Turf Management for Municipal Athletic Fields

A resource guide and planning tool
for environmentally responsible turf management

Massachusetts Department of Agricultural Resources
Essex Conservation District
Commission for Soil, Water and Related Resources

SECOND EDITION

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Background

Athletic fields are among the most complex landscapes to manage. Subject to the wear and tear of a multitude of sports activities, athletic field turf requires considerable knowledge and understanding to keep it at its best. Poorly maintained fields can be unsightly to look at. Fields with bare patches, weeds and compacted soils create uneven playing surfaces, can be difficult to play on and can potentially cause injuries to athletes who fall or slip.

The management of athletic field turf can also have an impact on sensitive resources such as surface water, groundwater, and users of the field (see Table 1 on Page 8). Nutrients and pesticides have the potential to move off-site; increasingly scarce water resources can be depleted for irrigation purposes; and sensitive individuals can become exposed to applied chemicals.

The challenge turf managers face is to schedule a management program around a busy athletic timetable while producing a healthy, functional turf; protecting sensitive resources from any potential impacts; and working within budgetary limits. This turf management guide is a joint effort by Essex Conservation District and the Massachusetts Department of Food and Agriculture to help municipal turf managers meet this challenge by providing guidance on how to maintain a high quality athletic field, while limiting chemical use, protecting municipal water resources, and efficiently managing water resources for irrigation. By serving as an assessment and planning tool for developing a turf management plan, this guide will help turf managers accomplish four important objectives:

Objective One:
Learn about better athletic field management and locate further information and assistance,

Objective Two:
Identify risks to sensitive resources in and around athletic fields,

Objective Three:
Promote better communications among local interest groups concerning the turf management of athletic fields, and

Objective Four:
Develop an effective and useful turf management plan which will address potential impacts to public health and the environment.

A well designed plan will allow turf managers to independently evaluate any existing or potential impacts on sensitive resources and address these impacts as part of their normal management activities. The plan can also serve as a helpful tool to communicate to the public the reasons why certain turf management practices, such as pesticide applications, are being implemented. Furthermore, it will document the considerations for environmental concerns and public health which were taken into account when planning turf maintenance activities.

TABLE 1
Sensitive Resources on which turf management practices can a have a potential impact

SENSITIVE RESOURCE	PRACTICE	POTENTIAL IMPACTS
Surface Water Resources Reservoirs, Stream, Ponds, Rivers, Lakes, Wetlands, Vernal Pools, Estuaries, the Ocean, Stocked Trout Streams, Designated cold water fisheries. Storm drains leading to any of the above	Irrigation,Fertilizer Application, Pesticide Application	Water quantities can be depleted by inefficient irrigation practices. Phosphorus or nitrogen run off into surface water can lead to eutrophication. The survival of wetlands plants can be threatened by pesticides. Aquatic organisms can be injured or killed as a result of pesticide run-off. Non target organisms may be exposed to pesticides. Increased turbidity can result from sediments which run-off due to erosion. This interferes with fish habitat affecting feeding habits.
Groundwater Resources Private Drinking Water Supplies Public Drinking Water Supplies Zone A, Zone 1, Zone 2,Interim Wellhead Protection Areas.	Fertilizer and Pesticide Applications	Groundwater infiltration from turf to which nutrients or pesticides have been applied may transport chemicals into the groundwater.
Adjacent Land Uses Natural Areas, Wilderness Areas, Conservation Land, Shellfish Growing Areas, Public Parks, Schools, Playgrounds, Nursing Homes, Hospitals, Users of the Field.	Pesticide Applications	Non-target plants or animals could be exposed to pesticides. Athletes or spectators using the field may be exposed to pesticides after an application. If pesticides are applied by spraying, drift could impact a neighboring land use application.

This guide takes a more encompassing approach to turf management than most other texts and manuals. It provides broadly applicable guidance for common elements of turf management, but also provides a framework to identify and understand any potential impacts of turf management on public health and safety, and on environmental resources. The guide outlines Best Management Practices (BMPs) to address these impacts. It also provides direction to additional resources which can provide further information and assistance. The guide has been divided into three principal parts:

Part One of the guide provides information on the elements which should be included in a turf management plan in order to achieve a healthy turf. These elements include General Management Practices, Water Management Practices, Nutrient Management Practices, and Pest and Pesticide Management Practices. Information is included on additional resources which can be accessed to help develop environmentally sound turf management plans.

Part Two of the guide is a series of worksheets to help develop a turf management plan which is specific to each athletic field. The worksheets provide a structured approach to developing a routine management plan and an inventory of on-site and bordering sensitive resources which could potentially be impacted by turf management practices. By recognizing these sensitive resources and the site's physical characteristics, a plan which can produce healthy turf and address potential impacts can be developed. An effective approach is to integrate the management practices from Part One into a plan with consideration for the field limitations due to identified sensitive resources.

Part Three of the workbook is a comprehensive glossary, reference and resource directory.

PART ONE
Essential Elements of a Turf Management Plan

CHAPTER 1

General Management Practices

REFERENCE
A Seasonal Checklist in Appendix A provides some general guidelines on turf management.

The goal of any turfgrass management program should be to produce and maintain a healthy coverage of turf. A healthy turf produces the best possible playing conditions for athletes and will also have the following benefits:

- potential pest problems are reduced because the chances of drought, stress and subsequent susceptibility to insect and disease damage are minimized,
- the turf can recover more quickly from the wear and tear of intense sports activities,
- safer playing surfaces are created for players with fewer weeds and areas of compaction,
- thicker healthier turf provides better groundcover, allowing for better water retention and less exposure of the soil surface thereby reducing soil water evaporation,
- soil erosion and runoff are minimized or prevented

Grass selection, mowing, watering, aeration, staff training, equipment maintenance, record keeping, and communication are routine turf management practices which are central to achieving the goal of producing and maintaining a healthy turf. Correctly implemented these best management practices can increase the turf's tolerance to environmental stresses and pests, and reduce the need for chemical treatment.

BEST MANAGEMENT PRACTICES

a. Grass Selection

It is important when establishing new turf to choose a grass that is suitable for the particular site. Conditions such as soil characteristics, light, intensity of use, and desired maintenance level should be considered when selecting the grass type. This is because grasses vary in their tolerances to environmental stresses, in their resistances to pests, and in their abilities to withstand wear and tear.

Many of the athletic turfgrasses are "seeded mixtures" which contain two or more species of turf grass. Cool-season grass mixtures are recommended in the Northeast because they are characterized by maximum growth in the cool spring and fall seasons and become semidormant in hot or dry summer seasons. The principal species of cool season grasses for athletic field use are Kentucky Bluegrass, Perennial Ryegrass, Fine Fescues and Tall Fescues.

REFERENCE
The grass variety chart below should help in choosing a suitable grass variety

Mixtures are used to get the most effective and long-lasting seasonal coverage. Because different species vary in their pest tolerances and resistances, the potential for damage due to a single pest is reduced. Some commercially available mixtures may include endophytic seeds which can reduce pesticide use. The endophytic grass contains a nonvisible and nonpathogenic fungus which is resistant to some common surface feeding insect pests. Some cultivars of endophytic seeds also tend to have a high tolerance for drought and nutrient deficiencies.

TABLE 2: Grass Variety Chart
Choosing the Right Grass Species for your Field

Grass Species	Leaf Texture	Preferred Environmental Conditions	Tolerance	Comments	Nitrogen (N) Requirement	Water Needs	Maintenance
Kentucky Bluegrass	Fine-medium. Dark Green.	Well drained soils. Sunny areas. High nutrient requirements.	High cold tolerance. High wear tolerance. Low shade tolerance.	Forms good sod. High accumulation of Thatch.	2-4 lbs N/ 1000 sq. feet	High water needs. Low drought tolerance	High
Perennial Ryegrass	Fine-medium	Well drained soils. Moderate fertility.	Low heat tolerance. High wear tolerance. Low shade tolerance.	Germinates rapidly. Establishes quickly. Good for over seeding. Competes with other grasses so use alone or in mix with 20% rye. Many cultivars contain beneficial fungal endophytes. Low thatch accumulation	2- 4 lbs N/ 1000 sq feet	Medium water needs. Low drought tolerance.	Medium
Tall Fescues	Fine Textured Dark Green.	Well drained soils Open sunny areas, Can withstand moderate shade.	Good heat tolerance Good wear tolerance.	Slow to establish. Low accumulation of thatch.	2.5-3 lbs N/ 1000 sq. feet	High drought tolerance	Low to moderate
Fine Fescues- (Creeping, Red, Hard Fescue.)	Narrow leaves, Medium to dark green.	Drier, shaded, less fertile areas.	Low heat tolerance Low tolerance for humidity. High tolerance for low pH or acidic soils.	Slow to establish. Low accumulation of thatch.	1-2 lbs N/ 1000 sq. feet	Low water needs. High drought tolerance	Low

b. Mowing

Mowing high to keep the grass two to three inches tall will encourage a dense turf with a well developed root system. As a result the turf will obtain water and nutrients from the soil more effectively. This will enhance the turf's drought tolerance, reduce fertilizer and water needs and crowd out or shade out weeds, especially annual weeds like crabgrass.

