Best Management Practices and Guidelines for the Development and Review of Golf Course Proposals

Prepared For:

Muskoka Golf Course Research Advisory Committee

Prepared By:
Gartner Lee Limited

GLL 20-649

September, 2001

Distribution

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1 French Planning Services
2 File

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Mr. Bob Bergmann
Chairman: Golf Course Research Advisory Committee
Fisheries Section, Ontario Ministry of Natural Resources
300 Water Street, PO Box 7000
Peterborough, Ontario
K9J 8M5

Dear Mr. Bergmann:

Re: Best Management Practices and Guidelines for the Development and Review of Golf Course Proposals

I am pleased to submit our final report to you and the Muskoka Golf Course Research Advisory Committee on behalf of Gartner Lee Limited and French Planning Services Inc.

We have now addressed all of the final set of comments. We were very pleased to see that no significant changes were requested after submission of the third draft but did subject the document to an edit at your request.

I have enclosed 23 copies of the report, as requested in the original RfP. I will send three copies of the reference materials under separate cover to reflect our agreement that copies be made available for MNR, the District Municipality of Muskoka and the Muskoka Heritage Foundation. I have also provided an electronic version of the report and all figures and tables on a CD-ROM.

I thank you for the opportunity to assist the Muskoka Golf Course Research Advisory Committee with this timely project and wish you well in implementing the results of this review. Please do not hesitate to contact me should you have any concerns or comments.

Yours very truly,
GARTNER LEE LIMITED

Neil J. Hutchinson, Ph.D.
Senior Surface Water Specialist

NJH:le
Attach.

Executive Summary

This handbook is to be used by the golf course industry, review agencies and municipal planners to improve the management of golf course development in Muskoka. It is intended to ensure complete and comprehensive development and review of golf course proposals in order to recognize the environmental constraints and unique sensitivities posed by thin acidic soils, sensitive lakes and abundant wetlands in the Precambrian Shield environment. Ratepayer groups can also use this manual to understand approval requirements and process, to ensure their concerns are presented at the appropriate stage of the review process and that there concerns are adequately addressed.

The objectives of the manual are:

a) to develop an applied handbook of Best Management Practices (BMPs) for the design, construction and operation of golf courses on the Canadian Shield. This handbook provides environmentally sensitive design and construction techniques that will help protect the natural resource and maintain the character of Muskoka;

b) to develop a handbook that will help define the background studies required to develop a golf course, the process required to ensure that environmental constraints are identified and managed in the approvals process, to develop appropriate design options, undertake the construction phase of a development, and operate the golf course in the most environmentally sensitive manner; and

c) to be written such that municipal planners and decision makers can easily use it to critically review golf course proposals.

The material presented in the handbook concludes that a prescriptive approach, based on a-priori specification of BMPs and specific management practices will not, on its own, produce an environmentally friendly golf course. Every golf course developer will have different requirements for course layout and turf maintenance and every site will have a different set of constraints to address. Although BMPs, planning requirements, design considerations and monitoring approaches are detailed in this report, none have been developed specifically for Precambrian Shield areas. The contents of this report must therefore be "validated" against future findings as they become available. In the interim, this report presents sound approaches and suggestions which, in the experience of the authors and reviewers, were judged to be acceptable means of reducing environmental impact in any biophysical environment.

Given the lack of specificity in published BMPs, and the early stages of research into Shield-specific BMPs, this report includes a strong focus on a process to ensure that environmental constraints are identified before the course is planned, incorporated into the plan at an early stage and then used to guide detailed design and any need for monitoring. Detailed description and review, at specific stages of golf course development, will ensure that the design and operation of the course will protect the environment, that BMPs are chosen which best mitigate environmental effects, or that certain activities are identified which preclude development on sensitive sites. The process is summarized as:

a) integrated assessment of the natural environment and collection of appropriate baseline data before design;

b) approval of baseline report and feasibility study;

c) concept design based on natural features and environmental constraints;

d) development and approval of an Environmental Impact Statement (EIS), including specification of BMPs for construction and operation;

e) detailed design and development of Environmental Management System (EMS, or operations/mitigation manual including BMPs;

f) development of a monitoring program and financial assurances (if required);

g) construction, development, and operation; and

h) monitoring and reporting as required during each phase of development.

Although the process is important there is, at present, no mandatory regulatory or planning process to ensure that a golf course development complies with it or that BMPs are implemented where required. The Canada Fisheries Act provides a powerful tool to prevent alteration of fish habitat and incentive for developers to implement BMPs. Any project that triggers a federal regulation (such as alteration of Fish Habitat under the Fisheries Act) may invoke the Canadian Environmental Assessment Act (CEAA) and result in a review of all potential environmental effects of the undertaking. A federal EA is unlikely, however, as proper course design, development and BMP implementation should prevent invoking any EA triggers. Most remaining tools are either reactive (i.e., are triggered in response to spills) or required, but with no provision for BMP implementation beyond their immediate focus (Pesticides Act, Permit to Take Water).

The most effective combination of municipal planning tools appears to be the requirement for a Zoning Amendment together with a Subdivision Agreement. The Zoning Amendment would allow council to request the appropriate studies to determine the impacts of a golf course development and the Subdivision Agreement would allow for the posting of securities and monitoring of the site. Site Plan Control is not as effective because it does not have as wide a range of matters that it can address and there is a question of whether there is legislative authority to use it to control activities that alter landscapes, require securities and monitor sites.

There does not appear to be a land use planning control that clearly allows municipalities to deal with landscape alteration. As a result, the pre-construction (forest clearing and landscape alteration) of a golf course can occur without triggering any approval process and this puts all agencies in a reactive mode. There is a need for a clear mechanism to ensure that long term monitoring can be implemented and that bonds or securities can be required to ensure environmental compliance.

The report provides details on the requirements and techniques for collection of environmental baseline data, design of an environmentally sensitive golf course and specific BMPs for design, construction and operation. It also provides advice on a comprehensive monitoring and reporting program. The monitoring program distinguishes development of an "Environmental Management Strategy" to guide routine operations and "Environmental Effects Monitoring" to detect changes in the environment.

Reporting structures and responsibilities are recommended with the recognition that, in the absence of a specific regulatory or planning process, there is no repository for monitoring data beyond the operator of the course.

A series of six, spreadsheet-based tables are provided as a checklist to guide reviewers and developers through the requirements of an environmentally sensitive golf course. Selected resource materials are provided in Appendix 1, under separate cover.

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1. Reference Material on Golf Course BMPs (submitted under separate cover)

1. Introduction

The Golf Course Research Advisory Committee, The Muskoka Heritage Foundation, The District Municipality of Muskoka, The Towns of Bracebridge and Gravenhurst, the Townships of Lake of Bays and Muskoka Lakes, the Department of Fisheries and Oceans (DFO), The Lake of Bays Association (LOBA), The Muskoka Lakes Association, and the Ministry of Natural Resources (MNR) have requested a handbook of "Best Management Practices Guidelines" for the design, construction and operation of golf courses on the Canadian Shield. This handbook is to be used by the golf course industry, review authorities and municipal planners to improve the management of golf course development and to ensure complete and comprehensive review of proposals in order to recognize the environmental constraints and accommodate the unique sensitivities posed by thin acidic soils, sensitive lakes and abundant wetlands in the Precambrian Shield environment of Muskoka. Ratepayer groups can also use this manual to understand approval requirements and process and to ensure their concerns are presented at the appropriate stage of the review process and that they are adequately addressed.

The objectives of the manual are:

a) to develop an applied handbook of Best Management Practices (BMPs) for the design, construction and operation of golf courses on the Canadian Shield. This handbook provides environmentally sensitive design and construction techniques that will help protect the natural resource and maintain the character of Muskoka;

b) to develop a handbook that will help define the background studies required to develop a golf course, the process required to ensure that environmental constraints are identified and managed in the approvals process, to develop appropriate design options, undertake the construction phase of a development, and operate the golf course in the most environmentally sensitive manner; and

c) to be written such that municipal planners and decision makers can easily use it to critically review golf course proposals.

The manual is not intended to remove the need for routine "peer review" of every application. It is intended to guide both the developers and the reviewers by identifying an approvals and design process, and construction and operation techniques which should reduce the potential for environmental and regulatory conflict.

This manual is not intended to provide prescriptive advice for all aspects of development or to all types of golf courses. There is a broad range of golf course types and each will vary in terms of potential environmental impact and management requirements. Not all BMPs, therefore, will apply equally to all courses. Developers must be free to choose their own Best Management Practices, and programs of watering rates, fertilizer, and pesticide applications and turf cutting which are specific to the environment of the individual course, to variations in the natural environment and to development of new techniques and products in their industry. These will vary with the design of the course or the requirements of the developer.

This manual is therefore intended to guide both the developers and reviewers through identification of the approvals and design process for construction and operation techniques which will identify natural sensitivities and accommodate them through BMPs and approaches to reduce the potential for environmental or regulatory conflict.

1.1 Background of Golf Course Development in Muskoka

There are presently 20 golf courses in Muskoka, a reflection of its status as a vacation and resort destination. The boom in golf course development in the 1990s resulted in plans for an additional 11 courses or expansions in Muskoka. At the same time, public awareness of the expansion of golf course activity in Muskoka increased and was galvanized by a series of activities in the mid-1990s which resulted in losses of large volumes of soil and sediment to Muskoka water bodies. These events occurred during development of a golf course, expansion of a resort, a sewage plant upgrade and road construction activities, and resulted in a series of charges being laid under the Canada Fisheries Act. Court settlements were reached which directed funds to research on the effects of shoreline development on sensitive oligotrophic lakes and to the impacts of golf courses on the Muskoka environment.

Funding was directed to Trent University to undertake research into the environmental effects of golf course development on the Canadian Shield. Specific research activities relating to water quality, algae, benthic invertebrates fish and fish habitat are presently underway, but studies have not been completed and so results are not likely to be available until after the current wave of golf course development is complete. Findings to date suggest that subtle effects are present, but they may not be determined by conventional sampling methods. Although water quality sampling does not detect the export of nutrients from golf courses during the early phases of construction (i.e., prior to turf establishment), an analysis of the algal community downstream shows increasing dominance by algae which are indicative of nutrient enrichment (Winter et al., 2000).

The desire of municipalities to understand the implications of golf course development, concerns raised by some ratepayer groups, and regulatory issues identified by the MNR prompted the formation of The Golf Course Research Advisory Committee. The Committee is comprised of a diverse group of individuals representing municipalities, ratepayers, the provincial government, the golf course industry, and the Muskoka Heritage Foundation. The mandate of the Committee is to ensure that appropriate golf course research is being conducted, to disseminate information on the research findings, and to develop a Best Management Practices (BMPs) manual that will assist with the review and implementation of golf course development and operations on the Precambrian Shield. The Committee will continue to function until all research initiated by the current funding has been completed, which is expected to be in approximately 2002.

The key research findings required to guide recommendations specific to Muskoka are several years away. This manual therefore combines existing knowledge gained from experience on and off the Shield with a conservative approach to environmental protection. It provides BMP's based on current knowledge and understanding of golf course development on the Shield and elsewhere. Our knowledge of golf course construction and operations in the Muskoka environment is just developing and so periodic review of the findings presented here is required to ensure that they remain current.

1.2 Approach to This Manual

Land-based impacts of golf courses are centred on physical alterations to soils and vegetation which are undertaken to produce a golf course which is visually appealing, a challenge to play, which mitigates potential environmental stressors and which is cost effective to manage. An understanding of the terrestrial environment is necessary to determine how a given design will alter species assemblages, wildlife movement corridors and habitat. Specific linkages to water management plans must be identified to understand interactions of the site plan such as runoff, irrigation and infiltration with the aquatic environment (wetlands, surface water, and groundwater). Wetlands are commonplace on the shield and will be intimately related with golf course development. They may be physically altered through changes to their water balance, infilling, or by incorporation into a stormwater management plan.

Surface waters are integral to golf course development. Water is required for irrigation and is an aesthetic amenity to the golf course developer and the golfer. Water bodies within and adjacent to a golf course, however, are habitat for aquatic life and serve as the primary receiver of any pollutants which cannot be retained on the golf course. Many of the recent golf course developments are located near popular recreational lakes, producing altered shoreline panoramas and heightened sensitivity to water quality among lake residents. Many golfers in Muskoka and other Shield areas are also seasonal residents and place equal value on both recreational experiences. A sensitive design and management plan is therefore required to accommodate the needs of the site operator, golfers and other residents.

Our review concluded that a prescriptive approach, based on a-priori specification of BMPs and specific management practices will not, on its own, produce an environmentally friendly golf course. Every golf course development will have different requirements for course layout and turf maintenance and every site will have a different set of constraints to address. Although BMPs, planning requirements, design considerations and monitoring approaches are detailed in this report, we note that none were developed specifically for Precambrian Shield areas. The Trent University study has, to date, documented some specific effects of golf course development on the aquatic environment of Muskoka, but has not yet reached the stage of comparing management practices or recommending BMPs. The contents of this report must therefore be compared with and up-dated as required: using the Trent University findings as they become available, experience gained in developing golf courses in Muskoka and BMPs developed for other areas which are applicable in Muskoka. In the interim, this report presents sound approaches and suggestions which, in the experience of the authors and reviewers, were judged to be acceptable means of developing golf courses with minimal environmental impact.

Given the lack of specificity to the Precambrian Shield environment in published BMPs, and the early stages of research into Shield-specific BMPs; this report includes a strong focus on a process to ensure that environmental constraints are identified before the course is planned, incorporated into the plan at an early stage and then used to guide detailed design and any need for monitoring. Detailed description and review, at specific stages of golf course development, will ensure that the design and operation of the course will protect the environment, that BMPs are chosen which best mitigate environmental effects, or that certain activities are identified which preclude development on sensitive sites. In addition, recognition of environmental sensitivities and adoption of BMPs throughout the process may reduce costs to the developer by preventing the need for "after the fact" mitigation of environmental effects, reducing the potential for environmental damage and litigation and by increasing understanding among the developer, review authorities and the public in general.

The process is summarized as:

a) integrated assessment of the natural environment and collection of appropriate baseline data before design;

b) approval of baseline report and feasibility study;

c) concept design based on natural features and environmental constraints;

d) development and approval of an Environmental Impact Statement (EIS), including specification of BMPs for construction and operation;

e) detailed design and development of Environmental Management System (EMS, or operations/mitigation manual including BMPs;

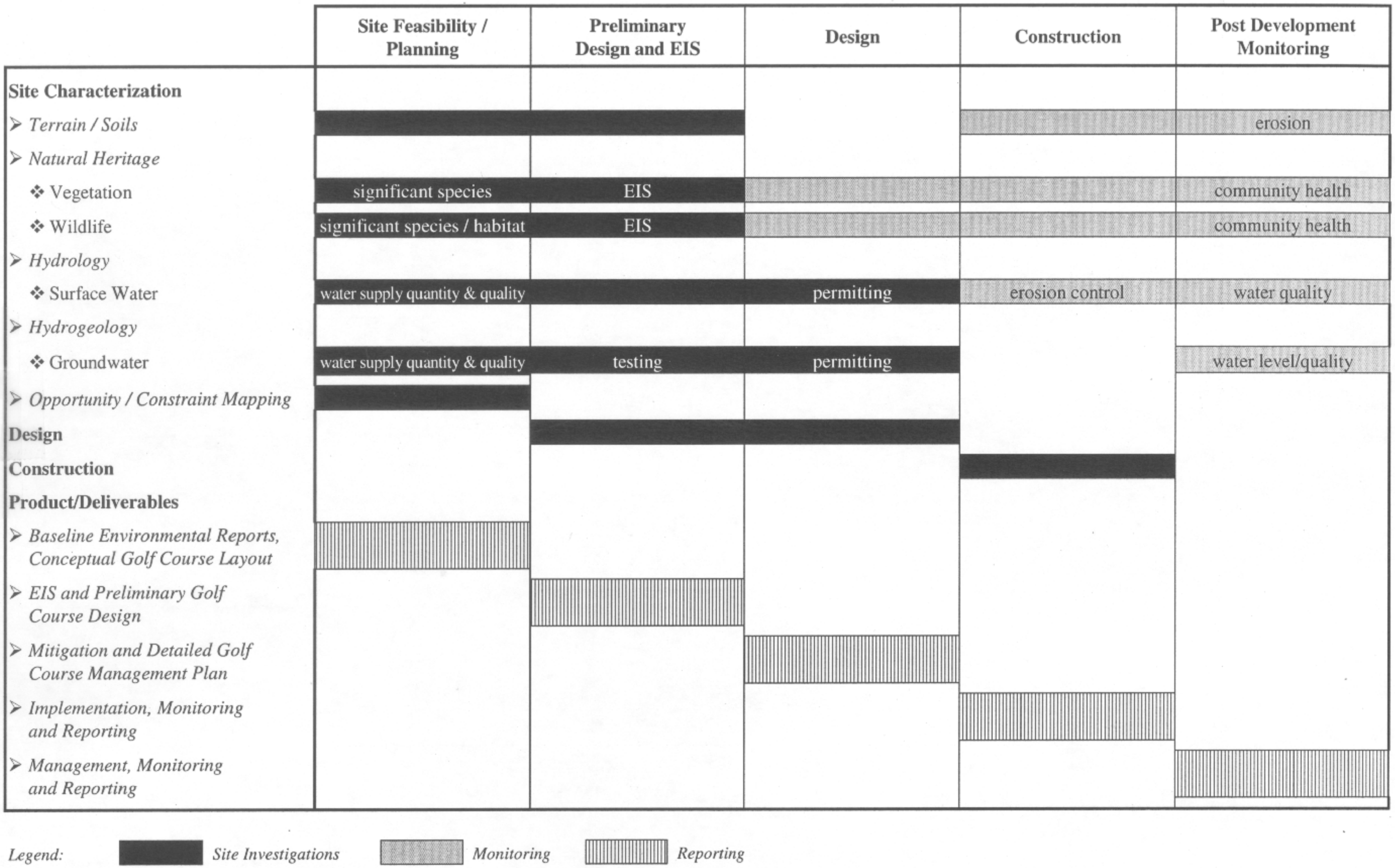
f) development of a monitoring program and financial assurances (if required);

g) construction, development, and operation; and

h) monitoring and reporting as required during each phase of development.

