



Environmental Stewardship Guidelines

Best Management Practices

Integrated Pest Management

Water Quality Monitoring

Wildlife Habitat Enhancement

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TABLE OF CONTENTS

ENVIRONMENTAL STEWARDSHIP GUIDELINES	1
Introduction.....	1
Objectives	1
Use of Guidelines.....	1
Overview of Guidelines	2
BEST MANAGEMENT PRACTICES	3
INTEGRATED PEST MANAGEMENT	11
Introduction.....	11
IPM Objective.....	11
Developing an IPM Plan.....	12
INTEGRATED PEST MANAGEMENT PLAN OUTLINE.....	13
INTEGRATED PEST MANAGEMENT PLAN EXAMPLE	17
WATER QUALITY MONITORING.....	35
Why Develop a Water Quality Monitoring Plan?.....	35
Objective of Water Quality Monitoring.....	35
Water Quality Monitoring Guidance	35
OGCSA Opinion.....	35
WATER QUALITY MONITORING PROGRAM OUTLINE	37
WATER QUALITY MONITORING PROGRAM EXAMPLE.....	41
WILDLIFE HABITAT ENHANCEMENT	47
Introduction.....	47
Why Enhance Habitat?	47
Opportunities for Habitat Enhancement	47
Terrestrial Areas.....	48
Wetlands	48
Aquatic Areas.....	49
Wildlife Habitat Enhancement Resources	50

Oregon Golf Course Superintendents Association

ENVIRONMENTAL STEWARDSHIP GUIDELINES

Introduction

The role of the golf course superintendent has evolved into a multi-task occupation in which a broad range of complex issues influences golf course management practice. One area of responsibility that has become increasingly influential is that of environmental stewardship. The OGCSA recognizes the importance of environmental stewardship and sustainability, and its membership is committed to optimizing golf course management practices to protect the environment within, and those areas surrounding golf courses. In an effort to assist superintendents in their efforts to address environmental issues, the OGCSA has undertaken an extensive review of relevant regulatory and public concerns with the goal of developing Environmental Stewardship Guidelines.

Objectives

The objectives of these Guidelines are to:

- Provide guidance to superintendents to assist them in the development of golf course specific management plans.
- Provide meaningful and useful feedback to the superintendent regarding his or her practice.
- Provide an efficient and effective means of documenting management practices that will address a broad array of environmental issues.
- Contribute to the development of uniformity of practices within the industry.

Use of Guidelines

The OGCSA does not consider these Guidelines to be mandatory, compulsory, or obligatory. Rather, the intent of the Guidelines is to provide general guidance for individual superintendents in their efforts to establish a comprehensive, documented environmental stewardship plan. Also, it should be noted that while a major objective of the Guidelines is to provide a means of adequately addressing regulatory issues of concern to the golf industry, the possibility always exists that expectations specific for local or regional locations may differ from the suggestions provided in this document. As a result, federal, state, and local regulations should always be reviewed and used as the final basis for the development of individual environmental stewardship programs.

Overview of Guidelines

The Guidelines consist of four separate, yet interrelated sections that include:

Best Management Practices

This section contains an outline of Best Management Practices (BMPs), which can be defined as general policies and procedures that are uniformly applicable to the golf course management industry. The outline was derived from a variety of relevant industry sources including the Golf Course Superintendents Association of America, the United States Golf Association Green Section, and the Northwest Turfgrass Association.

Integrated Pest Management

Integrated Pest Management can be viewed as the incorporation of the general policies and procedures of Best Management Practices into an operational document that defines specific golf course management practice tailored for an individual golf course. Included in this section are a suggested Integrated Pest Management document outline and a fully developed Integrated Pest Management plan that demonstrates the appropriate level of detail for the respective outline headings. The Integrated Pest Management outline has been derived and synthesized from a variety of sources, which include *Best Management Practices for Golf Course Development and Operation* (King County Environmental Division, 1993), the Portland Parks and Recreation *Pest Management Policy*, and the Audubon Cooperative Sanctuary System.

Water Quality Monitoring

The Water Quality Monitoring section describes the basic features of a comprehensive system for the implementation and documentation of a water quality monitoring program. A general description of the individual features of a water quality monitoring program is provided, and a complete water quality monitoring plan is included as an example. The water quality monitoring plan is structured based on the *Waterways Management Policy* contained within the Portland Parks and Recreation *Pest Management Policy*.

Wildlife Habitat Enhancement

Wildlife habitat enhancement practices are typically developed based on the unique environment of individual golf courses. This section provides general suggestions for wildlife habitat enhancement, and a number of resources that can be utilized to tailor specific golf course wildlife habitat enhancement programs.

BEST MANAGEMENT PRACTICES

The Best Management Practices (BMPs) outlined below are general policies and procedures that are uniformly applicable to the golf course management industry. However, circumstances may be unique for an individual golf course. If questions exist regarding specifics of the following guidelines, they should be addressed by cross-referencing appropriate guidance from relevant resources whenever possible. Examples of available resources include the Environmental Protection Agency, the Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, Oregon OSHA, the fire marshal, the universal building code, and the universal fire code.

I. Cultural Practice

A. Location

1. Develop location specific cultural practices (i.e., greens, tees, fairways and rough).

B. Hygiene

1. Remove clippings.
2. Optimize air circulation.
3. Minimize shade for turf areas. Whenever possible, retain shade over waterways to preserve habitat.
4. Remove leaves, fallen limbs, and other debris from turf areas. Whenever possible, do not disturb this material in waterways to preserve habitat.

C. Soil Moisture

1. Maintain proper soil moisture levels.
2. Avoid over-application of water to turf.

D. Mowing

1. Set mowing height appropriately for location.
2. Adjust mowing height to relieve turf stress when necessary.

E. Aeration

1. Adjust aeration frequency appropriate for turf location and conditions.

F. Topdressing

1. Use topdressing sand that meets USGA specifications for particle size distribution when available to maintain consistent rootzone content.
2. Apply topdressing following aerification when appropriate.
3. Apply “light” topdressing following verticutting.
4. Apply “light” topdressing when appropriate.

G. Overseeding

1. Select seed type best suited for the growing environment.
2. When available, use disease resistance cultivars.

II. Fertilization

A. Soil Nutrient Testing

1. Perform soil nutrient testing at regular intervals (typically every 1 - 3 years).
2. Maintain accurate records of soil sample locations, date of sampling, and soil conditions.

B. Nitrogen

1. Use slow release nitrogen when possible.
2. Regulate nitrogen application to optimize turf vigor and prevent disease development.

C. Phosphorus

1. Using soil test information, avoid over-application.

D. Potassium

1. Using soil test information to develop target levels, apply as required.

E. Micronutrients

1. Apply as required.

F. pH

1. Maintain soil pH appropriate for turfgrass type.
2. Adjust soil pH to optimize turf vigor.

G. Buffer Zones

1. Establish buffer zones near waterways where appropriate. Consistent with the remainder of this document, a 25 foot buffer zone is suggested.
2. Do not apply fertilizer to turf located in defined buffer zones.

H. Documentation

1. Record location, date, and type of fertilizer applied.
2. Record rate of application.
3. Record method of application.
4. Maintain current inventory of fertilizer on hand.

I. Storage

1. Maintain fertilizer inventory in a dedicated, enclosed area.
2. Keep fertilizer in a dry, well-ventilated environment.

III. Irrigation

A. Water Quality

Determine that water quality of irrigation source is suitable for application to turf.

B. Conservation

Optimize irrigation program to conserve water.

C. Reclaimed Water

When possible, use reclaimed water for irrigation.

D. Weather Data

When available, use weather station and evapotranspiration information to fine tune irrigation regimen.

IV. Pest Management

A. Integrated Pest Management

1. Develop an Integrated Pest Management document (refer to the Integrated Pest Management section of the Guidelines).
2. Use the Integrated Pest Management document as an operational reference for all golf course operations.
3. Educate staff on the contents and utility of the Integrated Pest Management document.
4. Revise the Integrated Pest Management document over time so that it remains a contemporary document reflecting the state of the art of golf course management.

B. Weeds

1. Define threshold levels.
2. Monitor turf regularly for presence of weeds.
3. Optimize turf vigor by proper application of fertilizer to prevent weed colonization and establishment.
4. When possible, use mechanical means (i.e., hand pulling) to remove.
5. Use selective herbicides only when thresholds have been exceeded, and when possible, limit applications to spot treatments.

C. Fungal Disease

1. Define threshold tolerance levels.
2. Understand disease symptoms and disease life cycle.
3. Monitor turf regularly for disease symptoms.
4. Monitor conditions (temperature, humidity, moisture etc.) that favor disease development.
5. Use fungicides with optimal efficacy and specificity.
6. When possible, use targeted, spot applications of fungicides.
7. Rotate chemical family of fungicides applied to prevent the development of fungal resistance.
8. Document problem areas, disease identification, and disease treatment.

D. Insects

1. Define threshold tolerance levels.
2. Understand relevant insect life cycles and symptoms of infestation.
3. Monitor turf regularly for symptoms of infestation.
4. If infestation is detected, correctly identify the insect.
5. Use target specific insecticides.

E. Rodents

1. Define threshold tolerance levels.
2. Use mechanical traps when possible.
3. Study the habits of the target rodent to enhance trap efficiency.
4. Use rodenticides as a last resort.

F. Aquatic

1. Define threshold tolerance levels
2. Keep ponds/lakes as deep as practical to minimize aquatic plant growth.
3. Where possible, use mechanical means to remove undesirable aquatic plants.
4. Use non-toxic blue dye to block sunlight from growing plants.
5. Use beneficial aquatic plants to out-compete undesirable plants and/or to remove nitrate from the water.
6. Use aerators to agitate water; this practice reduces the growth of bacteria and algae.

V. Environmental

A. Regulations

1. Become familiar with federal, state, and local regulations that apply to golf course operations including those related to habitat, surface water, groundwater, and storm water runoff.
2. Implement policies and procedures to achieve compliance with relevant regulations.

B. Habitat

1. Develop golf course operations to optimize preservation and enhancement of wildlife habitat (refer to the “Wildlife Habitat Enhancement” section of the Guidelines).
2. Where available, obtain advice from organizations such as the Audubon Cooperative Sanctuary, Fish and Wildlife, etc. to assist in habitat enhancement.

