transpiration.

Adopting Water Conservation Measures

Using water at optimal efficiency can be achieved through a combination of equipment, operational, and behavioral changes.

- **Equipment Changes**—Installing or retrofitting permanent indoor plumbing fixtures or outdoor irrigation equipment can provide long-term reduction in water use (*e.g.*, low-flow toilets, toilet displacement devices, low-flow showerheads, faucet aerators and pressure reductions at the faucet; computer-controlled irrigation systems, more efficient systems, part-circle irrigation heads, weather stations, soaker hoses).

Note: Due to their expense, the ACSP does not mandate irrigation system upgrades for certification in Water Conservation. The program advocates that superintendents and their staff maximize the efficiency of the system that is in place, properly maintain equipment, and employ proper watering practices and agronomics. Such a combination of mechanical and behavioral practices promotes judicious use of water resources and can result in overall turf health and improved playability. If the irrigation system is clearly in need of replacement, the course should demonstrate its plans to replace the system within a reasonable timeframe.

- **Operational Changes**—The golf course superintendent and irrigation technicians must be trained to operate and maintain the irrigation system correctly. Such basic training helps to ensure sound decisions about irrigation practices and system maintenance.
- **Behavioral Changes**—Proper watering practices and turf care will help you maximize water absorption and minimize water loss to evaporation and runoff. You may be able to alter water use habits so that water is used more efficiently (*e.g.*, checking moisture levels and ET rates and applying water only as needed, improving drainage and soil structure to increase water infiltration, using air to clean equipment and surfaces before or instead of using water).

Properly Installing and Maintaining Irrigation Equipment

A well-designed, correctly installed, properly utilized automatic irrigation system provides the best means of conserving water. Water savings of 40% to 75% have been documented on golf courses that converted from a manual to a good automatic system. Regardless of the type of irrigation system available, it should be operating at peak efficiency.

Optimizing Efficiency

The following practices will help you optimize efficiency:

- Use modern technological improvements, such as computers and weather stations. Weather stations, weather reporting services, and other resources can help you determine accurate daily irrigation replacement needs.
- Analyze your irrigation system. Careful evaluation of sprinkler head design, nozzle selection, head spacing, pipe size, and pressure selection can help improve irrigation uniformity. A qualified irrigation system engineer can conduct such an analysis. Many courses also use services provided by The Center for Irrigation Technology (CIT), an independent research and testing facility based at California State University at Fresno. CIT assists designers, manufacturers, and users of irrigation equipment to incorporate technological advances that will conserve water. Information can be obtained from CIT, Cal State University at Fresno, 5370 N. Chestnut, Fresno, CA 93740; telephone (209) 278-2066; website www.cati.csufresno.edu/cit.
- Relocate heads to improve water distribution, where necessary.
- Use half-circle sprinklers where applicable.
- Regularly monitor the system to ensure that all heads are operating properly.
- Repair all leaks.
- Check nozzle size as it relates to available pressure and resulting coverage.
- Check for nozzle wear.
- Check pump performance and other pump house systems.
- Indoors, adjust flush valves or install dams on existing toilets or install ultra-low flow toilets. Install faucet aerators and high efficiency showerheads.

Keeping Records

Monitoring your use of water and tracking yearly trends can help you gauge the success of water conservation efforts. Track water use via municipal usage records, information from a fully automated irrigation system, or estimates of the number of gallons used per cycle and per week. Tally the number of gallons used monthly and yearly. Use these records to set realistic conservation targets, detect trends, plan for drought, and promote your successes.

**Audubon Cooperative
Sanctuary Program
members saved
an average of
1.9 million gallons
of water per year
per course due to
irrigation system
improvements and
water conservation
practices.
(Audubon
International
Managed Lands
Survey, 2001)**

Proper Watering Practices and Turf Care

Employing proper watering practices and sound agronomics will help you promote healthy turf and conserve water. Evaluate current irrigation practices and identify ways to eliminate waste and promote efficiency.

Setting Water Priorities

When embarking on a water conservation program, particularly when water use has been restricted, it is important to set priorities for which areas will receive most of the available water and which areas will receive deficit irrigation. Establish water priority areas and identify areas that require little or no use of supplemental irrigation. Most golf courses set priorities in the following order:

- Greens and collars
- Tees
- Approach areas
- Fairway landing zones
- Other fairway areas
- Roughs
- Out-of-play areas

At first glance, allowing lower priority areas to receive deficit irrigation may seem unacceptable to today's golfers, many of whom have become accustomed to lush green playing surfaces from border to border. However, returning to the game of golf of earlier days, where fairways, tees, and greens represented the only highly maintained areas of the course, saves water and has little effect on the game itself. For many courses, changing management practices to favor water conservation reestablishes the enjoyment of the original golf course design.

Practicing Proper Irrigation

Proper use of the irrigation system is one of the most important factors in conserving water. Fine-tuning irrigation practices and maintaining peak irrigation system efficiency can result in substantial savings. Employ the following practices to save water:

- **Water on a deep, infrequent basis**—Watering on a deep and infrequent basis in spring prepares plants to be better acclimated to the heat later in the season and to perform better under periods of heat stress. Recent research also affirms the positive benefit of deep and infrequent irrigation in terms of the amount of root produced and the depth roots will penetrate. Frequent watering tends to promote shallow rooting and shoot growth similar to applying too much nitrogen. Be mindful, however, that deep, infrequent watering doesn't necessarily mean letting turf wilt before irrigating. The key is to monitor the existing root system and maintain adequate soil moisture for good growth.
- **Prepare turf for hot, dry summer weather**—Preparing for summer usually requires that over-irrigation be avoided during the spring. Maintaining the root-zone in a wet or saturated condition inhibits the establishment of a deep, fibrous root system during the spring, and spells trouble for summer survival.
- **Use a soil probe**—Use a soil probe before irrigating to determine existing soil moisture conditions.

- **Water uniformly**—Apply water as uniformly as possible (variable soil conditions and plant needs will require customized application in some instances).
- **Water slowly**—Apply water only as fast as the soil can accept it. To avoid puddling and run off, use short, repeated cycles or cultivate the soil (core, slice, spike) to improve water infiltration.
- **Water at the correct time**—Irrigate when there is little wind and avoid mid-day irrigation during peak evaporation periods.
- **Hand water if necessary**—Hand water dry areas if it can prevent over watering adjacent areas.
- **Use drip irrigation**—Add drip irrigation for tree and shrub areas.
- **Reduce irrigated acreage**—Try naturalizing out-of-play areas that will not affect playability. Even small reductions in irrigated turf can add up to big savings over time. Reduce or eliminate regular irrigation for the driving range.

Using Weather Data

Having a weather station that includes evapotranspiration (ET) rates can improve the efficiency of your watering program tremendously. Having daily access to ET rates can allow you to control how much water to replace. Rather than irrigate at 100% of ET, many golf courses are successfully replacing only 50–60% of their ET water loss. Replacing ET rates at a low level prevents excessive runoff and over-watering and better prepares turf for periods of drought.

Weather data should also be used to determine whether watering should occur at all. If you know how much natural precipitation has occurred, you will have a better idea of how much water has been put into the soil. If rain is likely, turn off automatic irrigation.

Altering Cultural Programs

Good cultural practices are the cornerstone of a comprehensive water conservation program. Employing sound agronomics promotes an effective water cycle. When you maintain good turf cover and root depth, healthy soils, and ample drainage, water will be drawn down through the soil layers, absorbed by plants, and replenish ground water supplies.

Conversely, poor plant cover, shallow rooted turf, inadequate drainage, or poor soil structure result in greater water loss to runoff and evaporation. Instead of being drawn down through the soil layers, much of the water applied (or resulting from precipitation) is drawn back toward the surface or runs off before it can be absorbed. Such conditions result in a vicious cycle of frequent watering that promotes weak, shallow rooted turf incapable of withstanding drought.

The following strategies will help you maximize the effectiveness of the water you use:

- **Aerification**—Core aerate turf areas during the spring or at other appropriate times to relieve soil compaction, promote root growth, and improve water infiltration.
- **Other cultivation**—Spike or slice turf areas when weather permits throughout the season to maintain good water infiltration.
- **Wetting agents**—A wetting agent can be used during the spring, and at lighter rates during the summer, to assist in water infiltration through thatch and soil, improve soil water retention, and prevent dew formation.
- **Fertilization**—Use low to moderate rates of nitrogen fertilizer where possible. A lush, fast-growing turf requires more water and is more susceptible to injury from drought, traffic, and other stresses.

- **Diseases and insects**—Avoid significant turf damage from diseases and insects by using proper monitoring and control programs.
- **Weeds**—Apply herbicides in the spring (or fall in some areas) for weed control only if large numbers of weeds are present (broadleaf) or can be anticipated (crabgrass). If weeds are present in certain areas and spraying must be done, spot-treat the infested areas rather than making a blanket application.
- **Cutting height**—Raise the cutting height as much as possible to reduce mowing frequency on tees, fairways, and roughs.
- **Thatch management**—If excessive thatch is a problem, then thatch reduction measures (topdressing, aeration, spiking, slicing, verticutting) should be practiced on a regular basis to reduce the excessive accumulation. Wetting agents may help irrigation penetration.
- **Overseeding**—Though overseeding bermudagrass with a cool-season grass provides green color during winter months, it requires more irrigation than dormant turf. Consider reducing overseeding from wall-to-wall to tees and greens only. Another beneficial practice for overseeding bermudagrass turf is to refrain from overseeding every third or fourth year. In addition to decreasing water use, this practice promotes stronger turf.

On turf areas composed primarily of *Poa annua*, overseeding during late summer or early fall with a more drought tolerant grass species is often recommended. Turf areas that cannot be irrigated during the summer will likely require renovation during the fall.

Reducing Turf Stress

Avoid placing turf under unnecessary stress. A healthy, vigorous turf is more likely to survive a drought if other stress factors can be reduced.

- **Cart and foot traffic**—Distribute traffic across the turf as uniformly as possible. When possible, eliminate traffic on important play areas by keeping carts on cart paths, banning cart use on certain days or weeks during the season, using a 90-degree rule, and by carefully monitoring traffic.
- **Drainage**—Good drainage is a prerequisite to good turf. Turf in poorly drained areas is usually shallow-rooted and weak.
- **Weeds, insects, diseases**—Reduce competition and injury from weeds, insects, and diseases by monitoring turf areas and following an integrated pest management plan.
- **Trees**—Trees can weaken turf by reducing air circulation, creating excessive shade, and competing with turf for available moisture and nutrients. Improve sunlight penetration and air circulation by thinning lower branches or removing trees when needed. Root prune near tees and greens to reduce competition for moisture in these areas.

Preparing For Drought

The most effective drought management plan is to implement water conservation measures in advance of a drought and on a long-term basis. Planning for drought before one strikes will allow you to mitigate its effects and reduce damage. Being prepared, coordinating conservation measures among staff of various departments of the golf course (grounds, clubhouse, resort amenities, etc.), and implementing a variety of conservation measures will go a long way toward mitigating the effects of drought. In addition to the information in this section, contact your local water management district or refer to these websites to better manage during drought conditions:

USGA: www.usga.org/green/index.htm

GCSAA: www.gcsaa.org/resource/drought.html

EPA Office of Water: www.epa.gov/owm/drouhome.htm

National Drought Mitigation Center: www.enso.unl.edu/ndmc/

Choosing Appropriate Turfgrass

A key component in water conservation is selecting turfgrass species and cultivars that are appropriate for your climate and soils. Ongoing university turfgrass breeding programs work towards developing better-adapted turfgrass cultivars. The USGA currently supports research in developing turfgrass species and cultivars that require less water and maintenance inputs. Evaluate water requirements when selecting turf for overseeding or new course construction. Where possible, incorporate drought tolerant turfgrasses and use native species that provide reasonable turf quality under minimal irrigation.

- Several improved cultivars of buffalograss (*Buchloe dactyloides*), a native of the American Great Plains, have been developed by turfgrasses breeders at the University of Nebraska. This grass can replace high water use grasses on fairways and roughs in a large geographic area of the Midwest, resulting in water savings of 50% or more.
- Improved cold-tolerant, seeded-type Bermuda grass (*Cynodon dactylon*) cultivars have been developed by breeders at Oklahoma State University, allowing this stress-tolerant, low water use grass to be established in the transition zone as a replacement for high water use cool season grasses. Water savings of 30% to 50% or more can be realized.
- Turfgrass breeders at the University of Georgia have developed improved cultivars of seashore paspalum (*Paspalum vaginatum*). This extremely salt-tolerant grass can be irrigated with high-salt or brackish waters with little effect on turf quality. Cultivars are available for greens, tees, fairways, and roughs.
- Certain cool season turfgrasses, such as tall fescue and perennial ryegrass, have higher water use rates than Kentucky bluegrass, but they also possess beneficial plant characteristics, such as a deep root system, that help them survive drought or minimal irrigation.

Selecting turfgrasses that require less irrigation varies from region to region and depends on a wide variety of factors. Consult your USGA regional agronomist for lists of the best turfgrass species and cultivars for your area.

Expanding the Use of Drought Tolerant Plants and Mulch

When considering choices for landscape trees, shrubs, and flowers, look for plants that tolerate low moisture conditions. Though annual flowers give a prominent burst of color throughout the growing season, use them sparingly, since they require near daily watering. Instead, select native perennials that can thrive with little supplemental irrigation. Native trees and shrubs also will be better adapted to your site, especially in areas of poor soils or drought conditions.

Incorporating mulches into landscape and garden beds will help conserve water and eliminate weeds. Mulches, such as shredded cedar or pine bark, cocoa mulch, crushed stone, and landscape fabric, reduce water demand by lowering surface temperatures, improving water infiltration, and reducing water lost to evaporation.

Self-Assessment Checklist

Judicious water use is key to a comprehensive environmental management program. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- ☐ Train employees to conserve water and make water conservation a priority in your management approach.
- ☐ Identify the water sources used for irrigation and drinking water.
- ☐ Know how to operate and manage the irrigation system correctly.

Water Conservation:

Irrigation Equipment and Plumbing Fixtures

- ☐ Irrigation system should be properly designed, correctly installed, and performance should be tested.
- ☐ Check irrigation system for proper water distribution in all irrigated areas at least once per year.
- ☐ Eliminate all non-target watering (*e.g.*, sidewalks, ponds, habitat areas).
- ☐ Check all irrigation equipment daily, and maintain the system on a regular schedule.
- ☐ Fix leaks in a timely manner.
- ☐ Regularly maintain the pump station so that it is working efficiently.
- ☐ Upgrade irrigation system, or components of the system (*e.g.*, valves, sprinkler heads, nozzles, computer software), to reduce inefficiency and malfunction and reduce water use.
- ☐ Install part-circle irrigation heads where possible to save water.

Water Conservation:

Watering Practices and Turf Care

- ☐ Incorporate evapotranspiration rates or weather data into daily irrigation decisions.
- ☐ Avoid running the irrigation system at peak evapotranspiration times.
- ☐ Water “hot spots” to target needed areas only, rather than running the entire irrigation system during the peak of the day.
- ☐ Work to maintain an effective water cycle to maximize water absorption and reduce runoff and evaporation, including: maintaining soil cover, improving soil structure, adding or maintaining natural organic matter in the soil, and improving drainage to minimize runoff and maximize water penetration through soil layers.
- ☐ Reduce or eliminate irrigation on all unused or minimally used portions of the property.
- ☐ Monitor daily water use, tally monthly usage, and set targets for yearly improvement.
- ☐ Select turfgrasses on greens, tees, and fairways that are appropriate for local climate and growing conditions.

Chapter 5

Water Quality Management



Gaillardia Golf and Country Club, Oklahoma City, Oklahoma

The goal of Water Quality Management is to ensure that course maintenance practices don't jeopardize water quality in water sources, such as ponds, lakes, wetlands, and streams.