A summary of this process is given in Figure 1.1 and more detailed presentation is presented in Section 2.1. Although this process is presented to guide development and review it must be stressed that this is an ideal and is, for the most part, voluntary. Review of planning controls (see Section 2) shows that there is no mandatory regulatory or planning process which will ensure that every golf course development will be reviewed for the purpose of minimizing environmental impact. Nevertheless, voluntary adoption of the process and recommended BMPs will have benefits to the developer and the community at large.

Figure 1-1. Muskoka Golf Course Development – Conceptual Development Process



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Many golf courses are being built as part of a resort or a package with condominiums. These commercial and residential activities are not covered by this manual but must be assessed properly as a separate, but integrated task with golf course development. The stormwater plan for the golf course, in particular, must be developed in concert with requirements for the entire development if there is any interaction between the two. Loss or fragmentation of forest habitat must also be assessed with regard to the cumulative effects of the entire development.

The review process must also ensure that uncertainties in economics and development do not jeopardize environmental protection if only a portion of the development proceeds, or if it is phased. The planning process must proceed with an eye to the entire development, and how one aspect interacts with the others.

1.3 Information Sources

The Terms of Reference for this project required documentation of BMPs to guide golf course development in Precambrian Shield areas of Muskoka. Studies which are focussed on the Precambrian Shield environment, as described above, are not yet complete, and so preclude recommendation of "field proven" practices. In the absence of this material, the report includes:

a) BMPs summarized from a series of publications produced in the United States;

b) BMPs summarized from two Canadian sources;

c) peer-reviewed, primary literature papers on nutrient mobility in soils, including Precambrian Shield soils, buffer strip effectiveness and approaches to golf course management;

d) research presented in poster format at recent research gatherings;

e) the experience of the technical specialists who produced this report; and

f) input from the Muskoka Golf Course Research Advisory Committee, including scientists conducting the Trent University Study.

The Terms of Reference also called for the submission of a technical appendix containing relevant documentation of BMPs. The key sources consulted for this report, which will be submitted in appendix form, are:

Anon, 1993:

Best Management Practices for Golf Course Development and Operation. King County Environmental Division, January 1993.

Anon, Undated:
Checklist Of Recommended Golf Course Management Procedures To Protect Water Resources. Surface Water Quality Division, Land and Water Management Division, Michigan Department of Natural Resources. 19pp.

Anon, Undated:
Guidance Manual for Design and Maintenance of Environmentally Sensitive Golf Courses in New Jersey. Standards and System Analyses Program, Office of Regulatory Policy.

Audubon Co-operative Sanctuary System, Audubon International, undated:
A Guide to Environmental Stewardship on the Golf Course.

Davis, N.M. and M.J. Lydy, 2000:
Evaluating The Effects Of Best Management Practices on an Urban Golf Course. Poster Presentation. Society of Environmental Toxicology and Chemistry Annual Meeting. Nashville TN.

Fraser River Action Plan, 1996:
Greening Your BC Golf Course. A Guide to Environmental Management. Environment Canada, Fisheries and Oceans Canada, UMA Engineering Ltd. DOE FRAP #1996-26, ISBN 0-662-25664 -6.

Klein, R.D., 1994:
Siting and Design Considerations To Enhance The Environmental Benefits Of Golf Courses. Ch. 15. CRC Press Inc.

Knutson, K.L. and V.L. Naef, 1997:
Management Recommendations for Washington's Priority Habitats: riparian. Wash. Department of Fish and Wildlife. Olympia. Appendix C.

Powell, R.O. and J.B. Jollie, 1990:
Environmental Guidelines for the Design and Maintenance of Golf Courses. Department of Environmental Protection and Resource Management, Baltimore Co., MD.

Robertson, W.D., S.L. Schiff and C.J. Ptacek, 1998:
Review of Phosphate Mobility And Persistence In 10 Septic System Plumes. Groundwater 36: 1000-1010.

Severn Sound Remedial Action Plan (RAP), 1995:
Habitat and Water Quality Improvement Manual for Golf Course Management. Environment Canada. Great Lakes Clean Up Fund, January 1995.

Winter, J.G., P.J. Dillon, K. M. Somers and R. A. Reid, 2000:
Golf courses on the Precambrian Shield and their effects on softwater streams. Poster Presentation. Society of Environmental Toxicology and Chemistry Annual Meeting. Nashville TN.

Woodard, S.E. and C.A. Rock, 1995:
Control of residential stormwater by natural buffer strips. Lake and Reserve. Manage. 11: 37 45.

2. The Regulatory Basis for Golf Courses in Muskoka

Past experience shows the process of design and approval of a golf course to be reactive in two areas. The first is that the Environmental Impact Statement (EIS) and Environmental Management System (EMS) follow the scheduling and design requirements of the development, so that all environmental constraints may not be considered from the outset of the design and approval process for the course. The second is that the existing planning and approvals environment may not ensure that environmental constraints are addressed. A municipality may have the planning instruments it needs if the proper zoning, Official Plan, subdivision's agreement or holding zone provisions are in place. If these are not in place, or are not implemented, then there is little opportunity to ensure that environmental concerns are addressed during site design, construction and operation. Alternatively, intervenors may choose to challenge a golf course development through the OMB if their concerns on environmental security are not addressed.

Costly OMB hearings or delays may be circumvented to the benefit of all parties through a process which obtains "buy in" early in the development stage and if the regulatory environment provides the means to ensure compliance with best available environmental management practices. Conversely, new legislation may be required to ensure that monitoring and compliance are enforced through specific planning tools. This section of the report will:

a) provide details on a process guiding the timing and development of an EIS and an environmental management system;

b) recommend approvals steps; and

c) review the existing planning tools and legislation available to assist in the review process.

The report presents a full range of regulatory instruments of potential use in the management of golf course development. Most golf courses will not be subject to all of these, or can address their concerns through proper design and implementation of the recommendations made in this manual, in a manner which promotes a good golf course, protects sensitive environments and which reduces costs by avoiding after the fact mitigation or prosecution. Use of the manual is intended, therefore to guide golf course development in a fashion which reduces regulatory conflict.

2.1 Design and the EIS

Development in sensitive environments must begin with an environmental inventory and an understanding of site attributes, their functions and interactions. In the past, scheduling requirements may not have allowed the EIS to reflect a complete field season, or the EIS may have been prepared on the basis of a limited number of site visits. The EIS should be developed as part of a process in which the environmental constraints form the basis of the design and not around a preconceived golf course design. Design must be a proactive and co-operative process, in which the environmental specialists work with the architect from the initial concept to the final design. The following process is proposed to meet this objective and should be reviewed in conjunction with Figure 1.1.

2.1.1 The Process of Golf Course Development

At the outset of considering a site for golf course development, **an environmental baseline and feasibility study** should be undertaken to assess the environmental constraints of the site. The feasibility study will identify and map environmental constraints and the potential magnitude of environmental sensitivities of the site on order to guide the initial course design.

The feasibility study can normally be undertaken **using existing information sources,** including natural heritage and geological/terrain mapping, supporting environmental documentation from Official or Secondary Plans, interpretation of natural conditions (i.e., aquatic, terrain and vegetation) from air photos, detailed topographic maps, recognized naturalists groups and limited field study. The amount and quality of existing information will assist in focusing the effort required in completing the EIS.

Should the feasibility study determine that the site presents opportunities to develop a golf course, **a terms of reference for a site specific Environmental Impact Statement** (EIS) should be prepared to the satisfaction of the developer, the municipality and other relevant review agencies. At this early stage in the process, this should be prepared as a co-operative effort by qualified environmental consultants, the golf course developer and architects, and the municipality. Public notification of intent should be considered in order to guage public reaction, identify stakeholders and develop means for their meaningful input. Upon completion of the review, the **Environmental Impact Statement** can be prepared using existing information as well as site-specific data. The EIS will identify site constraints, potential effects and will propose mitigation, if warranted.

Resulting from the detailed studies, certain **legislated approvals** may need to be acquired. These normally involve such things as Permits-to-Take-Water for irrigation and site facilities and Certificates of Approval for sewage treatment and disposal.

The need for any **approval of the golf course land use application** is addressed at the local level and may involve amending the official plan and/or the zoning by-law (Section 2.2). Through the enactment of the by-law to permit the golf course, certain obligations may be identified as **conditions of approval** related to the construction and operation phases of a golf course. These conditions can be implemented **through either a Site Plan Agreement or a Subdivision Agreement** (see Section 2.2.2) that may involve securing a **Letter of Credit** from the golf course owner. A **reporting mechanism** should be established to allow review authorities, the municipality or the public to review the supporting documentation that addresses the conditions.

These **conditions of approval** may include but are not necessarily limited to the following:

a) **monitoring programs** involving surface water and groundwater quantity and quality, as well as preservation and restoration of natural heritage features, as appropriate. These monitoring programs would incorporate triggering mechanisms such as monitoring results or thresholds for implementing a contingency, if necessary, and the contingencies should be identified (e.g., adjusting a fertilizer program to comply with water quality objectives);

b) **detailed erosion control and stormwater management plans** for construction and operations phases;

c) a **nutrient management program** involving soil sampling and analysis. This will assist in optimizing the use of fertilizer and in hydrogeologically sensitive sites can help to control the loss of nutrients from the site;

d) an **operations manual** (or **EMS**) for the purpose of training and communicating protocols to staff. This manual will detail the specific requirements of the monitoring and nutrient management programs, including fertilizer type;

e) application rates and timing of applications, maintenance and operation requirements of sewage and irrigation systems, and pesticide use and mode of application by certified handlers; and

f) **major changes** to the golf course plan that may impact on site operation should be reviewed and approved by the municipality, and appropriately reflected in the operations manual.

This process represents the ideal, in which all planning and approval mechanisms exist or can be developed. It is necessary, however, to review the planning and legislative environments to determine the availability of the necessary compliance tools.

Best Management Practices Summary ***Golf Course Development Process***
The Best Management Practices for the Golf Course Development Process include the following: ➢ Completion of a Pre-Development Environmental Baseline and Feasibility Study. ➢ Identification of Environmental Constraints. ➢ Preparation of a Site Constraint Map. ➢ Submission of a Terms of Reference for an EIS. ➢ Co-ordination of input from the developer, the architect, qualified environmental professionals, review authorities and the public. ➢ Obtaining review by municipality and government agencies (MNR/MOE/DFO). ➢ Completion of an EIS which is specific to the entire project and site. ➢ Obtaining the necessary legislated approvals such as Permits to Take Water and Certificates of Approval for disposal of Sewage. ➢ Obtaining the necessary Land Use Approval (including Site Plan Agreement or Subdivision Agreement and Conditions of Approval). ➢ Completion of an EMS for the golf course which details : monitoring programs for the construction and operations phase, monitoring results which will trigger mitigation, potential mitigation techniques for detrimental environmental responses, operational requirements for turf grass maintenance, irrigation, pesticide and fertilizer use, sediment control, maintenance of buffers, naturalized areas and wetlands and response plans for environmental emergencies such as spills.

2.2 Planning and Legislative Tools

There are a wide range of planning and legislative tools available to assist with the approval and management of golf course developments. Not all will be used in any application and proper planning by the proponent will avoid the use of many instruments which are intended for prosecution in the event that environmental damage occurs. There are considerable planning, environmental and economic benefits associated with prior consideration of the approvals process.

For the most part, golf course development is guided by the planning requirements of the District Municipality of Muskoka and local municipalities. These are presented first, to illustrate the instruments and process involved in routine and non-routine applications.

Of the federal and provincial legislation, the Canada Fisheries Act provides a powerful means of preventing damage to the aquatic environment. Provincial legislation (Ontario Water Resources Act) governing Permits to Take Water and Certificates of Approval for the discharges are routinely required for golf course development. These are therefore discussed in detail, while other legal instruments are discussed in less detail.

2.2.1 Planning Act and Local Planning Options

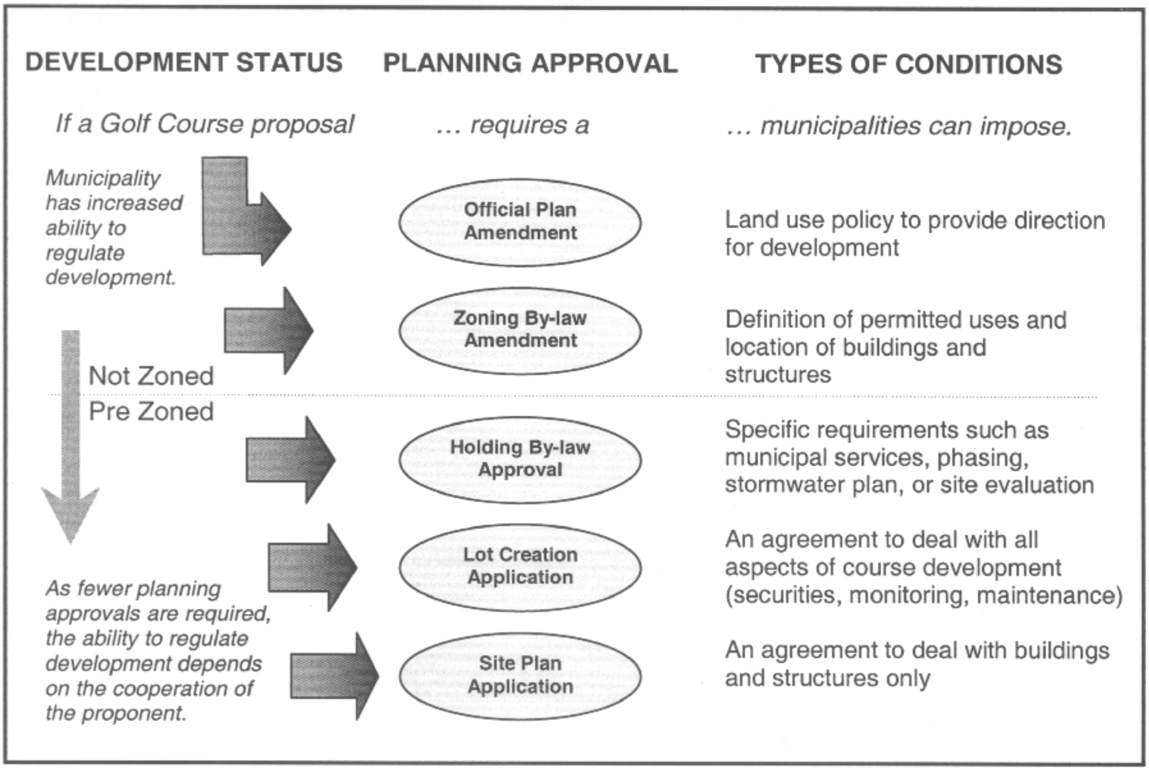
There is a wide range of planning tools available to deal with the impacts of golf course development, and the opportunity to use these tools depends directly on the type of planning approvals that are required. The main factor that affects the development status of a proposal and the availability of control tools is whether the principle of use is established in zoning by-laws.

Planning tools, such as Official Plans and Zoning By-laws, can deal with the design and impacts of a golf course, however, there are only a few planning tools available to regulate site alteration, long-term maintenance, require securities or to ensure the ongoing monitoring of the lands. There is a need for a specific tool, with legislative authority, to deal with site alteration and the ongoing operation of a golf course after construction is completed.

The ability of a municipality to regulate development depends on the stage that the proposal enters the planning process and is directly related to the required planning approval. As fewer planning approvals are required there are limited opportunities for a municipality to regulate the development and there is a greater dependence on the co-operation of the proponent to ensure effective land use control (Figure 2.1).

While the best planning tool is the municipal Zoning By-law, this tool is ineffective if the current zoning by-law permits golf courses. When lands are pre-zoned to permit golf courses, the ability to regulate and monitor design, construction and maintenance greatly depends on whether the proponent is willing to co-operate.

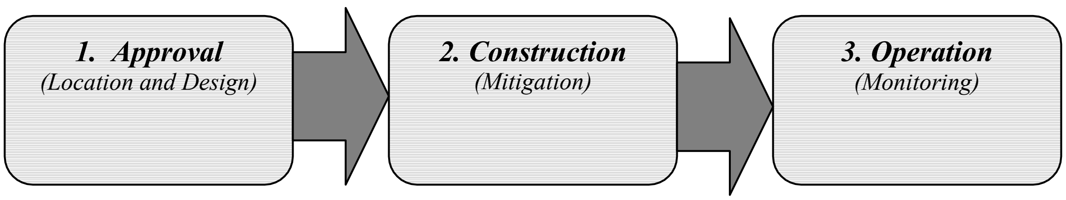
Figure 2.1 Relationship of Planning Approvals to Municipal Input to Golf Course Development



While municipalities currently use a range of planning controls, the underlying issue is whether they have proper authority and jurisdiction to use certain tools, such as Site Plan Control, to impose the conditions they feel are desirable. This concern is directly related to the municipality's ability to enforce these conditions.

2.2.2 Development Activities and the Planning Process

Potential impacts from golf course developments can occur throughout three stages of development and operation:



1. <u>Approval</u>

Assessing the impacts of the location and design of the golf course is the most important part of the planning process. Impacts that occur as a result of a poor design can relate to traffic, parking, aesthetics, water balance, landscape, fish habitat, streams, shorelines, slopes, significant areas and features, and natural features. In order to appropriately address the design and location of a golf course, a municipality must be able to request a number of studies, such as:

a) Environmental Impact Statements – Environmental Assessment;

b) Geochemistry and Hydrogeology Reports (water balance, quality for surface and groundwater);

c) Construction Mitigation Practices;

d) Cut and Fill plans;

e) Stormwater Management;

f) Golf Course Management – Pesticides, fertilizer and grasses; and

g) Traffic Study.

The most effective planning tool to trigger these studies is the requirement of a zoning by-law amendment.

2. Construction

The construction phase has the greatest potential to damage natural features due to removal of natural vegetation, site alteration and the exposure of soils. The ability to proactively mitigate construction activities depends on the type of planning approval that is required.

3. Operation

The long-term operation and maintenance of a golf course involves the application of fertilizers and pesticides as well as taking of ground or surface water. Monitoring is necessary to ensure that environmental impacts do not occur and that remedies are immediately available to address impacts. At present, there are no effective planning tools directly related to regulation of operations and monitoring.

2.2.3 Current Planning Tools

There are a number of municipal planning tools that can be used. The use of these tools depends on the:

a) development status of the subject lands;
b) ability of a municipality to use them; and
c) willingness of the developer to co-operate.