C. Monitoring

1. Monitor and document habitat improvements and related wildlife response (e.g., installation of bird boxes leading to increased bird population).
2. Monitor and document water quality of relevant surface waters to assess impact of golf course management practice (refer to the “Water Quality Monitoring” section of the Guidelines).
3. If monitoring information reveals a potential problem, implement and document corrective action.

D. Corrective Action

1. In the event that monitoring information identifies a potential problem, design and implement action to correct the situation.
2. Document any corrective action taken.

E. Spill Response

1. Maintain appropriate spill response equipment.
2. Train staff on proper use of spill response equipment.

VI. Pesticides

A. Selection

1. Confirm identity of pest requiring pesticide treatment.
2. Select pesticide based on efficacy, target specificity, and environmental compatibility.
3. Rotate chemical family of pesticide used for a specific pest to prevent the development of pest resistance.

B. Application

1. Read and understand pesticide labeling before use.
2. Use pesticides for labeled use only.
3. Mix pesticides for target pests at rates recommended by the manufacturer.
4. Mix pesticides in a dedicated area.
5. Wear appropriate personal protective equipment during pesticide mixing and application.
6. Properly calibrate sprayer or spreader before use.
7. Apply pesticides to target areas only. Do not apply pesticides in buffer zones.
8. Minimize pesticide drift by applying when winds are 5 mph or less, or use hooded booms.
9. Use curative applications only when threshold levels have been reached.
10. Use preventative applications only when conditions favoring outbreaks occur (e.g., summer stress favoring anthracnose, winter conditions favoring fusarium).
11. Use check plots to determine pesticide effectiveness (i.e. 2 x 2 foot square of plywood laid on turf to block application and serve as an untreated control area.)

C. Storage

1. Store pesticides in a restricted access, dedicated room or cabinet.
2. Ensure that the pesticide storage area meets OSHA requirements (i.e., dry, ventilated, temperature control, etc.)

D. Disposal

1. Triple rinse containers prior to disposal. Apply rinsate to turf.
2. Inspect rinsed container to confirm that all visible residues have been removed prior to disposal.
3. Contact local pesticide distributor for container recycling instructions.

E. Documentation

1. Follow state regulations for proper documentation procedures
2. Record target of pesticide application.
3. Record location, date, and type of pesticide applied.
4. Record weather conditions.
5. Record rate of application.
6. Record method of application.
7. Maintain current inventory of pesticides on hand.

VII. Petroleum Products

A. Fuel Storage

1. Store fuel in certified, double walled, self-contained concrete or steel tanks.
2. Keep gas cans in a separate metal cabinet.
3. Label fuel storage containers clearly and accurately.

B. Disposal

1. Store used fluids in separate containers appropriate for specific fluid type.
2. Maintain used fluid containers in an easy access, safe area that is out of the weather.
3. Store used fluid containers on a non-corrosive secondary containment deck.
4. Label used fluid containers clearly with fluid contents.
5. Contact local petroleum company to arrange pick up of containers for disposal.

VIII. Waste Management

A. Compost

Compost as much biomass as possible and reuse on golf course.

B. Wash Water

Pre-wash all mowing equipment in a designated area in rough or use a leaf blower or pressurized air to dry to remove material prior to rinsing. Rotate this location daily or weekly. Perform final rinse at wash pad. When possible, recycle rinse water. Ideally, rinse water should be discharged into a sanitary sewer. If this is not possible, the Oregon Department of Environmental Quality should be contacted to determine if permits are required.

C. Hazardous Waste

Contact the Oregon Department of Environmental Quality to perform a hazardous waste audit through the agency's Waste Reduction Assistance Program.

D. Recycling

Implement recycling program (cardboard, plastic, pop cans, etc.).

IX. Safety Program

A. Safety Meetings

1. Establish a regular meeting time (i.e., first Monday of the month).
2. Keep accurate records of meeting discussions.
3. Create safety committee consisting of maintenance crew members.

B. Safety Training

1. CPR and first aid.
2. Eye protection.
3. Noise exposure and protection.
4. Hard hat use and head protection.
5. Personal protection equipment.
6. Respirators
7. Gloves
8. Rubber boots
9. Rain suit
10. Chemical suit
11. Safety glasses

C. Equipment training

1. Tool and accessory training.
2. Lightning safety and protection.
3. Emergency procedures.
4. Bomb threat.
5. Signage.
6. Highlight all fire extinguisher locations
7. Display signage appropriate for location or situation
8. Request free safety training videos from OSHA.
9. Understand how to interpret a Material Safety Data Sheet (MSDS). Place MSDS documents in a file and store in a location accessible to all staff.

D. Safety Audits

1. Have fire marshal perform an audit of fire safety.
2. Have OSHA perform a “consultative” general safety audit.
3. Contact insurance company to determine if they will perform a safety audit.

INTEGRATED PEST MANAGEMENT

Introduction

Integrated Pest Management (IPM) has become an increasingly important aspect of golf course management and environmental stewardship programs. IPM plans are intended to function as internal use documents that reflect the contemporary management practice of the golf course. Accordingly, the plan should be tailored for the specific environment of the individual golf course, and should be used as an operational reference that describes and directs golf course management practice. The IPM plan should be viewed as a functional, working document that will evolve and undergo revisions over time to reflect industry developments that will bolster and optimize the effectiveness of the plan.

IPM Objective

The broad objective of Integrated Pest Management is to maximize the health of the plant as a means of minimizing the susceptibility of the plant to pests. This is accomplished by the use of optimized, disciplined, and documented golf course management practices. Pest control strategies should be developed and implemented following the consideration of safety, scientific, economic, environmental, and feasibility issues. Although there are numerous definitions of Integrated Pest Management, the OGCSA recognizes the definition provided in the Oregon Revised Statute 634.650:

“Integrated pest management” means a coordinated decision-making and action process that uses the most appropriate pest control methods and strategy in an environmentally and economically sound manner to meet agency pest management objectives. The elements of integrated pest management include:

- Preventing pest¹ problems
- Monitoring for the presence of pests and pest damage
- Establishing the density of the pest population, which may be set at zero, that can be tolerated or correlated with a damage level sufficient to warrant treatment of the problem based on health, public safety, economic or aesthetic thresholds.
- Treating pest problems to reduce populations below those levels established by damage thresholds using strategies that may include biological, cultural, mechanical and chemical control methods and that shall consider human health, ecological impact, feasibility and cost effectiveness.
- Evaluating the effects and efficacy of pest treatments.

¹Pest means any vertebrate or invertebrate animal, pathogen, parasitic plant, weed or similar or allied organism which can cause disease or damage to crops, trees, shrubs, grasses or other plants, humans, animals or property.

Developing an IPM Plan

The IPM plan is a working document that potentially will be reviewed by a wide variety of readers ranging from golf course owners to golf course maintenance staff. The plan should be thorough and contain sufficient detail to allow the reader to understand all aspects of the plan. The plan should also be written in such a way that readers with a variety of comprehension levels can easily and quickly identify specifics of the plan. Ideally, the plan should be written based on an outline form that has short, clear descriptions under each outline heading. In certain instances, the use of tables is recommended to provide a concise presentation of certain aspects of the plan.

INTEGRATED PEST MANAGEMENT PLAN OUTLINE

I. Introduction

II. Integrated Pest Management Definition

III. IPM Objectives

IV. IPM Structure

V. Area Definition

A. Turfgrass Areas

Golf Course Area Definition and Maintenance Requirements

Area	% Total Area^a	Fertilizer Requirement^b	Irrigation Requirement^b	Mowing Frequency^b	Cultural Requirement^b
Greens					
Green Surrounds					
Tee Surface					
Tee Surrounds					
Fairway					
Rough					
Ornamental					

^a = percent total turf area

^b = expressed as high, medium, low, or N/A (not applicable)

B. Non-turfgrass Areas

1. Bunkers
2. Ornamental Plantings
3. Environmentally Sensitive Areas
4. Aquatic Areas
 - (a) Streams
 - (b) Lakes
 - (c) Buffer Zones

VI. Pest Population Definition

Pest Definition and Distribution

Category	Pest ^a	Turfgrass ^b	Ornamentals ^b	Aquatic ^b
Fungal Disease				
Weeds				
Insects				

^a = list all pests by name under each category

^b = check mark denotes that the specific pest affects this area of the golf course

VII. Pest Threshold Levels

Action Threshold Limits for Specific Pests

Pest ^a	Tees	Fairways	Rough	Greens	Ornamentals
Fungal Disease ^b					
Weeds ^c					
Insects ^c					

^a = list all pests under each category

^b = threshold = % of area affected

^c = threshold expressed as number per 1000 ft²

VIII. Pest Monitoring

- A. Fungal Disease
- B. Broadleaf Weeds
- C. Insects
- D. Aquatic

IX. Pest Control

- A. Fungal Disease
- B. Weeds
- C. Insects
- D. Aquatic

X. Turfgrass Maintenance Practice

A. Cultural Practice

1. Mowing
2. Aeration
3. Thatch Management
4. Topdressing
5. Overseeding

B. Fertilization

1. Turfgrass Nutrient Requirements
 - (a) Nitrogen
 - (b) Phosphorus
 - (c) Potassium
 - (d) Additional Requirements
 - (e) pH
2. Fertilizer Treatment Areas

Fertilizer Application Areas and Typical Application Frequencies

Area	% Total Area ^a	Fertilizer Treatments per Year
Greens		
Green Surrounds		
Tee Surface		
Tee Surrounds		
Fairway		
Rough		
Ornamental		

^a = percent total turf area

3. Soil Nutrient Testing
4. Fertilizer Storage
5. Fertilizer Documentation
6. Buffer Zones

C. Irrigation

1. Water Source
2. Irrigation System
3. Irrigation Water Quality
4. Water Conservation

XI. Pesticides

- A. Pesticide Definition
- B. Pesticide Use Determination
- C. Current Practice

Pesticide Application Areas and Typical Application Frequencies

Area	% Total Area ^a	Pesticide Treatments per Year	Pesticide Category
Greens			
Green Surrounds			
Tee Surface			
Tee Surrounds			
Fairway			
Rough			
Ornamental			