“At Gaillardia Golf and Country Club, we planted aquatic plant species around all our water features and allowed our native grasses to grow right up to the lake's edge. We minimize nutrient loading from runoff through the use of organic and slow-release fertilizers.”

—Brian Peterson, Golf Course Superintendent

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FOCUS ON:

- Water features—
lakes, ponds,
streams,
wetlands
- Irrigation water
sources
- Maintenance
facility

Overview

Ensuring clean water supplies and protecting the health and integrity of water bodies, such as oceans, rivers, streams, wetlands, lakes, and ponds, is an essential component of showing your commitment to environmental stewardship.

Water quality has long been a critical environmental issue for the golf course industry. Governmental agencies, environmental organizations, and the general public continue to raise concerns about the impacts of golf course chemical use on the water quality of lakes, streams, and groundwater.

Recent research on nutrient fate, chemical leaching and runoff, and the impacts of chemical use on aquatic organisms has played a key role in helping the golf industry to address these concerns. Research results translate into practical information to help golf courses monitor and minimize their impacts on water quality.

Still, many golf course superintendents find water quality management one of the most challenging aspects of their jobs. Managing water sources for golf, wildlife, aesthetics, irrigation, and overall water quality is not easy. Success depends on having a basic understanding of the factors that influence water quality and incorporating Best Management Practices (BMPs) as part of an environmental management program.

Information in this chapter will help you to meet the following goals:

1. Improve your general knowledge regarding your local watershed and pollution prevention strategies.
2. Employ best management practices or structural controls near all water bodies to eliminate the potential for chemical runoff, nutrient loading, and drift.
3. Monitor the health of all water features to detect possible movement of nutrient and chemical inputs into water sources and correct problems as needed.



The Sugarloaf Golf Club, Kingfield, Maine

The Sugarloaf Golf Club is nestled among the wooded mountains of western Maine. The Class A Carrabassett River flows through 7 holes of the 18-hole course, and represents the primary water quality consideration for Superintendent Ed Michaud. Understanding how water moves onto and off of the golf course helps managers plan appropriate water quality management strategies.

Hindman Park Golf Course, Little Rock, Arkansas

A variety of Best Management Practices help to ensure good water quality. At Hindman Park Golf Course, fountains improve the oxygen content of water features, reducing algae concentrations and improving fish habitat.



Woodway Country Club, Darien, Connecticut

Monitoring the health of water features is a valuable tool for detecting possible movement of nutrient and chemical inputs. Superintendent Larry Pakkala at Woodway Country Club teamed up with Peggy Minnis, Ph.D., an environmental researcher at Pace University, and Sound Waters, an environmental education program for inner city students, to test water quality of the Noroton River, which flows through the golf course.

General Knowledge

Properly managed water resources provide good quality irrigation water, aesthetically pleasing ponds and streams, appropriate storm water treatment, and no offsite surface or ground water pollution problems. In addition, good water quality provides habitat for a variety of plants and animals that can add beauty and enjoyment to your course.

In contrast, poorly managed water sources can cause significant problems. For example, poor quality irrigation water may severely injure greens, while pond algal blooms can cause aesthetic and odor problems. Improper use of chemicals can damage aquatic organisms and degrade water quality.

Understanding on-site water resources, as well as local and regional influences affecting water quality, is the first step in developing a management plan that is right for your course.

Identifying Your Watershed

Ponds, streams, creeks—in fact, all water bodies—are inseparably linked to their watersheds. A watershed is the *entire area of land* that drains into a specific river or river system. Water drains from the highest elevations within the watershed to the lowest, contributing to a particular stream, river, or lake. Sometimes called a *drainage basin*, a river's regional watershed includes the many smaller local watersheds of the creeks, feeder streams, lakes, and wetlands that drain into it.

To figure out what watershed your course is located in, use a map of your local area and locate the nearest water body—lake, stream, river, or estuary—into which water from your property drains. If it is a stream or river, trace it back to its source and then follow it to its final destination—the major river or other water body into which it drains. Note land uses and any smaller feeder streams that enter it along the way. The name of the watershed is generally taken from the name of the major stream, river, or lake into which water flows.

Because water is always moving, what happens in one area can impact water quality in other parts of the watershed. Golf courses must be mindful of five primary impacts to water quality as a result of their operations:

1. Discharges of chemical pollutants via leaching, drift, or runoff from chemical applications and storage, equipment maintenance, grass clippings, and parking areas;
2. Sedimentation due to eroding shorelines;
3. Thermal pollution—water temperature increases due to lack of shade when tree cover is removed along stream margins;
4. Impacts associated with excessive water withdrawals, such as low water levels and increased temperatures in ponds or streams, altered habitats for aquatic organisms, and inability of the water body to dilute or flush pollutants adequately.
5. Oxygen depletion due to excessive growth of algae, often caused by nutrient loading from spring fertilizer applications.

As you begin planning effective water management strategies, try to answer the following questions:

- How does water enter your property: rain, snowmelt, stream, wetland, springs?
- What neighboring sites drain onto your property?
- What's the quality of the water as it enters?
- What is the lowest point or points where water settles?
- Does it pick up any contaminants because of your land use practices?
- Where does water go when it leaves the property?
- Does water quality improve, decline, or stay the same as it moves off your course?

Because water is always moving, what happens in one area can impact water quality in other parts of the watershed.

The more you can prevent problems from occurring, the easier, less costly, and more effective your water quality protection program will be.

Your answers will help you evaluate golf course impacts on water quality and consider your local watershed when planning water quality management strategies.

Make water quality protection a maintenance priority. Key maintenance staff—superintendent, assistant superintendent, crew foreman, irrigation technician, chemical spray technician—should be able to identify the local watershed in which the golf course is located and know where wastewater and runoff go after leaving the property. Key maintenance staff also need to be aware of water quality issues and potential impacts from golf operations.

Best Management Practices

Employing Best Management Practices (BMPs) as a routine part of golf course maintenance operations is an essential way to protect surface and ground water. BMPs minimize the potential for chemical runoff, nutrient loading, and drift. Protecting water quality using BMPs includes a three-fold approach:

1. **Preventive measures and structural controls** constitute the building blocks of a watershed protection program for surface and ground water quality and quantity at a golf course. The more you can prevent problems from occurring, the easier, less costly, and more effective your water quality protection program will be. Preventive controls include land use planning, integrated pest management, and source reduction to eliminate or minimize contamination in a watershed. For example, proper siting and care of equipment and chemicals at the maintenance facility can help you eliminate pollution problems.
2. **Control measures** are BMPs that protect water quality through removal, filtration, detention, or rerouting of potential contaminants before they enter surface or ground waters. Structural controls are more costly since they involve capital improvements. Many courses use a combination of prevention practices and structural controls to manage surface water effectively.
3. **Detection** involves an environmental monitoring program that provides feedback to the superintendent about water quality conditions and movement of materials, such as sediments, nutrients, and other chemicals.

One way to think about your water management program is as a “BMPs train” in which the individual BMPs are linked together as the cars of the train. In most cases, the more cars on the train—the more BMPs incorporated into the system—the better the performance of your “treatment train.” The first cars might include BMPs to minimize generation of runoff and pollutants and the final car might include filtration through a buffer or retention in a pond. This section outlines a variety of preventive strategies and control measures that you may employ to prevent or address water quality problems.

Controlling Erosion

Erosion is the loss of soil due to water, wind, or gravity. Erosion is most commonly found along the banks of water bodies or along steep slopes. Several problems are associated with erosion:

- Poor aesthetics;
- Loss of soil;
- Potential mud slides once erosion has started;
- Decreased clarity in water bodies;
- Altered habitat for fish and other aquatic organisms;
- Increased nutrient input.

Once erosion starts, the problem tends to escalate. Banks or slopes become even less stable, thus causing more problems. To minimize erosion, shorelines and steep slopes must remain vegetated so that plant roots can hold the soil in place. This can be done by leaving existing shoreline plants or by replanting areas where vegetation has been removed. If erosion has already occurred, you may need to stabilize the eroded area before you can revegetate it. Fiber logs and stone riprap can be effective means of stabilizing a shoreline, but stone is far less beneficial to wildlife and provides no supplemental filtering value.

Eliminating Chemical Runoff and Drift

The ways chemicals are applied can have a significant influence on how they impact water quality. The following practices can greatly decrease the chances of chemicals coming into contact with water bodies.

- **No-Spray Zones**—Designating a zone around water features in which no chemicals are used eliminates runoff and drift from the immediate surrounding area. Ideally, a no-spray zone should be about 25-feet wide, but this width may need to vary depending upon slope, location, and relation to in-play areas. Pulling weeds by hand has proven to be an effective strategy for many golf courses for minimizing weeds in no-spray zones. Spot treatment may be employed occasionally to control the spread of noxious weeds.
- **Limited-Spray Zones**—Designating an additional 25-foot zone around water features in which limited chemicals are used further reduces the probability of runoff and drift. A limited-spray zone frames the no-spray zone and, combined, provides a 50-foot zone of protection. (Actual width may need to vary depending upon slope, location, and relation to in-play areas.)
- **Spoon Feeding**—Applying small amounts of the turf's nutritional requirements in more frequent applications is an effective strategy for minimizing runoff and ensuring that the fertilizer applied is taken up by the turf.
- **Fertigation**—Applying fertilizers through the irrigation water offers two distinct advantages. First, fertigation tends to be more economical by reducing maintenance costs and reducing the amount of product that is applied. Second, fertigation offers better control of when, where, and how fertilizers are applied.
- **Slow-Release Fertilizers**—There are many different types of slow-release fertilizers that can be used. These products have less potential for leaching.

Designate a zone around water features in which no chemicals will be used to eliminate runoff and drift from the immediate surrounding area.

Developing Vegetated Buffers

A vegetated buffer is an area around the edge of a water body specifically maintained with plants that will reduce storm water flow and potential pollution from runoff. A buffer may be made up primarily of turfgrass, or include a combination of grasses, herbaceous (non-woody) plants, and shrubs. The plants in a vegetated buffer take in nutrients, trap sediments, reduce erosion, and slow down water as it moves from the land into a pond, lake, or stream.

One type of effective vegetated buffer, often referred to as a *vegetated filter strip*, is turfgrass mown at a height of three inches, or as high as possible for the particular turfgrass species. In research trials, such filter strips, maintained at widths between 15 feet and 30 feet, reduced nutrient runoff from adjacent areas by 90 to 99%, respectively. Sediment removal rates are generally greater than 70%.

In the field, the best height, width, and overall size of a vegetated buffer depend on several factors: slope, type of vegetation, playability, and potential pollution from maintenance practices, including chemical applications.

Many golf courses are able to maintain a full buffer all the way around a pond or stream bank. For sites where this is not feasible, golf courses combine partial vegetated buffers with specialized management zones, such as no spray zones or limited spray zones that may involve spot treatment of disease and weed problems. The use of slow release or natural organic fertilizers or spoon-feeding also reduces the potential for chemical runoff into water sources.

Using Settling Ponds and Detention Ponds

BMPs that use settling and filtering processes are relatively effective at removing sediment and pollutants that are bound to sediment particles. The effectiveness of pollution removal strategies is a function of three interrelated factors:

- The removal mechanisms used (which include physical, chemical, and biological processes);
- The percentage of runoff treated;
- The nature of the pollutant being removed.

Ponds and infiltration BMPs can achieve 60 to 100 percent removal efficiencies for sediment. Infiltration BMPs are capable of similar removal efficiencies for sediment, but are subject to clogging if sediment inputs are excessive.

Wet ponds and extended-detention ponds with shallow marshes have a moderate to high capability for removing both soluble and particulate pollutants via settling and biological uptake. Construction of such structural controls requires on-site consultation. Seek out expert advice to find out more about the appropriateness of such a project for your course.

Properly Storing, Handling, and Disposing of Chemicals

One of the easiest ways to reduce the potential of water pollution or leaching is to use BMPs in the maintenance facility. The following procedures should be followed:

- Maintenance equipment should be cleaned in a manner that does not allow chemicals to move into waterways. Installing a wash pad with a filtering or recycling system is the preferred method for minimizing chemical rinsate with surface and ground water (refer to the *Chemical Use Reduction and Safety* section for more information). Pesticide rigs may also be cleaned directly on turf in areas that require the chemical that is being cleaned out. The area in which the rig is cleaned should rotate frequently.
- Chemicals should be stored in a safe manner (refer to the *Chemical Use Reduction and Safety* section for more information).
- Spill containment should be guaranteed throughout all areas of the maintenance facility, especially in the mix/load area and the fueling station. Emergency protocols should be in place and well understood by all employees. It is important that all employees understand the health, safety, and environmental risks posed by the chemicals they handle.
- Containers that hold chemicals either for storage purposes or spill containment purposes should be dealt with in a manner that eliminates the risk of on-site or off-site contamination of water bodies. Proper disposal of hazardous wastes is imperative.

Reducing Thermal Pollution

When tree cover is removed along stream margins, the increased exposure to the sun causes water temperatures to rise. Cold-water fish, such as trout, and other aquatic organisms are adversely impacted by such changes in water temperature. When modifying or renovating a golf course, avoid clearing wooded streams. Leave large trees and shoreline plants where streams must come into play. Existing courses with exposed streams can add shoreline vegetation. Vegetated stream banks will not only shade the water, but have the added benefit of reducing erosion and filtering runoff.

Conserving Water

Efforts to conserve water play an important role in maintaining water quality. Excessive water withdrawals contribute to low water levels in streams, lakes, and ponds, which can decrease the ability of these water sources to dilute or flush pollutants adequately. Low water levels combined with increased temperatures in summer also may alter habitats for aquatic organisms. Likewise, excessive withdrawals from groundwater contribute to aquifer depletion and poor water quality, such as saline or hard water. In extreme cases, excessive water withdrawals from an aquifer can cause soils to contract and the land itself to sink. Refer to the *Water Conservation* section for information on maximizing the efficient use of water.

Reducing the Need for Chemical Inputs to Ponds

A combination of sunlight, warm temperatures, and phosphorous promote plant growth in ponds. Many golf courses have problems when surface water drains directly into water bodies, adding increased levels of nutrients and stimulating excessive growth of aquatic plants and algae. Not only is the resulting murky-green water unattractive, but too much algae depletes the oxygen in the water, which adversely affects fish and other aquatic organisms.

To create a balanced pond ecology, it is essential to eliminate nutrient loading to golf course ponds. A careful review of maintenance practices is a good place to start. A common culprit of pond problems is spring fertilization programs, since these nutrient applications coincide with warmer temperatures and increasing sunlight. A combination of all of the measures listed below will produce the best results for managing healthy ponds for golfers and wildlife.

- **Vegetated Buffers**—As discussed above, vegetated buffers help to absorb nutrients and slow runoff prior to entering water bodies.
- **Emergent and Floating Plants**—Emergent and floating plants, such as water lilies, can be installed to shade the water surface, thus reducing sunlight and water temperature. A single mature water lily can cover an area of eight square feet or more, and small-leaved species can be used in small pools. Planting overhanging vegetation along pond margins can have the same effect. (Refer to the *Appendix* for aquatic plant lists.)
- **Aerators**—The amount of oxygen in the water can be increased by using oxygenating plants or by installing fountains, waterfalls, or cascades to aerate the water. This promotes healthy fish populations, which will feed on algae and insect larvae and help control mosquitoes.
- **Filters**—Pond filters rid the water of algae and debris, thus promoting a cleaner pond environment.