Generally no one tool by itself will address all the concerns and issues. As a result, many municipalities use a combination of tools that best fit the type of conditions to be imposed and the approvals that are required. While it is the decision of each municipality to determine the combination of planning tools to be applied, a concern can be raised about a municipality's authority to use the tools in the manner they have prescribed.

There are generally two types of planning control tools that can be used, policy and implementation:

a) policy tools include the Provincial Policy Statement and local Official Plans; and
b) implementation tools include Zoning By-laws, Holding By-laws, Site Plan Control and Subdivision Agreements.

A future option that may also offer effective regulation is the Development Permitting System. A summary of their application is provided in Table 2.1.

Table 2.1 Planning Tools and Phases of Golf Course Development

Planning Tools			Phases of Development		
			1. *Approval*	2. *Construction*	3. *Operation*
Policy	Provincial Policy Statement		✔		✔
	Official Plans (OP, OPA)		✔		✔
Implementation	*Planning Act*	Zoning By-laws	✔	-	-
		Holding By-law	✔	O	-
		Site Plan Control	✔	O	-
		Development Agreements	✔	✔	✔
	Municipal Act	Cut and Fill By-law	-	O	-
	Forestry Act	Trees Cutting By-law	-	-	-

Note: ✔ effective tool – no direct control O application is unclear

<u>Provincial Policy Statement</u>

The Provincial Policy Statement (PPS) provides provincial direction to be regarded when local land use decisions are being made. Policy 2.3 of the PPS specifically requires "development" and "site alteration" to be compatible with Natural Heritage Areas and Features such as wetlands, habitats of endangered and threatened species, fish habitat, wildlife habitat and ANSI's. In order to ensure compatibility with these features, the PPS requires the submission and review of an Environmental Impact Statement (EIS) to demonstrate that no negative impact will occur.

The PPS defines development to mean "the creation of a new lot, a change in land use or the construction of buildings and structures", and site alteration to mean "activities, such as fill, grading and excavation that would change the landform and natural vegetative characteristics of a site". Although the PPS provides clear direction to consider both development and site alteration, there does not appear to be an implementation tool available for municipalities to effectively deal with site alteration. The Province should be encouraged to provide regulations that enhance the capability of municipalities to deal effectively with site alteration through the provision of adequate tools.

The limiting factor for using the PPS is that it is dependent on a Planning Act application to trigger its use. If there are no planning approvals then there is no opportunity to apply the policies contained in the PPS. The other constraint of the PPS is that it has no enforcement capabilities.

<u>Official Plan</u>

An Official Plan provides land use policies that describe how land should be used and how development should proceed. Official Plans must have regard to the policies of the Provincial Policy Statement. Similar to the PPS, Official Plans cannot regulate development or be used to enforce conditions of development.

Official Plans provide the planning framework for the review and approval of golf courses. Policy can identify the issues to be addressed at the zoning stage and describe the implementation process as well as the matters to be addressed through the use of Holding Zones. The Official Plan can recognize that the types of studies and environmental issues to be addressed will differ between land use designations such as Urban, Rural or Waterfront, as well as the potential impacts according to the existence of sensitive features or landforms. Table 2.2 provides a potential list of studies that could be requested in Urban, Rural and Waterfront designations.

Table 2.2 Studies Required by Land Use Designation

Study	Land Use Designation		
	Urban	*Rural*	*Waterfront*
Hydrogeology	✔	✔	✔
Fish	if on waterbody	if on waterbody	✔
EIS	if on waterbody	✔	✔
Stormwater	✔	✔	✔
Construction Mitigation	✔	✔	✔
Traffic	✔	-	-
Lake Sensitivity	-	-	✔

Official Plans can provide a wide range of policies and matters to be considered in the development of a golf course, and it is essential that municipalities provide detailed direction in Official Plans. Official Plans can include policies that require:

a) studies such as Environmental Impact Studies, Hydrological, Stormwater, Construction Mitigation, traffic, golf course management plan;

b) protection of the natural environment;

c) locational constraints and criteria such as soil type and lake sensitivity;

d) site design;

e) buffering and lighting; and

f) compatibility with surrounding uses.

If a golf course is already a permitted use in the zoning by-law, then the policies of the Official Plan may not be used to prohibit the intended use. However, if a zoning by-law amendment is required to permit a golf course, then the policies of the Official Plan will apply. If the proposal requires site plan approval, the Official Plan can also provide direction on the matters to be addressed.

Zoning By-law

Zoning By-laws implement Official Plan policy by identifying and regulating:

a) permitted uses;

b) the height, size and location of buildings and structures, parking requirements; and

c) lot sizes and dimensions.

Zoning By-laws are the most important regulatory tool available to a municipal council because they provide a process to require studies to be completed (e.g., EIS) and issues to be addressed. Municipalities should not pre-zone lands to permit golf course development. Instead, a specific zoning amendment should be required to ensure that the appropriate studies are completed and issues addressed.

When lands are zoned to permit a golf course, the municipality cannot prohibit the proposed use if it is determined to be inappropriate. Therefore, in order to ensure that the municipality has the best control, zoning by-laws should not pre-zone lands to permit golf courses. Zoning approval should be permitted on a site specific basis only after it is demonstrated that there will be no negative impact on natural, social or physical features through studies such as an Environmental Impact Statement.

One of the main constraints with Zoning By-laws is the inability to regulate site alteration. A landowner can undertake predevelopment site activities (e.g., cut trees or alter the natural grade) without the approval of a Zoning By-law. Zoning By-law provisions can only be applied when there is construction of buildings and structures (which requires a building permit) or when the site is to be used for the intended use.

Zoning by-laws cannot impose "conditions of approval" and municipalities must ensure that their concerns are dealt with through a mechanism such as Site Plan Control, letters of credit, or letters of understanding, before approval is granted.

Holding By-Laws

Holding By-laws are used to identify future uses for land or buildings, but delay any development approvals until specified conditions are satisfied. In order to use a Holding By-law, the municipality must have detailed policies in their official plan indicating where and how they will be used.

Holding By-laws should not be used if there is a concern with establishing a golf course as a permitted use. Holding By-laws should only be applied when it is clear that the permitted use is appropriate, and to ensure that technical conditions are completed, such as:

a) requiring municipal services or roads are in place;

b) ensuring a final Stormwater Management Plan is prepared;

c) ensuring appropriate agreements are in place;

d) the requirement of studies such as Environmental Impact, fish or wildlife inventories and assessments to the satisfaction of the municipality;

e) the phasing and timing of development;

f) the provision of layout and construction plans; or a

g) site evaluation.

Interim Control By-Laws

Interim Control by-laws are only appropriate in situations where municipal by-laws already permit golf courses as a development right. Interim control by-laws temporarily prohibit the use of land until the municipality has an opportunity to undertake a study to determine the impact of a permitted use or regulation.

Interim control by-laws cannot be used to regulate or permanently prohibit golf course development, but are an effective short-term tool for those municipalities with older zoning by-laws that permit golf courses in a wide range of zones. Interim control by-laws can be imposed for one year with an extension of another year to afford the municipality an opportunity to conduct a study of the issue. Once completed, a municipality may put in place specific regulations to deal with the issues studied.

Site Plan Control

Site Plan Control By-laws are used to deal with the location of buildings and structures, as well as specific landscaping matters that zoning by-laws cannot regulate. Site plans generally ensure that:

a) buildings and structures are specifically located as approved;

b) there is appropriate landscaping, parking, drainage and lighting; and

c) there is safe and easy access for pedestrians and vehicles.

A Site Plan Control By-law can require a Site Plan Agreement to be entered into between a municipality and the proponent of a development, and these agreements can be registered on title to provide notice to future landowners about restrictions or conditions of development.

Site Plan Control was originally intended as a development tool to deal with the design and landscaping of urban properties, however, due to the lack of other more appropriate tools in rural areas, many local municipalities use site plan agreements as a method to ensure that matters such as buffering are dealt with.

The main problem with the use of site plan control is the uncertainty about whether it can be properly applied to site alteration if there are no buildings and structures involved. The Planning Act specifically defines "development" for the purpose of applying Site Plan Control, to *mean "the construction or placing of one or more buildings and structures on land or the making of an addition or alteration to a building or structure… or the laying out of a commercial parking lot"*. At present, there does not appear to be any cases that have been tested in the courts to determine the application of this tool for the purpose of regulating site alteration for golf course developments.

Another concern with Site Plan Control is with regard to the posting of securities or requiring the long term monitoring of maintenance activities. Although some municipalities have requested the posting of securities and monitoring to be completed as a condition of site plan approval, this practice is not clearly authorized in the Planning Act.

When a new golf course proposal does not require a zoning by-law amendment, many municipalities use Site Plan Control as the main tool to deal with site regulation matters. Site Plan Control is especially effective if there is a "co-operative" developer.

Some municipalities use Site Plan Control Agreements to:

a) specifically locate buildings and structures;

b) prohibit the cutting of natural vegetation in sensitive areas;

c) require post construction monitoring of the site; and

d) implement recommendations of studies (i.e., Stormwater Management Plans and Environmental Impact Studies).

Subdivision Agreements

A subdivision agreement can only be used in combination with a plan of subdivision or consent application. Specific authority is provided by Section 51 (26) of the Planning Act, to permit municipalities to enter into an agreement as a condition of subdivision or consent approval, and the agreement is registered on title to the subject property to ensure that it is binding on future owners. The Planning Act does not provide specific detail about the intended use of the agreement and as a result its application has been wide in scope.

Subdivision agreements are the strongest planning tool available and can implement the findings of any study in order to address many concerns, however, they can only be used when a new lot is being created through the subdivision or consent process, which is not usually required for the construction of a golf course.

Some municipalities have used this form of planning tool to:

a) include the retention of vegetation;

b) implement the Golf Course Management Plan, including the application of fertilizers and pesticides;

c) require the posting of securities to ensure that onsite monitoring is completed;

d) require the provision of municipal services such as roads and sewers; and

e) ensure long term monitoring.

Development Agreements

Another form of agreement used by some municipalities in southern Ontario is called the Development Agreement. This agreement is not related to the subdivision of land and does not have authority under the Planning Act, however it is considered a legal document based on contract law and the signing of this agreement may be tied to a planning approval, usually a zoning by-law amendment. Some municipalities have merged the form of a development agreement together with a Site Plan Agreement to enable the document to be registered on title to the property, pursuant to Section 41(10) of the Planning Act, and to have only one complete document. The legislative authority of this is unclear and any use should be carefully reviewed to ensure that it doesn't jeopardize the validity of the Site Plan Agreement. The agreement has been used to require a letter of credit, monitoring, ongoing management and to address other concerns.

Cut and Fill By-Law

Section 223.1 of the Municipal Act permits municipal Councils to pass by-laws to prohibit or regulate the alteration of the grade of land or the placing or dumping of fill. Although this section was added to the Municipal Act in 1994, there are no municipalities in Muskoka that have passed a by-law for this purpose. The Cut and Fill By-law is a proactive by-law that requires local municipalities to establish a permit system to review and evaluate the appropriateness of each application. It may therefore have direct relevance to golf course design and construction but, at present, there are no examples of the Cut and Fill By-law in place that regulate golf course developments. Planning authorities should monitor its use and success in other jurisdictions to establish its effectiveness in promoting BMPs.

Tree Cutting By-Law

Tree Cutting By-laws, under Chapter F.26 of the Forestry Act are a municipal tool designed to ensure that large scale destruction of trees does not occur. The District of Muskoka has enacted a Good Forestry Practices By-law under this section of the Act that applies to all commercial harvests on property over 50 acres in size. Although Tree Cutting By-laws were not intended to deal with the protection of natural values as a result of impacts from development proposals, they can be used to ensure that no commercial cutting and site alteration occurs on a forested property prior to addressing identified issues, and that approvals are granted at the local level.

Tree Cutting By-laws were originally intended to deal with the small remnant forests in Southern Ontario and are not necessarily designed for the contiguous forest cover of the Precambrian shield. However, some municipalities may attempt to use this tool when there are no other remedies or when dealing with an un-co-operative developer.

Summary of Current Planning Tools

Table 2.3 provides a summary of the utility of current planning tools for golf course development.

Table 2.3 Strengths and Weaknesses of Current Planning Tools

Planning Tools	Strengths	Weaknesses
Provincial Policy Statement	➢ Provides policy direction for: • consideration of development and site alteration; • protection of Natural Heritage Areas and Features; and • the quality and quantity of ground and surface water. ➢ Requires an Environmental Impact Statement.	➢ Does not have any enforcement capabilities. ➢ Cannot be applied if there are no Planning Act approvals required.
Official Plan	➢ Provides policy direction for the development, use and management of land. ➢ Can provide direction for considering a wide range of impacts (environmental, social, physical, financial).	➢ Does not have any enforcement capabilities. ➢ Has limited application if lands are zoned to permit golf courses.
Zoning By-Law	➢ Can prohibit golf courses as a permitted use. ➢ Regulates location and size of buildings and structures. ➢ Enforceable with fines. ➢ Requires the consideration of impacts by requesting studies (e.g., EIS) before approval in principle is granted.	➢ Does not regulate site alteration. ➢ Can only deal with the location and construction of buildings and structures, and the use of land. ➢ If the lands are pre-zoned, it does not allow consideration of: • conformity with PPS or OP; • suitability of the land for its intended

Table 2.3 Strengths and Weaknesses of Current Planning Tools

Planning Tools	Strengths	Weaknesses
	➢ Requires a public meeting to consider public comments and can be appealed to the OMB.	use; and • environmental, Social and Physical impacts.
Holding By-Law	➢ Provides ability to impose various technical conditions. ➢ Must conform with detailed OP Policy.	➢ Should only be used when it is clear that the use is appropriate. ➢ Cannot prohibit golf courses.
Interim By-Law	➢ Provides ability to temporarily prohibit development to undertake studies to determine appropriateness of use.	➢ Cannot be used to regulate or permanently prohibit golf courses.
Site Plan Control	➢ Allows an agreement to be registered on title and is applicable to future land owners. ➢ Enforceable with fines or letters of credit.	➢ It is unclear whether it can be used for: • ongoing monitoring; • site operation; and • obtaining securities for monitoring and operation. ➢ Does not require a public meeting to consider public comments. It is a private agreement between two parties.
Subdivision Agreements	➢ Allows an agreement to be registered on title and is applicable to future land owners. ➢ Enforceable with fines or letter of credit. ➢ Can cover a wide range of issues including monitoring and securities.	➢ It can only be used when a subdivision or consent application is required and there is limited opportunity to apply it. ➢ Does not require a public meeting to consider public comments. It is a private agreement between two parties.
Development Agreements	➢ Two party legal document under contract law. ➢ Has been coupled with Site Plan Agreement ➢ Can deal with a number of issues such as letters of credit and monitoring. ➢ Enforceable by letter of credit.	➢ Does not have authority pursuant to the Planning Act and may jeopardize validity of the Site Plan Agreement. ➢ Does not require public review.

Future Planning Control Tools

Development Permit

The Development Permit System is a new planning mechanism that blends zoning, site planning and minor variances into one process. According to Section 70.2 of the Planning Act, a development permit system can "regulate, vary or supplement" the matters currently covered by the zoning and site plan approval process. Therefore this new system may provide the ability to deal with matters that are currently difficult to address by standard planning tools. The Province must enact a Regulation to enable municipalities to use this system.

A demonstration project was undertaken for the waterfront designation in the Township of Lake of Bays to illustrate how a development permit by-law could be used. This demonstration project appeared to indicate that the Development Permit system could provide an effective and efficient approach to implement the policies of the Official Plan, particularly with regard to environmental issues associated with shoreline development. It could also provide flexibility to deal with the issues in the context of site specific environmental or terrain constraints.

As a condition of obtaining a development permit, the municipality would be able to require the owner of land to enter into a permit agreement. However, the Province must enact a Regulation to enable the use of this system, and since it is a relatively new planning tool, Development Permitting has not been applied by many municipalities, and the extent of its application is unknown.

Table 2.4 Strengths and Weaknesses of Future Planning Tools

Planning Tools	Strengths	Weaknesses
Development Permits	➢ Combines zoning, site plan control and minor variances into one system. ➢ Allows the use of a development agreement.	➢ A relatively new planning tool that has not been tested. ➢ Requires MMAH to put a regulation in place to permit its use.

2.2.4 Summary and Recommendations

The most effective combination of municipal planning tools appears to be the requirement for a Zoning Amendment together with a Subdivision Agreement. The Zoning Amendment would allow council to request the appropriate studies to determine the impacts of a golf course development and the Subdivision Agreement would allow for implementation of recommendations including the posting of securities and monitoring of the site. Where the only implementation option is Site Plan Control (SPC) there are limits to the scope of issues that can be addressed. SPC may be the only tool appropriate in certain circumstances and some municipalities have used it quite effectively to achieve design, construction or monitoring objectives.

There does not appear to be a land use planning tool that clearly allows municipalities to deal with landscape alteration. As a result the pre-construction (forest clearing and landscape alteration) of a golf course can occur without triggering any approval process and this puts all agencies in a reactive mode. There is also a need for a clear mechanism to ensure long term monitoring or the posting of bonds to ensure actions are completed, where such actions are appropriate. Strengths and weaknesses of the various current and future control tools are summarized in Tables 2.3 and 2.4.

Best Management Practices Summary Recommendations ***Golf Course Planning Approvals***
The Best Management Practices for Golf Course Planning Approvals include the following: ➢ Compliance with all applicable Federal and Provincial Statutes. ➢ A Municipal planning environment which includes: • good Official Plan policy to detail implementation tools and provide a framework for the review of golf courses at the zoning or site plan stage; • no pre-zoning of lands to permit golf course development; • specific zoning by-law amendments for new golf course development to ensure that their required studies are completed; • Holding By-Laws, where appropriate, to impose technical conditions; • Site Plan Control By-laws which require plans and agreements for golf course development; and • Subdivision Agreements when lot creation is proposed to deal with a range of concerns. ➢ Development of a specific planning tool, with legislative authority, to deal with site alteration and the ongoing operation of a golf course.

2.3 Federal and Provincial Legislation

Federal Legislation which enters into the planning process includes the Canadian Environmental Assessment Act (CEAA) and the Canada Fisheries Act. The CEAA will not to be invoked by a golf course development unless it triggers a federal permitting requirement or authorization such as the Fisheries Act. The Canada Fisheries Act is a very important planning and regulatory tool as it requires consideration of fish habitat through all aspects of design, construction and operation. It will have great bearing on most golf courses in Muskoka. Other statutes are intended to address environmental damage after the fact and require less detailed consideration or are not a requirement of the planning process.