Mowing should be done regularly. No more than one third of the grass blade should be removed at a time to avoid root shock. Leaving the grass clippings on the ground can serve a number of functions: valuable nutrients can be recycled into the soil; the soil can be protected from the impact of falling rain; and the velocity of runoff can be reduced.

It is best to mow when it is dry to avoid spreading any disease. To avoid increased loss of moisture and nutrients, heat or drought-stressed grass should not be mowed in the middle of the day unless watering is done shortly afterward.

Alternating mowing patterns each time the turf is cut promotes level turf surfaces by forcing the grass to grow upward rather than falling in a horizontal position. Different mowing patterns also reduce soil compaction and wear of turf from the mower wheels. By keeping mower blades sharp, shredding the turf can be avoided.

c. Irrigation

Irrigation is a fundamental management practice for healthy turfgrass. Under irrigating leads to wilt and desiccation. Over irrigating can make the turf susceptible to disease, increase the potential for runoff and leaching, and lead to low tolerance for drought conditions. Efficient irrigation, especially during the spring, will enhance turf drought tolerance and reduce water needs during the summer. Soil moisture should be monitored and used to determine the need for irrigation.

REFERENCE:
Irrigation is addressed in depth in the chapter on Water Management Practices.

d. Aeration

Aeration is the process of increasing the soil's air content by mechanically punching holes into the soil. Plugs are deposited on the soil's surface where they break down. Aeration will help prevent a number of problems including soil compaction and thatch build up.

Soil compaction is a process which reduces oxygen availability and nutrient movement in the soil. Compaction results in poor turf coverage and bare soil conditions on the fields. Heavily compacted soil cannot support good turf development and can create poor drainage and runoff problems. Aerating the soil helps to loosen compacted soil so that air, water, and nutrients can move to the root zone and become available to the turfgrass.

Aeration is also necessary to control the thatch layer. The thatch layer is a tightly intermingled layer of living and dead stems, leaves and roots which accumulates between the layer of actively growing grass and the soil underneath. Thatch can prevent water and nutrients from penetrating to the root zone. Thatch also serves as an excellent breeding ground for harmful insects and disease organisms. Aeration allows soil organisms to break down the thatch into nutrients and new living soil.

There are two types of aeration. The most common type is core aeration. Core aeration is correctly done in two directions. There should be nine or more holes per square foot to a depth of two or three inches. After

core aerating the soil should be allowed to dry, then dragged back and overseeded. The second type of aeration is called Deep Tine Aeration. This is usually only used for very compacted soils and is done every three years. The hole depth for this type is 14 inches.

Both procedures are time consuming, which may increase the labor costs to a field. However, entire field aeration may not be necessary and localized treatments can be done for compacted areas such as around the goal post area. Over the long term, aeration can save expensive renovation costs.

e. Staff Training

Another challenge to municipal turf managers is to provide adequate staff training. It is important to have all employees, including temporary seasonal employees, trained properly on how to use and maintain equipment. By holding an orientation or training session, turf managers can save themselves time and money by avoiding any future problems that could be caused by lack of training. All employees should be familiar with the basics of the turf management plan used for a particular field.

Any employee who applies pesticides as part of their job must be licensed by the Massachusetts Pesticide Bureau.

f. Equipment Maintenance

Equipment should be well maintained and staff trained in its operation. All equipment should be kept in good working order. This is an effective preventative practice that saves labor and money over the long term.

All equipment should be cleaned, blades sharpened, and calibrated on a regular basis. This is especially important for the spreader and irrigation equipment used to apply fertilizers and/or pesticides, seed, lime, and water. Poorly functioning application equipment can result in improper amounts being applied. Low applications can result in poor pest control, nutrient deficient turf, ineffective re-seeding, and costly repeat applications. Excessive applications lead to a waste of materials and may result in damage to the turf, needless exposure to the users, and unnecessary impacts to the environment.

Equipment logs should be kept for each piece of equipment. Any defective parts should be repaired or replaced as soon as possible.

g. Record Keeping / Communication

A thorough record-keeping system is not only important for documenting applications. It also can be used as a valuable planning tool to address a nutrient or pest problem early on and avoid expensive and time-consuming crisis management practices.

Record-keeping helps in decision making, scheduling of activities, and in evaluating the effectiveness of the turf management practices. As a communications tool it demonstrates to the community how the turf management plan addresses any potential impacts on sensitive resources. Pesticide use reports are required to be submitted to the Department of Food and Agriculture annually.

REFERENCES:

Chapter 4 of this document. Massachusetts Pesticide Bureau: www.massdfa.org, UMASS Extension Pesticide Education, UMASS Extension Turf Program

REFERENCE:
Pesticide Use Reports are contained in Appendix F

Observing the following points should help ensure good record keeping practices.

- Keep records of all management practices. Massachusetts state regulations require thorough and detailed records of all pesticide applications to be kept.

- General information that should be included in the records includes:
  - Date and time of management practice implementation.
  - Employee who implemented the practice.
  - Weather-temperature, wind, rainfall.
  - Method and rate of lawn management material (such as lime, pesticides, nutrients) application.
  - Location of treatment: spot, patch, or entire field.

- Other records that are important to maintain:
  - All treatments to athletic fields.
  - Monitoring (or Field Survey) notes/ observations/ comments or questions received from the public.
  - Seasonal turf maintenance plan/ schedule.
  - Equipment maintenance logs.
  - Soil tests.

CHAPTER 2

Water Management Practices

Potential Concerns

- reduction of water levels due to poorly maintained irrigation systems or overwatering.
- run off and off-site movements of sediments with chemicals into sensitive resources due to overwatering.
- poorly targeted irrigation will cause water to be distributed not only to turf areas, but also to roads, sidewalks, and other areas that do not require water.

Irrigation is a key management practice in the development and maintenance of healthy turfgrass. If enough water is not applied, desiccation and wilting will result. Excessive watering, or "overwatering", can lead to restricted root growth, promote disease and reduce the turf's tolerance to wear and heavy traffic. Overwatering also increases the potential for runoff and leaching.

Many existing sources of water are being stressed by withdrawals to meet offstream needs such as irrigation. Recent droughts in some areas has emphasized the need to balance water demand with available supply. Efficient use of water can help prevent waste and lessen the effects of drought.

Proper irrigation management will help minimize run-off and leaching, improve water use efficiency, and result in an athletic field with dense turf coverage. While each site will have different considerations such as soil type, grass species, weather, and sun exposure, some general Best Management Practices can be used for developing an efficient irrigation schedule for a particular field.

BEST MANAGEMENT PRACTICES

a. Frequency of Watering and Amount of Water

Determining the appropriate quantity of water to irrigate an area of turfgrass is a crucial component of any turf management plan. Signs that turf is not receiving enough water include leaf rolling and wilting, sustained footprints, and a change in the turf to a blue green color.

The amount and frequency of irrigation should be based upon the needs of the grass, soil conditions, soil properties and expected weather conditions. Light and frequent watering is ineffective because much of the water will be lost to surface evaporation resulting in shallow-rooted grass, which is much less drought tolerant. Most turfgrasses need an inch of water per week during the growing season. However more water will be required in the hot mid- summer months. This can come from rainfall or irrigation.

For those fields with irrigation systems the most efficient watering schedule

RESOURCE:
For additional information on water conservation practices for property owners and managers responsible for recreational fields, contact the Massachusetts Executive Office of Environmental Affairs at 617-626-1000

is one that uses the principle of “deep and infrequent”. This method allows the water to move deeply into the soil to the effective root zone area of the turf grass (six inches below the soil surface). Roughly one inch of water will penetrate the soil enough to accomplish this. This approach also encourages roots to seek water farther down in the soil, resulting in a stronger, deeper rooted turf that is more drought tolerant.

The general rule of thumb is to irrigate heavily, but slowly, once a week. It may be necessary to water more often in the summer months. While this is an effective approach, the physical properties of the soil must also be considered. Very sandy soils have higher drainage capacity and may require more frequent watering. Clay soils have a slower infiltration rate and will initially not accept much water. They will, however, hold water for longer amounts of time necessitating a slower, lighter watering to avoid sediment runoff.

By placing a rain gauge (or a can) on the field in several locations, the amount of water the turf is receiving can be established.

b. Timing
The timing of the irrigation schedule should provide enough water to keep a constant moisture level in the root zone. Watering should be timed to take place early in the morning just prior to or just after sunrise. This allows for better soil penetration and absorption by reducing excessive evaporation loss. Watering early in the morning will allow the turf blades to dry quicker. This can reduce disease susceptibility by limiting moist conditions which encourage spore germination and the spread of fungal infection.

It is important to consider any scheduled field usage when planning any watering. Heavy irrigation a few hours before a game or public event can lead to slippery and even dangerous conditions. Early morning watering usually does not interfere with any sports activities and allows for adequate drying of the field before an athletic activity takes place. This can minimize player injury due to slippery turf surfaces.