STANDARD AQUATIC NUISANCE PLANT CONTROL METHODS

METHOD	DESCRIPTION
Prevention	Eliminate nutrient loading. Install aerators to increase water movement and oxygen.
Physical Removal	Hand harvest aquatic vegetation by pulling, rolling, cutting, or digging.
Mechanical Removal	Use specialized mechanical equipment to cut and harvest aquatic weeds.
Environmental Controls	
• Bottom barriers	Made of plastic, rubber, or fiberglass, these can be used to inhibit or prevent rooted growth in selected areas.
• Shading	Use of black plastic, soluble dyes, or artificial structures will inhibit or shade out aquatic plant growth. Trees can be used to permanently shade certain areas.
• Drawdown	Periodic lowering of water levels will expose bottom sediments; can control some weeds by desiccating (drying out) or freezing.
• Dredging	Remove existing rooted plants and nutrient rich sediments to reduce nutrient accumulations and create greater water depth to control aquatic growth.
Biological Controls	
• Fish	Grass carp or white amur can be introduced in certain areas to eat plant material.
• Insects	Adults or larvae of certain moths and weevils have been introduced to selectively eat plant populations. This method has been proven to control water hyacinth and alligator weed.
• Plant Diseases	Introduction of pathogens such as bacteria, viruses, fungi, and other microorganisms is a new approach that is working on many courses.
Chemical Controls	
	The use of chemicals is the most common and versatile management strategy for controlling nuisance aquatic plant populations. However, chemical management often treats the symptom and not the cause of weed and algae problems. Chemical controls should be used as a last resort and great care should be taken in their application.

Water Quality Monitoring

A water quality monitoring program is a valuable way of getting feedback about the effectiveness of your best management practices. Based on sound, scientific principles, the results can be a powerful tool to help you confirm and communicate that you are employing the correct management strategies. A water quality monitoring program serves three primary purposes:

1. Establishes a baseline of water and sediment quality;
2. Provides data that will establish environmental conditions, thus providing a basis for measuring compliance with environmental regulations and effectively communicating that your course is not having adverse impacts on water quality;
3. Ensures that your IPM program is functioning properly and that no negative impacts have developed.

There are two primary approaches to monitoring. Employing both will help you obtain information upon which to make adjustments in cultural programs and maintain environmental quality.

- **Visual Inspection**—Periodic observation will disclose changes or trends in water quality. As an integral part of the golf course IPM program, spot-checking for problems should be part of the scouting routine. An example of this type of monitoring is associated with an algal bloom. The course personnel constantly spot-check locations that are known problem areas.
- **Objective Monitoring and Data Collection**—Water quality tests conducted to measure dissolved oxygen, pH, nutrients, and other water quality indicators provide data for use in developing or confirming the results of on-going management programs.

Visual Inspection

A visual survey of water quality requires little or no equipment and takes a minimal amount of time. It simply involves surveying the conditions of a golf course water feature, looking at the water and surrounding land, and noting what you see. Despite its simplicity, it is an important aspect of environmental monitoring. By collecting information on a regular basis, you can develop a baseline of normal conditions and record changes over time.

When you visually monitor your water bodies, you should make sure to write down any abnormalities noted, as well as the date, time of day, previous and current weather conditions, previous chemical applications in the area, and any other changes that could be a possible cause of the abnormality.

This simple chart can be carried with you in the field or posted in a central location to provide essential information about water quality conditions that you see.

Objective Monitoring and Data Collection

Baseline water quality data for representative water bodies and water sources that may be affected by golf course management practices can be obtained by testing:

- **Physical characteristics**—Tests for dissolved oxygen, pH, temperature, and specific conductivity;
- **Nutrients**—Tests for nitrogen (nitrate and ammonia) and total phosphorus;
- **Macroinvertebrates**—surveys for aquatic organisms, where water enters and exits the property, to determine water quality in streams. (Contact Audubon International to obtain a guide to sampling for macroinvertebrates or check with your local water resources agency.)

VISUAL INSPECTION

If the water is...	It could be...	You should...
Green or blue-green	Nutrients released into the water causing an algae bloom	Check for possible fertilizer or manure run-off, sewage discharge or septic failure.
Orange-red	Acid drainage or the presence of synthetic dyes	Check for industrial waste or for landfill seepage draining into the water.
Grey/Black	Sewage or livestock waste	Check for sewage discharge or animal populations.
Light brown (muddy or cloudy)	Sediment deposition caused by erosion	Look for disturbed ground left open to rainfall (e.g., construction).
Yellow-brown to dark brown	Acids released from decaying plants. Also common in streams draining from a marsh or swamp	If it's not fall, search upstream for some foreign item in the water.
If you can smell...	It could be...	You should...
Rotten egg odor	A natural occurrence in swampy or marshy land or sewage pollution	Look for sewage or septic inputs.
Musky odor	Untreated sewage, livestock waste, algae or other conditions	Check your watershed for sewage/septic input and animal populations.
Chlorine	Over-chlorination of sewage input water or swimming pool discharge	Look for sewage input or a recently drained swimming pool.
Fishy Odor	Excess algal growth or presence of dead fish	Search for dead fish or look for cause of excess algae.
If you notice...	It could be...	You should...
Fish kill	Naturally occurring, (accompanies annual spawning) or toxic dumping/nutrient overloading	Check upstream for discharges or seepage; check fish lifecycle in your area. Check dissolved oxygen levels in the water. Depressed dissolved oxygen levels are the primary cause for fish kills.
Increase or decrease in wildlife sightings	Many reasons: habitat changes, water quality changes, natural population increases during breeding season or decreases after migration	Have any changes, such as construction or development, occurred since you last monitored? Note the time of year. Can this be correlated with breeding or migration?
Increase or decrease in water flow	Weather-related or possible obstruction or discharge into stream	Note weather conditions such as temperature and recent rainfall. Check upstream for blockage and/or discharge source.
If surface or bottom has...	It could be...	You should...
Yellow coating (bottom)	Sulfur or natural color	Check for industrial waste.
Multi-color reflection (surface)	Oil or a natural algae	Check for a petroleum smell. If so, look for road runoff or canisters of oil.
White cottony masses	"Sewage fungus"	Check for sewage or septic inputs.
White or cream-colored foam	A natural occurrence (cream-colored) or detergent or industrial waste	If higher than 3 inches and white, check for industrial or residential discharge.

- **Pesticides**—You may wish to test for pesticides used at the golf course. Consider testing for pesticides that are both mobile and toxic. Pick the three most mobile and toxic products and test for these. These pesticides will be a good indicator of the probability of movement for other pesticides as well.

The following information will help you understand the parameters involved in water quality testing and provide direction to assist you in getting started.

- **Testing Frequency**—When starting a water quality monitoring program, testing should be conducted four times per year during the first two years. It is important to sample during different seasons because the environment responds differently during each season. After setting a baseline, sampling twice a year is sufficient, unless problems arise. Problems may include algal blooms, fish kills, or wildlife that acts in a manner inconsistent with normal behavior. Once you have collected baseline data, you will have a starting point from which you can compare the quality of your water from year to year.
- **Sampling Locations**—To determine sample locations, survey the water bodies on the golf course. If there are only a few, you may choose to sample each. Golf courses with many water features may choose to sample representative ponds, as well as those with known problems. How many sample locations you choose is highly site dependent. Three or four sample locations are the minimum number required to assess water quality.

Sample the same locations over time. This will allow you to compare results and assess environmental conditions over time.

Potential Locations:

- Does water from wash pads or irrigation drain into water features or consistently soak into the ground in the same location? If so, these locations may be good candidates for sampling. If the answer to the latter part of the question is yes, you need to test ground-water. At no time should water from a wash pad enter a water feature.
- Inflow and outflow points on a stream are important locations because they indicate the quality of water coming onto and leaving the course.
- Effluent water quality should be measured before it reaches the surface water on the course so the impact of this water source can be accurately measured.
- **Conducting and Analyzing the Tests**—Determine whether you want to conduct tests yourself, contract with an independent lab, or partner with a local organization or cooperative extension.

Do-it-yourself—Several companies offer test kits and instructions. You should develop quality control and quality assurance protocols to make sure your samples are truly representative. Be sure that detection limits are above acceptable measurement levels. Check holding times and preservatives.

Contract laboratory—If you contract out your water monitoring, use a laboratory to analyze your samples that has a written quality assurance and quality control manual. The lab should be certified by the state to analyze the type of samples that you are requesting. In addition, it's useless to obtain a lot of numbers about water quality with no means to interpret them. Detection limits are critical to interpretation and should always be given with the results.

Working with local organizations—Because water quality testing requires some technical knowledge, you may wish to partner with your local cooperative extension service, a high school or college biology class, or independent lab to sample and analyze the water. If your area has a local watershed commission or non-profit environmental organization that

monitors water quality, it also may be a valuable resource for support and information. Consider working with other golf courses in your area to broaden the scope and share costs of monitoring.

- **Data Storage**—Storage of data should be determined in the beginning of the monitoring program. Storage should be both on a computer diskette and on paper. The computer storage allows you to easily analyze and use the data to help better manage the course.
- **Data Analysis**—Data analysis should be determined in the beginning of the monitoring program. The data should be organized in a way that allows you to determine any problems or trends. Graphing data or arranging them in a table can be very useful in determining environmental conditions over time and allowing comparisons with standards.
- **Criteria for Management Response**—It is vital to set up a management response if samples indicate a problem. Outline specific, step-by-step actions you will take if the results indicate that a non-pesticide or pesticide is increasing in the sample.
 1. **The cause of the increase must be established**—For example, if a sample indicates high phosphorus levels, it may indicate erosion, low dissolved oxygen levels, or nutrient loading. High nitrogen levels may indicate nutrient loading. Was fertilizer inadvertently broadcast directly into a water feature? Was fertilizer applied before a rain event?
 2. **Preventative action must be taken after the cause is established**—Action must be taken to reduce contaminant inputs. Examples of actions include:
 - Make sure that all staff know about and adhere to no-spray zones.
 - Establish no-spray zones around buffer zones in swales or around drainage that enters water features.
 - Change your maintenance practices (*e.g.*, timing of applications, wash pad design or maintenance, etc.).
 3. **Curative action must also be taken**—This will reduce the current level of the contaminant. For example, if there is too much phosphorus in a water feature, planting aquatic vegetation will help to use up nutrients and increase oxygen levels. Aerification will increase dissolved oxygen levels and thus help reduce phosphorus levels.
- **Sampling Parameters**—Parameters refer to the physical and chemical measurements that you will be testing for. Many different parameters can be analyzed in the water. The following parameters are highly recommended. If your water measurements are not within the acceptable range, you need to implement a planned management response to improve water quality.

Sampling Parameters for Water Quality Management

Parameter	Explanation and Importance of the Parameter	Acceptable Range	Possible Effects When Outside the Acceptable Range
Water Temperature	<ul style="list-style-type: none"> Determines the suitability of a water body to support aquatic life; fish species and other aquatic life require specific temperatures Effects the amount of oxygen dissolved in the water 	Varies from region to region. Establish the range of your water temperatures by measuring water temperatures over the year.	<ul style="list-style-type: none"> Lower temperature, greater dissolved oxygen Higher temperature, lower dissolved oxygen Too low or too high will result in a fish kill or damage to other aquatic life and perhaps the aquatic food web.
Dissolved Oxygen (DO)	<ul style="list-style-type: none"> Mandatory for aquatic life Dependent on temperature, time of day (photosynthesis will release oxygen during the day and respiration consumes it at night), and the amount of organic matter in the water (oxygen is essential for decomposition) 	6.0—13.0 mg/L	<ul style="list-style-type: none"> Below 4.0 mg/L can cause a fish kill Lower levels (generally below 2 mg/L) can result in anaerobic decomposition, which can release noxious gases, such as hydrogen sulfide, and degrade aesthetics.
pH	<ul style="list-style-type: none"> pH measures the level of hydrogen ions in the water and gives an indication as to what reactions are occurring pH of 7 is neutral pH above 7 is basic—the greater the pH, the more basic the water pH below 7 is acidic—the lower the pH, the more acidic the water 	6.5–8.5, unless you are in a naturally low pH area (e.g., a blackwater swamp)	<ul style="list-style-type: none"> pH outside of the acceptable range may disrupt natural chemical reactions, and cause changes in the naturally occurring biota and their food webs.
Alkalinity	<ul style="list-style-type: none"> Measure of the water's ability to neutralize, or buffer, inputs to water Geology of the underlying bedrock will affect alkalinity (e.g., lakes over limestone have a high alkalinity and therefore a constant pH, whereas lakes over granite are highly susceptible to acidic inputs) 	Depends on location	<ul style="list-style-type: none"> Low alkalinity will cause the water to have less buffering capacity and the water body may react by exhibiting greater fluctuations.
Conductivity	<ul style="list-style-type: none"> Measurement of the ability of water to conduct electricity Directly related to the amount of mineral salts (e.g., calcium chloride, potassium chloride, sodium hydroxide) present and the temperature of the water 	Depends on location	<ul style="list-style-type: none"> Outside the acceptable range can disrupt the natural physiology of aquatic life. In irrigation ponds, increased levels can cause excess corrosion of equipment.

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When reviewing the chart, keep in mind that:
 1 mg/L = 1 ppm (part per million)
 1 ug/L = 1 ppb (part per billion)

Sampling Parameters for Water Quality Management

Parameter	Explanation and Importance of the Parameter	Acceptable Range	Possible Effects When Outside the Acceptable Range
Visibility and Turbidity	<ul style="list-style-type: none"> Water clarity is measured with a secchi disc—the disc is lowered into the water and a measurement of the depth is taken when the secchi disk disappears Affected by phytoplankton (microscopic algae), suspended inorganic material, silt, and dissolved organic substances, as well as material from the watershed (e.g., sediment from runoff) These substances impart a color to the lake water and influence the amount of light that can pass through. Can also be affected by cloud cover, reflection from the bottom, presence of rooted aquatic vegetation, and wave action 	Should not exceed background	<ul style="list-style-type: none"> Decreased clarity implies more suspended solids, which may clog fish gills Reduced light penetration decreases algae's ability to produce food and oxygen. Decreased visibility can alter temperature (greater heat absorbance of particulates) and dissolved oxygen concentrations.
Macro-Nutrients	<ul style="list-style-type: none"> Aquatic plants, including rooted aquatics and algae have nutritional requirements: <ul style="list-style-type: none"> micronutrients: required in small quantities macronutrients: required in large amounts Available nutrients influence plant growth 	See specific nutrient levels	<ul style="list-style-type: none"> When nutrients are available in abundance (due to fertilization practices, erosion, sewage effluent, etc.) excessive aquatic plant and algae growth can result. An algal bloom may result from the increase in nutrients. Eutrophication is the term to describe changes in a lake caused by an increased rate of supply of plant nutrients, the resultant ecosystem response to increased plant production, and the changes in biota and the reductions in dissolved oxygen.
Nitrogen	<ul style="list-style-type: none"> Present in considerable concentrations as nitrogen gas in the atmosphere Nitrogen gas is not readily available to plants and most algae. Nitrogen is fixed from the atmosphere by nitrogen fixing bacteria, including blue green algae (which are actually bacteria). 	Range varies widely based on water body; see below for specifics	<ul style="list-style-type: none"> Nitrogen is a major nutrient that affects the productivity of fresh water. In coastal waters, nitrogen is often the critical limiting nutrient in eutrophication. Whereas, in freshwater, phosphorus is the limiting nutrient. Nitrogen exists in many different forms in aquatic systems: dissolved molecular (N₂), ammonia nitrogen (NH₄⁺), nitrate (NO₂⁻), nitrate (NO₃⁻), and a large number of organic compounds. Typical ranges for total nitrogen in waters is from 0.3 to 2 mg/l.
Nitrite/Nitrate Nitrogen	<ul style="list-style-type: none"> Common form of nitrogen measured in lakes and ponds Nitrites are quickly converted to nitrates Occurs in low concentrations in natural, undisturbed environments Common reason for excessive concentrations is over fertilization in areas that drain into water bodies 	Highly variable, but a goal of < 0.5 mg/L	<ul style="list-style-type: none"> Nitrate is the common form of inorganic nitrogen entering water fresh waters from the drainage basin. Too much nitrite can cause blood diseases in fish; in humans, concentrations greater than 10mg/l in drinking water may cause health problems in infants.