The Provincial legislation of most importance governs routine operations such as the Permit to Take Water and the discharge of any treated effluents to surface water under the Ontario Water Resources Act, and the application of pesticides under the Pesticides Act. Other statutes are intended to address environmental damage after the fact and require less detailed consideration or are not a requirement of the planning process.

Federal Legislation

Canadian Environmental Assessment Act

The Canadian Environmental Assessment Act (CEAA) provides for full environmental review of projects where they intersect with areas of Federal interest, including First Nations, navigable waters, fish habitat, migratory birds, and transboundary waters. The project will be circulated to the Federal government departments having regulatory or administrative interests in these areas for their review and comments. They will establish whether the project will trigger the application of any federal regulations and therefore whether CEAA is invoked. Golf course development in Muskoka will not generally interact with navigable waters or transboundary waters and First Nations consultation is assumed for projects on First Nations lands. Any need for an Authorization under The Fisheries Act is therefore the most likely potential CEAA trigger.

Canada Fisheries Act

Any modification to a stream, lake, or other water body may be determined to be a harmful alteration, disruption, or destruction (HADD) of fish habitat. The HADD of fish habitat is prohibited unless authorized by the Department of Fisheries and Oceans (DFO) pursuant to Section 35(2) of the Fisheries Act. Authorization under Section 35(2) would trigger the Canadian Environmental Assessment Act (CEAA) for the project. In keeping with the DFO's "Policy for the Management of Fish Habitat," (1986) no such authorizations are issued unless acceptable compensation measures for the habitat loss are developed and implemented by the proponent. Section 35(2) has been included in the list of laws that trigger the CEAA, meaning that the DFO is required to review the impact of any project, as prescribed by the CEAA, before an authorization can be issued.

The determination of whether a HADD will occur with the undertaking is subject to some interpretation as dictated by the project, local conditions and individual agency interpretation. Typically, works in water that modify the size, shape or characteristics of a waterbody, such that there would be a short or long term effect on the ability of that habitat to produce fish, are considered harmful and would require an authorization under the Fisheries Act.

The need for an "authorization", however, is not automatic and should be considered as a last resort. The developer should, instead, seek a letter of advice on means to prevent a HADD, thus avoiding the need for an authorization. The proponent must therefore consult with OMNR and with DFO at the early stages of the project to ensure that fish habitat concerns can be addressed and avoid any aspect of design or construction that result in a harmful alteration, disruption or destruction. Proper attention to design and mitigation of effects to fish and fish habitat mean that golf course developments are not likely to trigger a HADD. Compliance with advice gained through consultation ensures compliance with the Fisheries Act.

There are a number of guidance tools that can be applied during the design process to reduce potential effects to fish habitat. The Ministry of Natural Resources document entitled *Fish Habitat Protection Guidelines for Developing Areas* (March 1994) outlines planning process, policy application as well as mechanisms for the protection of habitat. The referral process for determining fish habitat approvals requirements is outlined in Fisheries and Oceans *et al.* (2000).

A hierarchy of acceptable options to protect fish habitat has been put forward by the Department of Fisheries and Oceans and is replicated in the Fish Habitat Protection Guidelines (MNR 1994). A proponent is encouraged to work co-operatively with the agencies to gain advice and information through the early stages of planning to facilitate project approval and ensure that fish habitat concerns are addressed in a proactive manner.

To prevent impact to fish habitat, the preferred option is to avoid encroachment on fish habitat as a result of golf course development. The proponent should therefore ensure that:

a) fish habitat is correctly identified;

b) surface and groundwater linkages to that habitat are well understood;

c) the site design avoids any physical alteration of fish habitat;

d) mitigation measures are identified; and

e) the site construction and operations avoid any physical alteration of fish habitat, or any interference with base flow.

If the development is likely to harmfully alter fish habitat then the preferred approach is to physically move, or **relocate**, the development or components of it to eliminate the risk of effects to fish habitat. For example, this may mean applying setbacks or siting holes or paths well away from the water. Where effects to fish habitat are noted, **redesign** may be applied to reduce impacts (e.g., alternate materials, crossing location or use of a bridge versus a culvert, redesign of a hole to increase buffer widths or to reduce vegetative loss). **Mitigation measures**, while always used to some degree, may be specifically designed to further reduce effects on fish habitat, such as construction timing restrictions, sediment and erosion control measures, and site restoration. **Compensation** is the least desirable option and involves creation, restoration or improvement of habitat on site or at another location, to make up for the HADD on the site. Compensation will only be considered where there is no opportunity to apply the other measures, or where some benefit may be achieved by the application of such measures. Typically, where there are highly productive habitats for rare species or those of recreational benefit and habitats where the physical conditions will be difficult to replicate (e.g., groundwater discharge), compensation is not accepted.

It is advisable to obtain "approval in principle" for the project before proceeding to detailed design to ensure that the input to be received can be accommodated in the design and that delays are not encountered. Continued liaison throughout the design process is advised to ensure that changes are consistent with the original intent of the plan. Compliance with the letter of advice means that the project will not generate a HADD and can proceed without an authorization. In some situations, however, it may be impossible to protect fish habitat through design or mitigation. In such cases a request for a Fisheries Act Section 35(2) Authorization can be made by submitting:

a) an "Application for Authorization for Works or Undertakings Affecting Fish Habitat"; and

b) background Documentation or EIS including:
- an assessment of existing conditions;
- a description of the HADD;
- the mitigation measures to be implemented and the residual, or non-mitigable HADD; and
- the compensation plan, and a rationale that the loss of habitat due to the residual HADD combined with the compensation plan will result in a net gain in fish habitat.

If, as a result of this review, the DFO is satisfied that the project, after taking into account the implementation of any mitigation measures that the Federal departments consider appropriate, is not likely to cause significant adverse environmental effects, an authorization under the Fisheries Act may be issued.

In Muskoka, the proponent should make initial contact with OMNR in Bracebridge and with DFO in Parry Sound. DFO implement Section 35(2) of the Fisheries Act dealing with habitat alteration. MNR are responsible for Section 36, which prevents the addition of harmful or deleterious substances to fish habitat.

In addition to habitat provisions, the **pollution of fish habitat** is also covered by the Federal Fisheries Act (Section 36(2). This section of the act advises that *"no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish…"*. Deposits may be accidental or intentional. Deleterious substance means *"any substance that, if added to any water, would degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water…"*. Sediment from construction sites, pesticides and fertilizers, for example, may all be considered deleterious substances on a golf course. Fishery infractions are generally of most concern due to the potential for habitat sedimentation during golf course construction. Diligence to stormwater management plans, in particular, is therefore encouraged to prevent losses of soil to surface water. Due diligence in applying mitigation measures is required in golf course operations. No permitting process is currently available to allow for discharges under the Fisheries Act.

Migratory Birds Convention Act

The Migratory Birds Convention Act implements the 1916 treaty between Canada and the United States protecting migratory birds from indiscriminate harvesting and destruction. Regulations under the Act control, among other things, the hunting and possession of migratory gamebirds (e.g., waterfowl); the issuance of permits to kill, harass, or capture nuisance migratory birds (e.g., geese, gulls); prohibition against the killing, capturing, injuring or disturbing of migratory birds and their nests; and prescribe protection areas for migratory birds and the control and management of these areas.

There are several provisions of the Act that are applicable to the construction and operation of a golf course, most specifically those relating to the issuance of and conditions attached to permits to kill or harass nuisance Canada Geese, or to destroy/sterilize their eggs. Such permits may be issued to a golf course operator by the Canadian Wildlife Service, where it has been demonstrated that an overabundance of geese has resulted in a serious nuisance situation.

Another provision of the Act that could apply to the construction and operation of a golf course states that: "*No person shall deposit…oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds*."

Provincial Legislation

Ontario Water Resources Act

This Act, administered by MOE, applies to permits to take water, well installations, water works and sewage works. The specific aspects of the Act and associated Regulations applicable to a golf course are as follows :

a) Section 34 requires a Permit to Take Water where more than 50,000 L of surface water or groundwater are taken per day.

b) Section 36 requires that wells be constructed in accordance with a well construction permit.

c) Section 52 requires a Certificate of Approval for a water works that provides potable water, if its capacity is greater than 50,000 L per day.

d) Regulation 459/00 under the Act requires that potable water supply systems that are capable of supplying water at a rate greater than 250,000 L per day, or serve more than five private residences, be supplied with a water treatment system and that regular sampling and analysis of the water be carried out. The parameters that must be included in the analysis are provided in the Regulation.

e) Section 53 of the Act requires a Certificate of Approval for private wastewater treatment systems such as a communal sewage system that may be constructed in association with a golf course, if the sewage works has a design capacity in excess of 10,000 L per day or if the treated sewage drains to a watercourse or surface water body.

The proponent must apply to the MOE to obtain the specific requirements and to ensure that they collect sufficient information to address them. The proponent will have to document the specific characteristics of each proposed water taking or effluent disposal including system description and design, an analysis of receiving water characteristics, discharge characteristics, environmental impacts, monitoring requirements and compliance criteria. The proponent should contact the MOE at an early stage of the development to determine the specific requirements for their project and to seek guidance in meeting the regulatory needs of the OWRA. In Muskoka, the Barrie office of the MOE is the point of contact.

Pesticides Act

The Pesticides Act prescribes regulations governing the application, transport and training requirements for application of pesticides. It is administered by the MOE. The application of pesticides to a golf course must be done by a trained and licensed applicator.

Endangered Species Act

Endangered species and their habitats are protected by the Provincial *Endangered Species Act*. The Provincial Policy Statement prohibits development and site alteration in the "significant portions of the habitat of endangered and threatened species". Furthermore, any development contemplated within adjacent lands to these habitats (a distance of 50 m, as recommended by the OMNR) requires the preparation of an EIS demonstrating no loss of the feature or its function. Therefore, the layout of any golf course design contemplated in Muskoka must avoid known locations of any Vulnerable, Threatened or Endangered, ("VTE") wildlife and the significant portions of their habitat.

There is no standard list of species considered threatened or endangered in Muskoka. Listings change with new information and so the developer must ensure that the results of their site investigations are compared against current listings of species at risk. Resources include:

- MNR's Natural Heritage Information Centre in Peterborough, Ontario.
- The website for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) www.cosewic.gc.ca.
- The website for the national Species at Risk program www.speciesatrisk.gc.ca\species.

Environmental Assessment Act

This Act is implemented by the Ontario Ministry of the Environment but is not normally used in golf course development. Section 3(b); however, states that it does apply to "major commercial or business enterprises or activities or proposals, plans or programs in respect of major commercial or business enterprises or activities of a person or persons." There is the potential that the Minister could determine that the Act applies to the construction of a golf course. This has not been tested. We also note that golf course development is a good candidate activity for development of a "Class EA" process, for routine or repetitive undertakings.

Environmental Protection Act

This Act prohibits the discharge of "any contaminant" into the natural environment and is implemented by the Ontario MOE. . The natural environment includes air, land and water, as well as vegetation. For a golf course, operations that could fall under the Environmental Protection Act include solid and hazardous waste management activities and spills from the application of herbicides and pesticides.

Regulation 347, as amended, requires that wastes be deposited in a licensed facility. The Regulation also requires hazardous wastes and liquid industrial wastes that are being removed from the property to be manifested and to be transported by a licensed carrier. In addition, the generator of hazardous wastes, unless a small quantity exemption applies, must have a Generator Register Number issued by the Ministry of the Environment. These are routine and well known requirements and do not form an impediment to the approvals process.

Lakes and Rivers Improvement Act

The purpose of this Act includes provision for the use of waters of the lakes and rivers of Ontario and to regulate improvements in them. Any planned alteration to a lake or river would be subject to the requirements of this Act. In practice, such alterations typically include dams, shoreline alterations or alterations of stream channels. These would not be allowed under the Fisheries Act without an authorization and so the golf course design should avoid such alterations. The proponent should consult with MNR (the ministry responsible) to determine if the Act applies to any of the proposed activities and, if so, to apply for the necessary work permit.

Summary

Overall, federal and provincial legislation provide a framework to ensure that some specific aspects of golf course development do not result in environmental damage. Legislation does not provide a thorough overview or requirement for the review and management of golf course developments during the development stages. The legislation is more usefully applied to prosecution "after the fact", to ensure protection of fish habitat or for the licensing of routine infrastructure associated with golf courses such as water supply, waste treatment, dam construction or pesticide application.

3. Baseline Environmental and Feasibility Study

Baseline environmental studies are part of the business planning that determines the feasibility of the course, its potential layout and which identify factors which may delay or jeopardize approvals in a proactive fashion. A thorough understanding of the physical setting and the environmental functions of the property is essential in assessing the environmental constraints and the potential for impact from golf course development. Preliminary characterization of the property will therefore be useful in determining whether a proposed golf course development should proceed to the detailed design and construction stage. Environmental baseline studies are therefore required to assess:

a) terrain;
b) soils;
c) hydrogeology;
d) hydrology and water quality;
e) aquatic biology;
f) vegetation communities; and
g) wildlife.

3.1 Terrain

Although the bedrock geology of Muskoka is primarily comprised of Precambrian granites and gneisses, the surficial geology exhibits a wide range of characteristics, from bare rocks and ridges, to thicker outwash plains and moraine deposits, to organic soils in poorly drained wetlands. These soils and drainage conditions, in turn, support a wide diversity of terrestrial vegetation and wetland types. Understanding the baseline terrestrial characteristics is a necessary prerequisite to golf course development. They determine the site sensitivity to development, the movement and availability of water and the on-site features that will influence golf course layout. These will, in turn, influence the development process and any mitigation requirements.

The development process must begin with a detailed evaluation of physical terrain and natural heritage features, sufficient to identify constraints, opportunities and linkages between environmental components. The recommended approach is to complete this analysis prior to any design of golf course features. Environmental concerns may guide the course layout to enhance natural features, achieve cost savings in construction, mitigation and operation and avoid the need for excessive mitigation of an inappropriate design.

The baseline studies must be carried out by qualified environmental professionals and must include notifications to, and discussions with municipal planners and provincial and federal environmental agencies (MNR, DFO) to a) ensure their requirements are addressed, and b) ensure local knowledge is included in the assessment.

3.1.1 Terrain Conditions in Muskoka

Terrain conditions within Muskoka are variable. The area is dominated by shallow soil over an irregular bedrock surface. There is an abundance of surface water and drainage is poor in many areas. In places, there is thicker soil cover although these are localized and scattered throughout the District. Three main terrain types have been identified within the Muskoka area. These are based on the landform classification proposed by Gartner Lee et al. (1980), and include: bedrock, glaciolacustrine/glaciofluvial, and organic terrain. A fourth category which occurs locally includes moraine terrain features that consist of glacial till. The bedrock areas are predominant within the Muskoka region. The relative distribution of these terrain features is shown for the Port Sydney-Baysville area on Figure 3.1 as an example.

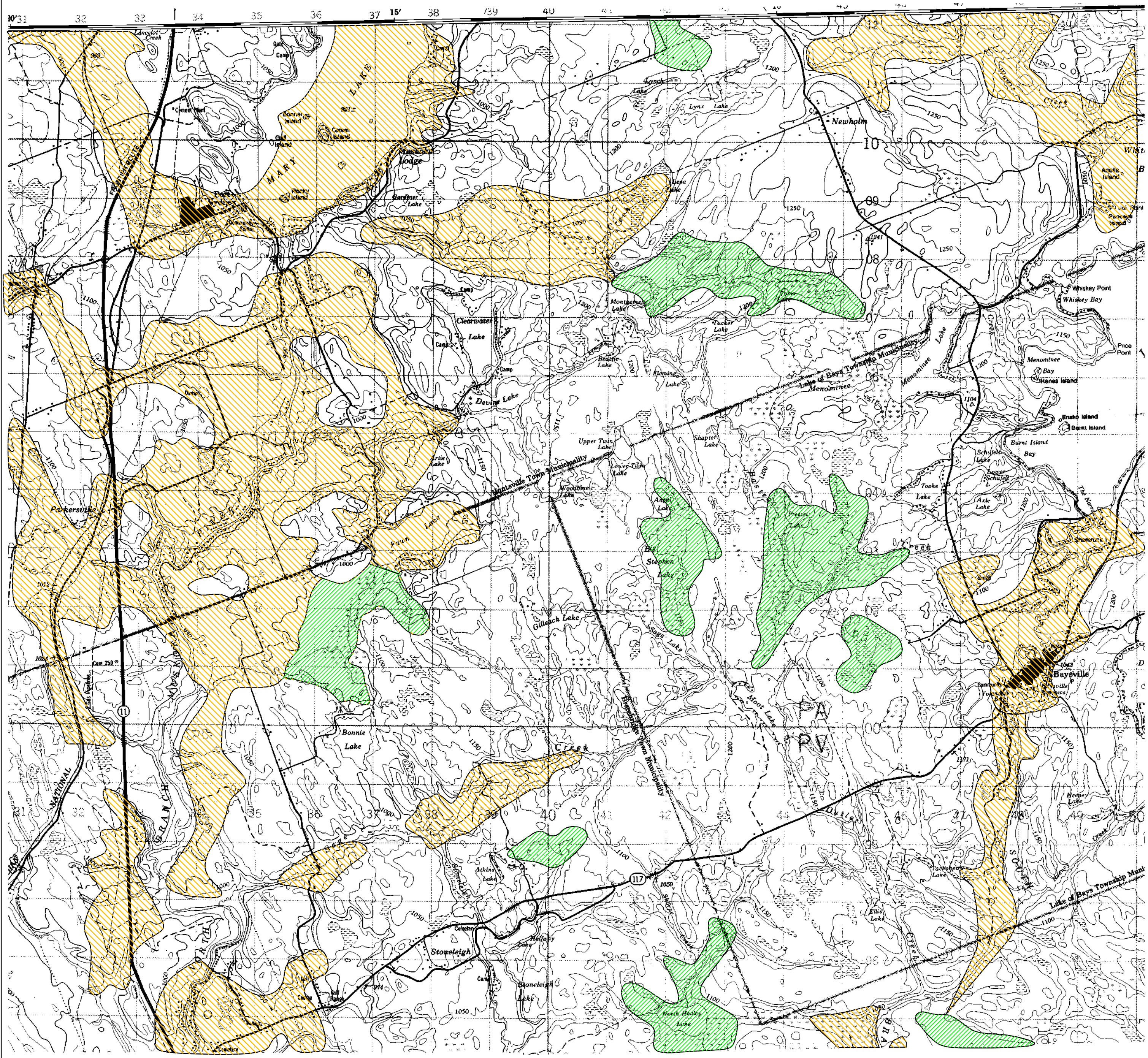
Soils

Areas of thick soil cover (>1m depth and continuous) including the glaciolacustrine/glaciofluvial and moraine features provide the fewest constraints to golf course development within Muskoka as these areas provide the greatest ability to absorb and filter contaminants from infiltrating water. Areas of finer grained till soils have the greatest ability to attenuate contaminants and provide a greater degree of protection to the shallow groundwater system by restricting groundwater flow to depth. Sandy soils will provide some contaminant attenuation although they are less effective in this regard than finer grained soils. Sandy soils tend to have high infiltration rates and are also more susceptible to erosion.