^a = percent total turf area

Pesticide Selection for Potential Application

Pesticide Chemical Name ^a	Pesticide Category
	Fungicide
	Herbicide
	Insecticide
	Nematicide

^a = list each pesticide in each category that has the potential to be used on the golf course

- D. Pesticide Storage**
- E. Formulation**
- F. Application**
- G. Clean Up and Disposal**
- H. Pesticide Documentation**

XII. Facilities Description

- A. Maintenance Building**
 - 1. Mechanical Shop
 - 2. Equipment Storage
 - 3. Fertilizer Storage
 - 4. Pesticide Storage
 - 5. Staff Quarters
- B. Fluids Storage**
- C. Fuel Depot**
- D. Equipment Wash Area**
- E. Pesticide Formulation Area**

XIII. References

INTEGRATED PEST MANAGEMENT PLAN EXAMPLE

Bushwood Country Club

I. Introduction

Bushwood Country Club recognizes the importance of sound environmental stewardship, and is committed to optimizing its golf course management practice to protect the environment within, and surrounding the golf course. The following document defines an Integrated Pest Management plan that describes detailed and specific practice at Bushwood Country Club, and serves as an operational reference that directs golf course management practice. Bushwood Country Club is dedicated to the philosophy and the practicality of Integrated Pest Management, and remains vigilant to incorporate emerging and useful golf course management practices into the Integrated Pest Management plan. Accordingly, this document is viewed to be a functional document that will evolve over time, and one that will be revised to incorporate industry developments that will bolster and optimize the effectiveness of the plan.

II. Integrated Pest Management Definition

Although there are numerous definitions of Integrated Pest Management, the Bushwood Country Club recognizes the definition provided in the Oregon Revised Statute 634.650:

“Integrated pest management” means a coordinated decision-making and action process that uses the most appropriate pest control methods and strategy in an environmentally and economically sound manner to meet agency pest management objectives. The elements of integrated pest management include:

- Preventing pest¹ problems
- Monitoring for the presence of pests and pest damage
- Establishing the density of the pest population, which may be set at zero, that can be tolerated or correlated with a damage level sufficient to warrant treatment of the problem based on health, public safety, economic or aesthetic thresholds.
- Treating pest problems to reduce populations below those levels established by damage thresholds using strategies that may include biological, cultural, mechanical and chemical control methods and that shall consider human health, ecological impact, feasibility and cost effectiveness.
- Evaluating the effects and efficacy of pest treatments.

Simply stated, the broad objective of Bushwood Country Club Integrated Pest Management plan is to maximize the use of natural methods to control pests through optimized, disciplined, and documented golf course management practice. To meet this

¹Pest means any vertebrate or invertebrate animal, pathogen, parasitic plant, weed or similar or allied organism which can cause disease or damage to crops, trees, shrubs, grasses or other plants, humans, animals or property.

objective, the Bushwood Country Club Integrated Pest Management plan defines turfgrass, non-turfgrass, and aquatic management areas; pests of concern within these areas; methods to monitor pest populations; pest threshold levels that when exceeded require action; and the proper action to be taken once threshold levels have been reached.

Several examples of natural methods to control pests include optimizing turf health through maintenance practices to enhance natural plant resistance to pest infestation, optimizing habitats for beneficial species, and minimizing turf damage resulting from routine golf course operations. However, in spite of the use of natural methods, in certain instances the use of chemicals such as pesticides to control some pests is unavoidable. An essential component of the Integrated Pest Management plan is the coordination of the ongoing use of natural methods with the selective use of these agents as a means of minimizing pesticide application.

III. IPM Objectives

- Minimize potential hazards to human health and the environment
- Optimize playing conditions of the golf course
- Utilize effective monitoring to enable selective control of pest populations
- Minimize pesticide use through targeted application while optimizing pesticide efficacy
- Improve turf grass quality
- Lower operating costs

IV. IPM Structure

The structure of the Integrated Pest Management plan is based on the selective targeting of plant pathogens, weeds, and insects that threaten the agronomic health of the golf course. In addition, the Integrated Pest Management plan includes provisions to optimize the quality of aquatic areas of the golf course. The strategy of the Integrate Pest Management plan is as follows:

- Define areas requiring management and the relative maintenance intensity associated with each area
- Identify pests likely to be encountered
- Establish threshold levels for each pest which when exceeded, trigger corrective action
- Scout and monitor for the presence of pests
- Maintain vigorous turf health through maintenance practices to optimize pest tolerance
- Implement sequential corrective action when threshold levels have been exceeded
 - Adjust maintenance practices
 - Utilize biological controls when appropriate
 - Apply minimum amounts of selective chemical agents in a highly targeted fashion. Chemical agents will be selected based on minimal toxicity and optimal efficacy.
- Document all scouting and monitoring observations, treatments, and treatment results

V. Area Definition

Bushwood Country Club is an 18 hole, privately owned golf course located on 175 acres in Tansy, Oregon (Malheur County). Property surrounding the golf course includes commercial, residential, and city owned property. The golf course was built in 1931 with native materials being used for all aspects of the initial construction. The managed areas of the golf course include turfgrass areas, non-turfgrass areas, and aquatic areas. A description of each specific area is provided below:

A. Turfgrass Areas

The turfgrass areas of the golf course are dominated by *Poa annua*, with small amounts of ryegrass and bent grass being present at select locations on tee boxes. All grass types are well suited and adapted for the climate of the location. The turfgrass and ornamental areas and their respective management requirements are defined in Table 1.

Table 1. Bushwood Country Club Area Definition and Maintenance Requirements

Area	% Total Area*	Fertilizer Requirement	Irrigation Requirement	Mowing Frequency	Cultural Frequency
Greens	1.7	medium	medium to low	high	high
Green Surrounds	2.0	medium to low	medium to low	medium	medium
Tee Surface	1.7	medium to low	medium to low	medium	medium
Tee Surrounds	1.3	medium to low	medium to low	medium	medium
Fairway	16.0	medium to low	medium to low	medium	medium
Rough	77.0	medium to low	medium to low	low	low
Ornamental	0.3	medium to low	medium to low	N/A	low

* = percent total turf area

B. Non-Turfgrass Areas

Non-turfgrass areas consist of bunkers, ornamental plantings, wetlands and natural areas, and aquatic areas.

1. Bunkers

Fairway and green-side bunkers are located throughout the golf course. Bunker management is confined to routine maintenance including raking and smoothing of sand contained within the bunkers.

2. Ornamental Plantings

Ornamental plantings are limited to areas in the immediate vicinity of the Bushwood Country Club clubhouse.

3. Environmentally Sensitive Areas

To date, no areas of the golf course are officially designated as wetlands or environmentally sensitive areas. However, Bushwood Country Club considers any area of the golf course that potentially serves as wildlife habitat to be by definition

environmentally sensitive. These areas include aquatic, native vegetation, and forested areas.

4. Aquatic Areas

(a) Streams

A single, year-round stream (Bogey Creek) traverses the southwestern quadrant of the golf course. The stream enters the golf course from the western boundary, flowing across the 7th and 8th fairways, and finally exits the golf course property behind the 12th green.

(b) Lakes

The golf course contains a single, spring-fed lake in the southern half of the golf course that is located near the 4th green of the golf course.

(c) Buffer Zones

Buffer zones are defined as a corridor of land that is 25 feet in width on the sides of a stream or other body of water. In specific areas, buffer zones may be smaller than 25 feet and shall never be less than 10 feet.

Buffer zones at Bushwood Country Club will be 25 feet with the exception of turf located on the 4th hole of the golf course. For three, limited areas adjacent to the lake bordering the 4th hole (tee box, fairway peninsula, and green surround), the buffer zone will be 10 feet.

VI. Pest Population Definition

A summary of the total pest population at Bushwood Country Club is shown in Table 2.

Table 2. Pest Definition and Distribution at Bushwood Country Club

Category	Pest	Turfgrass	Ornamentals
Fungal Disease	Anthracnose	<input type="checkbox"/>	
	Pink Snow Mold	<input type="checkbox"/>	
Broadleaf Weeds	Clovers	<input type="checkbox"/>	<input type="checkbox"/>
	Mouse-ear Chickweed	<input type="checkbox"/>	<input type="checkbox"/>
Insects	Cutworms	<input type="checkbox"/>	
	European Cranefly	<input type="checkbox"/>	

VII. Pest Threshold Levels

The action threshold levels for specific pest types are shown in Table 3. Action threshold level is defined as the number of pests detected within a specified area that leads to corrective action to reduce the density of the specific pest below the threshold level.

Table 3. Action Threshold Limits for Specific Pest Categories

Pest	Tees	Fairways	Rough	Greens	Ornamentals
Fungal Disease	10% ^{a,b,c}	N/A	N/A	0.2% ^{a,b,c}	N/A
Broadleaf Weeds	1-5/1000 ft ²	5-10/1000 ft ²	20/1000 ft ²	1/1000 ft ²	20/1000 ft ²
Insects					
Cutworms	2/ft ²	N/A	N/A	10/1000 ft ²	N/A
European Crane fly	25-40/ft ²	25-40/ft ²	N/A	15-25/ft ²	N/A

^a = % of area affected

^b = when conditions dictate, preventative measures will be used

^c = spot treatments are used when conditions dictate

VIII. Pest Monitoring

All golf course maintenance staff will be trained to routinely scout the golf course and monitor for evidence of pest infestation appropriate for their individual job descriptions. The intensity and frequency of monitoring will be adjusted based on the likelihood of pest infestation (i.e., seasonal) or in situation/site specific instances. All monitoring observations of potential pest infestation will be reported directly to the superintendent on the same day of the observation, and will be documented in a monitoring log book. Recorded observations will include the area observed and a description of the pest(s). No action will be taken until the threshold for a specific pest has been exceeded. If the threshold for a given pest is exceeded, the resulting corrective action and the corresponding results will also be recorded in the log book.