REFERENCE:
Refer to Table 2: Grass Variety Chart in Chapter 1

Watering should be avoided at night during hot, humid weather and when any turf disease is present. To conserve water, mid-day watering should be avoided except for during extremely hot conditions.

c. Selection of Drought Tolerant Grass Species
Some cultivars of endophytic seeds tend to have a high tolerance for drought and nutrient deficiencies.

d. Equipment Maintenance
All irrigation equipment should be properly maintained to ensure the water is being properly and evenly distributed only to turf areas.

e. Selection of irrigation systems that will enhance water conservation
The following points address types of irrigation system hardware that will enhance water conservation.

(i) Install good quality sprinkler heads that provide for low precipitation rates and keep them in good repair

(ii) Use the controller to adjust the system according to the current weather conditions. Consider installing a controller with the following features:

- At least three independent programs to allow watering different parts of the yard on different days
- Station run times from one to 99 minutes
- Three start times per program
- Odd, even, weekly and interval program capability up to 30 days; and
-Rain shutoff device on the irrigation system

(iii) Locate irrigation heads at least eight inches from paved areas

(iv) Repair broken sprinkler heads

(v) Turn off the irrigation system if runoff occurs and allow the soil to absorb the water

(vi) Abide by water restrictions and other conservation measures put into place by the community as appropriate

N**OTE: Summer Dormancy Due to Drought**
Under conditions of drought turf may appear straw colored or brown and withered. These are normal signs of dormancy on cool season grasses. Dormancy is a drought avoidance mechanism that cool season grasses use to avoid death. Turf allowed to go dormant should be watered every three weeks in the absence of rainfall. This prevents injury to grasses due to heat and drying.

CHAPTER 3

Nutrient and Soil Management Practices

Potential Concerns

- groundwater contamination due to leaching of fertilizers especially with sandy soils.
- off-site movement of excess nutrients can cause eutrophication of water bodies and affect sensitive water habitats.

All plants require nutrients for growth. Nutrients are usually applied to the land as commercial fertilizer in a dry or fluid form. Of all the nutrients that turf grass requires the two most vital ones are Nitrogen (chemical symbol, N) and Phosphorus (P).

Nitrogen causes fast shoot development, the dark green color of turf grass and improves recovery from stress or pest damage. A deficiency of nitrogen can cause yellowing. However, too much nitrogen can be very damaging to turf by creating too much succulent new growth. This can attract pests and weaken the turf tolerance to environmental stress. Phosphorus is good for root development and winter hardiness.

Nitrogen and phosphorus are the two major nutrients that degrade water quality. When nutrients run-off into a stream, lake, or an estuary, aquatic plant productivity may increase dramatically. This process, known as cultural eutrophication, adversely affects the suitability of the water for other uses. Excessive nitrogen has been found to accelerate eutrophication in some coastal waters. Phosphorus is a contaminant in fresh, surface waters. Runoff can occur if the nutrients are applied to frozen ground, to steep slopes, at high rates or before excessive rainfall or heavy irrigation. Nitrogen, in the form of nitrates, has the highest potential to leach into groundwater. Infiltration is likely if the soil has been saturated through intense irrigation, has insufficient organic matter and is sandy.

Proper nutrient management will deliver the required amount of nutrients to the plant while reducing surface water run-off of nutrients and minimizing leaching of nitrates. Nutrient management is a process which has as its main objective the wise use of plant nutrient resources. In developing a nutrient management program it is important to be knowledgeable about the best management practices described in the following pages.

ADDITIONAL RESOURCE:
University of Massachusetts- Soil Testing Lab, Amherst, MA 01003-2082, Telephone: (413) 545-2311.

REFERENCE:
Appendix B contains a University of Massachusetts Soil Testing Order Form

a. Base Fertilizer Applications on a Soil Test

Soil tests are valuable tools for the early diagnosis and correction of a soil deficiency that could lead to turf damage or disease susceptibility. Additionally, by applying only the needed amount of lime or fertilizer, time and money can be saved. Soil tests should be conducted prior to any applications of lime and/ or fertilizer. By determining the soil nutrient level (nitrogen, phosphorus, and potassium) and soil pH (acidity), soil tests enable the lime and fertilizer needs of the soil to be established. Often the results include specific recommendations on how to improve the soil conditions. Other soil tests that can be done include tests for soil texture and organic matter. The most commonly used tests for turf managers are the pH and nutrient level tests.

b. Fertilizer Selection

The form of nitrogen applied in fertilizer can affect the degree of runoff or leaching. In fertilizer products there are two forms of nitrogen:

- Water Soluble Nitrogen (WSN) is fast acting or quickly available to be absorbed by the turf, and
- Water Insoluble Nitrogen (WIN) is slow acting or slowly available for absorption and is released over a longer period of time.

Both forms have advantages and disadvantages. In areas of sandy soil, soils are highly permeable and groundwater is at great risk from contamination. On highly permeable soils, slowly available nitrogen fertilizers (WIN) are less likely to leach below the root zone than quickly available sources (WSN). Fertilizing programs using only WSN will require more frequent applications than a program which incorporates some WIN. Fertilizer containing only WSN should not be applied before a heavy rainfall because nitrogen has the highest chance of leaching under cool and wet weather. A widely used strategy in the spring is to fertilize with products that have a combination of fast- and slow-release nitrogen sources. Fast-release nitrogen stimulates

REFERENCE:
Table 3 below

Table 3: Nitrogen Fertilizers : Water Soluble Nitrogen and Water Insoluble Nitrogen Comparisons

Types of Fertilizer	Release Rate	Response Rate (green-up)	Duration of Responses	Leaching Potential	Cost	Potential to burn Grass	Types of Nitrogen Fertilizer
WSN	Fast	Rapid-flushes of growth and green -up	Short (6 - 8 weeks)	High	Low	High	Urea Potassium nitrate Ammonium phosphate Ammonium sulfate Ammonium nitrate
WIN	Slow	Slow color Response	Long	Low	High	Low	Urea formaldehyde Isobutylidene diurea Sulfur coated urea Organic fertilizers such as Fish meal, pelletized sewage sludge, seed meal

earlier green-up and growth which is frequently needed by a turf manager. Slow-release nitrogen sources, whether synthetic or natural organic, last eight to 15 weeks, and are less likely to burn the turf and release nitrogen more uniformly than fast release N sources.

c. Timing of Fertilization

Deciding how often and when to fertilize is a challenge. Visual cues from periodic field surveys and the soil testing are useful guides.

Late August/ early September is considered to be a critical time for cool-season grasses. At this time the nitrogen can help the turf recover from summer stress and pest damage. Early spring applications are used to promote greenup. Often late spring applications are done to promote growth before the heat and drought stress of summer can impact the turf. It is important that the type of fertilizer used at this time contain high amounts of slow release nitrogen (WIN).

Late Fall applications can be done after the last mowing (when turf has stopped growing), but just before the turf loses color. Not only does this timing enhance Winter turf color but it also can cause a Spring greenup three to four weeks earlier. Kentucky Bluegrass specifically benefits from this late season application by improved rooting the following Spring.

REFERENCE
Table 4 below is a general guide to the timing of fertilization.

When fertilizing it is important to remember that nutrient uptake is through the roots of the turf. The goal is to feed the soil, not the grass. Fertilizing turf should thus be avoided when wet because the fertilizer stays on the grass blade and can cause “fertilizer burn”. Any fertilizer application should be followed with watering. This washes off the blade and forces the fertilizer material closer to the soil surface for absorption. Quickly available sources should not be applied before a heavy rainfall.

Table 4: Nitrogen Fertilizer Guide (to be used only as a general guide)

Frequency of Fertilizing	When to Fertilize (Time of year)	How Much & What Type of Nitrogen
Once	Fall	WIN with a high organic content for slow release throughout season
2 Times	Early May September	Over 50% total N as WIN applied at a rate of 1.5-2.5lbs. N / 1000 sq. ft
3 Times	Mid April Mid-Late June September	20-50% total N as WIN applied at a rate of 1-1.5lbs. N / 1000 sq. ft
4 Times	Start in April and Every 6-8 weeks till September	Up to 20% total N as WIN applied at a rate of 1 lbs. N / 1000ft sq. ft

d. Rate of Application of Fertilizer
Fertilization rate depends on many factors such as N source to be applied, time of the year, and fertility requirements. When using only WSN, an application rate of 0.75 to 1.5 lbs. N per 1000 square feet is recommended to avoid undesirable growth surges and potential foliar burn. WIN sources may be applied at rates as high as 3 lbs N per 1000 sq feet per application without burning the turf.

e. Equipment Calibration
To minimize the chance of misapplication of fertilizer, equipment should be inspected and calibrated. Ensure that the spreader is properly calibrated for the specific application rate. Always follow the label instructions for the rate and appropriate spreader calibration. This step is especially important for fertilizing because it also ensures an even distribution of the material. Overlapping of applications can cause brown streaks lined with new grass. Missed areas will show up as yellow nutrient deficient streaks. Too much fertilizer can cause excessive thatch buildup in the turf and set the stage for turf disease and pest problems. A record should be kept of equipment operation, maintenance and calibration.

f. Liming
The pH (acidity) of the soil affects the availability of other nutrients. Phosphorous is most available when the soil pH is nearly neutral between 6.0 and 7.0. In highly acidic soils with pH of less than 5.0, phosphorous gets “tied up” with iron and aluminum to form complexes which are unavailable to turfgrasses.