When reviewing the chart, keep in mind that:
1 mg/L = 1 ppm (part per million)
1 ug/L = 1 ppb (part per billion)

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Sampling Parameters for Water Quality Management

Parameter	Explanation and Importance of the Parameter	Acceptable Range	Possible Effects When Outside the Acceptable Range
Ammonia Nitrogen	<ul style="list-style-type: none"> • Naturally present in surface waters • Toxicity of this nutrient is based on temperature and pH, as these increase, the toxicity increases 	Generally low	<ul style="list-style-type: none"> • Ammonia concentrations are generally low because of plant assimilation. • Ammonia may be toxic to biota. This is a pH dependent relationship, with toxicity increasing with pH. In waters above pH 8, ammonia toxicity may be a concern.
Total Phosphorous	<ul style="list-style-type: none"> • Total phosphorous includes all chemical forms of phosphorous found in water body • Phosphorous is found in limited quantities naturally • Sources of phosphorous are weathering rocks, decayed plant material, precipitation, sewage, and fertilizers • Phosphorous can attach to bottom sediments and remain there only to be reintroduced into the water column by 1) bottom organisms stirring or burrowing the sediment, water currents, or wind; or 2) depletion of dissolved oxygen at the bottom of the water body allows phosphorous to re-enter the water column. 	Goal is < 0.02 mg/l Most freshwater is between 0.01 and 0.05 mg/l	<ul style="list-style-type: none"> • Phosphorous plays a major role in biological metabolism, is frequently the least abundant nutrient, and commonly, is the first element to limit plant production. • Most high phosphorous levels result from inputs to the water body (e.g., from fertilization, sewage treatment plants, or street runoff.) • It is prudent to keep phosphorous out of water bodies, rather than trying to remove it once it has entered the water.

When reviewing the chart, keep in mind that:

1 mg/L = 1 ppm (part per million)

1 ug/L = 1 ppb (part per billion)

Self-Assessment Checklist

Your efforts to ensure good water quality will keep water supplies clean and protect the health and integrity of water bodies, such as oceans, rivers, streams, wetlands, lakes, and ponds. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- ☐ Protecting water quality both on and off the golf course is a management priority. All key maintenance staff should be trained regarding water quality concerns and priority given to pollution prevention.
- ☐ All key maintenance staff (*e.g.*, superintendent, assistant superintendent, crew foreman, irrigation technician, chemical spray technician) should be able to identify the specific *watershed* in which the property is located.
- ☐ All key maintenance staff should be able to identify where wastewater and runoff go after leaving the property.

Best Management Practices (BMPs)

- ☐ Eliminate/mitigate erosion to water bodies such as streams, lakes, and ponds.
- ☐ Employ more environmentally sensitive plant management techniques within 25-feet of all water bodies to minimize nutrient and chemical inputs.
- ☐ Eliminate potential chemical runoff and drift near all water bodies by designating no-spray zones, using spot treatments, or increasing thresholds for pest problems.
- ☐ Where shorelines are in play, raise the mowing height along the water's edge to slow and filter runoff.
- ☐ Reduce the potential for nutrient loading to water bodies, such as streams, lakes, and ponds, by employing BMPs such as: using slow-release fertilizers, spoon-feeding, filtering drainage through vegetated or mechanical filters prior to entering water bodies, etc.
- ☐ Maintain and clean maintenance equipment in a manner that eliminates the potential for on-site or off-site contamination of water bodies.
- ☐ Store all chemicals in a manner that eliminates the potential for on-site or off-site contamination of water bodies. Proper spill containment should be in place.
- ☐ Mix and load pesticides in an area that guarantees spill containment.
- ☐ Handle and apply fertilizers, pesticides, and other chemicals in a manner that eliminates potential on-site or off-site contamination of water bodies.
- ☐ Dispose of all chemical containers and all waste materials in a manner that eliminates the potential for on-site or off-site contamination of water bodies.
- ☐ Reduce/eliminate the need for chemical algae control in ponds through proper aeration, nutrient reduction, bio-filters, vegetation management, or bio-controls.

- ☐ When aquatic weed management is required, first seek a physical solution (*e.g.*, hand removal of plants), and then seek the least toxic method of chemical weed control. Address any underlying causes of the problem.

Water Quality Management: Monitoring

- ☐ Visually monitor water bodies for water quality problems, such as erosion, algae, aquatic weed growth, fish kills, and sediment buildup, as part of regular IPM scouting activities.
- ☐ Report water quality problems immediately to supervisors and, if required, regulatory agencies for appropriate action.
- ☐ Establish baseline data for representative water bodies and water sources that may be adversely affected by golf course operations. Testing practices include:
 - A. Physical characteristics: tests for dissolved oxygen, pH, temperature, and specific conductivity.
 - B. Nutrients—test for nitrogen (nitrate and ammonia) and total phosphorus.
 - C. Macroinvertebrates—survey for aquatic organisms, particularly where water enters and exits the property, to determine water quality in streams.
 - D. Conduct baseline tests 4x/year for at least a year.
 - E. Re-test water sources at least one time per year, or sooner if problems occur.
- ☐ Keep written records of monitoring activities, results, and control measures taken if needed.

Chapter 6

Outreach and Education



Aspen Glen Club, Carbondale, Colorado

Member and public awareness, education, and involvement build a broad base of support for environmental stewardship on the golf course. At the Aspen Glen Club, Superintendent Richard Eide invited a local Boy Scout troop to build and mount nest boxes throughout the course.

“By speaking to community groups, writing articles for local newspapers, and working with local organizations like the Boy Scouts, we can get our message out to the public.”
—Richard Eide, CGCS

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FOCUS ON:

- Golfers
- Management team/committees
- Employees
- Neighbors
- Local Community

Overview

The purpose of Outreach and Education is to ensure ongoing support for stewardship initiatives, strengthen local community connections, and extend participation in environmental conservation activities.

When you invest in environmental improvement projects at your golf course, it's wise also to invest in outreach and education activities to help build support and ensure the long-term success of your efforts. Outreach and education are designed to help you accomplish three primary goals:

1. Improve your ability to communicate your commitment to environmental stewardship and implement conservation activities.
2. Educate patrons, staff, decision makers, and community members about programs and projects on the golf course that improve environmental quality.
3. Provide opportunities for people to be involved in environmental projects on the golf course.

This section provides information to help you focus your efforts, increase participation, build support, and generate positive publicity for your environmental stewardship efforts.



Glendoveer Golf Course, Portland, Oregon

Signs, such as this one at Glendoveer Golf Course, effectively communicate a message of good stewardship to golf course patrons and guests.



Legacy Hills Golf Club at Sun City Georgetown, Georgetown, TX

Many golf courses invite local experts or community residents to participate in project planning or implementation. Volunteers can lead nature walks, conduct wildlife surveys, test water quality, or take photographs for displays and publications. A nature club at the Sun City Georgetown Community Association tours the nature trails and documents and photographs wildlife at Legacy Hills Golf Club.



Victoria National Golf Club, Newburgh, Indiana

Victoria National Golf Club worked with the Warrick County school system to help elementary school students develop wildlife and butterfly gardens on school properties. Adopting schools or partnering with local organizations, like 4-H or scouts, are ways to reach out to the community and send a message that your course cares about the environment.

General Knowledge

Golf course managers across North America have long expressed a desire for the general public, as well as their members, to understand what it really takes to manage a golf course. Faced with negative stereotypes about golf courses as polluters of the environment, superintendents also need to find ways to communicate their commitment to good stewardship and help people appreciate the value that a well-managed golf course can provide for wildlife and the environment. Implementing outreach and education projects can help you achieve these important goals.

The Benefits of Reaching Out

Communicating with golfers and the public about your environmental efforts can help you:

- Gain recognition and support for your management efforts.
- Increase golfer understanding of wildlife and environmental quality on the golf course.
- Let the public know that environmentally managed golf courses can be valuable community resources—whether or not the public ever gets to step on the course.

Forming a Resource Advisory Group is a good first step in creating a successful outreach and education program. Resource Advisory Groups can be made up of fellow employees, golfers, and even people outside the golf course who can provide technical expertise. The primary role of resource people is to aid the superintendent in communicating a commitment to environmental stewardship and implementing conservation activities.

Facing Concerns

Reaching out to public golfers, members, guests, and the local community is not always easy. Superintendents from private clubs are often concerned about keeping a low profile, while public course managers often feel their golfers are too transient to care about what's happening beyond the greens. Both may be reluctant to invite more oversight or input from golfers or the public. Most of all, taking that first step—picking up the phone and reaching out—is often the hardest obstacle to overcome.

All of these concerns have been successfully dealt with by golf course managers. Outreach and education can take many forms and you can choose projects that are best suited to your course. By taking one step at a time, you can build support and effectively communicate your environmental management strategies.

Identifying Support

The first logical step is to designate at least one staff person or Resource Advisory Group member who will take primary responsibility for communicating your environmental goals, objectives, and projects to patrons, staff, decision makers, and community members. This person may be the superintendent, manager, pro, or someone in a respected position who can comfortably communicate with a variety of people.

Start by contacting golfers at your course. Inform them of your involvement in conservation projects and invite their participation. A newsletter article or announcement on the bulletin board requesting help from individuals to assist with projects, such as wildlife surveys, nest box construction, or monitoring, may result in more positive responses than you may think.

Faced with negative stereotypes about golf courses as polluters of the environment, superintendents need to find ways to communicate their commitment to good stewardship.

Achieving public input doesn't mean you have to have an open house for your community or base decisions on what your neighbors want.

Prepare a list of organizations, agencies, and people from the community who might be interested in helping with conservation projects on the course. This list could include a local schoolteacher, scout leader, or garden or bird club member. For larger projects, consider college interns, local Fish and Wildlife agency personnel, Cooperative Extension agents, or members of your town conservation committee or local board. Some people may be interested in helping with specific projects, while others may be willing to get involved in all aspects of project implementation and communication.

Remember, achieving public input doesn't mean you have to have an open house for your community or base decisions on what your neighbors want. Think of "the public" as members of the local community who can help you with publicity, habitat enhancement, water monitoring, native plant selection, or other environmental projects.

(For more information about forming a resource advisory group, see the Environmental Planning section of this guide.)

Education

There are many ways to let people know about your commitment to conservation. Education projects can inform people about your efforts or teach people how they can support environmental practices. Try one or more of these ideas. All have been successfully implemented on a number of golf courses.

Creating a Display

Creating a display in your clubhouse can help to educate members about wildlife species, natural areas, water conservation, and IPM. The purpose of a display is to promote the positive efforts you have undertaken to maintain a high degree of environmental quality at your course. The following information will help you set up an attractive display in your clubhouse or pro-shop—a display that draws people's interest and encourages their support.

Step 1: Choose the best style and format for your clubhouse or pro-shop.

Before deciding *what* you want to include in your display, determine *how* information would be best presented. The display could be *formal* or *informal*; you may want to design it in such a way that you can periodically change information, or simply create a permanent display. Determine what style and format will best suit your needs.

Step 2: Determine how you want to present information.

There are many ways to present information about your environmental efforts. The display could be instructional, interactive, or simply a collection of artwork or photographs of the wildlife and natural features on your course. An instructional display might describe the Audubon Cooperative Sanctuary Program, explain the needs of wildlife, or tell how the golf course is maintained. For a more interactive presentation, invite participation in creating a wildlife inventory or present questions to test golfers' knowledge about the natural history of the course.

Step 3: Present information to encourage interest.

While there are many things you might want your display to say, remember that *pictures speak a thousand words*. Choose a combination of pictures and text for the best results.

We suspect that there are people at your course who would enjoy volunteering their time or expertise to help you create a display. Someone with knowledge of birds or wildlife may be interested in writing wildlife descriptions. Other members may be talented artists. Let people know of your plans and invite the help, talent, and suggestions of interested members.

Display Features

The following features could be incorporated into your display to create interest and inform people about your golf course sanctuary:

- Audubon Cooperative Sanctuary Program information and certificates
- Photographs or artwork
- Information about wildlife and habitats on the course
- Information about conservation projects
- Wildlife inventory
- List of Resource Advisory Group members
- Upcoming events and activities
- List of what golfers can do to support environmental stewardship on the course
- Map

Writing Newsletter Articles

Newsletter articles at your golf course are a natural. Start by letting people know that you have joined the ACSP and provide background information about the program drawn from our brochures, informational literature, or website. Promoting your stewardship efforts doesn't only include writing about wildlife or habitat management. Think about the various aspects of the ACSP and choose from this variety of topics for articles. Best management practices, water quality testing, dealing with problem wildlife, and water conservation measures are just a few topics to address. Feel free to use information from ACSP fact sheets or newsletters for your own newsletter.

Mounting Signs

Mounting signs is a simple way to educate the public about different projects you are doing. They also can be used to protect areas of special concern or to create a display garden. The primary objective of any sign is to communicate your message concisely to all who will see it.

Sample Statements for Educational Signs

- Natural Area
- This area is being (has been) naturalized to improve wildlife habitat and environmental quality.
- Environmentally Sensitive Area—*Please keep out.*
- Shoreline Naturalization
- Vegetative “buffers” provide important sources of food and cover for wildlife and improve the environmental quality of ponds.
- (Course Name) is a proud member of the Audubon Cooperative Sanctuary Program.
- Critical Nesting Habitat—*Please keep out.*
- (Course Name) is committed to environmental quality.
- Wildflower Meadow: Once meadow flowers are established, we hope you'll enjoy the beauty and variety of native flowers and grasses in this area.

Developing an Educational Brochure

An educational brochure is an excellent way to inform people who use your site about your general environmental efforts or specific conservation projects. A brochure doesn't have to be elaborate, with fancy text, color, or graphics—though if you have the budget, you can certainly choose to go that route. A simple layout that is easy to read can be just as effective. It can even be produced on a home or office computer with little expense.

Step 1: Determine whom the brochure is geared for.

Before producing a brochure, determine the kinds of people who are likely to read it. If they have specific needs or concerns, you can address them right in the brochure.

Step 2: Figure out how the brochure will be distributed.

You also need to decide how to distribute the brochure. Is there a central location where it can be displayed? Do you want to mail the brochure to everyone who regularly uses your course? Keep in mind that without a good method for distribution, your brochure will be useless. In addition, consider how many copies you are likely to use. If you are having the brochure professionally printed, the price per copy generally decreases as the number of copies increases.

Step 3: Include basic information.

The brochure layout can follow a fairly standard format. Usually a three-fold brochure will be large enough to communicate your message. Your brochure should include the following components:

- **What**—Write a paragraph that describes your commitment to stewardship and your involvement in the ACSP. List the environmental aspects of the program that you will focus on. Use larger headlines to communicate key words or phrases, such as “Committed to Stewardship,” “Environmental Projects,” or “What golfers can do.”
- **Why**—Clearly and concisely state the benefits of good stewardship for golfers and your course. You may want to bullet this information to make each benefit stand out.
- **How**—You may want to include a section about how you will implement the ACSP or particular projects. Tell *how* golfers can help.
- **Who**—Describe who is involved. If you have formed a Resource Advisory Group, list each member's name.
- **For More Information**—Tell people whom they should contact with questions or to get involved. Make sure your address and phone number are included.

The best rule to follow in creating any educational brochure is to *keep it simple*. This allows the reader to understand the message. Another helpful hint is to gather other educational brochures you've received and look at them carefully. Ask yourself these questions: “*Why am I attracted to this brochure?*” or “*Why is this brochure hard to read and confusing?*” Learning from other's mistakes and successes will help you design a great educational piece.

Writing a Press Release

A press release is a useful vehicle for announcing your environmental plans or projects. Because it is designed to attract media and public attention, it must spark interest and conform to the style of layout and writing used by the media.

Though some news sources may publish your press release exactly as you wrote it, most will re-write the information to fit the style of their publications. They'll use the basic information you've provided, including quotes, but build a story around it. Therefore, one of your primary

goals is to spark interest in your subject. Secondly, you must be concise, while giving enough detail to explain your project.