A. Fungal Disease

Fungal disease represents a serious threat to turf health and is of concern primarily on tees and greens. Tees and greens will be inspected regularly for symptoms of fungal disease. The primary means of identifying fungal disease will be diagnosis by the superintendent. However, in some instances symptoms consistent with fungal disease may have alternative causes (nutrient deficiency, insects, etc.). When uncertainty regarding potential fungal disease is encountered, samples will be sent to a plant pathology lab for confirmation of the presence of fungal pathogens. Heightened monitoring of greens and tees will occur when conditions known to favor the development of these pathogens occur. Conditions favoring each specific disease are as follows:

1. Anthraxnose (*Colletotrichum graminicola*)

Anthraxnose appears in the summer when temperatures exceed >78°F and soil moisture conditions are high. Disease development is promoted by compaction, excess thatch, and low nitrogen conditions. Symptoms of Anthracnose include

yellow to brown irregular shaped areas on turf with grass leaves having yellow lesions with black centers.

2. Fusarium Patch (*Microdochium nivale*)

Fusarium Patch appears in the autumn, winter, and spring and is very common in Western Oregon during the winter. Conditions favoring disease development include cool temperatures (35° - 65°C) and lush turf growth in which turf contains high nitrogen and low potassium. Symptoms of Fusarium Patch include light reddish to brown patches ranging from one to eight inches in diameter

B. Weeds

All turfgrass and ornamental areas will be monitored regularly for the presence of broadleaf and grass weeds.

C. Insects

Monitoring for insects will consist of visual inspection of susceptible areas on a daily basis. Conditions favoring the development of specific insects are as follows:

1. Cutworms (*Noctuidae* family)

The adult cutworm is a moth that lays eggs on grass leaves at night. The resultant larvae are thick-bodied caterpillars approximately 1.5 to 2 inches in length that may be greenish gray, brown, or black, and often have spots or stripes. The larvae reside in the thatch layer during the day and emerge to the surface to feed on the grass blades at night. Cutworm infestation results in small brown circular patches on the turf. Also, an indication of cutworm infestation is the presence of birds attempting to feed on cutworms by digging at the thatch layer during the day.

2. European Crane fly (*Tipula paludosa*)

The European Crane fly is a flying insect that resembles a large mosquito. Adults lay eggs on the turf in late summer, which hatch in late fall. The resulting larvae are approximately one inch long and are brownish gray in appearance. The larvae feed on the turf during the fall, overwinter, and then become active in the early spring. The larvae reside under the surface of the turf and feed on the turf root system, becoming especially active after soil temperatures exceed 50°F in the early spring. Evidence of infestation is the presence of irregular brownish patches on the turf surface and general turf thinning.

D. Aquatic

Monitoring of the streams and ponds on the golf course will consist of visual inspection of these areas on a daily basis. The optimal condition is to have zero aquatic pests. As a result, early detection of aquatic pests is very important, and corrective action will be engaged as soon as evidence of these pests is recognized.

IX. Pest Control

The pest control strategy is sequential and consists of using maintenance practices as the first line of defense, followed by biological/chemical control where appropriate. Pest control strategy will be developed on a case by case basis with all potential control options given consideration. The decision to implement appropriate pest control measures beyond maintenance practices will be based on the review of relevant safety, scientific, economic, environmental, and feasibility information.

Specific pest control strategies are defined below.

A. Fungal Disease

Within the overall spectrum of pest management, fungal disease represents the most serious and consistent threat to turfgrass health at Bushwood Country Club. An essential aspect of preventing the development fungal disease is the optimization of turf vigor through routine management practice. In addition, fungal disease control is dependent on the correct identification of the disease, understanding the disease cycle and conditions that promote disease development, and the selective use of the appropriate fungicide agents. Certain, specific maintenance practices can be employed to minimize the potential for fungal disease, which are described below. In general, if these measures fail and symptoms of fungal infestation are observed, the next tactic is the selective application of fungicides.

1. Anthracnose

(a) Cultural Control

Nitrogen will be applied at the rate of 1/2 lb N/1000 ft²/4 weeks or less. Light-weight mowing equipment will be used when practical to minimize compaction of turf and the thatch layer will be monitored and managed in an effort to restrict the thatch layer to 1/4" or less. Shade will be minimized to improve air circulation for enhanced drying of turf, and irrigation of tees and greens will be avoided in the late afternoon and evening prior to midnight. Disease resistant cultivars will be used during overseeding.

(b) Fungicide Control

In the event that conditions favoring Anthracnose growth develop, select turfgrass areas will receive preventative treatment with Azoxystrobin. If actual Anthracnose infestation is diagnosed, affected areas will be treated with Thiophanate Methyl, Chlorothalonil, or Iprodione.

2. Fusarium Patch

(a) Cultural Control

Moderate rates of nitrogen will be applied at the rate of 1/2 lb N/1000 ft²/month or less during late summer and fall. Moderate to high levels of potassium and phosphorus will be maintained. Shade will be minimized to improve air circulation for enhanced drying of turf and drainage will be optimized. Irrigation of tees and greens will be avoided in the late afternoon and evening prior to midnight, and soil moisture will be monitored to avoid drought stress.

(b) Fungicide Control

In the event that Fusarium Patch infestation is diagnosed, affected areas will be treated with Thiophanate Methyl, Chlorothalonil, Iprodione, Pentachloronitrobenzene, or Azoxystrobin.

B. Weeds

1. Turfgrass

The standard means of controlling broadleaf infestation will be to optimize turf health through standard maintenance practices. Selection of well-adapted turfgrass cultivars in combination with proper cultural practice, fertilization, irrigation, insect and disease control produces a dense vigorous turf that optimizes resistance to colonization by broadleaf weeds. If maintenance practices are not completely effective, the first approach to broadleaf control at Bushwood Country Club will be mechanical removal (i.e., hand pulling).

Clover is the primary broadleaf weed pest that occasionally requires management outside of management practice and mechanical removal. When threshold levels of clover have been exceeded, clover containing areas will be selectively treated with applications of Triclopyr + Clorpyralid.

Mouse-ear chickweed is detected occasionally on greens, and when encountered, will be removed by hand pulling.

At this time grass weeds are not a threat nor are any control measures warranted. Scouting and monitoring for undesirable grass weeds will continue.

2. Ornamentals

Broadleaf and grass weeds in ornamental areas will be controlled primarily by mechanical means (hand pulling). In addition, mulches such as bark dust will be used to control weed populations. On occasion, the herbicide Glyphosate will be used for weed control.

C. Insects

General turfgrass maintenance practices leading to optimal turf vigor aid in minimizing the impact of insect infestation. However, when threshold levels of a specific insect have been exceeded, the selective use of biological agents and/or insecticides will be employed.

1. Cutworms

(a) Cultural Control

Optimize turf vigor through standard maintenance practices.

(b) Biological Control

Several biological agents including azadirachtin (Turplex, Margosan-O) and *Bacillus thuringiensis* (Bactimos, Dipel, M-One, M-Peril, MVP, Teknar, Thuricide, etc.) have been shown to be effective agents against cutworms. These agents will be considered for use following a cost/efficacy analysis.

- (c) Insecticide Control
The insecticide used to control cutworm infestations exceeding threshold levels will be Chlorpyrifos.

2. European Cranefly

- (a) Cultural Control
Optimize turf vigor through standard maintenance practices.
- (b) Biological Control
Steinernema carpocapse (Turfco Vector) is a commercially available nematode shown to be effective at treating European Cranefly infestation. This agent will be considered for use following a cost/efficacy analysis.
- (c) Insecticide Control
The insecticide currently used to control European Cranefly infestations that exceed threshold levels will be Chlorpyrifos.

D. Aquatic

Management of aquatic areas at Bushwood Country Club is primarily restricted to the mechanical removal of weeds. To date, no acute or chronic aquatic pests have required management (including pesticide application) in aquatic areas.

X. Turfgrass Maintenance Practices

Turfgrass area maintenance is the most labor intensive element of the Integrated Pest Management program, requiring greater than 95% of resource allocation. As stated repeatedly throughout this document, the primary intent of the Integrated Pest Management program is to optimize turfgrass vigor utilizing sound maintenance practices as a means of preventing and/or minimizing pest infestation. The three basic components of turfgrass maintenance practices at Bushwood Country Club include cultural practice, fertilization, and irrigation.

A. Cultural Practice

Cultural practice includes the routine use of mechanical controls such as mowing, aeration, topdressing, thatch removal, and overseeding to promote a healthy turf environment.

1. Mowing

Mowing will be performed on an as-needed basis and mowing frequency is area dependent. Mowing of Greens occurs daily, mowing of tees and fairways occurs three to four times per week, and mowing of the rough occurs on an average of one to two times per week.

Lightweight mowing equipment is used as often as practical to minimize turf compaction and mowing heights are adjusted for individual areas. Mowing heights include 0.115 to 0.200 inches for greens, 0.35 to 0.5 inches for tees, 0.5 to 0.75 inches for fairways, and 1.5 to 2.5 inches for rough.

2. Aeration

Aeration is the practice of removing soil cores from turf and is performed to minimize turf compaction. This practice enhances the movement of air, water and nutrients in the soil and is a useful technique to manage thatch layers.

Aeration frequency is greatest for greens and tees and to a lesser extent for fairways. Aeration is typically performed during periods of active turf growth in the early spring, early summer and fall; although selective aeration may occur at the discretion of the superintendent. In the case of greens, topdressing sand is applied to fill the cores resulting from the aeration treatment.

3. Thatch Management

Thatch is a layer of organic debris and the roots, crowns, and stems of grass that exists between the soil and the turf canopy. In the absence of cultural management, this layer becomes thicker over time, resulting in sub-optimal turf growth. Management of thatch is particularly important on greens and consists primarily of aeration and topdressing practices. The thatch layer on greens will be maintained at a depth of 0.5 inches or less.

4. Topdressing

The practice of topdressing consists of the application of a layer of sand to greens and is used to assist in thatch layer management and to provide a smooth and firm playing surface. Topdressing applications typically follow the aeration or verticutting of greens, and are also made in the absence of aeration ("light" topdressing). Following the application of sand, the sand is lightly brushed into the turf surface.