Maintaining near neutral soil pH values also favors the activity of beneficial soil microorganisms, the release of nitrate from nitrogen fertilizers and more vigorous growth of most turfgrasses.

In highly acidic soils, toxic concentrations of aluminum, iron and manganese may develop and cause impaired rooting (roots will appear short, brown and spindly) a decrease in overall turf vigor, shoot growth, drought tolerance and recuperative potential.

The optimum pH range for cool-season turfgrass is 6.0 to 6.5. Since most soils in New England are acidic, the application of lime will adjust the soil pH or acidity to the correct level. Lime is a calcium-based compound (ground limestone). Some turf grass diseases tend to increase with pH extremes.

Two ways to ensure that correct amounts of lime are applied to the athletic field are to:
- conduct a soil test prior to the liming application and use the amounts recommended by the soil lab,
- ensure that the spreader is properly calibrated for the specific application rate.

The best time to apply lime is in the late Summer or early Fall. Late Fall applications should be avoided because they are known to increase some turf diseases such as pink snow mold. Staff should be properly trained in the application procedures.

g. Top dressing
Top-dressing is a way to slowly enhance the soil's texture and nutrient level by lightly spreading a compost material on turf. By improving the soil texture (increasing the organic matter), the moisture holding capacity of the soil is increased and less water and nutrients are wasted. Because of the high cost, top dressing is seldom done on municipal fields.

Often aerating, top-dressing and over-seeding are executed at the same time.

h. Vegetative Buffer Zone
Planting a vegetative buffer zone of low maintenance grasses or natural vegetation between areas of highly maintained turf and water prevents erosion and provides a filter for unwanted nutrients. The width of the vegetative strip will depend on soil characteristics, the type of vegetation used, and the topography. In addition to acting as a trap, the planting provides other benefits by serving as a wind buffer zone, visual screen, wildlife habitat and noise barrier for abutters.

i. Minimize Fertilizer Applications Near Sensitive Areas
The application of fertilizer on slopes near to surface water increases the risk of negatively impacting water quality. It is important to consider if there is a need to apply fertilizer at all in these areas. Applications should be minimized in these areas or should be avoided if possible.

j. Recycle grass clippings
When practical, clippings should be allowed to remain on the turf area to decompose and recycle nutrients back into the turf. Often clippings are removed but they should not be blown into ditches or concrete areas where they have a high probability of running off into surface water sources.

k. Field Rotation
Field Rotation reduces compaction due to overuse and wear. Different fields should be used for practice by alternating user schedules. Also, shifting the entire playing surface can be done simply by remarking the lines on the field which will reduce repetitive wear on the turf in places such as goal areas. An athletic field with a dense coverage of turf is an effective tool to reduce erosion and runoff.

l. Critical Area Planting
Planting in a highly erodable or critically eroding areas will reduce erosion and sedimentation by providing a soil cover. Use perennial plants such as shrubs, trees and grasses. This is a more specific and localized treatment that is perhaps inside the property perimeter

CHAPTER 4

Pest and Pesticide Management Practices

ADDITIONAL RESOURCE:
The complete Massachusetts Pesticide Bureau Regulations are available online at www.massdfa.org

Potential Concerns

- groundwater/ drinking water contamination due to off-site movement of pesticides.
- runoff of pesticides into water body causing damage to aquatic ecosystems.
- pesticide accumulation in soils due to spills and improper handling.
- chronic and acute toxicity to non-target organisms from exposure to pesticide application or misapplication.

REFERENCE:
Regulations specific to turf management are found in 333 CMR 13.07 (Appendix C)

Pesticides are often necessary to control pests. However, pesticides can present risks to the health of environmental resources and to the users of the fields. Surface waters are particularly vulnerable to contamination by pesticides. Groundwater contamination can also occur. Pesticides may harm the environment by eliminating or reducing populations of desirable organisms. Other sources of pesticide contamination may include spray drift during the application process, misuse and misapplication, spills, leaks, and discharges that may be associated with pesticide storage, handling and waste disposal. The application of pesticides to athletic fields is often a source of public concern, particularly as it relates to potential impacts on children.

REFERENCE:
"Pesticide Bureau Lawn Care Consumer Information Bulletin" (Appendix C)

"Sign Posting for Lawn Care Specialist" (Appendix C)

Because of the risks inherent in using pesticides a number of regulatory and non-regulatory mechanisms have evolved to help manage and reduce those risks. Included among these mechanisms are pesticide regulations enforced by government agencies, such as the Massachusetts Pesticide Bureau; and pesticide Best Management Practices such as the use of Integrated Pest Management, correct mixing, loading and storage approaches, proper disposal of waste pesticides, maintaining records of applications, and ensuring equipment is calibrated. The following best management practices should be a component of any turf management plan

REFERENCE:
Comprehensive information on the Childrens and Families Protection Act is found in Appendix D

BEST MANAGEMENT PRACTICES

A. INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is an approach to pest control that links together several related components, including pest identification, monitoring and scouting, threshold setting, biological controls, mechanical and/or other cultural practices, and pesticide applications. By combining a number of these different methods and practices, satisfactory pest control can be achieved with less impact on sensitive resources than if pesticides were the sole control mechanism. IPM aims to keep pests below levels which can cause unacceptable aesthetic or economic damage and which do not pose a hazard to the public. A significant benefit of IPM is that pesticides are used only when necessary to maintain turf quality.

A written IPM strategy is an essential component of any environmental assessment plan. The strategy should indicate knowledge of the principal turf pests, their life cycles, procedures for monitoring and the threshold levels for intervention. This information is readily available through publications such as Turf Facts from UMASS and the Lawncare guide of the Department of Food and Agriculture.

REFERENCE:

A helpful overview of management approaches for some commonly encountered turf pests in Massachusetts is presented at the end of this Chapter

The following measures are all part of an IPM approach to dealing with pest problems.

1. Pest Identification

Decisions on when and how to control a pest, such as an insect, weed or a disease depend on the ability to determine its identity. It is important for turf managers to identify the main pests that occur in the local area and become familiar with their life cycles. Control measures vary for different stages of the life cycle. Identifying the pest correctly helps to choose the proper pest control and avoids unnecessary use of the wrong application material.

2. Monitoring and Scouting

The site should be checked on a regular basis for pests. This periodic monitoring will help to identify a potential problem in the early stages thereby avoiding crisis management methods at later stages. Crisis management can be costly, both financially and environmentally because it may require a more toxic material to be used. However, early detection often allows the turf manager to use alternative approaches and to use localized spot treatments which reduces pesticide use and costs. A written record of observations should be kept.

REFERENCE:

The Weed and Insect Charts at the end of this chapter are useful guides to pest identification.

3. Thresholds

The simple presence of a pest does not mean a treatment has to be done. There may be a certain level of damage that is tolerable and not worth using a pesticide to control. The level at which pests should be controlled is referred to as a threshold, or the level of pest tolerance. To determine what level requires a response it is necessary to know what is the expected quality of the turf. The higher the desired turf quality, the quicker a turf manager will need to respond and this may mean using a pesticide.

REFERENCE:

The Seasonal Checklist in Appendix A should be referred to when monitoring.

4. Pest Control Techniques

Pest control techniques include mechanical controls, biological controls and chemical controls:

Mechanical Controls are a non-chemical approach to correct a pest problem. Examples include weed-whacking, pulling the weeds out by hand or with a hoe, and insect traps. The number and type of pests will determine how effective this manual approach will be.

REFERENCE:

For more information on threshold levels for the various turf pests, refer to the tables at the end of this Chapter which describe Insect Management and Weed Management control measures.

Biological Treatments are a non-chemical approach which may involve the use of the following :

a) beneficial insects:

Many insects that occur naturally have the potential to keep low-to-mid size populations of a pest in check. By learning to recognize these “beneficials” a pest may be controlled without any intervention. For example, the big-eyed bug is a natural predator of the chinch bug. Other examples of beneficial insects are ladybugs, tiny non-stinging wasps and spiders. Beneficial insects are very susceptible to pesticides. Use of broad-spectrum insecticides (pesticides used against insect pests) affects more than just the pest; they are often just as detrimental to beneficial insects. If you are considering a chemical

treatment, be aware that using a pesticide may eliminate natural controls along with the pest.

b) biological control products:
An increasing number of pest control products are being marketed which contain living organisms that act against pests. Biological products include beneficial insects, pest diseases, and parasites of pests which are released or applied in order to attack and control target pests. These biological products often work only during certain life stages of the pest, or under certain environmental conditions. While many biological controls pose fewer risks to the environment than chemical pesticides, their use may require more planning. Among commonly used biological control products are bacteria, fungi and nematodes.

Certain bacteria cause disease in insects. Strains of a type of bacteria named Bacillus thuringiensis (Bt) are effective against caterpillars such as the sod web-worm. These bacteria produce a chemical that causes the insect to stop feeding. This biological control product may be bought and sprayed onto the field. Similarly, milky spore or Bacillus popilliae, causes Japanese beetle grubs to appear "milky" and then, eventually, to stop feeding and die. The effectiveness of milky spore varies depending on soil temperatures, as well as on its availability to the pest.