Areas of exposed bedrock with thin soil cover are poorly suited for golf course construction. These areas have soils which are <1m thick or are discontinuous and provide the least amount of protection to the shallow groundwater system from contamination. The movement of shallow groundwater in these areas is potentially rapid due to the permeable nature of the weathered fractured bedrock. Once surface water infiltrates into the bedrock, it will move through fractures in the rock. Groundwater movement via bedrock fractures is potentially very rapid and little or no attenuation of contaminants occurs within the fractures. Contaminants can therefore quickly find their way into shallow wells and discharge into nearby streams and wetlands. Bedrock terrain with shallow soil cover provides significant environmental and physical limitations to development. The development of a golf course on this type of terrain produces the greatest threat to groundwater quality.

Wetlands

Wetland terrain is not suited for direct golf course development. Draining or filling is required to make these areas suitable for a golf course. This would cause significant alteration to the shallow groundwater functions such as recharge or discharge and baseflow maintenance to local surface waters. Wetlands provide contaminant attenuation potential as they may remove certain contaminants from the shallow groundwater system. This terrain may also possess significant vegetation and wildlife habitat characteristics.



Legend:

- BEDROCK
- GLACIOLACUSTRINE/ GLACIOFLUVIAL
- ORGANIC

NOTE:
MODIFIED FROM MOLLARD, 1980.

1000m 0 2000m 4000m

Scale 1:100,000

Designed By:		Drawn By:	J.M.C.
Checked By:	N.M.W.	Approved By:	N.M.W.
Date Issued:	SEPTEMBER 2001	Project No.	20-649
Site Name:	MUSKOKA	File Name:	206491.DWG

DISTRICT OF MUSKOKA
Best Management Practices and Guidelines for the Development and Review of Golf Course Proposals in Muskoka

TYPICAL TERRAIN CONDITIONS IN MUSKOKA

Gartner Lee

Figure 3-1

Wetland terrain is very commonly encountered throughout the Muskoka landscape and can rarely be avoided when siting a golf course. Its presence must be considered carefully in the site design phase and all efforts made to avoid direct encroachment during course layout. The need to avoid wetland areas, or to maintain naturalized buffers adjacent to them, may preclude golf course development in sites where wetlands are dominant. In some cases, wetlands have been incorporated into the surface water management system of a golf course to provide hydrologic buffers against runoff to surface waters. Early consultation with the MNR will help to establish the significance of wetlands identified during baseline studies and provide input to the need for protective measures in the course design and layout.

3.1.2 Terrain Analysis

Initially, a preliminary terrain analysis should be completed to identify the major physical characteristics of the property that provide opportunities or constraints to golf course development. This analysis should be based upon a review of available information (maps, existing reports, etc.), an analysis of recent air photos of the property at a scale suitable for the interpretation of individual landform features (see Section 3.2.2) and field investigations over a variety of hydrologic and vegetation conditions (i.e., late spring and late summer to capture changes in flowering plants, migratory birds and surface water).

The preliminary terrain analysis should include, but not be limited to the following:

a) identification of landforms and soil types (i.e., sand plains, bedrock ridges/plains, till plains, eskers, wetlands, etc.);

b) topography including slope analysis (i.e., low, medium, and steep slopes);

c) soil moisture conditions (seepage/discharge areas, recharge areas, high water table conditions); and

d) site drainage (streams, drainage channels, ponds, lakes, wetlands, etc.).

The natural heritage analysis should include identification of the following:

a) vegetation community types (Ecological Land Classification [ELC]);

b) significant natural features (evaluated wetlands, Areas of Natural and Scientific Interest [ANSIs], significant biological features, etc.); and

c) significant aquatic habitats (fish spawning areas, cold water fisheries, etc.).

The preliminary terrain analysis will identify environmental constraints for golf course development. This should form the basis of a feasibility analysis for the proposed development.

3.1.3 Air Photo Interpretation

One of the initial steps in carrying out an Environmental Impact Statement (EIS) in support of a golf course development is a detailed air photo interpretation. Stereo pairs of the most recent air photos should be obtained, ideally at a scale of not less than 1:15,000. Coverage should extend beyond the limits of the site proper, to include adjacent contiguous woodland and watercourses (creeks, rivers, lakes, wetlands), especially those situated downstream of the site. Spring or fall photography is often preferred over summer photography, as it is easier to interpret terrain conditions and detect micro-drainage patterns in the absence of foliage.

The following features should be identified from the air photos, prior to undertaking any field investigations:

a) extent of forest cover;

b) general forest type (coniferous, deciduous, mixed), if possible;

c) surface drainage features (including evidence of beaver dams);

d) wetlands by type (swamp, marsh, bog, fen), recognizing that the latter type is very difficult to detect from air photos;

e) areas of bedrock outcrops;

f) soil types;

g) areas of groundwater seepage (usually only detected by a highly experienced interpreter);

h) steep slopes vs. areas of flat to gentle terrain; and

i) anthropogenic features (buildings, roads, linear utility corridors, sand pits, man-made dams, etc.).

The level of detail derived from the air photo interpretation should be sufficient to gain a general appreciation of the site's biophysical setting. It should allow the identification of portions of the site that, at a preliminary level, may pose constraints (uneven terrain, deep organic soil deposits, surface water features) or provide opportunities (areas of overburden, disturbed land, sparsely vegetated areas) for golf course development.

The results of the air photo interpretation should be used to focus those portions of the study area where subsequent field investigations should be concentrated.

3.1.4 Information Sources

Information regarding the biophysical (terrestrial) resources of the study area should be obtained from the following sources:

a) local office of the Ontario Ministry of Natural Resources – wetland data records, ANSI files, fish collection records and habitat surveys, deer wintering yards, moose feeding areas, Forest Resource Inventory (FRI) stand mapping, forest management plans, resource use (trapping, hunting, fishing, forestry, mineral extraction);

b) Natural Heritage Information Centre (NHIC), Peterborough – rarity status of Ontario's flora and fauna (plants, birds, mammals, reptiles, amphibians, fish, butterflies, etc.); VTE (vulnerable, threatened, endangered) locality data, Ontario Breeding Bird Atlas data, significant vegetation community (ecosite) mapping;

c) published reports and maps documenting the geology, terrain conditions, surficial soils, and mineral and aggregate deposits of the area;

d) published accounts of the local/regional flora and fauna (e.g., *Birds of Muskoka and Parry Sound, Muskoka Natural Heritage Area Evaluation*); and

e) local naturalists – information regarding significant vegetation and wildlife species, conservation/recreational/educational uses of the site and its surroundings.

3.1.5 Field Investigations

The primary purpose of terrestrial field investigations is to obtain current site-specific information regarding the biophysical resources of the site and its surrounding lands. At a minimum, field work activities should be carried out in the late spring/early summer when the area is still wet and breeding birds may be present and again in late summer to document changes in moisture and vegetation. The investigations should focus on documenting the following:

a) confirmation of soil terrain conditions across the site through hand augering, test pitting and borehole drilling and sampling at a resolution sufficient to identify and map site characteristics;

b) identifying the precise boundaries of vegetation community types on the basis of dominant species associations, physiognomy and site characteristics, in accordance with the province's Ecological Land Classification (ELC) system (Lee *et al*. 1998);

c) documenting the presence of vascular plant species over a full growing season (late spring, summer, early fall);

d) documenting the presence of wildlife, focussing on breeding/resident species of amphibians and nesting birds. Spring surveys must be conducted to capture amphibian breeding habitat while early summer surveys are required to document site usage by breeding and migratory birds;

e) evaluating the value of habitat to wildlife (breeding, feeding, migratory stopover, winter cover, concentration or staging area, movement corridor, etc.);

f) incidental wildlife observations and indirect evidence of presence (scats, calls, browse, nests, burrows or dens, tracks); and

g) evidence of past or current disturbance (logging, fire, sand and gravel extraction, etc.).

Where undetermined plant species are encountered, particularly in sensitive or unique habitats (e.g., fens, alvars, shoreline areas), voucher specimens should be collected for future identification. Given the potential for discovering rare species in these habitats, specimen collection should be undertaken judiciously.

In addition to the field inventory data, a representative photographic record of the site should be compiled over the course of the field season.

3.1.6 Field Season

Timing is critical to the success of field work and many ecological features will not be assessed if a field season is limited to one visit, or if multiple visits are made at an inappropriate time of year. Initial visits should be scheduled for the latter stages of the spring freshet (i.e., late March and early April evenings) to detect the presence of chorusing frogs and toads in breeding ponds or adult salamanders moving to breeding ponds. These ponds are ephemeral and their significance to amphibians will not be determined if field visits are restricted to summer. Ideally, a site should be visited on at least two evenings in the spring, two to three weeks apart, to cover the peak period of amphibian breeding activity. These early-season visits should document the appearance of plants that bloom early in the season (known as spring ephemerals).

Late May to mid-July is the optimum time for conducting breeding bird surveys in Muskoka. At least two early morning visits (i.e., commencing pre-dawn), and preferably three, should occur. During the initial visit it may be difficult to distinguish between territorial birds (e.g., singing males) and transient individuals still moving through the area on their way to more northerly breeding grounds. By mid-July most young birds have hatched, and breeding can be confirmed through the observation of adults engaged in feeding their young.

Mid to late summer investigations should coincide with the peak flowering period and extend late enough in the season to capture the emergence of typical late-flowering plants such as many members of the composite family (e.g., goldenrods, asters). At this time of the year supplemental information regarding wildlife use of the site can be obtained, such as concentrations of waterfowl or shorebirds in lakes, ponds and open water wetlands during fall migration.

3.1.7 Field Reports

Detailed field maps, based on an air photomosaic and/or topographic base (i.e., one with elevational contour intervals), should be compiled in the field and these data transferred to preliminary constraint/opportunity maps that consider a wide range of factors beyond just terrestrial features (e.g., topography, soils, drainage, etc.). **It is imperative that this work be carried out *prior to* the preparation of even a preliminary course layout plan.**

The information plotted on these working maps should be one of the key tools used by the golf course architect/designer and project engineer to generate the first iterations of a conceptual layout. If the preliminary course layout is generated in advance of these technical considerations, there is the potential to raise unreasonable expectations or prejudge ultimate hole locations. It is more appropriate to complete this phase of the design process once the pertinent environmental data has been compiled and analyzed.

Best Management Practices ***Pre-Development Baseline Studies – Terrain***
The Best Management Practices for Golf Course Pre-Development Baseline Terrain Studies include the following: ➢ Contact with municipal, provincial and federal agencies to ensure their concerns are addressed in the baseline studies. ➢ Completion of a Preliminary Terrain Analysis to identify: • landforms; • topography; • soil moisture conditions; • drainage; • natural heritage (vegetation, natural features, aquatic habitat); and • completion of a detailed Air Photo Interpretation. ➢ Review of existing Terrestrial Information Sources. ➢ Completion of Field Investigations to identify: • soil conditions; • vegetation boundaries and types;

Best Management Practices ***Pre-Development Baseline Studies – Terrain***
• wildlife presence/habitat/breeding; and • evidence of past/current disturbances. ➢ Conduct of field visits or assessments in the late spring or early summer as well as the late summer to assess differences in water balance and differences in the vegetation or wildlife communities. ➢ Completion of a Field Report detailing the findings of these studies. ➢ Completion of a preliminary course layout which incorporates environmental sensitivities revealed in the terrain analysis.

3.2 Hydrology / Surface Water

Concerns with the interaction of golf course development with surface waters relate to site runoff and the potential for erosion, and the transport of sediment, nutrients, or pesticides to surface waters. These impacts can be minimized through:

a) water sensitive design, in which hydrologic and aquatic environmental constraints are identified before the course is designed, and form part of the constraint mapping exercise so that hydrologic issues are identified at the outset;

b) development of a water balance which ensures no increase in off-site runoff from routine operations and average storm intensities, which identifies sources and losses of water on a seasonal basis, which ensures that adequate irrigation water can be obtained without impacting the natural hydrologic balance of the site and which meets the needs of a Permit to Take Water application;

c) grading the golf course such that water either infiltrates or runs off in a diffuse manner, instead of collecting runoff in ditches and swales to more closely mimic the pre-development drainage pattern of a site. This will not always be possible, however, and so the water balance must also identify storage options for excess water, and opportunities to reuse runoff for site irrigation. Vegetated swales are preferred over engineered channels to maximize the potential for attenuation of pollutants on course;

d) the most challenging aspects of design involve the management of "natural" stormwater to reduce erosion and event-based transport of pollutants. Fortunately, stormwater management techniques are plentiful and well understood and the most significant challenge lies in developing them on a site specific basis;

e) development of mitigation options and a management plan which maximize the infiltration of excess water to soil, provide buffer strips to intercept runoff, include turf grass species with appropriate requirements for water and fertilizer and which incorporate principles of integrated pest management; and

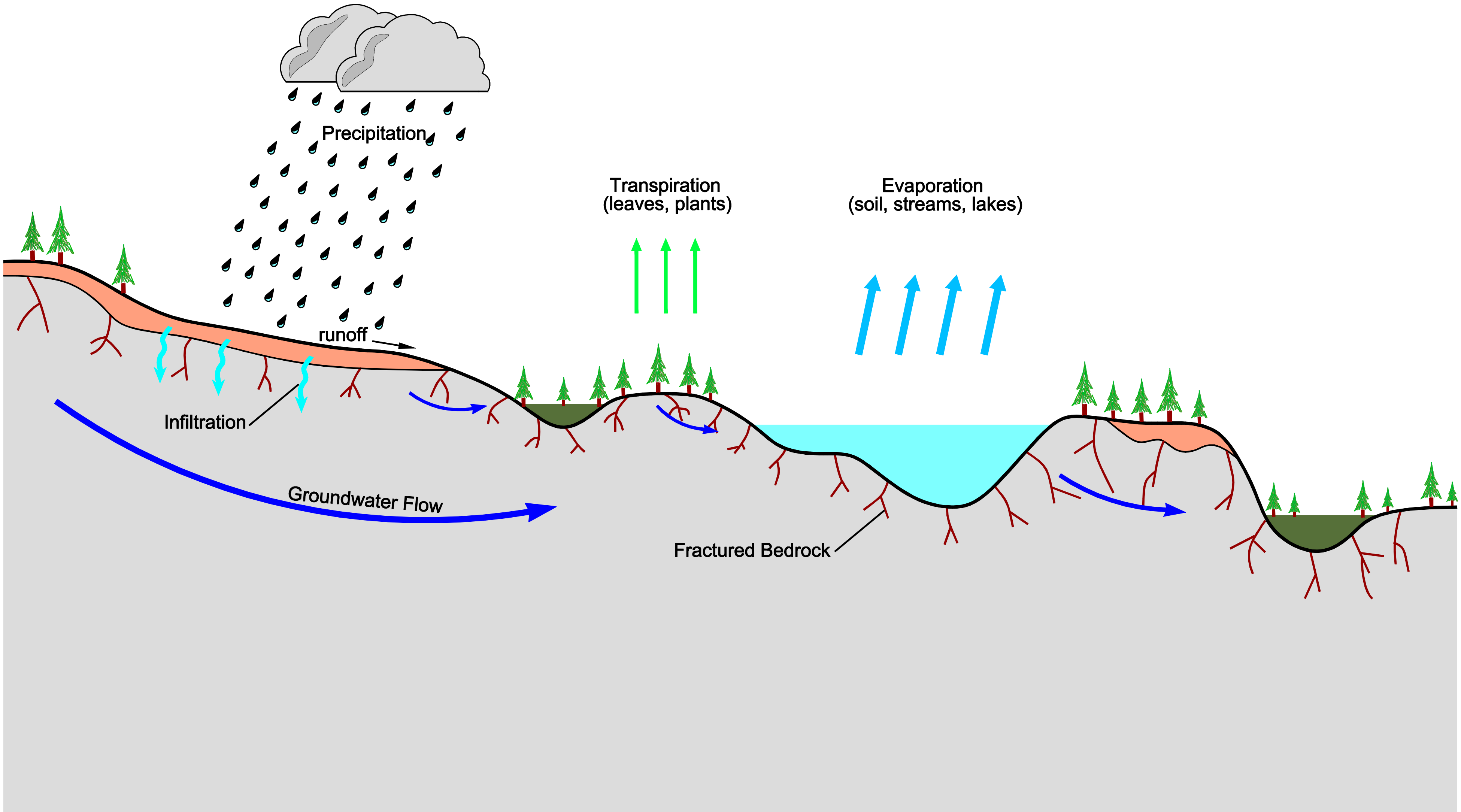
f) development of a sensitive and cost effective monitoring program where required and a reporting structure to demonstrate compliance to all parties.

3.2.1 Water Balance

Golf courses rely heavily on water for the maintenance of the turf areas and consequently there is potential for disruption of the natural water balance of the property. A main objective of golf course development should be to maintain pre-development or background water balance conditions. This is important in order to minimize impacts on the natural features of the property and downgradient areas that may rely upon the natural water balance. Of particular concern are the potential impacts on plant communities, wildlife, and aquatic habitat areas that may rely upon groundwater seepage and wetlands, as well as stream base flow that may support significant aquatic resources. In addition, a detailed water balance can be coupled with a monitoring program during course operations to document the losses of nutrients from the site and potential effects on downstream receivers. A water balance analysis is therefore an essential part of an impact assessment for any golf course.