5. Overseeding

Overseeding is the selective application of turfgrass seed to improve areas of turf depletion and to bolster turf density. Overseeding is performed in the late fall, early spring, or early summer.

B. Fertilization

The application of fertilizers is essential for development of turf vigor. Management of turf fertility involves the understanding of soil composition, fertility management history, and the use of soil test information. The objective of the fertilizer program is to provide maximum nutrient availability to turf while simultaneously avoiding the application of excess nutrients to avoid weed infestation, disease development, and nutrient runoff.

1. Soil Nutrient Testing

Soil testing for nutrient composition provides valuable information that allows for the development of strategic fertilizer plan development and also provides insight into the affect of preceding management practice. Soil testing will be performed on areas of the golf course selected by the superintendent to generate information that will provide technical support during the development of the fertilizer program.

2. Turfgrass Nutrient Requirements

The major nutrients required for turfgrass health are nitrogen, phosphorus, potassium, calcium, sulfur and iron. “Minor” nutrients, also referred to as micronutrients, include boron, copper, manganese, magnesium, and zinc. The availability of nutrients to turfgrass is influenced markedly by the pH of the soil. Consequently, maintenance of the appropriate pH is an important component of the fertilizer program.

(a) Nitrogen

The management of nitrogen levels is critical owing to the high turf demand for this nutrient and the potential for excess nitrogen to enter into surface water and groundwater. As a result, the amount of nitrogen delivered to turfgrass will be the minimum amount necessary to promote turf vigor. In general, nitrogen will be applied based on known rates to be effective for Western Oregon. In certain instances when turf and/or climate conditions dictate, rates of application will be adjusted (either higher or lower) at the discretion of the superintendent.

Nitrogen formulations consist of water insoluble (slow release) and water soluble (quick release) types. Slow release nitrogen sources include methylene urea, sulfur-coated urea, IBDU, polymer coated fertilizers, and organic preparations such as activated sewage sludge. Examples of quick release nitrogen sources include ammonium sulfate, ammonium nitrate, potassium nitrate, and urea. To maximize plant uptake and minimize nitrogen runoff (e.g., nitrate), slow release nitrogen sources and/or light applications of soluble nitrogen (“spoonfeeding”) will be used whenever possible.

Determination of the appropriate nitrogen source will be at the discretion of the superintendent and will be based on the season and relative growth rate of the turf at the time of application.

(b) Phosphorus

Turf requirements for phosphorus are relatively low and phosphorus does not leach from soil quickly. As a result, application rates tend to be corresponding low, which minimizes the possibility of storm water runoff carrying residual phosphorus into water systems.

(c) Potassium

Turf requirements for potassium are intermediate to high in relation to nitrogen and phosphorus levels. In general, potassium rates are dictated by the NPK formulation chosen for application. Although applied to maximize efficiency of uptake, potassium does not pose the extent of environmental risk that excess nitrogen and phosphorus levels represent.

(d) Additional Nutrients

In general, turfgrass requirements for sulfur, calcium, iron, and micronutrients are lower than for nitrogen, phosphorus and potassium. These nutrients are available in a variety of formulations and application of these nutrients will be at the discretion of the superintendent.

(e) pH

Maintenance of the proper soil pH is essential in optimizing the availability of nutrients, and also is important in minimizing overall turfgrass stress. When the soil pH requires adjustment to a more alkaline pH, lime will be added until the targeted pH is obtained. When soil requires adjustment to a more acidic pH, ammonium sulfate will be added until the targeted pH is obtained.

3. Fertilizer Treatment Areas

The rate and frequency of fertilizer application is area and situation dependent. A typical fertilizer application frequency is shown in Table 4. Fertilizer application is most frequent on the greens with less frequent applications being made to tees and fairways, and the least frequent application being made to the rough.

**Table 4. Bushwood Country Club:
Fertilizer Application Areas and Typical Application Frequencies**

Area	% Total Area ^a	Fertilizer Treatments per Year
Greens	3.5	12 ^b
Green Surrounds	5.5	3
Tee Surface	3	8
Tee Surrounds	1.5	3
Fairway	38	1 - 3
Rough	48	0 - 1
Ornamental	0.5	2

^a = percent total turf area

^b = light rates applied frequently to minimize growth and potential leaching

4. Fertilizer Storage

All fertilizers will be maintained in a dedicated moisture free, well-ventilated storage area.

5. Fertilizer Documentation

Records of all fertilizer purchases will be maintained in a fertilizer log book. All fertilizer applications will be documented on a fertilizer application form. Information recorded will include date of application, location of application, type of fertilizer(s) applied, rate of application, irrigation following application, and the identity of the applicator(s).

6. Buffer Zones

No fertilizer will be applied to turf located in designated buffer zones.

C. Irrigation

1. Water Source

Bushwood Country Club irrigates with water taken from a spring-fed lake located on the fourth hole.

2. Irrigation System

The irrigation system is currently an automated satellite control system that is computer controlled. Areas of localized dryness are treated by hand watering.

3. Irrigation Water Quality

Historically, no turfgrass problems have been correlated with problems in irrigation water quality. Accordingly, testing of irrigation water quality is not performed. In the event that turfgrass symptoms indicate potential contaminants in irrigation water, water samples will be acquired from all irrigation water sources and submitted for irrigation suitability testing by a qualified analytical laboratory.

4. Water Conservation

Irrigation is limited to prevent over-application of water as a means of optimizing turf vigor and conserving water. The areas requiring the most frequent irrigation are tees, fairways, and greens. Because it represents a substantial percentage of the overall turfgrass area, the rough is irrigated as sparingly as possible to conserve water.

The primary means of determining turfgrass irrigation requirements is the daily observations of the superintendent and staff. Additionally, the computer controlled irrigation system has a water budgeting feature, which relies upon evapotranspiration data acquired from a weather monitoring station located on the golf course.

XI. Pesticides

A. Pesticide Definition

A pesticide is any substance that is used to control pests including insects (insecticides), weeds (herbicides), and fungi (fungicides). The mechanism of action of most pesticides is to eliminate the pest by suppressing, weakening or eradicating the target pest.

B. Pesticide Use Determination

The ideal pesticide is highly potent (requires minimal application), is target-specific (is safe for non-targeted species), and is compatible with the environment. While these properties are ideal and pursued by pesticide manufacturers, the degree of cross-toxicity and environmental compatibility in pesticides approved for use by the Environmental Protection Agency can vary considerably. As a result, if avoidable, pesticides will not be used. In the event that pesticide application is necessary, pesticides will be applied according to label.

The primary strategy for pest management as defined in this Integrated Pest Management plan is to optimize turf vigor through maintenance practices to optimize turf resistance to, or tolerance of pests. In the event that maintenance practices do not maintain pest populations below damage thresholds, biological/chemical controls will be considered when necessary. Pesticides applied to control pests will be selected by the superintendent based on their safety, efficacy, economic impact, toxicology and environmental compatibility. In addition, the superintendent will monitor developments in pesticide research and development; and he/she will incorporate the use of newly developed, tested and improved pesticides approved by EPA where appropriate.

C. Current Practice

In certain instances the use of pesticides for pest management is unavoidable. The locations of pesticide use and the typical frequency of the application of these agents is shown in Table 5.

**Table 5. Bushwood Country Club:
Pesticide Application Areas and Typical Application Frequencies**

Area	% Total Area ^a	Pesticide Treatments per Year
Greens	3.5	6 - 12
Green Surrounds	5.5	0 - 1
Tee Surface	3	0 - 4
Tee Surrounds	1.5	0 - 1
Fairway	38	0 - 1
Rough	48	0 - 1
Ornamental	0.5	0

^a = percent total turf area

On occasion, the herbicide Glyphosate will be applied to limited areas surrounding trees and along fence lines.

The pesticides that have potential for use at Bushwood Country Club include eleven fungicides, nine herbicides, one insecticide, and one nematocide (Table 6). To minimize the development of disease resistance, pesticides with different mechanisms of action will be rotated as frequently as practical and necessary. In addition, if pest resistance to these agents does develop, or if unanticipated circumstances arise, the superintendent may use alternative EPA approved pesticides as required.

**Table 6. Pesticide Selection for Potential Application at
Bushwood Country Club**

Pesticide Chemical Name	Pesticide Category
Azoxystrobin	Fungicide
Chloroneb	Fungicide
Chlorothalonil	Fungicide

Table 6. Pesticide Selection for Potential Application at Bushwood Country Club

Iprodione	Fungicide
Mancozeb	Fungicide
Metalaxyl	Fungicide
Propiconazole	Fungicide
Thiophanate Methyl	Fungicide
Triadimefon	Fungicide
Pentachloronitrobenzene	Fungicide
Copper Sulfate	Herbicide
Dichlobenil	Herbicide
Halosulfuron-methyl	Herbicide
Glyphosate	Herbicide
Pelargonic Acid	Herbicide
Oryzalin	Herbicide
Triclopyr	Herbicide
Triclopyr + Clopyralid	Herbicide
Chlorpyrifos	Insecticide
Phenamiphos	Nematicide

D. Pesticide Storage

All pesticides will be maintained in a dedicated, dry, well-ventilated area that has restricted access.

E. Formulation

Prior to pesticide formulation, the superintendent will determine that local weather conditions are suitable for pesticide application. All pesticides will be formulated according to manufacturer's labeling instructions by properly trained personnel. Personnel will wear personal protective equipment appropriate for the pesticide being formulated during the entire mixing process. All formulations will be prepared in a dedicated pesticide mixing area.

F. Application

All pesticides will be applied by personnel properly trained in the safe application of these agents. Applicators will wear appropriate personal protective equipment appropriate for the pesticide being applied. All pesticide application equipment will be properly calibrated prior to the addition of the pesticide formulation to the equipment and application to the golf course. Mobil spill response equipment and safety equipment will accompany applicators during the application process.

The areas of the golf course requiring pesticide application will be specifically defined by the superintendent. Whenever, possible, applications will be selective and limited to localized, targeted areas to minimize the amount of pesticide being applied.

Pesticide delivery in buffer zones will be carried out by hand with directed, low volume, single wand sprayers, or drop spreaders. No pesticide spray applications will occur if wind speed is above 5 miles per hour or if wind direction or activity will carry pesticides toward, or deposit them upon open water. No broadleaf herbicides will be applied to turf located in designated buffer zones.