Your press release must include the following information:

- Use letterhead stationery or type your organization's name and address at the top of the page.
- Include a contact name and telephone number.
- Type the words "PRESS RELEASE" and indicate when the information can be released, *i.e.*, "FOR IMMEDIATE RELEASE" or "MARCH 5, 2002".
- Include a short title to introduce the subject of the release.
- Begin your first paragraph with the CITY and STATE.
- Explain WHO, WHAT, WHY, WHEN, and WHERE in the first paragraph. If the newspaper were to print only this paragraph, it should say enough to tell the basic details of your story.
- Use quotes in the second and third paragraphs to spark interest and embellish the story.
- Keep the press release to 1 to 2 pages of double-spaced copy.
- Check your spelling, dates, and contact information carefully. There should be no mistakes in your release.
- End with the following notation: #####

Review the following sample to get ideas for writing a press release for your course.

When writing a press release, one of your primary goals is to spark interest in your subject.

SAMPLE PRESS RELEASE

Orion Golf Course
21 Fairway Drive, Toronto, Ontario L9Y 1T1, Telephone 617-212-7654

PRESS RELEASE

FOR IMMEDIATE RELEASE, 3/5/02
Contact: Mary Becker, 617-212-7654 ext. 12

Orion Golf Course Going Wild

TORONTO, ONT.—The Orion Golf Course will be going wild this spring. Employees of the eighteen-hole golf public facility plan to naturalize five acres of the manicured out-of-play areas with wildflowers and native grasses to diversify the landscape and increase wildlife habitat on the course.

"We couldn't be more excited about the project," stated Horticulturist Mary Becker. "We've seen so much growth and development in this area over the last four years and we want to do our part to give something back to the natural landscape." Indeed, Orion employees hope the meadow, which is designed to compliment existing woods on the property, becomes a refuge for butterflies and songbirds.

"We're aiming for a beautiful site that is attractive to both people and wildlife," Becker added. She envisions golfers and the public taking a stroll around the meadow, or enjoying the view of colorful flowers from the clubhouse windows.

The idea to create a meadow came about when Becker read about similar naturalization projects taking place at other golf course properties both in Canada and the U.S. Rather than maintain expansive turf throughout out-of-play areas, Becker rallied fellow employees to go wild and transform the site. A group of interested employees has been planning the meadow for the past few months and ground breaking is scheduled for April 1, 2002.

#####

Communicating with neighbors before making landscape changes improves dialog and reduces conflict.

Working Proactively With Neighbors

Working with neighboring homeowners may be essential to the success of your stewardship efforts—particularly if your course is part of a residential development. Many courses report that homeowners sometimes tamper with sensitive habitats, cut back natural buffers between their homes and the golf course to improve the view, or add trees or shrubs that are inconsistent with the ecological region of the property. Other courses struggle with homeowner complaints when a course attempts to naturalize in areas that border homes.

To address concerns effectively or avoid problems from the outset, it is critical to inform neighbors of landscape changes that may affect them and develop strategies for dealing with problems. By working together in a positive way, property managers and community association members or neighboring homeowners can find common goals and work to achieve them. Flexibility on both sides is often key.

If a homeowner association exists, introduce yourself and communicate your commitment to environmental stewardship. Let people know about management practices that protect water quality, minimize chemical use, or provide wildlife habitat. Make yourself available as a community resource.

Several golf courses have had success in appointing a *Design Review Committee* to assist homeowners with planning appropriate backyard landscape changes. Such a committee can set policy regarding the removal of any golf course buffer or sensitive habitat that would have an adverse impact on the environment or wildlife. This committee may also discuss homeowner issues and review proposed projects.

Golf courses bordered by property owners who have not formed an association may find it wise to communicate with individual landowners directly. This is especially important if changes in golf course maintenance will alter views or manicured aesthetics. A straightforward letter sent *before* naturalizing along property boundaries will be far more effective than a letter sent *after* homeowner complaints are registered.

Seven Steps to Minimizing Homeowner Impacts on Natural Areas in a Planned Unit Development

1. Appoint a project management team or *Design Review Committee* made up of a planning or development engineer, landscape coordinator, community manager, golf course manager, design review manager, or other qualified personnel.
2. Mail a formal policy letter outlining the guidelines for habitat maintenance or removal to residents and property managers. Ask several managers to sign the policy letter. Re-mail the letter each year.
3. Establish an approved vendor list for landscape maintenance.
4. Develop a recommended landscape plant list for trees, shrubs, and perennial flowers that are native to your site. Distribute the list to homeowners.
5. Promote a unified effort by informing all staff of your habitat maintenance policy.
6. Encourage residents to call for an appointment and make a drawing of their plan for habitat maintenance or removal before the committee meets with them.
7. Use the club or community newsletter to communicate the policy to residents.
8. Make no exceptions. Consider an appropriate penalty that may be applied for infractions against the policy.

Outreach and Involvement

Providing opportunities for people to be involved in environmental projects on the golf course can help to ensure an understanding of your stewardship activities. It also helps the golf course maintenance crew share the work of conservation activities, such as nest box monitoring, inventorying wildlife, or developing a display, which are often viewed as “non-essential” projects. Spreading the work and enjoyment among many people builds a broader base of support for conservation activities and best management practices.

Inviting Participation

Inviting participation in ACSP activities can begin when you form a Resource Advisory Group. This gives staff, patrons, decision makers, and community members an opportunity to become involved in planning and implementing stewardship projects right from the start. Some golf course superintendents designate all activities related to obtaining certification in the ACSP to someone from this group, such as the assistant superintendent. Others retain overall control and designate specific environmental components (*e.g.*, wildlife habitat management, water conservation, water quality management) to various members of the ACSP team or staff.

As we have stressed elsewhere in this guidebook, inviting participation from people *outside* the golf course builds positive community relations, while providing technical expertise or volunteer assistance with specific projects. There are many stewardship activities that can include an outreach component. By simply inviting patrons or their children or community members to participate, you will spread good will and communicate good stewardship.

Inviting participation from people outside the golf course builds positive community relations, while providing technical expertise or volunteer assistance with specific projects.

Choosing Outreach Projects

It goes without saying that every golf course is different, but this is especially true when it comes to choosing outreach activities that are best suited to each course. What works for one golf course may not be appropriate for another. Some courses may have greater flexibility in inviting community participation, while others may be bound by labor union contracts or club regulations that prohibit certain types of activities. Hence, the ACSP does not stipulate specific outreach projects that must be done to achieve certification. Instead, we recommend that courses choose *at least two* outreach projects to meet certification requirements.

Listed in this section are a variety of outreach activities that have been successful on a number of golf courses that participate in the ACSP. Your Resource Advisory Group can help determine which activities will be most appropriate for your course.

- **Request help with nest boxes**—As a good starter project in *Wildlife Habitat Management*, nest boxes may also serve as a catalyst for ACSP involvement. Here are a few suggestions:
 - Invite golfers to “adopt-a-box” by donating money for one or more boxes and agreeing to check and maintain them throughout the spring and summer.
 - Make a few extra birdhouses every year. Donate the boxes to golfers, schools, or the local cemetery association to stimulate interest in your stewardship activities.
 - Invite a local scout troop or Eagle Scout to make and monitor your nest boxes.
 - Sponsor a workshop for members’ children or resort guests to make nest boxes for the golf course. Extra boxes can be given away.
 - Place a few nest boxes within view of your property border. These boxes will subtly communicate a message that the course is concerned about local birds and wildlife.

- **Create a garden**—If you choose to create a garden for butterflies, hummingbirds, or songbirds, invite gardeners at your course to help with planting. A local school class, scout troop, or after school program may also like to help. You can expand garden activities to include a brief lesson about connections between plants and wildlife. Invite a local newspaper to visit on planting day to garner positive publicity.
- **Inventory Wildlife**—A great way to get people involved in inventorying wildlife is to provide wildlife inventory cards to golfers as they pick up their scorecards. You can even encourage people to fill out these cards by creating a raffle. Each filled out card can serve as one raffle ticket. Alternately, you can simply post a wildlife inventory list in the pro-shop or in locker rooms. Provide books on natural habitat, building nest boxes, butterflies, bird identification, or environmental issues as a service to your golfers. These can be checked out at the club or offered in a lounge area.
- **Create a nature guide**—Create a simple hole-by-hole environmental guide for golfers. At each stop, you can point out interesting natural features or environmental projects. This can include: native plants, nest boxes, unique trees, habitat areas, common wildlife, IPM practices, and water conservation measures.
- **Host nature walks**—Ask golfers who are knowledgeable about birds to host an early morning walk to look for birds and other wildlife species on the course. People who attend can add their sightings to the club's wildlife inventory. Providing refreshments is a nice way to conclude the walk.
- **Lead a golf course tour**—Very basic golf course tours have a great impact on public perception. A successful outing demonstrates goodwill and will spread by word of mouth. Consider hosting an outing once per year for members or regular golfers, or extend the invitation to specific golfing groups (*e.g.*, seniors, ladies), grade school children, young adults, biology clubs, scout groups, college students, local golf course superintendents, or even local media. Your tour should showcase various aspects of your stewardship efforts.
- **Use tournaments to showcase environmental aspects of the course**—If you are hosting a tournament, use the opportunity to educate people about the environmental quality of your course. For example, highlight your ACSP involvement through the media or put up a simple display to show some of the environmental projects you've undertaken. Create a media fact sheet that highlights stewardship accomplishments and key natural features of the course.
- **Teach good stewardship to golfers**—If your course offers golf lessons or has a junior golf program, include lessons on how golfers can support good environmental stewardship while they play. Repairing ball marks and divots are just the beginning of what golfers can do. Discuss how golfer demands for fast greens and perfect conditions can stress turf and pose risks to turf health and the environment. Encourage people to view natural areas as integral to the nature of the game and to respect wildlife and natural habitats on the property.
- **Offer a workshop**—A wonderful way to develop communication skills is to begin talking to small community groups. You might speak with a local school class, garden club, homeowner association, or superintendent association. Choose a topic you're comfortable with, such as tree and shrub care, integrated pest management, environmental quality on your golf course, or your involvement with the ACSP.
- **Encourage neighborly stewardship**—Write a letter to course neighbors to encourage participation in environmental stewardship activities in their own backyards. This may tie in well with nest box giveaways, providing garden or lawn care tips, or a seasonal golf course tour. When the golf course serves as a catalyst for such activities, it spreads the word regarding environmental stewardship and extends environmental quality improvements beyond the course itself.

Environmental Code of Ethics for Golfers

The American golf community is dedicated to preserving golf's treasured links to nature. We recognize our historic tradition of integrating the game with the natural heritage, character and challenges of the landscape on which it is played. As golfers, we accept our responsibility to ensure that golf courses are managed in harmony with the environment.

We commit to...

- Use and protect natural resources on the golf course in an environmentally responsible way.
- Foster wildlife and natural habitats in non-play areas of the golf course.
- Respect designated environmentally sensitive areas within the course.
- Support golf course management decisions that protect and enhance the environment.
- Encourage maintenance practices that promote healthy turf.
- Plan long-range conservation efforts on the golf course.
- Educate others about the benefits of environmentally responsible golf course management for the future of the game and the environment.

Adapted from "Environmental Principles for Golf Courses in the United States," March 1996, Golf & the Environment Summit, Pinehurst, N.C.

- **Host kids projects**—Get kids involved by making bird feeders or houses for the course or their own backyards, hosting a fishing derby, or leading a school tour. You can also get kids involved with planting gardens, creating nature guides, or tracking wildlife on the course in the winter. Getting kids involved in environmental activities pulls parents into the golf course for non-golf activities and helps people begin to see the property not just as a golf course, but as a community asset.
- **Sponsor a school**—Sponsor a local school in the Audubon Cooperative Sanctuary Program for Schools. This is a sure way to let the community know you care about the environment. You might also offer one field trip to your course as part of your involvement with the school. To receive a school program brochure, write or call Audubon International.

Self-Assessment Checklist

Outreach and education efforts will help ensure support for stewardship initiatives, strengthen local community connections, and extend participation in environmental conservation activities. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- ☐ Form a *Resource Advisory Group* to help plan and implement environmental projects and educational efforts on the golf course.
- ☐ Identify at least one staff member or *Resource Advisory Group* member who will take primary responsibility for communicating environmental goals, objectives, and projects to patrons, staff, decision makers, and community members.
- ☐ Contact at least one member of the local community or one community organization (not affiliated with the golf course) to participate in project planning or implementation. This person may provide advice, assist with projects or monitoring, or provide technical support.

Education

- ☐ Develop written materials to be made available to patrons that describe your involvement in the ACSP or highlight different stewardship projects taking place on the course (*e.g.*, brochures, regular newsletter articles, locker room signs, signs that highlight key habitats or projects, educational posters, letters to members, yardage books, e-mail newsletter, scorecards).
- ☐ Create a display that describes your involvement in the ACSP and highlights stewardship projects taking place on the course.
- ☐ Communicate with neighboring property owners/homeowner association or key community contacts to explain your involvement in the ACSP and various stewardship projects (*e.g.*, letters to neighbors, press releases; presentations at workshops, seminars, or committee meetings).

Outreach and Involvement

- ☐ Invite employees, patrons, and community members to be involved in your *Resource Advisory Group*.
- ☐ Invite employees, patrons, and community members to help with stewardship projects. Provide at least two of the following activities to encourage participation:
 - ☐ Mount or monitor nest boxes with golfer/community assistance.
 - ☐ Help with wildlife gardens or ecological restoration projects.
 - ☐ Inventory wildlife species.
 - ☐ Maintain or use a nature trail.
 - ☐ Provide a hole-by-hole guide to environmental stewardship.
 - ☐ Host wildlife walks on or around the golf course.
 - ☐ Host tours of the golf course for patrons and staff to showcase different stewardship projects.
 - ☐ Host tours of the golf course for various community groups to showcase different stewardship projects.
 - ☐ Host tournaments to support environmental stewardship projects.
 - ☐ Host workshops on stewardship projects or environmental issues.
 - ☐ Encourage patrons, staff, decision makers, and community members to join the ACSP for Backyards.
 - ☐ Sponsor a local school's involvement in the ACSP for Schools.
 - ☐ Other: *(You may have personalized projects that also meet this objective.)*

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Bird Inventory Checklist

Common Birds of North America

Though not a complete listing, this bird inventory checklist should help you get started on inventorying the birds you see.