Understanding the relationship of the major components of the hydrologic cycle is fundamental to a water balance. The components illustrated in Figure 3.2 can all be adapted to any site and each must be addressed in the balance. Most of the data needed to construct the balance can be obtained from the nearest meteorological station. These data are used to determine evapotranspiration, precipitation, and water surplus components of the water balance. The water surplus represents the runoff and infiltration portion of the water balance that remains after precipitation and evapotranspiration have occurred. This can be calculated specifically from meteorological data or regional estimates can be obtained from the Hydrologic Atlas of Canada (Fisheries and Environment Canada 1975). Long term runoff depth can also be established through the long-term hydrologic records of the Water Survey of Canada (Environment Canada). They should be consulted directly to establish the monitoring location closest to any proposed golf course.

The Muskoka area is fortunate to have a long term record of climate and hydrology developed specifically from local catchments by the Ministry of the Environment's Dorset Environmental Science Centre. MOE scientists have maintained several calibrated watersheds, numerous stream records and three meteorological stations over the past 25 years. The longest term records, and those closest to Muskoka, are maintained for the Harp Lake catchment, immediately east of Huntsville. Meteorological data, annual depth of runoff, watershed, soil and forest characteristics, daily records of runoff and calculated



Site Name:	MUSKOKA
File Name:	206492.DWG

Gartner Lee

District of Muskoka

BEST MANAGEMENT PRACTICES AND GUIDELINES FOR THE DEVELOPMENT AND REVIEW OF GOLF COURSE PROPOSALS IN MUSKOKA

SCHEMATIC OF HYDROLOGIC CYCLE FOR MUSKOKA

Project No.	20–649
Date Issued:	SEPTEMBER 2001

Figure 3-2

evapotranspiration records can all be obtained from the MOE. These data represent the best source of hydrologic data for water budget analysis and should be consulted as the preferred source. They address only unaltered catchments, however, and so some interpretation to the altered golf course landscape is required. The MOE records also include mass balances of phosphorus, nitrogen and other water quality parameters of interest. The Dorset Centre is also the location of the Trent University/MOE study of golf course effects on the Precambrian Shield and may shortly be able to provide the necessary information on response of the natural water budget to golf course construction.

In addition, physical site characteristics such as soil type, topography (i.e., slope), and cover types are required to partition the water surplus into runoff and infiltration. In all cases, the water balance must consider seasonality to determine irrigation requirements and variation of runoff. A water surplus in May, for example, must be managed to avoid flooding or erosion whereas a surplus in July may be retained as a supplement to normal irrigation requirements.

Best Management Practices Summary ***Pre-Development Baseline Studies – Hydrology***
The Best Management Practices for Golf Course Baseline Hydrologic Studies include the following: ➢ Delineation of all surface water features and wetlands on-site and their linkage to off-site hydrologic features. ➢ Completion of a water balance for the site in its pre-development state which includes monthly estimates of precipitation, evapotranspiration, infiltration and runoff for the spring, summer and fall and which determines differences due to on-site soils, bedrock or slope. ➢ Completion of a water balance for the site in its developed state which estimates monthly changes in runoff, evapotranspiration and infiltration due to changes in vegetation and soil alterations. ➢ An estimate of monthly irrigation requirements. ➢ An estimate of the effects of changes in hydrology on the natural water balance of any affected wetlands, streams, ponds and lakes. ➢ A water balance for each separate sub-catchment on-site.

3.2.2 Water Quality

The quality of water leaving the site during construction and operation is important to aquatic life downstream and as a demonstration that design and mitigation are effective. Water quality in Muskoka's lakes and rivers is generally excellent, with low concentrations of nutrients, low levels of algae and low levels of suspended solids. These characteristics, and a water-based recreational economy make protection of water quality an important consideration in golf course design and management. Potential water quality responses to golf course development include:

a) increases in suspended solids as a result of erosion;

b) increases in phosphorus and nitrogen in response to losses of fertilizer;

c) losses of pesticides from the golf course;

d) increased temperature and resultant effects on fish habitat and the toxicity of ammonia; and

e) decreased levels of dissolved oxygen in response to warming of the water or increased algal growth in response to losses of fertilizer residues.

All of these changes can be minimized at the design stage by:

a) reducing encroachment on streams, ponds, wetlands and lakes through site layout;

b) reducing losses of natural vegetation around surface water features; and

c) use of buffer strips around surface water features.

All of these factors must therefore be considered during the baseline environmental studies so that sensitivities can be identified.

Baseline Monitoring Programs

Delineation of surface water features and development of a hydrologic balance were covered in previous sections. A pre-development baseline of water quality on the site is also required:

a) to allow comparison with post development water quality and reference locations in order to determine if the course has had effects on water quality; and

b) to allow the separation of natural sources of nutrients (i.e., wetlands) from golf-course-related sources.

The baseline water quality monitoring program must be sufficient to characterize pre-development water quality but must also acknowledge the tight time-schedule around course development. Water quality, particularly in streams, is highly variable and an intensive, multi-year program is required to establish an adequate estimate of pre-development conditions. A long-term baseline study is not generally feasible for a developer. In addition, climate and factors such as atmospheric acid loadings can alter water quality in the absence of a golf course. The monitoring program must therefore be able to separate golf course from non-golf course related changes in water quality and provide sufficient resolution of water quality in a short time.

The preferred means of baseline monitoring is therefore locating a monitoring site upstream of a golf course, on a stream which runs though the golf course. The upstream site provides a spatial reference for water quality which is not altered by golf course operations and which will track changes due to natural stressors independently of golf-course-related changes. If this is not possible, the baseline must be established on-site for a minimum of one year before any construction starts and an off-site reference stream chosen to compare effects of golf-course development and operations against local water quality. The rationale for selection of the reference site must be clearly elaborated to ensure that it is valid.

All golf course developments should document the water quality on-site prior to any development work. Any streams leaving the site should be monitored on six occasions (three event-based samples and three routine water samples, one taken during summer baseflow) for at least one year as a baseline reference. Each monitoring event should record :

a) temperature (water and air);

b) pH;

c) dissolved oxygen;

d) streamflow in L/sec;

e) total Phosphorus, Nitrate, Nitrite, Total Ammonia and Kjeldahl Nitrogen species, Total Suspended Solids, Turbidity, Dissolved Organic Carbon and Total Iron; and

f) no pesticide sampling is required for pre-development reference unless an existing source is suspected.

Streams should be monitored at the furthest downstream point on the site as a measurement of what may leave the site. Stream flow is recorded to capture the range in conditions and to provide an estimate of the accuracy of the water balance. Nutrients are measured for comparison with any future changes from fertilizer application. Solids and turbidity are measured during rain events to determine the existing sensitivity of the site and to provide a baseline for future changes during operation or construction.

In many cases, ponds may form part of the golf course landscape, either as stormwater management, natural features or "visible amenities". Water quality in natural ponds and lakes or in ponds serving as "visible amenities" should be established and monitored as part of the baseline and as ongoing monitoring. Ponds serve as visible indicators of water quality. The onset of an algal bloom, for example, may indicate nutrient losses long before any impacts are established off-site. Bloom conditions may also generate complaints from golfers. Ponds form important habitat for insects, vegetation, amphibians and birds and so detrimental water quality in ponds will have an effect on the local ecosystem.

Finally, preliminary research results suggest that streams flowing from ponds may be a significant vector for off-site nutrient transport. Dr. J. Winter (Trent University, unpublished data) reports significantly elevated total phosphorus concentrations in streams draining on-site ponds at two Muskoka area golf courses. The same patterns were observed in previous work at a Muskoka area golf course (Tymowski, 1997, N.J. Hutchinson, pers. obs.). Preliminary interpretations suggest that the phosphorus may be mobilized from the sediments during periods of anoxia (i.e., at night) but this has not yet been substantiated. In the absence of conclusive data, the sensitivity and importance of golf course ponds is worthy of monitoring.

Pond monitoring should include those parameters identified above for streams. Dissolved oxygen and temperature should be measured at 1 m intervals from the surface to just above the bottom at the deepest point of the pond. Total phosphorus and iron should be measured at the surface and just above bottom. Chlorophyll "a" concentrations should also be measured on the same sampling schedule as nutrients. Sampling can be undertaken in conjunction with stream sampling, but should include at least one oxygen measurement made before sunrise, when anoxia is most likely.

The monitoring program should be developed at the earliest possible stages of the assessment. Completion of the entire baseline program is not a requirement for any approvals but any approvals should require demonstration that a baseline program has been implemented. It serves as a baseline for future changes or for the development of any water quality triggers later in the process.

Lakes and Phosphorus Loading Capacity

Golf courses are also located on lakeshores in Muskoka. The District Municipality of Muskoka maintains a water quality program on all of Muskoka's recreational lakes. This program includes phosphorus – based development capacities and a monitoring program. The golf course developer should therefore consult with District Planning staff to:

a) determine whether or not the lake receiving drainage from a proposed golf course has the capacity for additional phosphorus loading. Lakes are determined to be at capacity if the results of the District's water quality model show that human sources of phosphorus jeopardize water clarity through increased algal growth. If a lake is "at capacity" then no further loading from shoreline development is permitted and applications for severance are denied. A golf course may increase phosphorus loading from natural levels by clearing of the forest cover and losses of fertilizer and so golf course development must be considered in the context of phosphorus "capacity" of the adjacent lake. Although the actual export may be small the lake capacity program works on the basis of a strict loading limit. Therefore, best management for phosphorus enrichment is that golf courses (and any other human sources of phosphorus) will not be permitted within 100 m of the shoreline of a "capacity" lake or any permanent stream flowing directly into the lake. In practice, this translates to a requirement for a 100 m buffer strip of unaltered natural vegetation between the fairways and the shoreline and full sewage servicing (i.e., no septic system) for the club house; and

b) review results of the District's water quality monitoring program and determine any needs to enhance it, in those cases where lake capacity remains and a revised monitoring program may be required to address the District's needs.

The developer should also contact the Ontario Ministry of Natural Resources who advise against additional phosphorus loading to lakes which contain lake trout and which have low levels of dissolved oxygen in the deeper waters which lake trout prefer. If MNR are enforcing a phosphorus limit on the basis of lake trout habitat then they will object to a golf course development.

Best Management Practices Summary

Baseline Studies – Water Quality

The Best Management Practices for Golf Course Baseline Water Quality Studies include the following:

- Identifying hydrologic and aquatic constraints before starting course design.
- Developing a water balance that ensures no runoff from routine operations.
- Developing a sensitive and cost-effective baseline monitoring program which includes:
  - a reference site upstream from (preferred) or off-site (less preferred);
  - monitoring at the downstream boundary of the golf course;
  - three event-based and three routine water samples for a minimum of one year for streams leaving the site and for a reference site; and
  - on-site pond quality monitoring.
- Consultation with the District Municipality of Muskoka to establish the sensitivity and monitoring requirements for any lake adjacent to or downstream from the proposed course.
- Consultation with the Ontario Ministry of Natural Resources to establish whether lake trout habitat requirements will prevent any additional phosphorus loading from golf course development.
- Golf course development will not be permitted within 100 m of the lake shoreline or any permanently flowing inflow stream of any lake deemed to be "at capacity" in terms of phosphorus loading by either the District Municipality of Muskoka or the Ontario MNR.

3.3 Stormwater Management

The primary pathway for potential transport of sediments, nutrients and pesticides to surface waters is storm runoff. Changes in the quantity and timing of stormwater can also have a significant impact on the wetlands and watercourses that convey runoff to lakes and rivers. Therefore, it is important that changes to the natural drainage system that are associated with the development of a golf course are carefully planned and understood beforehand in order to design effective stormwater management practices and techniques.

To prepare a design that will minimize the potential for negative environmental impacts, it is necessary to gain an understanding of existing conditions at the site. Section 3.1 discusses the baseline information required to characterize the terrestrial environment of a given site. Sections 3.2 and 3.4 describe how to undertake a site water balance and how to characterize site hydrogeology. Information regarding each of these aspects of the environmental setting is important for the determination of opportunities and constraints for the design of the stormwater management system.

The collection of baseline data at the site will lead to an overall characterization of the environmental setting. Only after this characterization is complete should the layout of the golf course be considered. In terms of existing site drainage, the following tasks should be undertaken to characterize the site:

a) review aerial photographs and topographic maps in order to determine the location of existing drainage pathways through, or adjacent to the site. This information should be overlain with the location of surface water receptors such as significant wetlands, lakes and watercourses. The catchment areas draining to each surface water receptor should be delineated and their areas calculated. The location of steep slopes on the site should also be noted. Ground-truthing should be undertaken to confirm the data inferred from the aerial photographs and topographic maps;

b) the relationship between groundwater and surface drainage pathways on the site should be defined. Drainage pathways that only convey runoff (swales) may be altered by the design of the golf course without an impact on the groundwater flow regime. On the other hand, drainage pathways that intersect the water table for part of the year (intermittent watercourses) cannot be altered without an assessment of the impact on-site hydrogeology;

c) the relationship between wetlands and site drainage pathways should also be defined. Wetlands are sustained by surface water and/or groundwater inputs. Any change to the amount of water that is provided to a wetland will require an assessment of the impact;

d) the results of the terrestrial, aquatic, hydrogeologic and surface water assessments should be superimposed on the same plan to produce a constraint map for the site. This plan will illustrate the location of important or sensitive features on the site that should be protected or avoided; and

e) appropriate buffers should be applied to each identified constraint in order to provide an added level of protection for significant features of the site.

Once appropriate buffers have been added to the constraint mapping, the golf course layout can be designed so as to minimize the conflicts between golf course features and environmental constraints.

Best Management Practices Summary *Pre-Development Baseline – Stormwater Management*
The Best Management Practices for Golf Course Baseline Stormwater Management Studies include the following: ➢ Review of aerial photographs and topographic maps to: • determine existing drainage pathways on and surrounding the site; • delineate catchments draining to each surface water receptor and calculate their areas; and • locate and identify any steep slopes. ➢ Ground-truthing of all data inferred from mapping and photos. ➢ Definition of the relationship between groundwater and surface water drainage pathways. ➢ Definition of the relationship between wetlands and site drainage pathways. ➢ Superimposing results of terrestrial, aquatic, hydrogeologic, and surface water assessments onto one plan to produce a constraint map for the site. ➢ Application of appropriate buffers to each identified constraint to provide added protection.

3.4 Hydrogeology

The District of Muskoka has terrain conditions that are considered to be hydrogeologically sensitive and susceptible to contamination. These include thin soils, sandy soils or organic soils over bedrock throughout much of the District and only smaller areas which are overlain with glacial tills or thicker sands. Thin soil cover reduces the assimilation of fertilizer and pesticides and increases the sensitivity of a site to development.

Much of the “groundwater” in Muskoka is, in fact, subsurface seepage through thin soils or between soil and shallow bedrock and this tends to drain quickly to the nearest surface water. There is therefore little easily accessible groundwater for irrigation and high potential for contamination of surface water through shallow groundwater. Irrigation water is therefore obtained from surface water.

Site specific hydrogeologic conditions of the proposed golf course site must be clearly defined and sufficiently understood to effectively assess the potential for impact from the proposed development. The major groundwater issues associated with golf course development include:

a) the availability of groundwater supply for potable supply and irrigation (if necessary);

b) impact of water takings on the hydrogeological functions (i.e., recharge/discharge conditions) of the property;

c) impacts on baseflow to streams;

d) impacts to natural features such as wetlands; and

e) groundwater quality impacts with respect to golf course management practices.

Hydrogeological investigations would be required to address on-site as well as potential off-site impacts.

Issues such as water supply will have a significant bearing upon the potential for impact and should be resolved early in the design process as it affects the feasibility of the golf course. Given the abundance of surface water supplies within Muskoka it is more likely that the use of groundwater will apply to the associated facilities of the golf course rather than for irrigation of the golf course itself. Hydrogeological investigations for water supply of the clubhouse and any other potable uses such as residential development would require separate investigations. These types of development would also require sewage treatment and disposal investigations. The use of treated sewage effluent for irrigation has often been proposed for golf course developments. In this situation, the sensitivity of local hydrogeology must be investigated as part of the environmental baseline.

Studies specific to clubhouse uses are beyond the scope of this document but will be required in support of applications to the MOE for a Permit to Take Water or a Certificate of Approval for Discharge. It should be recognized that these parts of a golf course development can have impacts on the natural features and the hydrology of the golf course property. The potential for such impacts will need to be considered as part of the hydrogeological investigations.

A preliminary assessment of water availability is necessary in the early stages of the development proposal as part of the feasibility study. Golf courses require significant quantities of water for irrigation purposes and will require a Permit-To-Take-Water from the Ministry of the Environment. Detailed requirements specific to each site should be identified in consultation with the local and /or regional Ministry of the Environment office. The water supply study will determine whether a suitable source of water is available to meet the anticipated needs. Initial investigation will utilize existing information including the following:

a) air photographs of the property;
b) Ministry of the Environment well record information;
c) published geologic and hydrogeologic maps and reports;
d) site specific hydrogeological reports for the property and/or adjacent areas; and
e) a detailed site water balance including surface water.

The water supply feasibility study should include both surface water and groundwater components. Major objectives of the detailed study will be to confirm groundwater availability as well as interference with existing users and natural features such as wetlands, seepage areas and fisheries habitat. For example, if use of the groundwater source potentially affects a sensitive surface water body such as a cold water fishery stream, there may be significant constraints to the water supply and limitations to the golf course development.

The groundwater investigations must also establish the quality of local groundwater – that which feeds on-site surface waters. Infiltration of storm and irrigation water may increase nutrient concentrations in groundwater on-site and subsequently enrich surface water features. Mini piezometers should be installed during the baseline investigations and four monthly samples of groundwater analyzed for phosphorus and nitrogen (nitrate, ammonia, Kjeldahl) to establish a baseline by which to assess future impacts or determine the effectiveness of mitigation. Alternative sampling schemes include installation of seepage interceptors which collect infiltration and direct it to a sampling location. For example, plastic swimming pool liner material can be used as a barrier to collect infiltrated water in reference areas during baseline investigations. During operations, these results can be compared to those obtained using barriers beneath greens and tees to establish whether or not fertilizer or pesticide is being lost to the environment.

Once the feasibility of the proposed development has been established, detailed site investigations will be required to confirm existing (i.e., baseline) conditions. Depending on the nature, location and size of the development, varying amounts of site data collection will be required.