G. Clean Up and Disposal

Pesticide containers, mixing tanks, and equipment will be rinsed in accordance with recommended procedures and rinse water will be distributed onto the golf course.

H. Pesticide Documentation

All pesticide purchases and usage will be documented in a pesticide log book as a means of monitoring inventory control. Pesticide application information recorded will include date of application, location of application, type of pesticide applied, rate of application, weather conditions, and the identity of the applicator(s). In addition, current pesticide labels and MSDS sheets will be compiled and maintained in a location accessible to all employees. All pesticide documentation will be in accordance with federal and state regulations.

XII. Facilities Description

A. Maintenance Building

The maintenance facility at Bushwood Country Club consists of a single building containing approximately 10,000 square feet of floor space. The building is segregated into five main areas which are described below.

1. Mechanical Shop

This area is dedicated area of the maintenance building where all equipment maintenance and repair work is performed. All fluids and solvents required for maintenance and repair are maintained within this area and used fluids and solvents are disposed of according to federal, state, and local guidelines.

2. Equipment Storage

This area contains all equipment used in golf course maintenance operations including mowers, tractors, and fertilizer and pesticide application equipment.

3. Fertilizer Storage

All fertilizer is stored in a dedicated storage room within the maintenance building. The storage room is completely isolated and allows for the maintenance of fertilizer in a dry, well-ventilated environment.

4. Pesticide Storage

All pesticides are stored in a dedicated storage room that has restricted access. The storage room includes dedicated ventilation and temperature control systems. Spill response equipment is also contained within this room. Liquid pesticides will be stored below dry pesticides in the storage rack areas.

5. Staff Quarters

This area consists of the superintendent's office, the staff lunchroom, staff locker room and staff rest room.

B. Petroleum Fluid Storage and Disposal

1. All oils, solvents, lubricants, and antifreeze are stored in a dedicated storage room adjacent to the mechanical shop.
2. Used fluids are stored in separate containers appropriate for the fluid type.
3. Used fluid containers are labeled with the identity of the used fluid.
4. Used fluids are disposed of according to state and federal regulations.

C. Fuel Depot

The fuel depot is located approximately 100 feet from the maintenance building and consists of a gravity feed gasoline tank and a gravity feed diesel tank.

D. Equipment Wash Area

All washing of equipment will occur at a dedicated equipment wash bay located on the south end of the maintenance building. The wash bay consists of a curbed, concrete pad with a centrally located drain. Drain water from the pad will be processed through a dedicated series of filters to remove grease, oil, and solvent residues.

E. Pesticide Mixing Area

All pesticide mixing occurs at a dedicated mixing area located at the south end of the maintenance building. The mixing bay consists of a curbed, concrete pad with a centrally located drain. Drain water from the pad will be processed through a dedicated series of filters to remove pesticide residues.

XIII. References

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WATER QUALITY MONITORING

Why Develop a Water Quality Monitoring Plan?

A golf course specific water quality monitoring program provides the superintendent with direct and informative feedback regarding the impact of golf course management practice on water quality. In addition, a water quality monitoring program assists in addressing a wide variety of local, state, and federal regulations that govern the protection of surface water and groundwater.

Objective of Water Quality Monitoring

The primary objective of a water quality monitoring program is to establish accountability for management practice as it pertains to water quality. Although regulatory expectations can vary, the two basic issues that should drive the development of a water quality monitoring program include eutrophication (nutrient loading) and toxicity. The chemicals used in golf course management practice that are of primary concern with respect to these issues are nitrogen, phosphorus, and pesticides.

Water Quality Monitoring Guidance

Historically, the development of a formal golf course specific water quality monitoring program has been hampered by the lack of a suitable monitoring model (i.e., testing frequency, etc.). However, the National Marine Fisheries Service (NMFS) has published a significant document in the *Federal Register* on January 3, 2000 (vol 65, No.1) entitled "Endangered and Threatened Species: Proposed Rule Governing Take of Seven Threatened Evolutionarily Significant Units (ESUs); Proposed Rule." This document "represents the regulations NMFS believes necessary and advisable to conserve the seven listed threatened salmonid ESUs and defines programs that NMFS concludes will lead to the conservation of the listed endangered species." One of these programs is the Portland Parks and Recreation (PPR) Pest Management Policy, which includes a description of golf course management practice. Comment on the PPR Pest Management Policy by NMFS represents a stringent review of management practice (including golf courses) as it affects a highly sensitive aquatic environment

OGCSA Opinion

At the outset of the development of Environmental Stewardship Guidelines, OGCSA determined that the top priority for the Guidelines was to establish the highest quality of standards possible. With this objective in mind, OGCSA believes that the favorable comment on the PPR pest management policy by NMFS represents an independent, thorough, and highly qualified scientific review of relevant, highly sensitive environmental and water quality issues. In addition, OGCSA has determined that technical elements defined in the PPR policy provide clear and concise guidance that can be used in the formulation of golf course specific water quality monitoring guidelines. Accordingly, technical guidance within the PPR pest management policy

has been used to develop the following OGCSA recommended water quality monitoring guidelines.

WATER QUALITY MONITORING PROGRAM OUTLINE

I. Introduction

The water quality monitoring program outline shown below consists of four sections which include application restrictions, monitoring plan design, sample collection and testing, and proper methods for documenting monitoring activity.

II. Application Restrictions

Maintenance of buffer zones and minimizing pesticide drift are preventative, operational measures (i.e., not monitoring functions), and typically are described in IPM documents. These restrictions have been included in this section in an effort to create a single document that is as faithful to the Portland Parks and Recreation (PPR) *Pest Management Policy* as possible.

A. Buffer Zones

Buffer zones are defined as a corridor of land 25 feet on the sides of a stream or other body of water, but may be as little as 10 feet in specified areas. No fertilizer or broadleaf herbicides should be applied to turf in designated buffer zones.

B. Pesticide Drift

No application of pesticides is to occur if wind exceeds 5 mph or if wind direction will carry pesticides toward open water.

III. Monitoring Plan Design

A rugged water quality monitoring program is dependent on a number of individual features that collectively contribute to a system of monitoring golf course management practice that is comprehensive, thorough, and meaningful. The strength of the information generated is directly dependent on each of the individual components, listed below, functioning properly.

A. Water Quality Testing Parameters

Water should be tested two times per year for the presence of fertilizer runoff indicators (nitrate and phosphorus) and for any pesticides that have been applied to the golf course during the preceding 6 months.

B. Timing of Water Testing

Water samples should be collected in the late spring at the same time each year. A 7-day sample collection window is advised. A second set of samples should be collected in the fall during a 7-day window six months from the spring sample collection event.

C. Sample Locations

The sample locations will vary from golf course to golf course. The ideal monitoring plan design should include samples taken from all locations where surface water enters the golf course (“water on”) and at each location where surface water exits the golf course (“water off”). Testing of samples taken from entry points serves to establish a baseline to determine the influence of golf course management practice on water quality by comparison of testing results for these locations with those obtained for water exiting the golf course. Test results obtained for these locations also allows for the evaluation of influences of upstream locations on the quality of water entering the golf course.

In the event that resource limitations restrict testing from entry and exit points, sampling from all exit points should be viewed as the minimum in order to develop meaningful monitoring information.

IV. Sample Collection and Testing

A. Sample Labeling

After determining the sampling locations, assign a unique sample identifier or code, to each sampling location. Try to use simple identifiers and restrict the sample code to five characters or less. An example would be assignment of the “Avery Country Club north exit point” sample with the sample identifier of “ACCNX.” The use of short, unique sample identifiers streamlines the testing laboratory documentation process, reduces the possibility of sample mix-up, and minimizes the documentation demands for the superintendent.

B. Sample Collection Methods

Proper sample collection methods are also important in developing optimal testing information value. The basic principles of proper sample collection are as follows.

1. Develop a written description of the sample collection procedure so that a single, uniform method can be referred to by various staff members that may be responsible for sample collection.
2. The most critical aspect of sample collection is to be consistent in obtaining samples from the *exact* same location during each sample collection event. A map that clearly defines the sampling location(s) will assist in this process.
3. Use appropriate sample collection vessels.
 - (a) Water for nitrate and phosphorus testing should be collected in new, clean plastic bottles.
 - (b) Collection bottles must contain the appropriate preservative (e.g., sulfuric acid for phosphorus testing).
 - (c) Water for pesticide testing should be collected in new, clean, brown glass bottles which should be sealed with a clean, teflon-lined lid.

4. Sample volume
 - (a) Collect approximately 250 milliliters (one cup) for nitrate and phosphorus testing.
 - (b) Collect a minimum of one liter (one quart) for pesticide testing.
5. Label each sample collection bottle with the appropriate sample identifier (code), the date and time of collection, and the type of testing to be performed.

C. Sample Handling and Transport

Following collection, maintain samples in a refrigerated condition until delivery to the testing laboratory. This can be accomplished by placing samples into a simple cooler containing ice or cold packs. Samples requiring nitrate testing need to be received by the testing laboratory within 48 hours from the time of sample collection. Samples collected for pesticide testing need to be received by the testing laboratory within 7 calendar days of sample collection.

D. Test Methods

Samples should be tested using methods approved by the Environmental Protection Agency (EPA). Confirm that the testing laboratory uses EPA test methods before delivering samples to the laboratory for testing.

E. Testing Laboratories

The data generated from the testing of samples is the foundation of the water quality monitoring plan. Accordingly, it is essential that the testing laboratory is reputable and has demonstrated proficiency in water quality testing expertise to relevant, independent certification agencies. When considering a testing laboratory, ask the laboratory for a copy of their credentials. Ideally, the laboratory should be a certified drinking water testing laboratory. Additionally, certain laboratories have certification credentials from other state agencies. It is also important to know if the laboratory you will be working with actually performs the testing on site. Many laboratories sub-contract out this type of testing. If possible, work directly with the laboratory that performs the actual testing.