Date _____ Location _____ Weather _____

Notes _____

Loons & Grebes

- ☐ Red-throated Loon
- ☐ Arctic Loon
- ☐ Pacific Loon
- ☐ Common Loon
- ☐ Yellow-billed Loon
- ☐ Least Grebe
- ☐ Pied-billed Grebe
- ☐ Horned Grebe
- ☐ Red-necked Grebe
- ☐ Eared Grebe
- ☐ Western Grebe
- ☐ Clark's Grebe

Ducklike Birds

- ☐ American White Pelican
- ☐ Brown Pelican
- ☐ Great Cormorant
- ☐ Double-crested Cormorant
- ☐ Neotropic Cormorant
- ☐ Pelagic Cormorant
- ☐ Red-faced Cormorant
- ☐ Anhinga
- ☐ Brown Noddy
- ☐ Black Noddy
- ☐ Black Skimmer
- ☐ Dovekie
- ☐ Common Murre
- ☐ Thick-billed Murre
- ☐ Razorbill
- ☐ Black Guillemot
- ☐ Pigeon Guillemot
- ☐ Marbled Murrelet
- ☐ Kittlitz's Murrelet
- ☐ Xantus's Murrelet
- ☐ Craveri's Murrelet
- ☐ Ancient Murrelet
- ☐ Cassin's Auklet
- ☐ Parakeet Auklet
- ☐ Least Auklet
- ☐ Whiskered Auklet
- ☐ Crested Auklet
- ☐ Rhinoceros Auklet
- ☐ Tufted Puffin
- ☐ Atlantic Puffin
- ☐ Horned Puffin

Waterfowl

- ☐ Fulvous Whistling-Duck
- ☐ Black-bellied Whistling-Duck
- ☐ Tundra Swan
- ☐ Trumpeter Swan
- ☐ Mute Swan
- ☐ Greater White-fronted Goose
- ☐ Snow Goose
- ☐ Ross's Goose

- ☐ Brant
- ☐ Canada Goose
- ☐ Muscovy Duck
- ☐ Wood Duck
- ☐ Green-winged Teal
- ☐ American Black Duck
- ☐ Mottled Duck
- ☐ Mallard
- ☐ Northern Pintail
- ☐ Blue-winged Teal
- ☐ Cinnamon Teal
- ☐ Northern Shoveler
- ☐ Gadwall
- ☐ Eurasian Wigeon
- ☐ American Wigeon
- ☐ Canvasback
- ☐ Redhead
- ☐ Ring-necked Duck
- ☐ Tufted Duck
- ☐ Greater Scaup
- ☐ Lesser Scaup
- ☐ Common Eider
- ☐ King Eider
- ☐ Spectacled Eider
- ☐ Harlequin Duck
- ☐ Oldsquaw
- ☐ Black Scoter
- ☐ Surf Scoter
- ☐ White-winged Scoter
- ☐ Common Goldeneye
- ☐ Barrow's Goldeneye
- ☐ Bufflehead
- ☐ Hooded Merganser
- ☐ Common Merganser
- ☐ Red-breasted Merganser
- ☐ Ruddy Duck
- ☐ Masked Duck

Seabirds

- ☐ Wandering Albatross
- ☐ Waved Albatross
- ☐ Short-tailed Albatross
- ☐ Black-footed Albatross
- ☐ Laysan Albatross
- ☐ Black-browed Albatross
- ☐ Northern Fulmar
- ☐ Black-capped Petrel
- ☐ Bulwer's Petrel
- ☐ Cory's Shearwater
- ☐ Pink-footed Shearwater
- ☐ Flesh-footed Shearwater
- ☐ Greater Shearwater
- ☐ Buller's Shearwater
- ☐ Sooty Shearwater
- ☐ Short-tailed Shearwater
- ☐ Manx Shearwater

- ☐ Black-vented Shearwater
- ☐ Audubon's Shearwater
- ☐ Wilson's Storm-Petrel
- ☐ Fork-tailed Storm-Petrel
- ☐ Leach's Storm-Petrel
- ☐ Ashy Storm-Petrel
- ☐ Band-rumped Storm-Petrel
- ☐ Black Storm-Petrel
- ☐ Least Storm-Petrel
- ☐ White-tailed Tropicbird
- ☐ Red-billed Tropicbird
- ☐ Masked Booby
- ☐ Blue-footed Booby
- ☐ Brown Booby
- ☐ Red-footed Booby
- ☐ Northern Gannet
- ☐ Magnificent Frigatebird
- ☐ Pomarine Jaeger
- ☐ Parasitic Jaeger
- ☐ Long-tailed Jaeger
- ☐ Great Skua
- ☐ South Polar Skua
- ☐ Black-legged Kittiwake
- ☐ Red-legged Kittiwake
- ☐ Gulls & Terns
- ☐ Laughing Gull
- ☐ Franklin's Gull
- ☐ Little Gull
- ☐ Black-headed Gull
- ☐ Bonaparte's Gull
- ☐ Heermann's Gull
- ☐ Mew Gull
- ☐ Ring-billed Gull
- ☐ California Gull
- ☐ Herring Gull
- ☐ Yellow-legged Gull
- ☐ Thayer's Gull
- ☐ Iceland Gull
- ☐ Lesser Black-backed Gull
- ☐ Slaty-backed Gull
- ☐ Yellow-footed Gull
- ☐ Western Gull
- ☐ Glaucous-winged Gull
- ☐ Glaucous Gull
- ☐ Great Black-backed Gull
- ☐ Ross's Gull
- ☐ Sabine's Gull
- ☐ Ivory Gull
- ☐ Gull-billed Tern
- ☐ Caspian Tern
- ☐ Royal Tern
- ☐ Elegant Tern
- ☐ Sandwich Tern
- ☐ Roseate Tern
- ☐ Common Tern
- ☐ Arctic Tern

- ☐ Forster's Tern
- ☐ Least Tern
- ☐ Aleutian Tern
- ☐ Bridled Tern
- ☐ Sooty Tern
- ☐ White-winged Tern
- ☐ Black Tern

Long-legged Wading Birds

- ☐ American Bittern
- ☐ Least Bittern
- ☐ Great Blue Heron
- ☐ Great Egret
- ☐ Little Egret
- ☐ Snowy Egret
- ☐ Little Blue Heron
- ☐ Tricolored Heron
- ☐ Reddish Egret
- ☐ Cattle Egret
- ☐ Green Heron
- ☐ Black-crowned Night-Heron
- ☐ Yellow-crowned Night-Heron
- ☐ White Ibis
- ☐ Scarlet Ibis
- ☐ Glossy Ibis
- ☐ White-faced Ibis
- ☐ Roseate Spoonbill
- ☐ Wood Stork
- ☐ Sandhill Crane
- ☐ Whooping Crane

Smaller Wading Birds

- ☐ Yellow Rail
- ☐ Black Rail
- ☐ Clapper Rail
- ☐ King Rail
- ☐ Virginia Rail
- ☐ Sora
- ☐ Purple Gallinule
- ☐ Common Moorhen
- ☐ American Coot
- ☐ Limpkin
- ☐ Black-bellied Plover
- ☐ American Golden-Plover
- ☐ Pacific Golden-Plover
- ☐ Mongolian Plover
- ☐ Snowy Plover
- ☐ Wilson's Plover
- ☐ Semipalmated Plover
- ☐ Piping Plover
- ☐ Killdeer
- ☐ Mountain Plover
- ☐ American Oystercatcher
- ☐ Black Oystercatcher
- ☐ Black-necked Stilt
- ☐ American Avocet
- ☐ Northern Jacana
- ☐ Greater Yellowlegs
- ☐ Lesser Yellowlegs
- ☐ Wood Sandpiper
- ☐ Solitary Sandpiper
- ☐ Willet
- ☐ Common Sandpiper
- ☐ Spotted Sandpiper
- ☐ Upland Sandpiper
- ☐ Long-billed Curlew
- ☐ Hudsonian Godwit
- ☐ Bar-tailed Godwit
- ☐ Marbled Godwit
- ☐ Ruddy Turnstone

- ☐ Black Turnstone
- ☐ Surfbird
- ☐ Red Knot
- ☐ Sanderling
- ☐ Semipalmated Sandpiper
- ☐ Western Sandpiper
- ☐ Red-necked Stint
- ☐ Least Sandpiper
- ☐ White-rumped Sandpiper
- ☐ Baird's Sandpiper
- ☐ Pectoral Sandpiper
- ☐ Sharp-tailed Sandpiper
- ☐ Purple Sandpiper
- ☐ Rock Sandpiper
- ☐ Dunlin
- ☐ Curlew Sandpiper
- ☐ Stilt Sandpiper
- ☐ Buff-breasted Sandpiper
- ☐ Ruff
- ☐ Short-billed Dowitcher
- ☐ Long-billed Dowitcher
- ☐ Common Snipe
- ☐ American Woodcock
- ☐ Wilson's Phalarope
- ☐ Red-necked Phalarope
- ☐ Red Phalarope

Fowl-like Birds

- ☐ Plain Chachalaca
- ☐ Gray Partridge
- ☐ Chukar
- ☐ Ring-necked Pheasant
- ☐ Spruce Grouse
- ☐ Willow Ptarmigan
- ☐ Rock Ptarmigan
- ☐ White-tailed Ptarmigan
- ☐ Ruffed Grouse
- ☐ Sage Grouse
- ☐ Greater Prairie-chicken
- ☐ Lesser Prairie-chicken
- ☐ Sharp-tailed Grouse
- ☐ Wild Turkey
- ☐ Northern Bobwhite
- ☐ Scaled Quail
- ☐ Gambel's Quail
- ☐ California Quail
- ☐ Mountain Quail

Birds of Prey

- ☐ Black Vulture
- ☐ Turkey Vulture
- ☐ California Condor
- ☐ Osprey
- ☐ Hook-billed Kite
- ☐ Swallow-tailed Kite
- ☐ White-tailed Kite
- ☐ Snail Kite
- ☐ Mississippi Kite
- ☐ Bald Eagle
- ☐ Northern Harrier
- ☐ Sharp-shinned Hawk
- ☐ Cooper's Hawk
- ☐ Northern Goshawk
- ☐ Common Black-Hawk
- ☐ Harris's Hawk
- ☐ Red-shouldered Hawk
- ☐ Broad-winged Hawk
- ☐ Short-tailed Hawk
- ☐ Swainson's Hawk
- ☐ White-tailed Hawk

- ☐ Zone-tailed Hawk
- ☐ Red-tailed Hawk
- ☐ Ferruginous Hawk
- ☐ Rough-legged Hawk
- ☐ Golden Eagle
- ☐ Crested Caracara
- ☐ American Kestrel
- ☐ Merlin
- ☐ Peregrine Falcon
- ☐ Gyrfalcon
- ☐ Prairie Falcon
- ☐ Barn Owl
- ☐ Ashy-faced Owl
- ☐ Oriental Scops-Owl
- ☐ Flammulated Owl
- ☐ Eastern Screech-Owl
- ☐ Western Screech-Owl
- ☐ Balsas Screech-Owl
- ☐ Pacific Screech-Owl
- ☐ Whiskered Screech-Owl
- ☐ Vermiculated Screech-Owl
- ☐ Tropical Screech-Owl
- ☐ Bearded Screech-Owl
- ☐ Bare-shanked Screech-Owl
- ☐ Puerto Rican Screech-Owl
- ☐ Bare-legged Owl
- ☐ Crested Owl
- ☐ Spectacled Owl
- ☐ Great Horned Owl
- ☐ Snowy Owl
- ☐ Northern Hawk Owl
- ☐ Northern Pygmy-Owl
- ☐ Andean Pygmy-Owl
- ☐ Least Pygmy-Owl
- ☐ Ferruginous Pygmy-Owl
- ☐ Cuban Pygmy-Owl
- ☐ Elf Owl
- ☐ Burrowing Owl
- ☐ Mottled Owl
- ☐ Black-and-white Owl
- ☐ Spotted Owl
- ☐ Barred Owl
- ☐ Fulvous Owl
- ☐ Great Gray Owl
- ☐ Long-eared Owl
- ☐ Stygian Owl
- ☐ Striped Owl
- ☐ Short-eared Owl
- ☐ Jamaican Owl
- ☐ Boreal Owl
- ☐ Northern Saw-whet Owl
- ☐ Unspotted Saw-whet Owl

Parrots

- ☐ Budgerigar
- ☐ Monk Parakeet

Pigeons & Doves

- ☐ Rock Dove
- ☐ White-crowned Pigeon
- ☐ Red-billed Pigeon
- ☐ Band-tailed Pigeon
- ☐ Eurasian Collared-Dove
- ☐ Spotted Dove
- ☐ White-winged Dove
- ☐ Mourning Dove
- ☐ Inca Dove
- ☐ Common Ground-Dove
- ☐ Ruddy Ground-Dove
- ☐ White-tipped Dove

Cuckoos

- ☐ Common Cuckoo
- ☐ Black-billed Cuckoo
- ☐ Yellow-billed Cuckoo
- ☐ Mangrove Cuckoo
- ☐ Lesser Roadrunner
- ☐ Greater Roadrunner
- ☐ Greater Ani
- ☐ Smooth-billed Ani
- ☐ Groove-billed Ani

Goatsuckers

- ☐ Lesser Nighthawk
- ☐ Common Nighthawk
- ☐ Pauraque
- ☐ Common Poorwill
- ☐ Chuck-will's-widow
- ☐ Buff-collared Nightjar
- ☐ Whip-poor-will

Hummingbirds

- ☐ Broad-billed Hummingbird
- ☐ White-eared Hummingbird
- ☐ Buff-bellied Hummingbird
- ☐ Violet-crowned Hummingbird
- ☐ Blue-throated Hummingbird
- ☐ Magnificent Hummingbird
- ☐ Plain-capped Starthroat
- ☐ Lucifer Hummingbird
- ☐ Ruby-throated Hummingbird
- ☐ Black-chinned Hummingbird
- ☐ Anna's Hummingbird
- ☐ Costa's Hummingbird
- ☐ Calliope Hummingbird
- ☐ Broad-tailed Hummingbird
- ☐ Rufous Hummingbird
- ☐ Allen's Hummingbird

Kingfishers

- ☐ Ringed Kingfisher
- ☐ Belted Kingfisher
- ☐ Green Kingfisher

Woodpeckers

- ☐ Lewis's Woodpecker
- ☐ Red-headed Woodpecker
- ☐ Acorn Woodpecker
- ☐ Gila Woodpecker
- ☐ Golden-fronted Woodpecker
- ☐ Red-bellied Woodpecker
- ☐ Yellow-bellied Sapsucker
- ☐ Red-naped Sapsucker
- ☐ Red-breasted Sapsucker
- ☐ Williamson's Sapsucker
- ☐ Ladder-backed Woodpecker
- ☐ Nuttall's Woodpecker
- ☐ Downy Woodpecker
- ☐ Hairy Woodpecker
- ☐ Strickland's Woodpecker
- ☐ Red-cockaded Woodpecker
- ☐ White-headed Woodpecker
- ☐ Three-toed Woodpecker
- ☐ Black-backed Woodpecker
- ☐ Northern Flicker
- ☐ Gilded Flicker
- ☐ Pileated Woodpecker

Swifts

- ☐ Black Swift
- ☐ White-fronted Swift

- ☐ Chimney Swift
- ☐ Vaux's Swift

Flycatchers

- ☐ Northern Beardless-Tyrannulet
- ☐ Olive-sided Flycatcher
- ☐ Western Wood-Pewee
- ☐ Eastern Wood-Pewee
- ☐ Yellow-bellied Flycatcher
- ☐ Acadian Flycatcher
- ☐ Alder Flycatcher
- ☐ Willow Flycatcher
- ☐ Least Flycatcher
- ☐ Hammond's Flycatcher
- ☐ Dusky Flycatcher
- ☐ Gray Flycatcher
- ☐ Pacific-slope Flycatcher
- ☐ Cordilleran Flycatcher
- ☐ Buff-breasted Flycatcher
- ☐ Black Phoebe
- ☐ Eastern Phoebe
- ☐ Say's Phoebe
- ☐ Vermilion Flycatcher
- ☐ Dusky-capped Flycatcher
- ☐ Ash-throated Flycatcher
- ☐ Great Crested Flycatcher
- ☐ Brown-crested Flycatcher
- ☐ Tropical Kingbird
- ☐ Couch's Kingbird
- ☐ Cassin's Kingbird
- ☐ Thick-billed Kingbird
- ☐ Western Kingbird
- ☐ Eastern Kingbird
- ☐ Gray Kingbird
- ☐ Scissor-tailed Flycatcher
- ☐ Fork-tailed Flycatcher

Larks

- ☐ Sky Lark
- ☐ Horned Lark

Swallows

- ☐ Purple Martin
- ☐ Tree Swallow
- ☐ Violet-green Swallow
- ☐ Northern Rough-winged Swallow
- ☐ Bank Swallow
- ☐ Cliff Swallow
- ☐ Cave Swallow
- ☐ Barn Swallow

Jays, Crows, & Ravens

- ☐ Gray Jay
- ☐ Steller's Jay
- ☐ Blue Jay
- ☐ Green Jay
- ☐ Brown Jay
- ☐ Florida Scrub-Jay
- ☐ Island Scrub-Jay
- ☐ Western Scrub-Jay
- ☐ Mexican Jay
- ☐ Pinyon Jay
- ☐ Clark's Nutcracker
- ☐ Black-billed Magpie
- ☐ Yellow-billed Magpie
- ☐ American Crow
- ☐ Northwestern Crow
- ☐ Fish Crow
- ☐ Chihuahuan Raven
- ☐ Common Raven