Best Management Practices Summary

Pre-Development Baseline– Hydrogeology

The Best Management Practices for Golf Course Baseline Studies on Hydrogeology include the following:

- Delineation of areas of groundwater discharge or recharge on-site.
- Use of soils and terrain maps to determine areas in which the potential alteration of groundwater quality is greatest.
- Identification of areas of greatest groundwater sensitivity for consideration in locating greens, tees and fairways .
- A preliminary assessment of water availability to assess groundwater supply and potential adverse effects of groundwater takings on wetlands and surface water features.
- Use of existing information such as air photos, MOE Well Records, published geologic and hydrogeologic maps and reports, site-specific/local hydrogeology reports, the detailed site water balance and site visits, as required.
- Monitoring the quality of groundwater on-site prior to course construction.

3.5 Aquatic Biology

As with any development activity, the decision to proceed with a golf course must be made with the understanding that changes to the physical landscape and water balance will occur. The biological community will only respond if significant changes in the physical or chemical environment of surface water result from golf course operations. The guiding principle is therefore that prevention or mitigation of physical (i.e., altered base flow or water temperature) and chemical (i.e., nutrient enrichment) impacts will also protect the biotic community. Specific management actions to protect aquatic biology must ensure minimal changes to the water balance as it relates to baseflow on any on-site or adjacent water bodies, no alteration of water quality and maintenance of the naturalized stream corridor. Biotic responses are therefore discussed separately from water quality and hydrologic changes to acknowledge the functional and management differences between stressors (water quality and hydrology) and response indicators (the aquatic biological community).

Methods to survey and document the physical, hydrologic, hydrogeologic, and water quality environment of on-site surface water were presented in the previous sections. This section documents information sources for characterization of the baseline aquatic community and habitat and the need for a detailed survey of the aquatic habitat and community as part of the baseline description. This will identify sensitive species or attributes early on in the process and allow decisions on the required level of protection.

The survey should begin with a review of aquatic surveys and inventories on file at the MNR and discussion of likely sensitivities site with field staff. Use of air photos is also valuable to define the characteristics of the water bodies to be sampled prior to initiating field activities. Field surveys using various sampling methods (e.g., electrofishing, seining, minnow traps as required) are necessary to determine the fish community which is present, to establish breeding use and to identify breeding or nursery habitat. Field surveys include spawning surveys and community characterization and should be undertaken with some consideration of the species expected to be in an area. Spawning surveys should therefore be undertaken at appropriate times of the year (e.g., fall where brook trout are suspected, spring for pike, early summer for bass). Surveys to characterize a fish community are typically undertaken in the summer, a period representing “worst case” thermal conditions (i.e., likely representing most sensitive habitat use) and when the young of the year are present. It is important to have a more thorough inventory (e.g., spawning surveys as well as community characterization) if habitat alteration is anticipated. A habitat survey is recommended as part of the natural heritage inventory but the required detail will depend on the species present and the types of habitat found. The specific requirements should be reviewed with MNR and DFO at the early stages of the pre-development design to co-ordinate with their requirements concerning the Fisheries Act.

Habitat descriptions should be accompanied by photographs and mapping. Reaches of like character should be defined and field efforts directed to ensure representation and evaluation of all areas. MNR has a field protocol (Stanfield *et al*. 2000) which, while rather intensive, can provide good replicable data. Otherwise, it is important to measure and document channel bankfull and wetted widths and water depth by establishing cross-sections for measurement. Water flow, bank stability, riparian vegetation, bed substrates, aquatic vegetation, existing influences, groundwater discharge and morphological characteristics and placement of existing cover types should also be established in the survey.

Detailed information will be required on which to base evaluation of the potential to prevent, mitigate or induce a harmful alteration disruption or destruction (HADD) of fish habitat. For purposes of constraint development at the feasibility stages, rapid assessment methods, also outlined in Stanfield *et al.* (2000) or more general descriptions will be sufficient.

The fisheries and aquatic habitat survey should be supported by a survey of benthic aquatic invertebrates. Benthic invertebrates include immature insect stages, clams, crayfish and free swimming invertebrates. These reside in a water body for extended periods and are not mobile so that the composition of the community provides a good index of long term water quality, as well as the availability of fish food. They are likely to respond to changes in water quality, temperature or flow before the fish community and are therefore a sensitive metric of environmental change. Although a survey is recommended to establish baseline conditions it must be cautioned that interpretation of changes in the future is not straightforward. Enhanced nutrient inputs may well be manifested as a more diverse community with greater biomass, provided that oxygen does not become limiting or plant growth does not alter habitat. In addition, streams that drain wetlands rarely contain sensitive aquatic invertebrate communities.

Best Management Practices Summary ***Pre-Development Baseline – Aquatic Biology***
The Best Management Practices for Golf Course Baseline Studies on Aquatic Biology include the following: ➢ a detailed survey of the aquatic habitat and community to identify sensitive species and habitat features and attributes. This should include: • review of existing surveys and inventories on file at the MNR; • field surveys to establish the fish community and habitat; and • a benthic invertebrate survey to establish baseline conditions, long term water quality index, and availability of fish food.

3.6 Wetlands and Vegetation

Wetlands are common and prominent features on the landscape of the Precambrian Shield. They form in low-lying and depressional areas, where soils accumulate and high water table conditions exist. There are four wetland types in Ontario: swamp, marsh, bog and fen (for definitions, see the Glossary, Sect. 9). On the Canadian Shield, swamps are typically the most commonly encountered wetland type, followed by bogs and fens. Marshes are the least represented wetland type in Muskoka, unlike throughout much of Southern Ontario where they are far more common and widespread.

Given the physiographic character of the Shield, it is virtually a certainty that a golf course proposal in the District of Muskoka will have to address wetlands. Very few Shield wetlands have been formally evaluated by the Ontario Ministry of Natural Resources (OMNR). Of those that have been evaluated, many are considered Provincially Significant Wetlands (PSWs). However, it is anticipated that many smaller, unevaluated wetlands will also be encountered when developing a golf course. The District of Muskoka Official Plan states that limited development, compatible with wetland areas, may be permitted only where the integrity of the wetland resource can be preserved and the suitability of the lot is confirmed by a site evaluation report (i.e., Environmental Impact Study). Where development will infringe on a wetland area, an impact assessment will be required and, depending on the initial evaluation of the area, may result in a full wetland evaluation in accordance with the OMNR's (1994) evaluation system for Northern Ontario.

When designing a golf course in Muskoka, it will likely be very difficult to avoid intrusion into wetland areas. On the other hand, in cases where a large amount of land is available within which to site the facility, there is an opportunity to protect large blocks of habitat, including wetlands. Generally speaking, one of the guiding principles in the design should be to avoid wetlands altogether. Where this is not feasible, the second priority should be to minimize intrusion, especially into marsh/wet meadow habitats. Swamps, as the least sensitive and most common wetland type represented, could withstand some displacement, but only in the event that intrusion is unavoidable.

The developer may also wish to work co-operatively with Ducks Unlimited, volunteer groups and the MNR in devising a management plan for wetlands on site. Management could include enhancement of habitat features to benefit the production of ducks and other wildlife and visual aesthetics in cases where some disturbance was not avoidable.

3.6.1 Wetlands and the Water Balance

The wetlands located on the Canadian Shield are primarily fed by surface inputs (streams, surface runoff and precipitation) owing to the nature of the bedrock and the low capacity for groundwater flow. Groundwater contribution to wetlands is more likely to occur in areas underlain by thick soil cover, particularly where the soils are granular (i.e., sand and gravel) or through more fractured bedrock. The residence time of the water in these wetlands is heavily dependent on storm frequency and severity as well as the size and moisture storage capacity of the wetland.

Wetland plant species have specific requirements for maximum depth and duration of flooding limitations (Kaldec and Knight 1993). General trends are that submergent plants cannot tolerate more than 3 m of water and can tolerate dry conditions 10% of the year. Floating rooted species can tolerate up to 3 m of water and dry conditions 10 or 20% of the year. Emergent herbaceous species can tolerate 0.5 or 1.0 m of water, with dry periods ranging from 25% to 50% of the year. A water budget must be constructed to ensure that the golf course does not severely shift the water levels to such an extent that the composition of the pre-development plant community would be altered. Hill and Devito (1997) documented water level fluctuations in northern wetlands to be within 15 cm on an annual basis and so this threshold should be considered in the evaluation of changes to the water balance.

Best Management Practices Summary ***Pre-Development Baseline Studies – Wetlands***
Best Management Practices for Golf Course Baseline Studies on Wetlands include the following: ➢ Documentation of the occurrence and attributes of all wetlands on-site, as well as any wetlands off-site which may be influenced by altered water balance. ➢ Use of the BMPs described for baseline analyses of terrain, hydrology and water quality. ➢ Development of a water budget to ensure the golf course will not severely shift the water levels to maintain pre-development plant composition. ➢ Avoidance of wetlands to the greatest extent possible in course design and minimal intrusion into marsh and wet meadow habitats where avoidance is not possible.

3.7 Wildlife

Baseline wildlife investigations should include review of relevant literature specific to the area and field visits to consider:

a) habitat types on the site;

b) wildlife usage of the site; and

c) connection of wildlife and habitat to off-site areas.

Wildlife are mobile and may be transient to an area so that their presence or site usage may not always be revealed in site surveys. Local expertise such as MNR, field naturalists or adjacent landowners should therefore be consulted to provide useful insight into wildlife use of the proposed golf course site.

Timing is critical to the success of field work and many ecological features will not be assessed if a field season is limited to one visit, or if multiple visits are made at an inappropriate time of year. Initial visits should be scheduled for the latter stages of the spring freshet (i.e., late March and early April evenings) to detect the presence of chorusing frogs and toads in breeding ponds or adult salamanders moving to breeding ponds. These ponds are ephemeral and their significance to amphibians will not be determined if field visits are restricted to summer. Ideally, a site should be visited on at least two evenings in the spring, two to three weeks apart, to cover the peak period of amphibian breeding activity. These early-season visits should document the appearance of plants that bloom early in the season (known as spring ephemerals).

Late May to mid-July is the optimum time for conducting breeding bird surveys in Muskoka. At least two early morning visits (i.e., commencing pre-dawn), and preferably three, should occur. During the initial visit it may be difficult to distinguish between territorial birds (e.g., singing males) and transient individuals still moving through the area on their way to more northerly breeding grounds. By mid-July most young birds have hatched, and breeding can be confirmed through the observation of adults engaged in feeding their young.

Given the extent of forest cover over much of the Canadian Shield, woodland ecosites within a potential golf course property likely provide habitat for interior breeding bird species, as well as those that are not quite as specialized in their habitat requirements, nesting in both interior and edge situations. Generally speaking, interior habitat is defined as an extensive block of contiguous forest with the required shape (ideally circular, square or rectangular) and a width of at least 200 m in all directions that is sufficiently large to provide core nesting habitat for a number of breeding bird species.

Consideration should also be given to the concept of "landscape connectivity", the notion that many species of wildlife require corridors to facilitate their movement from one core natural area to another. The core natural area is usually a large (>25 ha) habitat block that provides most of the essentials (breeding territories, food, cover, etc.) to support a diverse and productive wildlife community. Core natural areas are susceptible to fragmentation caused by design features such as fairways, roads and ponds.

Best Management Practices Summary ***Pre-Development Baseline Studies– Wildlife***
Best Management Practices for Golf Course Baseline Studies of Wildlife include the following: ➢ Documentation of wildlife occurrences and uses of the site as part of the baseline studies. ➢ Assessment of 'landscape connectivity' and maintenance of wildlife corridors to facilitate movement from the site to core natural areas off-site. ➢ Documentation of all "core" wildlife areas on-site and adjacent to the site. ➢ Documentation of natural woodland blocks of at least 200 m in all dimensions which provide "interior" habitat.

3.8 Soils

Soils requirements of golf course construction can be viewed in several ways. Soils on-site offer a resource, the medium for construction of the course. Where soil depths are insufficient, large volumes may have to be imported, making the operation cost-prohibitive. Where costs are not an issue soils can be imported and volumes and deposition can be tailored to the exact course requirements, selected water retention or other characteristics. In all cases, "cut and fill" plans for the course will ultimately be necessary which clearly delimit volumes and locations of alterations to the soil profiles on-site. These should be done at the design phase, but the early baseline analyses must determine the nature, distribution and characteristics of soils on-site to establish design requirements.

Soils investigation activities must include the following components:

a) Review of Existing Mapping of Surficial Geology

Three main terrain types have been identified within the Muskoka area. These are based on the landform classification proposed in the Southern Ontario Engineering Geology Terrain Study ("SOEGTS", Gartner Lee et al. (1980)), and include: bedrock, glaciolacustrine/glaciofluvial, and organic terrain. A fourth category which occurs locally includes moraine terrain features that consist of glacial till. The bedrock areas are predominant within the Muskoka region. The existing maps should be consulted to gain a general understanding of site characteristics prior to site visits.

b) Test Pitting, Soil Sampling, Laboratory Grain Size Analysis of Soil Samples

The distribution and thickness of the soil cover should be determined along with depth to the water table. The texture of the soil will assist in determining the infiltration potential of the soil for analysis of the water balance. Fine grained soils promote better retention of nutrients and contaminants. This will assist in the identification of areas sensitive to modification for golf course design. Soils should be mapped with sufficient resolution to characterize the extent of on site areas of similar characteristics. The exact number of test pits, bore holes and soil samples required to achieve the required resolution will vary with the site and so it is important that a qualified expert in both soils mapping and golf course requirements undertake the analysis.

c) Nutrient Content and Phosphorus Adsorption Measurements

A survey of soil types across the site should be undertaken to establish the nutrient content of soils and their ability to assimilate nutrients. Soils with high phosphorus adsorption characteristics are preferred for phosphorus attenuation while organic carbon content improves denitrification. Sampling resolution will vary with the site and so it is important that a qualified expert in both soils mapping and golf course requirements undertake the analysis. In general, laboratory measurements are only required for each of the major soil types on site.

Best Management Practices Summary *Pre-Development Baseline Studies – Soils*
Best Management Practices for Golf Course Baseline Studies of Soils include the following: ➢ A description of on-site soils, as determined from existing mapping of surficial geology and soils and supplemented with on-site surveys, test pitting and sampling. ➢ Clear mapping of depths, distributions and characteristics of soils across the site. ➢ Laboratory measurements of grain size analysis, nutrient content, pH, organic carbon and phosphorus adsorption for each soil type described on-site.

3.9 Summary – Baseline Studies

Baseline studies should be carried out prior to any design or construction activities to ensure that all environmental constraints have been identified and can be accommodated in the design phase. The studies should be compiled in a report describing baseline environmental conditions, interpreting them against conceptual course designs and identifying site characteristics which may constrain development. Baseline studies must address terrain and vegetation analysis, hydrogeology, soils, wetlands, surface water, aquatic biology and wildlife and incorporate existing knowledge supplemented with field work over several seasons. Baseline studies must be submitted to regulatory authorities for comment prior to design activities. The baseline study report should provide a preliminary Terms of Reference for the Environmental Impact Study.

4. Golf Course Design

The design process begins with the environmental baseline studies and ends with submission of an Environmental Impact Study (EIS). The EIS must provide:

a) a detailed review of the course design;

b) an assessment of environmental impacts relating to course design, construction and operations;

c) a summary of BMPs which will reduce the impact by the greatest extent possible;

d) a summary of residual environmental effects (those effects remaining after implementation of BMPs); and

e) a Monitoring and Operations Plan (or Environmental Management Plan) which describes how BMPs will be implemented throughout the life of the golf course to minimize environmental effects.

Golf course design follows from the environmental baseline studies and should not begin until the proponent has acquired a full understanding of the environmental constraints and features of the site. Design should strive to preserve the natural features of the Muskoka terrain and aquatic and terrestrial habitat features. Environmentally-sensitive design is favoured over "after the fact" mitigation which can be costly and less effective. Several BMPs are presented which can guide design to accommodate general environmental constraints identified in the baseline studies.

Best Management Practices ***Design – General Considerations***
Best Management Practices for general consideration in golf course design include: ➢ Selecting areas of thicker glacio-fluvial or glaciolacustine tills as the preferred areas for tees, greens and fairways. ➢ Laying out fairways, greens and tees to avoid wetland disturbance and to minimize intrusion where avoidance is not possible. ➢ Laying out fairways, greens and tees to avoid and minimize intrusion into surface water features such as ponds and streams. ➢ Providing buffers of natural vegetation or "no cut" areas of rough where sensitive features cannot be avoided. ➢ Maintaining natural cover on or avoiding areas of thin organic soils or shallow soil over bedrock ridges or knobs. ➢ Maintaining areas of fractured bedrock in natural cover. ➢ Minimizing disturbance of natural vegetation on thin sands. These areas may be best designed as rough or as naturalized buffers.

4.1 Surface Water

The water quality concerns of golf courses vary with the stage of development. Clearing and construction concerns are focussed mainly on losses of suspended solids and increased turbidity and with heating caused by removal of the tree canopy. During course green up erosion potential remains high and so concerns over solids and turbidity remain. Nutrient losses may occur as fertilizers are applied. As the course is developed, fertilizer applications remain as a potential concern, with the addition of potential pesticide losses. Dissolved oxygen concentrations in golf course streams may be altered by warming of the water, disruption of base flow, the introduction of organic solids (i.e., grass clippings) or by the decomposition of nutrient-induced algal production.

Many of these concerns can be addressed, however, at the design phase. Water quality concerns on-site are generally addressed through the preparation of an accurate water budget, diligence in the design of the stormwater management system and the incorporation of naturalized areas and buffer strips around all water bodies. The design stage should also include the consideration and development of pest and nutrient management plans which are specific to the golf course site and layout. These should consider the need to select soils and turf grasses which minimize the need for fertilizer applications and the potential for losses of fertilizer or pesticide residues to the environment.

4.1.1 Buffer Strips and Surface Water

The design of buffer strips around all water features is the primary means to mitigate any impacts of construction and operation of the golf course on the aquatic environment. In all cases, buffers are contiguous bands of vegetation along the banks of creeks or rivers and the shorelines of lakes. Buffer strips may take one of three forms, listed here in decreasing order of preference:

a) natural areas which are not disturbed at any stage of design or construction are the preferred design characteristics for the protection of surface waters;

b) if disturbance cannot be avoided then areas which are naturalized with native species of vegetation after construction are an option; and

c) at the minimum, areas of no or reduced mowing are better than manicured turf for the protection of surface water. These “No mow” zones should be encouraged on older courses which were not designed with buffers.