V. Monitoring Documentation

Monitoring documentation includes chain of custody, laboratory reports, interpretations of laboratory test data, and corrective action (if taken). It is advisable to maintain this documentation in a single, three ring binder so that all relevant information if available from a single source. Maintenance of documentation in this fashion provides a highly efficient means of displaying the specifics, as well as the history of the program to all interested parties (staff, management, regulatory, etc.).

A. Chain of Custody

Chain of custody is a formal means of documenting the location of a sample or samples from the time of sample collection until the time of sample delivery to the testing laboratory. Included in this documentation should be a description of the sample

storage conditions. The intention of chain of custody is to establish a clear “trail” that defines who was responsible for the possession and maintenance of the sample(s) from the start (sample collection) to the end (sample delivery to the laboratory) of the process.

Generally, chain of custody is documented on a single sheet of paper that includes sections for signatures, and the date and time of sample transfer from one individual to another. Often times, testing laboratories provide blank chain of custody documents for their customers.

B. Laboratory Reports

Laboratory reports containing the “raw” test data should be maintained in a separate section of the water quality monitoring program notebook in chronological order.

C. Test Result Interpretation

It is important to have written interpretation of the test results to support the “raw” test data. In general, most testing laboratories do not provide this type of interpretation, so it may become necessary for the superintendent to generate this document. The interpretation should be made by making “water on/water off” comparisons, comparison of testing results to relevant regulations, and commenting on the relative significance of the testing results with respect to golf course management practice.

D. Corrective Action

In the event that testing results indicate that management practice may potentially threaten to degrade water quality, it is very important to document the best way to change practice to correct the situation. A good example would be if test results showed a golf-course management related elevation in nitrate levels. A review of fertilizer records identified that nitrogen had been applied two days preceding water sample collection, and that heavy rains had followed application for the two days preceding sample collection. Documentation of corrective action would include the findings of the review of fertilizer applications records, and the corrective action statement that in the future greater attention will be paid to weather forecasts and that if heavy rain is imminent, application will be delayed until drier conditions exist.

It is very important that if corrective action is taken, it is taken as quickly as possible upon receipt of the test results and that it is documented in a clear, concise fashion.

WATER QUALITY MONITORING PROGRAM EXAMPLE

I. Introduction

A golf course water quality monitoring program provides the superintendent with direct and informative feedback regarding the impact of golf course management practice on water quality. In addition, a water quality monitoring program assists in addressing a wide variety of local, state, and federal regulations that govern the protection of surface water and groundwater.

The primary objective of a water quality monitoring program is to establish accountability for management practice as it pertains to water quality. The two basic issues of concern regarding the impact of golf course management practice on water quality include eutrophication (nutrient loading) and toxicity. The chemicals used in golf course management practice that have potential to cause eutrophication and/or toxicity are nitrogen, phosphorus, and pesticides.

Consistent with its *Integrated Pest Management Policy*, Bushwood Country Club recognizes the importance of sound environmental stewardship, and is committed to optimizing its golf course management practice to protect the environment within, and surrounding the golf course. The following document describes a program specific for Bushwood Country Club that is designed to monitor the quality of water obtained from specific locations of the golf course at specific time points during the year. Using EPA methods, water samples will be tested semi-annually for the presence of the nutrient indicators phosphorus and nitrate, and for all pesticides applied to the golf course during the six months preceding the sample collection event.

II. Structure

Historically, the development of a formal golf course specific water quality monitoring program has been hampered by the lack of a suitable monitoring model (i.e., testing frequency, etc.). However, the National Marine Fisheries Service (NMFS) has published a significant document [(4d) rule] entitled *Endangered and Threatened Species: Proposed Rule Governing Take of Seven Threatened Evolutionarily Significant Units (ESUs)*' *Proposed Rule*. This document "represents the regulations NMFS believes necessary and advisable to conserve the seven listed threatened salmonid ESUs and defines programs that NMFS concludes will lead to the conservation of the listed endangered species." One of these programs is the Portland Parks and Recreation (PPR) *Pest Management Policy*, which includes a description of golf course management practice.

Comment on the PPR *Pest Management Policy* by NMFS represents an independent, thorough, and highly qualified scientific review of relevant, highly sensitive environmental and water quality issues. The favorable comment on the PPR *Pest Management Policy* by

NMFS provides clear and concise guidance that can be used in the formulation of golf course specific water quality monitoring programs. Accordingly, the structure of the Bushwood Country Club water quality monitoring program is designed to be consistent with guidelines established within the PPR *Pest Management Policy*, and is specific for the environment of Bushwood Country Club.

The Waterways Pest Management Policy of the PPR *Pest Management Policy* states that for golf course waterways testing “Waters adjacent to treated areas within the golf course shall be tested on a regular basis for fertilizer and pesticide levels. Frequency of the testing will depend upon the scheduling of applications, but shall occur no less than twice per year.” As a result, a semi-annual testing frequency is a central feature of the Bushwood Country Club water quality monitoring program.

In addition, the water quality monitoring program is configured to incorporate Best Management Practices, and technical recommendations provided in relevant Environmental Protection Agency and Department of Environmental Quality guidance documents which include:

- A. *Volunteer Stream Monitoring: A Methods Manual* (EPA 841-B-97-003)
- B. *Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska* (EPA/910/9-91-001)
- C. *Oregon Department of Environmental Quality Laboratory Field Sampling Reference Guide, Revision 4.0*

III. **Sample Locations and Sample Collection Methods**

For nutrient testing, water samples will be collected from three separate locations for each sampling time point. For pesticide testing, water samples will be collected from two of the three nutrient sampling locations for each sampling time point. Each sample location will be assigned a unique sample identifier, and the same sample identifiers will be used to label respective samples throughout the course of the monitoring program. Samples with the same identifier but collected at different time points will be distinguished from one another by date of sample collection. Sample identifiers and the corresponding sample locations are as follows:

BCCBE (Bushwood Country Club - Bogey Creek Entry): This sample will be collected from the western border of the golf course where Bogey Creek enters the golf course on the 7th hole. A sample will be collected for nitrate testing from the center of the stream at a depth of approximately six inches in a clean, plastic bottle and will be sealed with a clean plastic lid. A sample will be collected for phosphorus testing from the center of the stream at a depth of approximately six inches in a separate clean, plastic bottle containing a sulfuric acid preservative and will be sealed with a clean plastic lid. A sample for pesticide testing will be collected from the center of the stream at a depth of approximately six inches in a clean, amber, one liter glass bottle, and will be sealed with a clean, teflon-lined lid.

BCCBX (Bushwood Country Club - Bogey Creek Exit): This sample will be collected at a location where Bogey Creek exits the southern border of the golf course behind the 12th green. A sample will be collected for nitrate testing from the center of the stream at a depth of approximately six inches in a clean, plastic bottle and will be sealed with a clean plastic lid. A sample will be collected for phosphorus testing from the center of the stream at a depth of approximately six inches in a separate clean, plastic bottle containing a sulfuric acid preservative and will be sealed with a clean plastic lid. A sample for pesticide testing will be collected from the center of the stream at a depth of approximately six inches in a clean, amber, one liter glass bottle, and will be sealed with a clean, teflon-lined lid.

BCC4G (Bushwood Country Club - 4 Green): This sample will be collected from the edge of the lake located adjacent to the 4th green of the golf course. A sample will be collected for nitrate testing from the center of the stream at a depth of approximately six inches in a clean, plastic bottle and will be sealed with a clean plastic lid. A sample will be collected for phosphorus testing from the center of the stream at a depth of approximately six inches in a separate clean, plastic bottle containing a sulfuric acid preservative and will be sealed with a clean plastic lid.

IV. Sample Collection Frequency

Samples will be collected semi-annually from each sampling location during the weeks of April 7th - April 14th and October 7th - October 14th.

V. Sample Collection

Samples will be collected between the hours of 7:00 a.m. and 11:00 a.m. by the Bushwood Country Club Superintendent or by an individual designated by the Superintendent who has received proper training in sample collection. Water samples will be acquired for testing based on methodology defined in *Volunteer Stream Monitoring; A Methods Manual* (EPA 841-B-97-003) and the *DEQ Laboratory Field Sampling Reference Guide, Revision 4.0*.

VI. Chain-of-Custody

Chain-of-custody will be documented for all samples from the point of sample collection to the point of sample receipt by the testing laboratory.

VII. Sample Maintenance and Transport

After collection, samples will be stored at 4°C (~39°F) in the dark. Samples will be maintained at 4°C during transport to the testing laboratory and will be delivered to the testing laboratory no later than twenty-four hours following sample collection.

VIII. Sample Testing

Water samples will be tested for the presence of nitrate and phosphorus using EPA methods.

Water samples will be tested for the presence of all pesticides used on Bushwood Country Club during the six months preceding the sampling event. Samples will be tested for the presence of specific pesticides using appropriate EPA methods.

All laboratory test results will be linked by the laboratory sample identification number and the Bushwood Country Club sample identifier assigned at the time of sample collection.

IX. Interpretation of Results

All testing results will be reviewed and compared to relevant federal and state water quality standards.

X. Corrective Action

A. Nutrients

In the event that either nitrate levels or phosphorus levels in water samples are determined to exceed water quality standards, the following corrective action will be taken.

1. Records will be reviewed to determine if a direct cause and effect relationship between fertilizer application events and nutrient levels can be established. If such a relationship is identified, adjustments in fertilizer application rates and/or methods will be implemented to reduce the load of the compound(s) entering waterways.
2. The Integrated Pest Management plan will be reviewed to identify and implement alternative management practices that will mitigate the situation.
3. Following adjustments in practice, additional samples will be acquired for re-testing to assess the effectiveness of revised management practice.

B. Pesticides

The inherent assumption is that when applied properly and in accordance with the Bushwood Country Club Integrated Pest Management plan, no pesticides applied to the golf course should be entering golf course waterways. However, in the event that a pesticide(s) applied to the golf course in the six months preceding the sampling event is detected in water samples, the following corrective action will be taken.

1. Testing results will be reviewed to determine if the pesticide(s) detected are entering the golf course from an upstream location (i.e., are present in the BCCBE sample).
2. Records will be reviewed to determine if a direct cause and effect relationship between pesticide application events and pesticide(s) detected in water samples can be established. If such a relationship is identified, adjustments in pesticide

application rates and/or methods will be implemented to reduce the load of the compound(s) entering waterways.