A type of fungus, Beauvaria bassiana, occurs naturally in the soil and infects chinch bugs and billbugs. It is especially prevalent in cool, wet springs. Infected insects may be seen with "cottony-looking" strands of fungus on them. This fungus may also be obtained commercially. See also endophytic grass species in the section on grasses.

Nematodes are tiny, worm-like organisms found in the soil. Nematodes penetrate into the insect causing death. Applied correctly, certain nematode products may be useful in treating sod webworm, and billbugs.

Chemical Controls involve the use of pesticides to repel, mitigate, or kill a given pest. Pesticides are toxic by design. They should be used carefully and applied strictly according to label directions. The use of chemical pesticides may be considered in order to manage the most stubborn of pests. The most common types of pesticides used in turf management include insecticides which are specially formulated to control insects, herbicides designed to control weeds, and fungicides which control fungi. If you choose to use a pesticide, select a chemical which poses the lowest risk to public health and the environment. Learn about the different types and uses of chemical pesticides so that you can make a wise selection.

The following section addresses pesticide use as it applies to turf management.

B. MINIMIZING PESTICIDE APPLICATIONS NEAR SENSITIVE AREAS AND MAINTAINING BUFFER ZONES

The application of pesticides near sensitive areas such as surface water increases the risk of negatively impacting water quality. It is important to consider if there is a need to apply pesticides at all in these areas. Applications should be minimized in these areas or should be avoided if possible.

Maintaining a buffer zone where no pesticides are applied is a practice which should be used for certain sensitive areas. These sensitive areas would include gathering points such as picnic bench areas; children's playgrounds; jungle gyms; areas where the water table is high; and areas which slope down to a sensitive water body. A twenty five feet no pesticide zone from a surface water area or around a gathering point, or a simple strip of grass along a stream bank where no pesticides are applied are alternatives turf managers may want to consider.

REFERENCE
For more detailed information on Storage, Mixing and Loading of Pesticides see Appendix E

C. PESTICIDE STORAGE AND HANDLING

Poorly stored pesticides and improper mixing/loading practices can present a potential risk to our health and to the integrity of the environment. The quality of surface water, groundwater and soil can be degraded in areas where pesticides are stored under inappropriate conditions, improperly mixed and loaded into application tanks, and where equipment is washed and rinsed after application. Accidents involving spills or leakages may have serious health and environmental consequences. Refer to the Massachusetts Department of Food and Agriculture guidelines for pesticide storage, mixing and loading for more information.

ADDITIONAL RESOURCE
For all questions regarding the Pesticide Collection Program, you must contact the Pesticide Bureau.
617-626-1700

D. PESTICIDE DISPOSAL

The Massachusetts Department of Food and Agriculture in cooperation with several other state agencies regularly facilitates collection events for waste pesticides in November. This non-regulatory and voluntary program allow pesticide users to dispose of all unused and unwanted pesticides, including those that are suspended or canceled. A regional hazardous waste disposal facility which operates on a regular schedule is located in Lexington, MA.

E. PESTICIDE EQUIPMENT CALIBRATION

Pesticide application equipment should be calibrated each season. Improper calibration can result in application rates that are significantly different from the intended rate. Low applications can result in poor pest control, and costly repeat applications. Rates which are too high waste pesticides and pose a greater risk of environmental contamination than necessary.

ADDITIONAL RESOURCES
The Pesticide Regulations are available online at www.massdfa.org.

REFERENCE
The Pesticide Regulations specific to turf are available in Appendix C www.massdfa.org.

REFERENCE:
Refer to Appendix C for a copy of the "Pesticide Bureau Lawn Care Consumer Information" bulletin.

REFERENCE:
Refer to Appendix C for the "Lawn Posting for Pesticide Applicators' bulletin.

REFERENCE:
Comprehensive information on the Childrens and Families Protection Act is found in Appendix D

Pesticide Regulatory Issues

The Pesticide Bureau of the Massachusetts Department of Food and Agriculture is responsible for regulating pesticide use in Massachusetts as contained in 333 CMR. Pesticides are generally classified as either general use or restricted use. Turf managers who apply pesticides as part of their job must be licensed to use general use pesticides or certified to use restricted use pesticides. Licensing and certification are mandated to ensure that individuals handling pesticides have a minimum competence to apply pesticides without causing harm to sensitive areas and that they possess basic knowledge of the pesticide laws of the Commonwealth. Some of the key points relating to turf management are:

1. The applicator must provide the municipality with the "Pesticide Bureau Lawn Care Consumer Information Bulletin" prior to entering into any agreement to apply pesticides. If the town itself is applying pesticides, the town must provide a copy of this document to anyone who requests it.

2. Signs developed by the Department must be posted on pesticide treated fields, including fertilizer/ herbicide (weed and feed) applications. The Department recommends that the signs be removed after 72 hours.

3. Application information must be left after the application for review by anyone who wishes to view information about the treatment. Such information shall include the applicator's name and license number; the name of the pesticide product (trade name) applied; the purpose of the application.

4. If you are applying pesticides to school property, you must follow the requirements of the Childrens and Families Protection Act. This involves, at the very least, providing information on the application for the purposes of parent and student notification. Details are in Appendix C.

Groundwater Protection List
Certain pesticides are restricted in recharge areas of public drinking water supplies (Zone Is and IIs). Pesticides may not be applied within a Zone I. Products on the Groundwater Protection List contain pesticides which may pose a risk to groundwater based on their chemical characteristics and toxicity or have been restricted due to groundwater concerns. These products may not be used within a Zone II. Alternative products which are not on the Groundwater Protection List must be used within the primary recharge area of large public drinking water supply wells.

ADDITIONAL RESOURCES
Check with the Pesticide Bureau for the latest version of the Groundwater List.

It is very important that the current most up to date Title V maps be consulted to determine if the application site is located within a Zone II. New wells can be added and Zone II areas change. The town Conservation Commission and Board of Health can provide assistance.

Active Ingredients Regulated Under the Public Drinking Water Protection Regulations (as of February 00)

Acetochlor	Bromacil	Diuron	Metolachlor
Acifluorfen	Chlorothalonil	Fenamiphos	Metribuzin
Alachlor	Cyanazin	Flufenacet	Simazine
Aldicarb	Cyproconazole	Folpet	Terbufos
Atrazine	Dacthal	Fonofos	PCP
Baygon	Dimethenamid	Lindane	Propazine
Bentazon	Disulfoton	MCPA	

Disease Management

A variety of diseases can effect your turf throughout the season. Often, turf diseases appear as circular patches. It is difficult to determine the specific cause and type of turf disease without extensive training or laboratory tests. In general, IPM programs for controlling diseases in turf involve maintaining a healthy field. For more information on how to maintain healthy turf, refer to the section on cultural management practices.

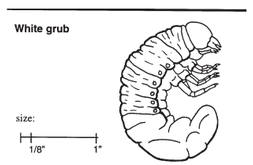
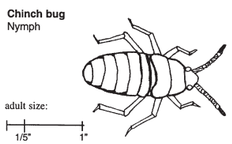
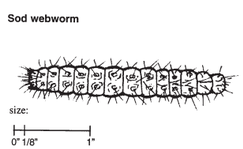
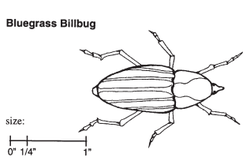
The following recommendations describe key decisions and practices for managing turf diseases.

- Plan your landscape so as to provide good air circulation which will allow turf to dry rapidly.
- Select disease resistant grass seed that is adapted to the conditions of your site.
- Prune trees and shrubs to allow for better light and ventilation.
- Avoid overwatering as waterlogging turf can lead to a variety of disease problems.
- Be aware that herbicide use can increase susceptibility to disease. Use herbicides, and/or any other pesticide product, only when a problem exists that cannot be managed through other non-chemical control measures.
- Water early in the morning in an effort to minimize the spread of disease and evaporation of water into the air. At this time, the grass is already wet from dew and the sun is still low. Fields can also be watered at night except during long periods of hot, humid weather; excessive. Watering under humid conditions is likely to promote diseases such as the growth of certain fungi. Mow only when the grass is dry