Chickadees, Titmice, & Nuthatches

- ☐ Rose-throated Becard
- ☐ Black-capped Chickadee
- ☐ Carolina Chickadee
- ☐ Mexican Chickadee
- ☐ Mountain Chickadee
- ☐ Boreal Chickadee
- ☐ Chestnut-backed Chickadee
- ☐ Tufted Titmouse
- ☐ Verdin
- ☐ Bushtit
- ☐ Red-breasted Nuthatch
- ☐ White-breasted Nuthatch
- ☐ Pygmy Nuthatch
- ☐ Brown-headed Nuthatch

Creepers, Bulbuls, and Wrens

- ☐ Brown Creeper
- ☐ Red-vented Bulbul
- ☐ Red-whiskered Bulbul
- ☐ Cactus Wren
- ☐ Rock Wren
- ☐ Canyon Wren
- ☐ Carolina Wren
- ☐ Bewick's Wren
- ☐ House Wren
- ☐ Winter Wren
- ☐ Sedge Wren
- ☐ Marsh Wren

Wrentit, Dippers, & Pipits

- ☐ Wrentit
- ☐ American Dipper
- ☐ Northern Wheatear
- ☐ Yellow Wagtail
- ☐ Gray Wagtail
- ☐ Black-backed Wagtail
- ☐ Red-throated Pipit
- ☐ American Pipit
- ☐ Sprague's Pipit

Kinglets and Gnatcatchers

- ☐ Golden-crowned Kinglet
- ☐ Ruby-crowned Kinglet
- ☐ Blue-gray Gnatcatcher
- ☐ California Gnatcatcher
- ☐ Black-tailed Gnatcatcher
- ☐ Black-capped Gnatcatcher

Mimic Thrushes

- ☐ Gray Catbird
- ☐ Northern Mockingbird
- ☐ Sage Thrasher
- ☐ Brown Thrasher
- ☐ Long-billed Thrasher
- ☐ Bendire's Thrasher
- ☐ Curve-billed Thrasher
- ☐ California Thrasher
- ☐ Crissal Thrasher
- ☐ Le Conte's Thrasher

Thrushes

- ☐ Eastern Bluebird
- ☐ Western Bluebird
- ☐ Mountain Bluebird
- ☐ Bluethroat
- ☐ Townsend's Solitaire
- ☐ Veery
- ☐ Gray-cheeked Thrush
- ☐ Bicknell's Thrush

- ☐ Swainson's Thrush
- ☐ Hermit Thrush
- ☐ Wood Thrush
- ☐ Clay-colored Robin
- ☐ Rufous-backed Robin
- ☐ American Robin
- ☐ Varied Thrush
- ☐ Aztec Thrush
- ☐ Northern Wheatear

Shrikes and Starlings

- ☐ Brown Shrike
- ☐ Northern Shrike
- ☐ Loggerhead Shrike
- ☐ European Starling
- ☐ Crested Myna

Waxwings

- ☐ Bohemian Waxwing
- ☐ Cedar Waxwing
- ☐ Phainopepla

Vireos

- ☐ White-eyed Vireo
- ☐ Bell's Vireo
- ☐ Black-capped Vireo
- ☐ Gray Vireo
- ☐ Solitary Vireo
- ☐ Yellow-throated Vireo
- ☐ Hutton's Vireo
- ☐ Warbling Vireo
- ☐ Philadelphia Vireo
- ☐ Red-eyed Vireo
- ☐ Yellow-green Vireo
- ☐ Black-whiskered Vireo

Warblers

- ☐ Arctic Warbler
- ☐ Blue-winged Warbler
- ☐ Golden-winged Warbler
- ☐ Tennessee Warbler
- ☐ Orange-crowned Warbler
- ☐ Nashville Warbler
- ☐ Virginia's Warbler
- ☐ Colima Warbler
- ☐ Lucy's Warbler
- ☐ Northern Parula
- ☐ Tropical Parula
- ☐ Yellow Warbler
- ☐ Chestnut-sided Warbler
- ☐ Magnolia Warbler
- ☐ Cape May Warbler
- ☐ Black-throated Blue Warbler
- ☐ Yellow-rumped Warbler
- ☐ Black-throated Gray Warbler
- ☐ Townsend's Warbler
- ☐ Hermit Warbler
- ☐ Black-throated Green Warbler
- ☐ Blackburnian Warbler
- ☐ Yellow-throated Warbler
- ☐ Grace's Warbler
- ☐ Pine Warbler
- ☐ Prairie Warbler
- ☐ Palm Warbler
- ☐ Bay-breasted Warbler
- ☐ Blackpoll Warbler
- ☐ Cerulean Warbler
- ☐ Black-and-white Warbler
- ☐ American Redstart

- ☐ Prothonotary Warbler
- ☐ Worm-eating Warbler
- ☐ Swainson's Warbler
- ☐ Ovenbird
- ☐ Northern Waterthrush
- ☐ Louisiana Waterthrush
- ☐ Kentucky Warbler
- ☐ Connecticut Warbler
- ☐ Mourning Warbler
- ☐ MacGillivray's Warbler
- ☐ Common Yellowthroat
- ☐ Hooded Warbler
- ☐ Wilson's Warbler
- ☐ Canada Warbler
- ☐ Red-faced Warbler
- ☐ Painted Redstart
- ☐ Yellow-breasted Chat
- ☐ White-winged Warbler
- ☐ Bachman's Warbler

Blackbirds & Orioles

- ☐ Bobolink
- ☐ Red-winged Blackbird
- ☐ Tricolored Blackbird
- ☐ Eastern Meadowlark
- ☐ Yellow-headed Blackbird
- ☐ Rusty Blackbird
- ☐ Brewer's Blackbird
- ☐ Great-tailed Grackle
- ☐ Boat-tailed Grackle
- ☐ Common Grackle
- ☐ Shiny Cowbird
- ☐ Bronzed Cowbird
- ☐ Brown-headed Cowbird

Tanagers

- ☐ Hepatic Tanager
- ☐ Summer Tanager
- ☐ Scarlet Tanager
- ☐ Western Tanager

Weaver Finches

- ☐ House Sparrow
- ☐ Eurasian Tree Sparrow

Finches, Sparrows, & Juncos

- ☐ Brambling
- ☐ Gray-crowned Rosy-Finch
- ☐ Black Rosy-Finch
- ☐ Brown-capped Rosy-Finch
- ☐ Pine Grosbeak
- ☐ Common Rosefinch
- ☐ Purple Finch
- ☐ Cassin's Finch
- ☐ House Finch
- ☐ Red Crossbill
- ☐ White-winged Crossbill
- ☐ Common Redpoll
- ☐ Hoary Redpoll
- ☐ Pine Siskin
- ☐ Black-capped Siskin
- ☐ Black-headed Siskin
- ☐ Yellow-bellied Siskin
- ☐ Red Siskin
- ☐ Antillean Siskin
- ☐ Lesser Goldfinch
- ☐ Lawrence's Goldfinch
- ☐ American Goldfinch
- ☐ European Goldfinch

- ☐ Eurasian Siskin
- ☐ Yellow-fronted Canary
- ☐ Common Canary
- ☐ Eurasian Bullfinch
- ☐ Hooded Grosbeak
- ☐ Evening Grosbeak
- ☐ Northern Cardinal
- ☐ Pyrrhuloxia
- ☐ Rose-breasted Grosbeak
- ☐ Black-headed Grosbeak
- ☐ Blue Grosbeak
- ☐ Indigo Bunting
- ☐ Varied Bunting
- ☐ Painted Bunting
- ☐ Dickcissel
- ☐ Green-tailed Towhee
- ☐ Collared Towhee
- ☐ Spotted Towhee
- ☐ Eastern Towhee
- ☐ California Towhee
- ☐ Canyon Towhee
- ☐ Abert's Towhee
- ☐ Bachman's Sparrow
- ☐ Botteri's Sparrow
- ☐ Cassin's Sparrow
- ☐ Rufous-winged Sparrow
- ☐ Rufous-crowned Sparrow
- ☐ Oaxaca Sparrow
- ☐ Rusty Sparrow
- ☐ Striped Sparrow
- ☐ Zapata Sparrow
- ☐ American Tree Sparrow
- ☐ Chipping Sparrow
- ☐ Clay-colored Sparrow
- ☐ Brewer's Sparrow
- ☐ Field Sparrow
- ☐ Worthen's Sparrow
- ☐ Black-chinned Sparrow
- ☐ Vesper Sparrow
- ☐ Lark Sparrow
- ☐ Black-throated Sparrow
- ☐ Sage Sparrow
- ☐ Five-striped Sparrow
- ☐ Lark Bunting
- ☐ Savannah Sparrow
- ☐ Baird's Sparrow
- ☐ Grasshopper Sparrow
- ☐ Henslow's Sparrow
- ☐ Le Conte's Sparrow
- ☐ Saltmarsh Sharp-tailed Sparrow
- ☐ Nelson's Sharp-tailed Sparrow
- ☐ Seaside Sparrow
- ☐ Fox Sparrow
- ☐ Song Sparrow
- ☐ Lincoln's Sparrow
- ☐ Swamp Sparrow
- ☐ White-throated Sparrow
- ☐ Golden-crowned Sparrow
- ☐ White-crowned Sparrow
- ☐ Harris's Sparrow
- ☐ Dark-eyed Junco
- ☐ Yellow-eyed Junco
- ☐ McCown's Longspur
- ☐ Lapland Longspur
- ☐ Smith's Longspur
- ☐ Chestnut-collared Longspur
- ☐ Rustic Bunting
- ☐ Snow Bunting
- ☐ McKay's Bunting

Wildlife Garden Plant List

HB= Hummingbird BF= Butterfly SB= Songbird

Perennials

Asters	<i>Aster</i> spp.	BF
Beebalm	<i>Monarda didyma</i>	HB, BF
Black-eyed Susan	<i>Rudbeckia</i> spp.	BF, SB
Blazing star	<i>Liatris</i> spp.	HB, BF
Bleeding heart	<i>Dicentra</i> spp.	HB
Butterfly weed	<i>Asclepias tuberosa</i>	BF
Cardinal flower	<i>Lobelia cardinalis</i>	HB, BF
Catnip	<i>Nepeta cataria</i>	HB
Columbine	<i>Aquilegia canadensis</i>	HB, BF
Coneflower	<i>Echinacea</i> spp.	BF, SB
Coral bells	<i>Heuchera sanguinea</i>	HB
Coreopsis	<i>Coreopsis</i> spp.	BF
Delphinium	<i>Delphineum</i> spp.	HB
Foxglove	<i>Digitalis</i> spp.	HB
Hosta	<i>Hosta</i> spp.	HB
Milkweed	<i>Asclepias</i> spp.	BF, SB
Paintbrush	<i>Castilleja</i> spp.	HB
Penstemon	<i>Penstemon</i> spp.	HB, BF
Sage	<i>Salvia</i> spp.	HB
Yucca	<i>Yucca</i> spp.	HB

Annual Flowers

Calendula	<i>Calendula officinalis</i>	BF, SB
Cosmos	<i>Cosmos</i> spp.	BF, SB
Flowering tobacco	<i>Nicotiana glauca</i>	HB
Fuchsia	<i>Fuchsia</i> spp.	HB
Impatiens	<i>Impatiens</i> spp.	HB, BF
Nasturtium	<i>Tropaeolum majus</i>	HB
Scarlet runner bean	<i>Phaseolus coccineus</i>	HB
Snapdragon	<i>Antirrhinum majus</i>	HB, BF
Spider flower	<i>Cleome spinosa</i>	HB
Sunflower	<i>Helianthus annuus</i>	SB, BF
Zinnia	<i>Zinnia elegans</i>	HB, BF, SB

Vines Ask for trumpet vines by the Latin name to be sure you get the right vine! Other varieties can be invasive.

Grape	<i>Vitis</i> spp.	SB
Trumpet creeper	<i>Campsis radicans</i>	HB
Trumpet honeysuckle	<i>Lonicera sempervirens</i>	HB

Shrubs

Bayberry	<i>Myrica</i> spp.	SB
Blueberry	<i>Vaccinium</i> spp.	SB, BF
Butterfly bush	<i>Buddleia davidii</i>	BF, HB
Current	<i>Ribes</i> spp.	SB
Dogwood	<i>Cornus</i> spp.	SB
Hibiscus	<i>Hibiscus</i> spp.	HB, SB
Rhododendron	<i>Rhododendron</i> spp.	HB, BF
Scarlet bush	<i>Hamelia erecta</i>	HB
Serviceberry	<i>Amelanchier</i> spp.	SB
Viburnum	<i>Viburnum</i> spp.	SB
Winterberry	<i>Ilex</i> spp.	SB

Aquatic And Shoreline Plants

For Ponds, Lakes, and Streams

Border Shrubs

These plants prefer periodic flooding, and should be planted on pond banks above normal water edge. Height ranges from 5 to 20 feet.

Alder, Speckled (*Alnus rugosa*)—This attractive shrub provides food for 15 species of songbirds, including goldfinches and pine siskins.

Bayberry, Northern (*Myrica pennsylvanica*)—Provides both cover for nesting sites and food for many songbirds.

Buttonbush, Common (*Cephalanthus occidentalis*)—This food source for waterfowl also bears attractive flowers used by ruby-throated hummingbirds.

Chokeberry, Red (*Aronia arbutifolia*)—Berries are eaten by 12 species of songbirds; provides fall color interest as well.

Dogwood, Silky (*Cornus amomum*)—Cover, nesting sites, and food source for birds; adds fall color interest.

Serviceberry, Shadblow (*Amelanchier canadensis*)—Berry food source for 36 species of songbirds.

Willow, Pussy (*Salix discolor*)—Grouse eat buds, American goldfinches use for nesting, mammals and songbirds eat the showy fruits.

Winterberry, Common (*Ilex verticillata*)—Berries provide a winter food source for birds.

Emergent Plants

Grow best in shallow water and prefer wet conditions. Plant in 6 to 12 inches of water. Height ranges from 2 to 4 feet.

Arrow arum (*Petrandra virginica*)—This clump plant does not spread. Wood ducks and other waterfowl eat the seeds.

Arrowheads, Duck Potato (*Sagittaria* sp.)—Underground tuber is eaten by waterfowl including wood ducks, trumpeter and whistling swans, sandhill cranes, and king rail.

Bulrushes (*Scirpus* sp.)—Many species of water birds and songbirds eat the seeds, while muskrats and geese eat stems and rhizomes. Birds also nest in the upright stems. This plant is also valuable for controlling shore erosion.

Iris, Yellow Water Iris, Blue Flag (*Iris* sp.)—Yellow or blue flowers of ornamental interest, but limited in wildlife value. Roots eaten by muskrats.

Pickerelweed (*Pontederia cordata*)—Slow spreading with colorful bright blue flowers; seeds eaten by wood and black ducks.

Rice Cutgrass (*Leersia oryzoides*)—Seeds and roots provide food source for waterfowl and songbirds.

Sedge species (*Carex* sp.)—Excellent for wildlife cover and food. Many species nest in the clumps of grass.

Sweet Flag (*Acorus calamus*)—This attractive clump plant does not spread; limited wildlife value.