3. Based on the best information available, levels of the pesticide detected will be compared to the allowable levels to determine if there is an immediate hazardous threat. In the event that a hazardous situation is identified, the appropriate agencies will be contacted.
4. The Integrated Pest Management plan will be reviewed to identify and implement alternative management practices that will mitigate the situation.
5. Following adjustments in practice, additional samples will be acquired for re-testing to assess the effectiveness of revised management practice.

XI. Documentation

All activities associated with the Bushwood Country Club Water Quality Monitoring Plan will be documented including sample collection, chain-of-custody, test results, interpretation of results, and summary reports. All original documents will be maintained on site at Bushwood Country Club.

XII. Reporting

Water quality monitoring results will be summarized and documented following each round of testing (i.e., twice per year) and a summary of the Water Quality Monitoring Plan will be prepared annually.

XIII. References

1. *Endangered and Threatened Species; Proposed Rule Governing Take of Seven Threatened Evolutionarily Significant Units (ESUs); Proposed Rule*. Department of Commerce. National Oceanic and Atmospheric Administration. *Federal Register*. January 3, 2000.
2. *Endangered and Threatened Species; Salmon and Steelhead; Final Rules*. Department of Commerce. National Oceanic and Atmospheric Administration. *Federal Register*. July 10, 2000.
3. *Golf Course Management and Construction Environmental Issues*. 1992. J.C. Balogh and W.J. Walker (ed). Lewis Publishers Boca Raton, FL.
4. *Guidelines and Specifications for Preparing Quality Assurance Project Plans*. 1991. Washington State Department of Ecology publication 91-16. Manchester, WA.
5. *Technical Guidance for Assessing the Quality of Aquatic Environments*. 1994. Washington State Department of Ecology publication 91-78. Olympia, WA.

6. *Monitoring Guidelines to Evaluate Effect of Forestry Activities on Streams in the Pacific Northwest and Alaska*. 1991. Environmental Protection Agency publication EPA/910/9-91-001. Region 10. Seattle, WA.
7. *Pest Management Policy*. 1999. Portland Parks and Recreation. Portland, OR.
8. *Volunteer Stream Monitoring: A Methods Manual*. 1997. Environmental Protection Agency publication EPA 841-B97-003. Office of Water.
9. *Methods for Chemical Analysis of Water and Wastes*. 1983. Environmental Protection Agency publication EPA-800/4-79-029. Cincinnati, OH.
10. *DEQ Laboratory Field Sampling Reference Guide, Revision 4.0*. 1996. Oregon Department of Environmental Quality. Portland, OR.
11. *Results from the USGA Environmental Research Program*. 1995. USGA Green Section Record. January/February.
12. *GCSAA's Golf Course Water Quality Study*. 1997. *Golf Course Management*. November.

WILDLIFE HABITAT ENHANCEMENT

Introduction

Golf courses are diverse ecosystems and by definition, high intensity turf management involves the management of complex habitat. Factors including nutrient availability, moisture, and geotechnical properties are routinely monitored and adjusted to enhance turf health, minimize disease, and optimize the microbial ecology of the turf rootzone. Sound turf management practice promotes the compatibility of the golf course with wildlife, and as such, wildlife habitat management is a natural extension of the turf management process. Wildlife habitat *enhancement* involves the implementation of additional, specific measures that are designed to recruit and sustain desirable species as a means of bolstering the unique ecology of individual golf courses.

Why Enhance Habitat?

The advantages of enhancing wildlife habitat are numerous. Recruitment and sustaining wildlife creates a heightened playing experience for the golfer, and represents an excellent opportunity to educate the public on the value of integrated management systems and the ecology of the location. Habitat enhancement not only aids in sustaining existing wildlife, but also strengthens the ecosystem by increasing habitat and species diversity. Finally, implementation of habitat enhancement measures can lead to significant reductions in the allocation of golf course resources.

Opportunities for Habitat Enhancement

The limited availability of property often drives golf course design to utilize the maximum amount of space available for playing areas. However, in many instances, non-play areas and areas designated as hazards offer the opportunity to develop wildlife habitat while maintaining the desirable playing characteristics of the golf course. Locations on the golf course that are potential candidates for wildlife habitat enhancement include terrestrial, wetland, and aquatic areas.

The *Best Management Practices*, *Integrated Pest Management*, and *Water Quality Monitoring* components of these Guidelines collectively define a comprehensive management system designed to optimize overall habitat management and protection. Habitat enhancement measures may involve the implementation of additional practices specifically tailored for the individual golf course. When considering any habitat enhancement project, it is always advisable to consult resources with relevant expertise to obtain detailed input prior to the implementation of habitat enhancement measures.

Terrestrial Areas

Maintaining and enhancing non-play areas, buffer zones, unmowed areas, woodlots, “edges”, or rough areas contributes to wildlife habitat enhancement. In addition to providing cover, nesting areas, and food sources, these practices also assist with storm water runoff control. The following suggested practices are designed to enhance habitat located in terrestrial areas.

I. Mowing

Minimize mowing in non-play areas to create dense habitat that provides a rich food source and excellent cover for a variety of species. These areas can be compatible with playing areas by the selective maintenance of growth heights. For example, vegetation along or across fairways (streams and ditches) can be allowed to grow from one to three feet in height, without disturbing playing conditions. A variety of approaches can be used to achieve this result while retaining sight distance, playing areas, hazards, and rough. These areas can be “sculpted” to create a naturally appearing continuation of playing areas into non-play areas, and this practice can actually lead to reduced mowing times, fertilizer and pesticide applications, tree care, irrigation, and irrigation system maintenance.

II. Cover

Promote the growth of natural vegetation in appropriate areas to develop food sources and provide cover for wildlife. Maintain understory vegetation, including brush piles where possible, to provide additional cover and nesting areas. Whenever practical and if no safety hazard exists, retain dead trees and snags to provide beneficial shelter and nesting habitat. Also, insects inhabiting these structures serve as an important food source.

III. Wildflowers

Plant wild flowers in non-play areas to improve plant diversity and create a visual enhancement of the golf course. The diversity of plant species recruits a variety of insects, which in turn serve as a valuable food source for birds and mammals.

IV. Nesting Boxes

Place nesting boxes in appropriate areas to recruit and sustain wildlife. Access to a water source and territorial boundaries for a given species are important strategic factors to consider prior to the placement of nesting boxes.

Wetlands

Wetlands, which can be seasonal in nature, are areas typically located in depressions or at the lowest point of landscapes. These areas are integral components of ecosystems and are important habitat for a variety of wildlife. Wetland identification and specific mitigation measures for new golf course construction and re-modeling projects are typically addressed on a case-by-case basis through permit processes. Detailed management practices designed to protect and enhance wetlands on existing golf courses should be developed based on input from the

appropriate regulatory agencies (e.g., Division of State Lands). The following are general suggestions for the management of wetland areas on existing golf courses.

I. Inventory

If wetland areas are present on an existing golf course, they should be thoroughly mapped and documented to develop a wetlands inventory. Also, a description of the management of these areas should be included in the Integrated Pest Management Plan.

II. Water Quality

Protection of wetland water quality is very important, and includes protecting these areas from the potential impact of stormwater runoff. Implementation of the practices described in the Best Management Practices, Integrated Pest Management, and Water Quality Monitoring sections of this document should optimize the protection of wetland water quality.

III. Vegetation

The growth of native wetland vegetation should be nurtured while discouraging the growth or invasion of non-native plants. The Oregon Department of Agriculture can provide assistance in the identification of non-native species and proper methods for control.

IV. Restricted Access

Entry of golfers into wetland areas, or any other areas of the golf course designated as environmentally sensitive, should be discouraged. These locations should be identified with signage such as “environmentally sensitive area: do not enter.” In addition, information on the score card that defines proper procedure if a golf ball enters an environmentally sensitive area aids in educating golfers, while minimizing the tendency of golfers to enter these areas.

Aquatic Areas

Aquatic areas, consisting of lakes, ponds, and streams, represent excellent opportunities for wildlife enhancement. The recent Endangered Species Act legislation for salmon and steelhead heightens the importance of protecting and enhancing waterways that support any phase of salmonid development and survival. In many instances, the same type of habitat enhancement measures can be applied to lakes, ponds, and streams. Examples include the promotion of native vegetation growth along shorelines and the positioning of nesting boxes.

Habitat enhancement for streams can be a relatively delicate process that requires design input from experts to achieve the desired result. Examples of stream modification include stream channel alteration, the addition of large woody debris, development of pools and alcoves, and instream boulder placement. Before beginning any stream habitat enhancement process, it is important to consult resources such as the Oregon Department of State Lands and the Oregon Department of Fish and Wildlife for advice on proper stream habitat enhancement methods.

Wildlife Habitat Enhancement Resources

Agencies and Organizations

City and County Planning Departments, Watershed Councils

Army Corp of Engineers

(503) 808-4376

<http://www.nwp.usace.mil>

Oregon Department of Agriculture

(503) 986-4621

<http://www.oda.state.or.us>

Audubon Cooperative Sanctuary

(518) 767-9051

<http://www.audubonintl.org>

Oregon Department of Fish and Wildlife

(503) 878-5252

<http://www.dfw.state.or.us>

Metro Regional Services

(503) 797-1510

<http://www.metro-region.org>

Oregon Division of State Lands

(503) 378-3805

<http://statelands.dsl.state.or.us>

National Marine Fisheries Service

(503) 231-2005

<http://www.nwr.noaa.gov>

Portland Audubon Society

(503) 292-6855

<http://www.audubonportland.org>

Documents

1. *Oregon Aquatic Habitat Restoration and Enhancement Interim Guide - 1998*. The Oregon Plan for Salmon and Watersheds. <http://www.oregon-plan.org>
2. *A Practical Guide to Ecological Management of the Golf Course*. 1995. R.S. Taylor (ed.). The British and International Golf Greenkeepers Association and The Sports Turf Research Institute.
3. *Managing Wildlife Habitat on Golf Courses*. 2000. R.G. Dodson (ed.). Sleeping Bear Press, Chelsea, MI.