TABLE 5 WEED MANAGEMENT

Weed	Life Cycle	Leaf Type	Preventative Practices	Chemical Control
Crabgrass Goosegrass Foxtail Barnyard-grass 	Summer Annual	Grassy	Do not aerate when crabgrass is germinating as it will bring weed seeds to the surface. Hand-pull, removing at least part of the root	Apply a selective pre-emergence herbicide 10-14 days prior to germination in the Spring (late April-early May). For crabgrass, apply up to the time the local forsythia ends bloom (in Massachusetts). Goosegrass geminates 3-4 weeks later.
Pineapple-weed Yellow Wood Sorrell **Prostrate Spurge** 	Summer Annual	Broad-leaved	Mow high to shade out germinating and Emerging weeds.	Apply a post-emergence herbicide once weeds have emerged; at the 2-5 leaf stage for crabgrass and at an early stage for all other grassy and broadleaf weeds.
Annual Bluegrass 	Winter Annual	Grassy	Mow flowerheads to prevent seed production. Correct compaction as many of these weeds are associated with that problem.	Apply a selective pre-emergence herbicide 10-14 days prior to germination in Fall; usually around September, but often not effective due to a long germination period.
Chickweed l Shepherd's Purse l Yellow rocket 	Winter Annual	Broad-leaved		Apply a selective post-emergence herbicide in the Spring just before fields start to regrow so turf grass can move into the newly killed area.
Yellow nutsedge **Quackgrass** Nimbleweed Bromegrass 	Perennial Perennial	Grassy	Remove clumps, including ENTIRE root system. Aim to control during the first year of growth.	Spot treat with a non-selective herbicide. Be aware that this will kill both the weed and the turfgrass as well.
Dandelions Plantain Ground ivy Cinquefoil 		Broad-leaved	Mow high so turf can out compete weeds. Mow flowerheads to prevent seed production.	Spot treat with a selective post-emergence herbicide in the Spring or, preferably, in the Fall

TABLE 6: INSECT PEST DESCRIPTIONS & INSECT PEST MANAGEMENT

Insect		Damage Stage	Monitoring Technique	Prevention Practices	Biological Controls	Chemical Controls
White Grub		White grubs are the immature stages of a number of beetles such as the Japanese beetle, European chafer, Asiatic Garden beetle, Oriental beetle, and June beetle. All are cream-white colored with a hard brown head capsule and 3 pairs of legs. All curl into a characteristic "C-shape." Depending upon the type, they may be 1/8-1 inch long.	Larvae Grubs Feed on roots causing grass to die. Skunks may tear up turf in search of grubs. Appear April-May August-October	Cut 3 sides of a square, 6 inches per side and flip back the sod. Remove grubs from soil around roots and in ground and place in a container to be counted. Flip turf back in place, press along edges, and water to re-knit patch of turf. Pest tolerance levels usually fall around 8-10 grubs/foot	Renovate	Milky disease", Bacillus popilliae.	Use insecticides to treat April 15-May 10 or August 1-20 (slower acting chemicals around August 11, faster acting ones after August 15)
Chinch Bug		Adults have black and white markings on their wings and are about 1/5 inch long. The nymph (immatures) appear similar but do not have wings and often have red or orange markings. DO NOT confuse this pest with the "big-eyed" bug that is a natural predator of the chinch bug. The two look similar but the big-eyed bug has large, bulging eyes. If at least 50% of the "bugs" are big-eyed then the population may be reduced naturally.	Young Bugs suck juices from grass causing regular, dead patches, especially in dry sunny areas with sandy soil. Appear June-end of July	Spread grass and look for scurrying insects. Flotation method: Remove both ends of a coffee can and pound into the ground 2-3 inches. Fill the can with water and watch for insects floating to the top. Do not confuse the pest with bigeyed bugs, the natural predator.	Water field Adequately. Plant edophytic Grasses.	If you find at least 50% big-eyed bugs then the population should be naturally reduced. Fungi-Beauvaria bassiana	If necessary, apply chemicals in mid June.
Sod Web-worm		Adults are tan-colored moths, sometimes having a small dark line on the top of each wing. They have a long "snout" and are cigar-shaped when at rest. They are often seen flying upward as you walk on the field, especially on a Spring evening. The caterpillars range from 1/8 - 1 inch long, are greenish-grey and have dark spots along the body. In larger caterpillars, the head capsule is light brown with some dark markings.	Caterpillars cause small, yellow-brown patches on leaf blades that enlarge into dead patches, especially in sunny areas in July-August.	Look for moths flying above the turf in the evening earlier in the season or for larval excrement later on. Irritating drench: On a hot, sunny day, prepare a solution of 1-2 table-spoons lemon-scented dish detergent in 1-2 gallons of water. Pour this onto a 2 feet X 2 feet space along the edge of a damaged area. Count the number of caterpillars that come to the surface within 5 minutes. Rinse turf with clear water to avoid burning.	Renovate using Endophytic Grasses	Bt. biological pesticides. Parasitic nematodes	Apply insecticides 2-3 weeks after the peak of moth flight activity. Apply late in the day. Water in lightly.
Blue-grass Billbug		Adults are grayish-black, approximately 1/4 - 1 inch in length with a long, narrow snout. Larvae are white-cream colored with a hard, brown head capsule and have no legs. They are approximately 1/16-1/4 inch long.	Larvae cause dead grass, especially along edges of paved areas. Resembles salt damage but appears in late July-August	Watch for adults scurrying along paved areas near mostly bluegrass fields on sunny days in late May-mid June. If you count more than 12 adult billbugs in 5 minutes, it may indicate damage by larvae (8-12/ft 2) about 6 weeks later. Fine, saw dusty "frass" (insect excrement) at the base of grass plants are evidence of larval feeding. Pest tolerance levels usually fall around 12 adults/5 min.8-12 larvae/ft 2	Renovate with Endophytic Grasses	Parasitic nematodes. Beauvaria Bassiana (fungus) Biological pesticide	Treat small larvae in June with pesticides.

PART TWO
Developing a Turf Management Plan

Developing the Plan

REFERENCE: Worksheets to assist you in the development of your Turf Management Plan are located in Appendix G

Your Turf Management Plan should be in writing and should consist of the following components:

- A Site Map
- Inventory of Potentially Impacted Sensitive Resources
- Selected Best Management Practices for General Management; Water Management; Nutrient Management, and Pest and Pesticide Management.
- Field Use Schedule
- A Month by Month Schedule of Management Activities

There are four steps involved in creating a practical Turf Management Plan for an athletic field

Step One: Develop a Site Map
With assistance from the local Conservation Commission or Watershed Team, map the site's physical characteristics and identify sensitive resources within 100 feet of the site,

Step Two: Develop an Inventory of Sensitive Areas and Select Best Management Practices
With assistance from the local Conservation Commission or Watershed Team and using this document as a resource develop an inventory of sensitive resource areas which could potentially be impacted by turf management activities. Based upon the limitations imposed by sensitive resource identification and the scheduling of field activities, select best management practices for General Management; Water Management; Nutrient Management and Pest and Pesticide Management. Describe how the selected practices reduce or prevent the potential impacts identified in Step Two.

Step Three: Develop a Turf Management Schedule
Using this document and the resources of the University of Massachusetts, develop a month by month schedule of best management practices for each field. Coordinate this schedule with the timetable of field use activities such as soccer matches, band practices and little league games.

Step Four: Communicate, Seek Comment and Evaluate:
Opportunity should be provided for comment and input on the plan from key stakeholders in the town. The plan should be modified where realistic to meet the needs of the stakeholders. Continue to evaluate and revise the plan as needed.

Step One: Develop a Site Map

REFERENCE
Worksheets to assist you in the development of your Turf Management Plan are located in Appendix G

Mapping the sports field is an important first step in evaluating potential impacts on sensitive resources both on and off site. The location of the sensitive resources in relation to your activities on the field is important. A good understanding of potential impacts can be gained by mapping both the sensitive resources within 100 feet of the site and the physical characteristics of the site.

(a) Sketch the Field and Identify Physical Characteristics

Every site has its own set of unique physical characteristics- both natural and man made. The physical characteristics of the site such as soil types and topography help in understanding permeability and susceptibility of the soil to turf chemical leaching and run off patterns. Using the graph paper provided sketch the following characteristics:

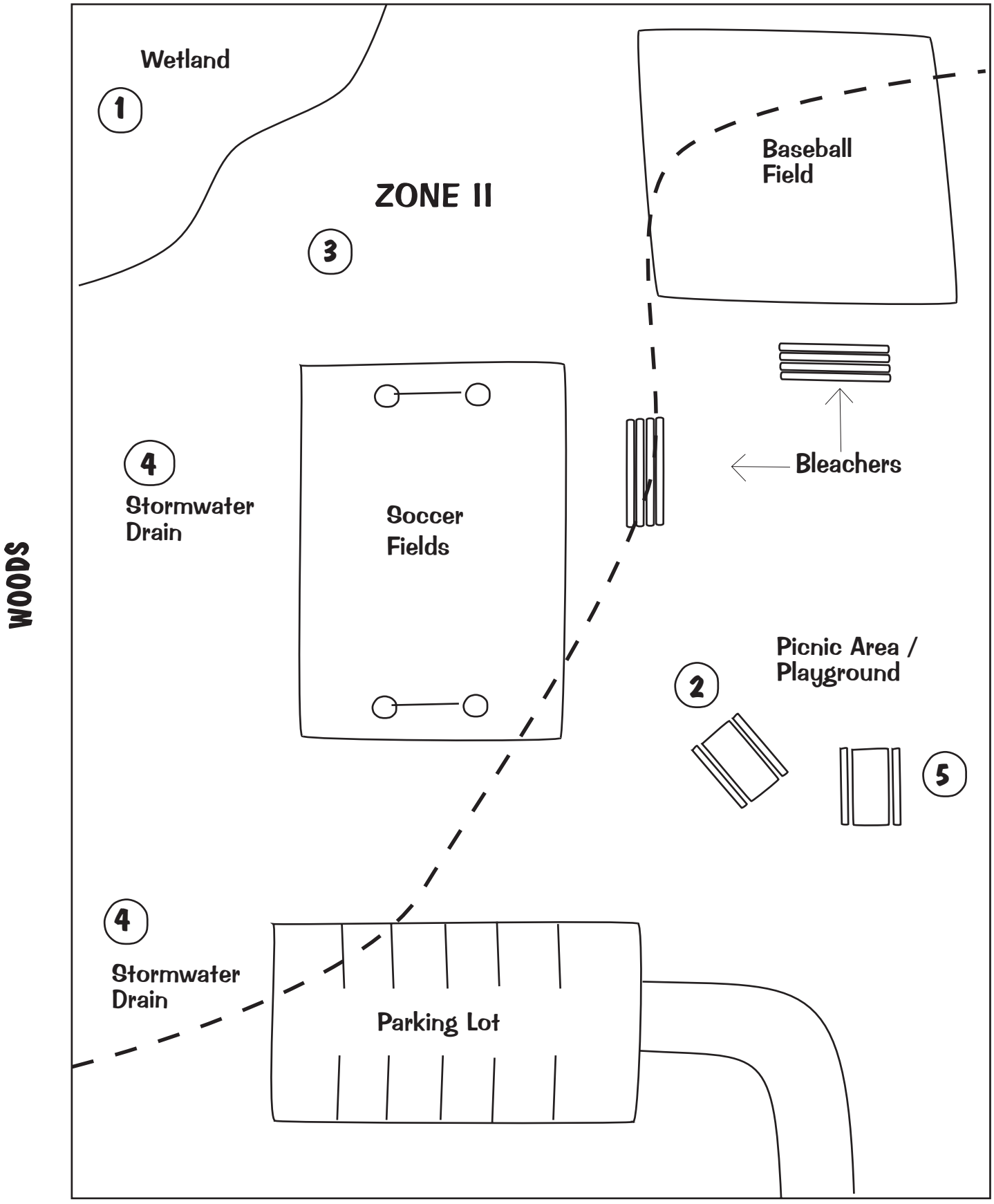
- Vegetation: such as woods, grass, hedges.
- Slope: determines affects patterns of runoff. Indicate slopes with arrows.
- Soil type: high leaching index soils; highly erodible soils
- Water Table Depth
- Stormwater drains
- Buildings:- storage sheds for pesticides and fertilizers
- High wear areas such as access paths, goalpost zone.
- Utilities (electric -lighting and irrigation)
- Impervious surface areas such as ground that is paved or not otherwise able to absorb water.

(b) Identify and Map Sensitive Resources

Using the graph paper provided, sketch all potentially impacted sensitive resources within 100 feet of the site, and any resources potentially impacted on site. Highlight and number the potentially impacted resources. Arrows should be used to indicate slopes and the direction of flow of any moving water. To help identify these resources consult the local Conservation Commission, Board of Health or Watershed Team. The following resources/areas of concern should be included:

- Public Water Supply: check for drinking water protection areas such as a Zone I, Zone II, Zone A or Zone B.
- Private Wells and other areas of direct access to groundwater. Water table depth and shallow aquifers
- Areas where people gather such as bleachers, picnic tables
- Children's playgrounds
- Surface water resources such as streams, rivers, wetlands, estuaries

WOODED AREA


Wetland
1
ZONE II
3
Baseball Field
Bleachers
4
Stormwater Drain
Soccer Fields
WOODS
Picnic Area / Playground
2
5
4
Stormwater Drain
Parking Lot

REFERENCE
Worksheets to assist you in the development of your Turf Management Plan are located in Appendix G

Step Two: Develop an Inventory of Sensitive Areas and Select Best Management Practices

With assistance from the local Conservation Commission, Board of Health or Watershed Team and using this document as a resource develop an inventory of potentially impacted sensitive resources. Highlight and number these areas on the map, and detail the activities that could potentially impact the resource in the worksheets as shown on the following page. Based upon the limitations imposed by sensitive resource identification and the scheduling of field activities, select best management practices to reduce or prevent the potential impacts identified in Step Two

#	IDENTIFIED SENSITIVE AREA	POTENTIAL CONCERNS	BMP
1.	Wetland	Chemical applications of nutrients or pesticides. Overwatering - runoff. Improper storage or disposal of chemical materials	Vegetative buffer. No chemical applications within 25 feet. Nutrient Management Plan. Use IPM. Store pesticides according to DFA guidelines.
2.	Picnic Area	Applications of pesticides	Do not apply pesticides within 25 feet
3.	Zone II Public Drinking Water	Pesticides and nutrients could impact groundwater	Only use pesticides approved for use by DFA in Zone II Nutrient Management Plan. Apply WIN
4.	Stormwater Drains	Pesticides, nutrients, and sediments can discharge directly into a water resource	Cover stormwater drains
5.	Playground Area	Application of pesticides could impact the health of children	Do not apply pesticides within 25 feet

REFERENCE
Worksheets to assist you in the development of your Turf Management Plan are located in Appendix G

Step Three: Develop a Turf Management Schedule

Using this document and the resources of the University of Massachusetts, develop a month by month schedule of best management practices for each field. Coordinate this schedule with the timetable of field use activities such as soccer matches, band practices and little league games

EXAMPLE OF A TURF MANAGEMENT SCHEDULE FOR THE MONTH OF MAY

MAY	BMP Implementation	Sensitive Area Protected
General	Mowing High Aeration of compacted areas	Water Conservation (esp. during water ban) Cultural weed control - no chemicals used Player safety (fall & injury)
Water	Check Irrigation equipment and zones	Water Conservation (ensures only field, not any paved areas receive water) Ensures even distribution of water and better turf growth and resulting even playing surface.
Nutrient	Use Fertilizer with high WIN % Fertilize only field areas Soil Test	Wetland - Water Quality Picnic/Playground Area - non-players, or visitors safe from chemical sensitivity. Ensures proper type & amt of material is applied & avoids unnecessary reapplication or corrective action.
Pest & Pesticide	Scouting / Monitoring	Allows early detection of pest & possibly less toxic control to be effective Wetland -Water Quality Picnic / Playground Zone II
Other Example: meetings Workshops (staff training)	Examples May 10th U Mass Turf Workshop - Integrated Pest Management May 21st Essex Conservation District Seminar on Drought Strategies for Turf Managers.	

REFERENCE
Worksheets to assist you in the development of your Turf Management Plan are located in Appendix G

Step Four: Communicate, Seek Comment and Evaluate

- Share the plan with identified key stakeholders such as the Town Board of Health, Recreation Department, PTA, Coaches, and Conservation Commission for their review and comment. Modify the plan according to their suggestions where possible.
- Offer to present your plan to the town either at Town Meeting or to the Board of Selectmen
- Make plan available to the public at the Municipal Offices, the local library, or by posting it on the municipal web site,
- Continue to evaluate the plan to determine if the practices used are effective in attaining the goal -a healthy turf with minimum impacts on sensitive resources. Review and revise the document as necessary.

PART THREE
Glossary, Resources & Appendices

Glossary

Buffer Zone: the zone around a perimeter of a riparian wetland where land use activities are limited in order to protect the water features.

Chemical Leaching: the removal of chemicals in a solution (water) from the soil. The washing out of chemicals from one level to another in the soil.

Cultivar: a variety of plant (or turf) that has been produced under cultivation.

Dormancy: summer dormancy is one of the plant's methods of drought protection in the hot mid-summer months.

Endophytic grass seed: grass seed which has been infected with a fungal endophyte (an organism living within another plant) that does not harm the host turfgrass and may provide benefits for both, such as higher resistance against surface feeding insects.

Environment Assessment: a study or review of a proposed action and the influence it could have on the environment.

Eutrophication: excessive growth of algae or eel grass depletes the oxygen supply required by aquatic organisms and reduces the quality of fish habitat.

Groundwater: the mass of gravity water that occupies the subsoil and upper bedrock zone. It is the water in the zone of saturation below the soil-water zone.

Interim Wellhead Protection Area (IWPA): generally, this is a 1/2- mile protectiver radius for sources whose approved pumping rate is 100,000 gallons or greater. For smaller sources, the radius in feet is determined by multiplying the approved pumping rate in gallons per minute by 32 and adding 400.

Leaching: the removal of minerals from a soil solution, washing out of minerals from one level to another in the soil.

Mitigation: a measure taken to lessen the impact of an action on the environment.

Mulch: an application of material that can enhances the soil's nutrient level and soil texture which can increase the moisture holding capacity and reducing water loss (example grass clippings)

Non-Point Source Pollution: pollution caused by water from a spatially diffuse source that runs over and through the land surface, picking up pollutants and

carrying them to surface and ground waters.

Nutrient Loading: excessive nutrient levels that accelerates growth in aquatic plants and can lead to eutrophication(or infilling of the water body basin).

Over-Seeding (or Reseeding): the application of grass seed to an existing turf surface. Often this is done after aerating.

Point Source: water pollution that comes from a single source.