Nest Box Construction Plans

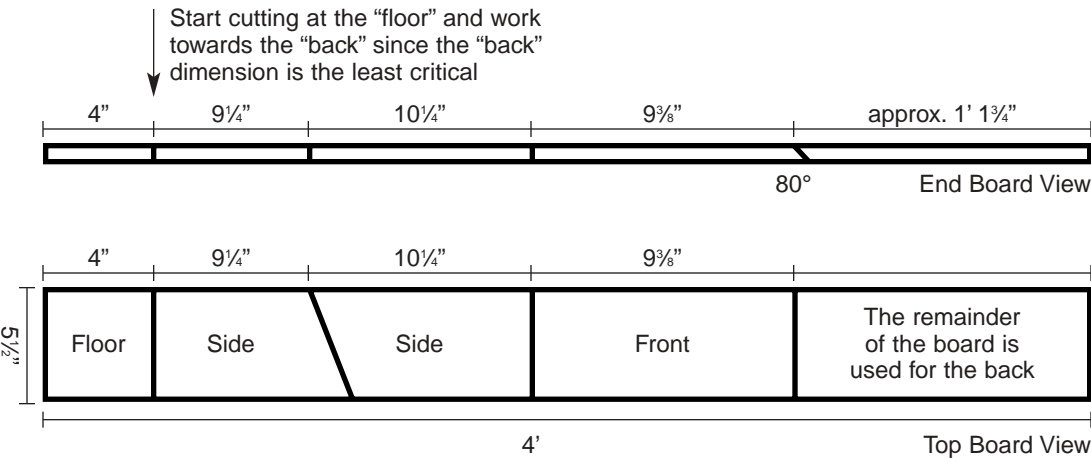
Putting up nest boxes is an easy and economical way to increase bird nesting success, help balance loss of natural habitat, and take an active role in conservation and enhancement of the environment.

Source: North American Bluebird Society, www.nabluebirdsociety.org

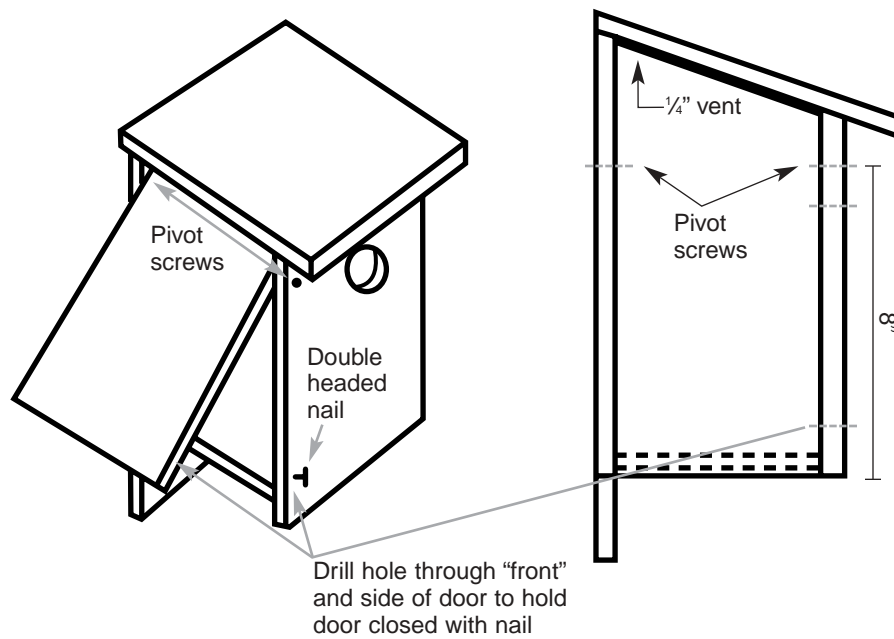
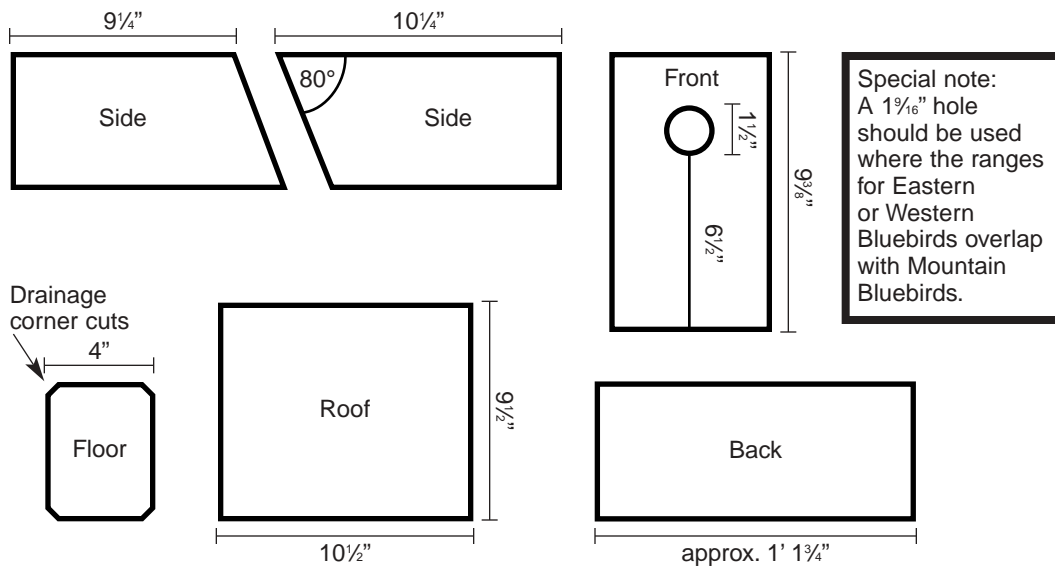
Materials List

- Standard Board 1" x 6" x 4' long
- Standard Board 1" x 10" x 10 1/2" long (for roof)
- 1 3/4" galvanized nails or screws—approx. 20
- 1 3/4" galvanized screw or nail for pivot point—2
- Double-headed Nail for holding door closed—1

BOARD DIAGRAM



CONSTRUCTION PLAN



How to Identify Nests and Eggs by Species

Bluebird: The 1-4 inch tall nest is built with fine grasses or pine needles with a fairly deep nest cup. Eggs (4-6) are powder blue or occasionally white.

Tree swallow: Their nest is also made of grasses but they may use somewhat coarser fibers than a bluebird. The nest generally has a flatter cup than the bluebird's and is usually lined with feathers or occasionally scraps of paper. Eggs (5-7) are white and smaller than those of a bluebird.

House wren: Wrens fill a nest box with sticks and line the deep nest cup with fine plant fibers or feathers. "Dummy nests" without the nest cup are often built in all other cavities within the male wren's territory to reduce competition for resources. The eggs (6-8) are tan, speckled with brown and quite small.

Black-capped chickadee: Chickadees build a nest of moss and plant down with the nest cup lined with hair. They lay 5-8 white eggs covered with brown speckles. Eggs are often covered with moss when the female leaves the box.

House sparrow: House sparrows build a tall nest of coarse grasses, often with pieces of scrap paper, cellophane, or other garbage. The nest forms a canopy with a tunnel-like entrance to the 5-7 cream-colored eggs with brown markings.

Source: North American Bluebird Society, Prepared by Kevin Berner, NABS Research Chairman, SUNY, Cobleskill, NY 12043 bernerkl@cobleskill.edu

Bat Box Plans

Bat Conservation International holds a copyright to standard bat house plans. You may join this organization and receive its publication on this topic: *The Bat House Builder's Handbook*, by Merlin D. Tuttle, and Donna L. Hensley. It is also available from University of Texas Press, P.O. Box 7819, Austin TX 78713-7819, ISBN 0-9638248-0-5. Also follow these guidelines for the best results:

The Bat Box

- **Size**—Larger houses seem to be far more likely to be occupied than small ones. Large houses may measure approximately 25"–36" tall by 10"–24" wide by 11" deep.
- **Wood Type**—Pine, cypress, cedar, and exterior plywood are all fine. Interestingly, old wood seems to attract bats sooner—within the first season after mounting. However, boxes constructed of new wood placed in suitable conditions will work too.
- **Paint and Stain**—Dark stain, black paint, or tar paper increases the absorption of solar heat and helps to keep boxes warm—a condition northern bats prefer. In fact, temperature is a key factor in bat house use. In northern parts of North America (above 40° latitude), bats prefer temperatures in the 80° to 90° range. However, in southern areas (below 30° latitude), just the opposite seems to be true. White or unstained bat houses help to prevent overheating in the South.
- **Guano**—Placing bat guano in or around the bat house doesn't appear to have a significant impact on whether bats take up residence. It may help to attract bats sooner, but proper house size and location are far more important in attracting bats.

Bat House Placement

- **Solar Radiation**—Bat house exposure to sun is one of the most significant criteria for attracting bats. In Northern areas, make sure your box gets at least four hours of sun per day. In the South, your box should get less than four hours.
- **Mounting**—Mount your box a minimum of 15' to 30' above the ground. Where solar exposure is important, mount your box on a pole for the best success. The side of a building or on a tree will also work, but be sure to look for hanging branches or other obstacles that block sunlight. In general, try to place bat houses in remote areas of the golf course and in places that do not receive high pesticide applications.
- **Water Source**—If at all possible, place your bat house close to a water source. Bats show a strong preference for habitat that is in close proximity to water. Boxes placed within 1/2 mile or less of a stream or river are most successful. Large lakes of three or more acres also attract bats.

Nestbox Survey

Name _____
 Business Name (if applicable) _____
 Address _____
 City _____ State _____ Zip _____ County _____
 Country _____ E-mail _____
 Phone _____ Fax _____
 What year is this survey being filled out for? _____
 What is the total number of nest boxes on your property? _____

Use the guide to the left when filling in the nestbox chart data. For more than one nest in the same box use a separate row.

[illegible]

Box Type	
S	Small (1 1/2" hole)
M	Medium (3-4" hole)
L	Large (6-8" hole)
C	Colonial boxes with multiple rooms

Habitat	
H	Hedge row or tree row
M	Mowed lawn
OF	Open field or pasture (not mowed)
WA	In standing water
WE	Edge of woods
WO	Woods

Distance	
A	< 10 feet
B	10 feet-50 feet
C	50 feet-100 feet
D	100 feet-500 feet
E	> 500 feet

Common Bird Species	
TS	Tree Swallow
BB	Bluebird
HW	House Wren
CH	Chickadee
PM	Purple Martin
WD	Wood Duck
K	Kestrel
U	Unknown
O	Other

Causes of Nest Failure	
W	Weather
PR	Predation
BF	Blow Flies
PE	Pesticides
HS	House Sparrows
AB	Nest Abandonment
V	Vandalism
U	Unknown
O	Other

Use the guide to the left when filling in the nestbox chart data. For more than one nest in the same box use a separate row.

[illegible]

1	Box Type	
	S	Small (1 1/2" hole)
	M	Medium (3-4" hole)
	L	Large (6-8" hole)
	C	Colonial boxes with multiple rooms
2	Habitat	
	H	Hedge row or tree row
	M	Mowed lawn
	OF	Open field or pasture (not mowed)
	WA	In standing water
3	WE	Edge of woods
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	Distance	
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	Common Bird Species	
	TS	Tree Swallow
5	BB	Bluebird
	HW	House Wren
	CH	Chickadee
	PM	Purple Martin
	WD	Wood Duck
Causes of Nest Failure	K	Kestrel
	U	Unknown
	O	Other
	Causes of Nest Failure	
	W	Weather
6	PR	Predation
	BF	Blow Flies
	PE	Pesticides
	HS	House Sparrows
	AB	Nest Abandonment
7	V	Vandalism
	U	Unknown
	O	Other

Turf IPM Field Infestation Report

Hole

Scout

Date

Turf IPM Field Infestation Report

Site (turf species)	Mowing Height	Soil Moisture	Weeds Species No. or %	Diseases Species No. or %	Remarks	Nematodes Species No. or %
Green						
Tee						
Fairway						
Rough						
Notes:			1. Goosegrass 2. Crabgrass 3. Broadleaves 4. Nutsedge, Yellow 5. Nutsedge, Purple 6. <i>Poa annua</i> 7. Other	1. Dollar spot 2. Leaf spot 3. <i>Pythium</i> blight 4. <i>Pythium</i> root rot 5. Fairy ring 6. Brown patch (<i>R. solani</i>) 7. Rhizoctonia leaf and sheath blight (<i>R. zeae</i>) 8. Algae/moss 9. Other		1. Sting 2. Lance 3. Stubby-root 4. Root-knot 5. Cyst 6. Ring 7. Spiral 8. Sheath 9. Other

Turf IPM Field History Report Form

Hole Scout Date

Site	Turf Species	Mowing Schedule	Soil Analysis			Soil Drainage	Spring	Summer	Fall	Winter	Irrigation Schedule
Green			pH	P	K						
Tee											
Fairway											
Rough											
Driving range											
Nursery green											
Practice green											

Comments on specific topics such as shade, overseeding blend, nitrogen carrier, topdressing mix, weather, irrigation salinity levels, etc.

Useful Resources

Wildlife Identification

- *Peterson, Audubon, Golden, National Geographic* all have field guides for birds, mammals, fish, amphibians & reptiles, and more.
- Peterson, A Field Guide to Birds—eastern and western editions available, great for identification. Check out the Peterson Guide to Bird Songs too.
- Peterson First Guide to Birds—beginner guide
- The National Audubon Society Field Guide to North American Birds—eastern or western edition, good for background information
- National Geographic Society Field Guide to the Birds of North America
- Golden Field Guides—simple beginner guides
- The Sibley Guide to Birds—although geared for experienced birders, this guide provides even the novice with a great deal of information
- Kaufman Focus Guides: Birds of North America—beginner guide using digitized photographs to highlight important field marks
- Stokes Nature Guides and Guides to Bird Behavior—goes beyond basic information to include ecology, behavior, habitat, and life cycle.
- The Birder's Handbook—comprehensive reference for in-depth information on birds
- North American Birdfeeder Handbook—valuable resource for backyard birders
- The Field Guide to Wildlife Habitats, by Janine Benyus—both eastern and western editions available

Web-Based Resources

Amphibian Conservation

- Partners in Amphibian and Reptile Conservation (PARC): <http://www.parcplace.org>
- Declining Amphibian Populations Taskforce: <http://www.open.ac.uk/daptf/>
- Great Lakes Declining Amphibians Taskforce:
<http://www.mpm.edu/collect/vertzo/herp/DAPTF/daptf.html>
- USGS—Frogwatch USA: <http://www.mp2-pwrc.usgs.gov/frogwatch/>
- Canadian Amphibians: <http://collections.ic.gc.ca/amphibians/index.html>

Bat Conservation

- Bat Conservation International: <http://www.batcon.org/>
- Bat Conservation and Management: <http://www.batmanagement.com/>

Bird Conservation and Nest Boxes

- The Birdhouse Network: <http://birds.cornell.edu/birdhouse/nestboxcam/>
- Cornell Lab of Ornithology: <http://birdsource.cornell.edu/>
- The Nest Box: <http://www.nestbox.com/intro.htm>
- Partners In Flight: <http://www.nestbox.com/intro.htm>
- US Fish & Wildlife Service—Migratory Birds: <http://www.nestbox.com/intro.htm>
- Birds of North America: <http://www.birdsofna.org/>

General

- Audubon International: <http://www.audubonintl.org/>
- United States Fish and Wildlife Service: <http://www.fws.gov>

Native Plant Landscaping

- EPA—Landscaping with Native Plants:
<http://www.epa.gov/glnpo/greenacres/natvland.html>
- Native Plants Galore: http://www.plantsgalore.com/Galore/Native_Plants_galore.htm

Water Conservation and Wetlands

- EPA's Surf your Watershed: <http://cfpub1.epa.gov/surf/locate>
- Society for Ecological Restoration (SER): <http://www.ser.com>
- U.S. Water News: <http://uswaternews.com>
- Water Resources of the United States: <http://water.usgs.gov>
- Wetlands Regulation Center: <http://www.wetlands.com>

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Audubon International



Audubon Cooperative Sanctuary Program
Audubon International
120 Defreest Drive
Troy, NY 12180

Telephone: (518) 767-9051
Fax: (518) 767-9076
E-mail: acsp@auduboninternational.org
Website: www.auduboninternational.org