Postemergent Pesticide: applied after the weeds have emerged and are already present on field

Preemergent Pesticide: applied one to four weeks prior to the expected weed germination period and is generally watered in so that the chemical can form a barrier in the soil prior to germination.

Rinsate: leftover rinse water that is used to clean any equipment. This remaining water contains the chemical residues of whatever pesticide or fertilizer has been used.

Riparian: a wetland area that forms on the edge of a major water feature such as a lake or stream.

Runoff: the amount of water (from precipitation or irrigation) that flows over the surface of the land without sinking into the soil.

Soil Erosion: the removal and loss of soil by the action of water, ice, gravity, or wind.

Thatch: a tightly intermingled layer of living and dead stems, leaves and roots which accumulates between the layer of actively growing grasss and the soil underneath. Thatch can prevent can prevent water and nutrients from penetrating to the root zone. Thatch also serves as an excellent breeding ground for harmful insects and disease organisms. Aeration breaks down the thatch layer.

Tolerance: the range of stress or disturbance that a plant is able to withstand without damage or death.

Top Dressing: compost, peat, or other soil additive applied to the field turf to enhance soil's texture and nutrient levels.

Turbidity: a measure of clearness or transparency of water as a function of suspended sediment.

Watershed: area of land, delineated by a ridgeline or basin divide, contributing runoff to a specific stream, lake, river,etc. The drainage basin and all land that contributes to the drainage network.

Wetland: lands where the water table is at, near, or above the surface long enough during the growing season to promote the formation of special (hydric) soils or to

support the growth of hydrophtyes (special water-loving plants).

WIN (Water Insoluble Nitrogen): slow-acting form of nitrogen that becomes slowly available for absorption by turf (often referred to as slow release). The amount of WIN in a fertilizer product will determine how much and how often the fertilizer should be applied.

WSN(Water Soluble Nitrogen): fast-acting form that is quickly available to be absorbed by turf.

Zone I: is the protective 400 feet radius around a public well or wellfield that a water supplier must own or control if pumping 1,000,000 gallons per day or greater as required by DEP Drinking Water Regulations (310 CMR 22.0) to protect groundwater from microbiological or other contamination. If pumping less than 100,000 per day then radius of protection can be less than 400 feet.

Zone II: is the primary recharge area to a well. It is the area that recharges a well under the most severe recharge and pumping conditions that can be realistically anticipated. It is bounded by the groundwater divides which result from pumping the well and by the contact of the edge of the aquifer with less permeable materials such as glacial till and bedrock

For Further Information

Telephone: (978) 774-5578

Essex Conservation District, 562 Maple Street Hathorne, MA 01937.

Website:
www.state.ma.us/envir/mwi/
Telephone: 978-661-7817

Ipswich and Parker River Watershed Team,
209A Lowell Street, Wilmington, MA 01887
Services include: grants, education, information about watershed environmental issues

Website: www.massdfa.org
Telephone: (617) 626-1700

Massachusetts Department of Food and Agriculture,
Pesticide Bureau. 251 Causeway Street, Boston, MA 02114.
Services include: licensing and certification of applicators, IPM information, enforcement of pesticide regulations, pesticide disposal events, mixing, loading and storage of pesticides.

Website: www.state.ma.us/dcs
Telephone: (617) 727-1552

Massachusetts Division of Conservation Services,
Executive Office of Environmental Affairs, 251 Causeway Street Boston MA 02114
Services include: providing technical and financial assistance to farmers in matters dealing with farm plans or sediment and erosion control: grants to municipalities for conservation and parkland acquisition and construction, development of open space plans and technical assistance in seeking approval of conservation restrictions.

Website: www.state.ma.us/dep
Telephone: (617) 292-5770

Massachusetts Department of Environmental Protection,
Bureau of Resource Protection, One Winter Street, Boston MA 02108
Services include: hazardous waste disposal, wetlands and waterways, rivers protection

Website:
www.state.ma.us/ dfwele/dmf
Telephone: (978) 282-0308

Massachusetts Division of Marine Fisheries,
30 Emerson Avenue, Gloucester MA 09130
Services include: information on shellfish beds anadromous (herring, salmon) fish runs.

Website:
www.state.ma.us/envir
Telephone: (617) 626-1000

Massachusetts Executive Office of Environmental Affairs,
251 Causeway Street, Boston, MA 02114.
Services include: information on water conservation practices for property owners and athletic field managers

Telephone: (508) 966-1694

New England Sports Turf Managers Association,
A professsional membership organization for sports turf managers

Website: www.parker-river.org
Telephone: (978) 462-2551

Parker River Clean Water Association,
P.O.Box 798 Byfield, MA 01922,
Services include: fish counts, volunteer water quality monitoring,teacher training, Parker River festival, wildlife tracking, little river projects, headwaters projects, riparian buffer gardens

Website: www.umass.edu/umext
Telephone: (508) 892-0382

University of Massachusetts Extension Turf Program,
27 Chandler Street, Worcester, MA 01609.
Services include: workshops, seminars and the publication of the following documents:

To order Turf Notes contact:
Mary Owen at (508) 892-0382.

Turf Notes a New England wide newsletter for professional turf and grounds managers, published 6 times per year. (1 year/6 issues) $15.00 (2 years/12 issues) $25.00,

IPM Protocols for Golf Course Management a workbook describing the basic elements of an IPM system. .

To order these documents access the extension bookstore website:
www.umass.edu/umext/bookstore/tgrass.html

Turf IPM Facts a packet of fact sheets covering turf management topics inclusing cultural practices, insect, disease, and weed management, IPM techniques and more.

Professional Guide for IPM in Turf for Massachusetts 1999 (with 2000 updates) a comprehensive guide to turf management, including information on insect, disease, and weed management for turfgrass. 51pp (1999) $15.00

APPENDIX A
Seasonal Checklist

Seasonal Checklist

This checklist provides some general guidelines for managing your turf throughout the season. As the turf manager, you can judge better the need and timing of a given practice. This checklist is to be used within the context of this guide.

SPRING mid March-April	✔
Rake away areas of dead grass.	
Reseed thin and bare areas.	
If necessary, control crabgrass with pre-emergence herbicides.	
Use postemergence herbicides on winter annuals.	
Monitor for white grubs. Use insecti-cides to treat April 15-May 10 if neces-sary.	
Later spring (May). Mow rapidly-grow-ing areas more often. Mow high.	
Monitor for Bluegrass billbugs.	
If necessary, use pre or postmergence herbicides for crabgrass, depending upon its stage of development.	
Dig out smaller patches of broadleaf weeds. If necessary, spot treat with a broadleaf weed killer. Observe your turf regularly and note any changes. Keep records of all management practices.	

SUMMER June-July-August	✔
Monitor for bluegrass billbugs adults.	
Monitor for chinch bugs and big-eyed bugs.	
Monitor for sod webworms.	
Monitor for Japanese beetle grubs. If necessary apply a slow-acting pesticide around August 11 and faster acting chemicals after August 15.	
Mow high and when flowerheads appear to reduce the invasion of crabgrass.	
Mow at 3 inches. Avoid mowing semi- dormant and dormant turf.	
Water deeply and infrequently just before grass wilts	
Observe your turf regularly and note any changes. Keep records of all management practices.	

FALL September-October	✔
Monitor for Japanese Beetle grubs, but it may be too late to treat.	
Mow as soon as flowerheads appear for broadleaf weeds.If necessary, use pre-emergence herbicides.	
In early Fall, prior to germination of Winter annuals. Fertilize in early Fall. Do a pH Test and adjust Accordingly.	
Renovate and reseed turf.	
Mow rapidly-growing grass more frequently.	
Observe your turf regularly and note any changes. Keep records of all management practices.	

Winter November - February	✔
Try to avoid piling lots of snow on areas of grass.	
Use sand or cat litter as an alternative to de-iceing salts which may cause damage to your field.	
Observe your turf regularly and note any changes. Keep records of all management practices.	

APPENDIX B
Soil Testing Form

APPENDIX C
Pesticide Bureau Information

APPENDIX D
Children's and Families' Protection Act

APPENDIX E
Mixing, Loading & Storage Guidelines

APPENDIX F
Pesticide Use Reporting

APPENDIX G
Worksheets For Turf Management Plan Development

ACTUAL WORKSHEETS

STEP ONE : DEVELOP A SITE MAP

STEP TWO:
DEVELOP AN INVENTORY OF POTENTIALLY IMPACTED SENSITIVE RESOURCES AND SELECT BEST MANAGEMENT PRACTICES

#	IDENTIFIED SENSITIVE RESOURCE	ACTIVITIES WHICH COULD POTENTIAL IMPACT SENSITIVE RESOURCE	BMP
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

JANUARY	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

FEBRUARY	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

MARCH	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

APRIL	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

MAY	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

JUNE	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

JULY	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

AUGUST	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

SEPTEMBER	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

OCTOBER	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

NOVEMBER	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		

STEP THREE: DEVELOP A TURF MANAGEMENT SCHEDULE

DECEMBER	BMP(S) AND DETAILS	SENSITIVE RESOURCE PROTECTED
General		
Water		
Nutrient		
Pest & Pesticide		
Other Ex: meetings Workshops (staff training)		