In all cases, buffer strips function by:

a) intercepting surface runoff to reduce the peak storm runoff to surface waters;
b) promoting infiltration into non-compacted soils;
c) promoting bank stability;
d) trapping sediments and associated surface-bound contaminants;
e) promoting uptake of nutrients into vegetation; and
f) providing shade and coarse organic detritus to aquatic habitat.

Buffer strips, whether natural or planted, have been widely cited as effective means of reducing phosphorus and sediment transport from source areas such as urban development, logging activities or feedlots. Although their effectiveness is not disputed, quantitative and relevant studies of their effectiveness are not common and buffer strips cannot be considered to be 100% effective.

A recent paper by Woodard and Rock (1995) measured sediment and phosphorus attenuation from urban areas by natural forest buffer strips ("typical of Maine backshore land") on steep and shallow slopes. They found that, on average, a 15 m buffer strip reduced phosphorus concentrations of 1 - 9 mg/L to "background" levels (0.7 - 2.0 mg/L). The slope of the monitored area (1 - 5% vs. 10 - 15%) had little influence on attenuation but maintenance of ground cover in the source areas was highly effective. Phosphorus in runoff was reduced, from 5 - 9 mg/L to 1 - 2 mg/L as lawns became established, in spite of the fact that lawns were fertilized. The buffer strips were also effective for sediment removal. These studies support a conclusion that buffer strips are effective mitigation but that 100% attenuation is unrealistic.

The recommended size of buffer strips appears to be the subject of some debate. A minimum 15 m buffer strip is recommended for water quality protection around streams supporting aquatic life and a 5 m strip for small streams providing food and nutrients to fish-bearing streams. (Fraser River Action Plan/UMA, 1996). Tay Township, Ontario, developed and adopted guidelines requiring a 30 m buffer around perennial watercourses for new golf course development (Env. Canada, 1995), in part to protect water quality in Severn Sound of Georgian Bay. In Muskoka, MNR recommends buffer strips of 15m around warm water habitat and 30m around cold. Other authors recommend buffer strips of 75 to 150 feet (~25 to 50 m) around all natural water courses on a golf course (Klein, 1994). While all of these recommendations are worthy, none are supported with quantitative evidence of their effectiveness or a rationale for the choice.

The most comprehensive reference on buffer strip effectiveness is that produced by Knutson and Naef (1997), for the Washington State Department of Fish and Wildlife. The soils and mountainous terrain in Washington differ markedly from those on Muskoka but the evidence presented by those authors suggest that a minimum 30 m buffer strip provides many beneficial uses:

a) maintenance of 50 to 100% shading of the stream is assured at 30 m;

b) maintenance of large woody debris requires 30 m to 50 m;

c) 90% sediment removal at a 2% grade requires 30 m or more;

d) removal of nutrients and coliform bacteria requires 4 m to 36 m (mode of 30 m);

e) bank erosion control requires 30 m (38 m in high mass-wasting area); and

f) aquatic invertebrates, salmonid fish and reptiles and amphibians all required a 30 m buffer strip.

Golf courses in Muskoka should therefore be designed to retain a 30 m buffer of natural vegetation around streams, lakeshores and wetlands, in accordance with the summary given above, MNR recommendations for cold water habitat and by the Severn Sound RAP program to protect the waters of Georgian Bay. Some flexibility should be provided so that developers can provide a rationale to alter buffer requirements to reflect site characteristics.

4.1.2 Stream Crossings

Stream crossings may be necessary to accommodate course layout in a wet landscape and these will impact on the stream corridor. Stream crossings must be minimized by following the processes described in this manual, where environmental constraint mapping precedes course layout and the course does not encroach on the stream corridor.

Any crossings must minimize disturbance of the buffer strip and naturalized areas and follow best engineering practices to minimize bank disturbance and erosion. Maintenance of the physical integrity of the stream corridor reduces impacts to the aquatic habitat. Crossings should be designed to maintain the function of the stream channel. For tributaries that are seasonally dry, culverts may be sufficient to provide conveyance of flow. For trout streams, small bridges will be preferable to reduce the potential for a harmful alteration of fish habitat (see Section 2.2.1) and to maintain the influx of groundwater to the stream bed. As a general rule, bridges that avoid impacts to the channel will be more readily approved.

The maintenance of natural vegetation along a stream course may interfere with the play of the course where the fairway crosses a natural channel, promoting desires to remove vegetation to improve course playability. The best means of mitigating this occurs during design, when fairways can be laid out parallel to stream features while maintaining vegetated buffers to avoid conflict. In cases where extensive stream reaches may preclude this design feature then perpendicular crossings are favoured to minimize the reach of stream which may be impacted. The number of stream crossings should be minimized when holes are laid out and stream crossings should be designed only to proceed from one hole to the next, and not as part of the play of any one hole.

4.1.3 On-Line Ponds

The design of on-line ponds as part of the golf course, whether for storage of irrigation water or as "amenities" is discouraged. On-line ponds will:

a) alter the flow of runoff and could increase the deposition of solids downstream by preventing "scour" during storms;

b) promote warming of water;

c) promote oxygen depletion;

d) attract nuisance waterfowl such as Canada geese;

e) allow algal proliferation;

f) form a barrier to fish movement; and

g) promote nutrient export through the formation of anoxic conditions.

The latter impact is of particular concern in Muskoka golf courses. High phosphorus export was reported downstream of on-line ponds on Muskoka-area golf courses by Tymowski (1997) and Winter et al. (2000). In both cases anoxia was suggested as the mechanism for enhanced phosphorus levels downstream.

Further, the construction of a pond on a stream considered to be fish habitat may be considered a Harmful Alteration, Disruption or Destruction of Fish Habitat (HADD, see Section 2.2.1) prompting the need for a Canada Fisheries Act Authorization.

The golf course design should not, therefore, include construction of on-line ponds or impoundment of streams. Ponds should only be considered as a stand-alone component of the stormwater management system.

Best Management Practices Summary ***Golf Course Design – Hydrology / Surface Water***
Best Management Practices for protection of Surface Water in golf course design include: ➢ Preparing an accurate water budget to guide design and mitigation features. ➢ Maintaining 30 m minimum buffer strips of natural vegetation around all water bodies. ➢ Designing site drainage to maximize infiltration and mimic pre-development conditions. ➢ Minimizing the disturbance of natural vegetation around surface water features. ➢ Identifying buffer strips around all water bodies to intercept runoff and clearly marking edge areas and discouraging intrusion by golfers and maintenance personnel into buffer zones. ➢ Laying out the course to minimize the number of stream crossings and ensure that they are only made between holes and not as part of the play. ➢ Not including on-line ponds on streams as part of the course design. ➢ Using site specific pest and nutrient management plans, including limited fertilizer applications and careful placement of phosphorus-retaining soils to minimize losses to surface water.

4.1.4 Stormwater Management

Once the general layout of the golf course has been established, the design of the stormwater management (SWM) system may commence. The SWM system should be viewed as a potential pathway for the transport of sediment, nutrients and pesticides from the source (golf course) to potential receptors (sensitive environmental features). A traditional storm drainage system is designed to collect runoff and transport it to a watercourse as quickly as possible. The approach to designing the SWM system for a golf course should view runoff as a resource that should be retained on-site if possible.

Stormwater management systems on golf courses should be designed to control the discharge of runoff off-site such that the potential for impacts associated with the transport of sediment and other contaminants is minimized. The capture of all runoff from frequent storm events (i.e., those with a one year return period vs. larger storms with greater return periods) will provide a significant level of protection to the natural environment. Since golf courses generally require significant amounts of water for course irrigation, this approach will help to minimize the reliance of the golf course on external water sources.

In order to design a SWM system that maximizes runoff retention and minimizes negative environmental impacts, the following tasks should be undertaken:

a) delineate the post-development catchment areas and compare them to the pre-development catchment areas. Changes to the amount of water flowing to wetlands may have a significant impact on the extent and type of wetland. Therefore any change to the water balance of a wetland should be quantified, evaluated to determine the potential impact and minimized. Similarly, changes to the amount of runoff that is discharged to a drainage pathway should be evaluated to ensure that any increase in flow will not result in erosion;

b) in order to protect sensitive natural features and to use runoff as a resource, it will be necessary to retain runoff from frequent storm events on the golf course site. On sites with significant overburden, this may be accomplished by keeping the overall drainage of the site diffuse. On sites with many bedrock outcrops, or only a thin layer of soil over bedrock, concentrated drainage should be directed to on-site ponds that are designed to capture the 1 year event. There may be many smaller ponds on a site or fewer large ponds depending upon the site topography. Ponds may be used as golf course features as long as there is sufficient active storage to capture runoff from frequent storm events;

c) each pond should be constructed such that runoff in excess of that expected from frequent storms is conveyed safely to the receiving watercourse or water body. This should be accomplished by constructing an overflow spillway in the berm on the downstream side of the pond, and a channel leading form the overflow spillway to the downstream watercourse/water body. Both the spillway and channel should be constructed with a channel lining that is capable of withstanding the expected flow velocities without eroding;

d) all flow paths leading to the runoff collection ponds should include a channel lining that is capable of withstanding the expected flow velocities without eroding. Every effort should be made to avoid the concentrated discharge of stormwater to steep slopes;

e) nutrient or pesticide retention will be low where shallow (1 m) or coarse, sandy soils are used beneath high-maintenance areas such as greens and tees. In these cases, drains should be installed and seepage directed to stormwater ponds, areas of thicker and medium-grained soils, or to specially designed filter beds which use peat or soils selected for their attenuation properties; and

f) maintenance of a 15m buffer strip of low growth-form ground cover of native vegetation around the perimeter of stormwater ponds will enhance the capture of sediments and nutrients so that there will be less potential for movement off-site.

The stormwater management system must be designed by a qualified professional engineer.

Best Management Practices Summary ***Golf Course Design – Stormwater Management***
Best Management Practices for protection of Surface Water in golf course design include: ➢ Maintaining post-development catchment areas of similar form and size to pre-development areas to minimize changes in runoff volume and velocity. ➢ Retaining runoff from frequent storm events (1 year storm) on-site by diffusing runoff or capturing it in on-site ponds. ➢ Constructing overflow spillways and lined channels in each stormwater pond to safely convey excess runoff to the receiving water body without erosion. ➢ Designing site drainage to maximize infiltration and mimic pre-development conditions. ➢ Minimizing the disturbance of natural vegetation around surface water features. ➢ Identifying buffer strips around all water bodies to intercept runoff. ➢ Avoiding concentrated discharges of stormwater to steep slopes. ➢ Preventing any direct discharge of stormwater to surface waters. ➢ Actively managing seepage from high maintenance areas to avoid losses of nutrients or pesticides to natural water courses. ➢ Planting a minimum 15 m buffer strip of low growth form ground cover of native vegetation around the perimeter of any stormwater ponds to enhance capture of nutrients and silt. ➢ Ensuring that stormwater management is designed by a qualified professional engineer.

4.2 Hydrogeology

The hydrogeological functions of the property will have been defined as part of the environmental baseline studies. The design of the course will minimize the potential for hydrogeological impact through consideration of hydrogeological sensitivities and by proper management of stormwater, as discussed in Section 4.2. The design of the course must therefore manage stormwater runoff and infiltration to avoid:

a) Groundwater Recharge/Discharge Areas

Interception or redirection of surface runoff could potentially affect groundwater discharge areas such as seeps or wetlands or could introduce contaminants into groundwater. These areas must be protected by buffer strips as outlined in the sections on surface and stormwater.

b) Areas of High Groundwater Table

These areas may limit development as they may be subject to filling or draining to provide playable golf areas. This may disrupt groundwater flow through these areas and could result in negative down gradient impacts. These areas should not be filled or altered, should be avoided where possible and protected by the incorporation of buffer strips where avoidance is not feasible.

Best Management Practices ***Golf Course Design – Hydrogeology***
Best Management Practices for protection of Groundwater in golf course design include: ➢ Avoidance of areas sensitive to changes in the hydrogeologic flow system and mitigation of any impacts to the system by considering: • groundwater recharge/discharge areas; • areas of high groundwater table; • groundwater flow directions and movement; • baseline groundwater quality; and • existing groundwater use on-site and adjacent to the proposed course.

4.3 Aquatic Biology

Maintenance of pre-development characteristics of water quantity and quality through design and mitigation will also protect the biological community and so many of the design features and requirements for the protection of aquatic biology are those already described for surface water. Alteration of the stream invertebrate community in operational golf courses has been documented in Muskoka by Winter et al. (2000) and in Kansas by Davis and Lydy (2000). The effectiveness of design-level mitigation is not clear, although the invertebrate community in the Kansas study did show a positive response to reduced fertilizer use, implementation of buffer and filter strips and other corrective measures.

The golf course development must avoid any alteration of surface water features that will result in alteration of fish habitat under the Canada Fisheries Act. In practice, this means that the designer must take care to avoid:

a) alteration of creek channels;
b) infilling of creek beds or lakeshore areas; and
c) placing physical barriers to fish movement.

to avoid direct physical alterations to aquatic habitat, in addition to the measures described previously to prevent alterations to water quality or quantity.

The design should also be sensitive to any characteristics which may cause fish habitat to degrade slowly over time. This would include designs which require high maintenance as this may not be assured throughout the life of a course. They would also include the loss of buffer strip vegetation through a failure to consider intrusion by golfers and maintenance personnel, such that small and incremental losses occur over time.

These objectives can generally be achieved by the design of generous and effective buffers (30 m minimum, see Sect. 4.1.1) to minimize the potential for introducing harmful substances into surface waters and to provide sufficient setback to avoid physical disturbances.

Best Management Practices Summary ***Golf Course Design – Aquatic Biology***
Best Management Practices for protection of Aquatic Biological Features in golf course design include: ➢ Fairways oriented parallel to surface water features to minimize stream crossings and the need to play golf balls over natural water features. ➢ Making stream crossings perpendicular to the stream to reduce physical disturbance of the banks and loss of riparian cover. ➢ The use of bridges and not culverts for stream crossings. ➢ Maintaining a minimum of 30 m of unaltered natural vegetation along the banks of any natural water course to provide shade, a supply of coarse woody debris and intercept nutrients, pesticides and solids generated in the active play areas. ➢ No development of ponds on natural water courses. ➢ Clearly marking edge areas and discouraging intrusion by golfers and maintenance personnel into buffer zones. ➢ No physical alteration of creek channels or shorelines.

4.4 Wetlands and Vegetation

Natural fluctuations in water levels are defining characteristics of wetlands and so no alteration of the natural water balance should be the design objective for protection of wetlands. The design of the golf course should minimize the potential for changes in the water balance of on-site wetlands by not altering catchment sizes, maintaining wetland buffer strips and maintaining natural vegetation.

4.4.1 Buffer Zone Design

The principal sources of disturbance are likely to include human intrusion into the edge of the wetland feature in search of lost balls and mechanical mowing of vegetation that may adversely affect some wildlife (i.e., frogs and snakes). Sensitive edge areas should be clearly marked as such to discourage intrusion by golfers and maintenance personnel with mowers etc.

In cases where golf course development is proposed within “adjacent lands” to an evaluated wetland (defined as 120 m), the Provincial Policy Statement (PPS) applies. Adjacent land areas can be used for the protection or enhancement of wetland function by mitigating the effects of noise, light, wetland drawdown, sediment flow, habitat loss and adverse human activities. Consideration will have to be given to the need for a “buffer” between the wetland feature and adjacent golf course. The determination of an appropriate buffer must take into consideration the following:

a) the attributes and functions for which the wetland is recognized, and their sensitivity to disturbance;

b) the specific details of the adjacent golf course development (cart path, fairway, water hazard, rough, etc.) and the likely impacts associated with it (drainage alterations, tree removal, etc.); and

c) appropriate examples of similar situations documented in the scientific literature.

In the case of golf courses, buffers to protect wetland functions comprise the major mitigation measure. In considering appropriate buffer widths for wetlands adjacent to golf courses on the Canadian Shield, the specific nature of the location and type of wetland attribute and function must be taken into account. A broad range of buffer strip widths may be necessary to protect various sensitivities but one standard width is not recommended. Wetlands will vary in their size, rarity and ecological value. A standard width will not protect sensitive functions and may over-protect less-sensitive functions. The OMNR suggests an “adjacent land” distance of 120 m for PSWs and 50 m for other significant wetlands to represent an area within which impacts may generally be anticipated but these distances are not intended to be taken as recommended buffer widths.

Surface water quality impacts to amphibian breeding habitat in wetlands from herbicide, pesticide and/or fertilizer-laden runoff also need to be considered when determining the appropriate width and treatment of a buffer. Golf course impacts on aquatic resources are addressed elsewhere in this manual and, in general, a 30 m buffer is considered the minimum requirement to protect water quality and aquatic life, if sensitive characteristics have been identified. In other cases the 5 m strip for small streams providing food and nutrients to fish-bearing streams which was recommended in the Fraser River Action Plan (UMA/DFO 1996) may provide a suitable buffer against direct alteration of wetland attributes.

The following sensitive wetland attributes and functions should be addressed in defining buffers. The recommended buffer widths are interpreted by Gartner Lee Limited from the review of Knutson and Naef (1997) :

a) rare wetland nesting birds – sensitive to humans and machinery (127 m "full complement of birds");

b) forest interior/area sensitive animals – generally tolerant to edge disturbance (50 to 100 m);

c) significant edge vegetation – sensitive to trampling (50 m);

d) feeding areas for moose, colonial nesting species (e.g., herons) – tolerant provided food sources remain (25 m for "species sensitive to disturbance", 100 m for feeding of Great Blue Heron, 250 m for nesting);

e) breeding amphibians – sensitive to impaired water quality (30 m); and

f) habitat connectivity – sensitive to narrowing and fragmentation (100 m "to maintain functional assemblages of common neotropical birds, greater for some species").

The wide range of recommended buffer strips shows the necessity of understanding the specific wetland attributes and functions that must be protected in the design phase. A 50 m buffer strip would appear to represent an effective average buffer width for wetland protection on the Shield. A 30 m buffer would be adequate for protection of wetland water quality but buffers in excess of 100 m may be warranted in specific cases for protection of wildlife.

Best Management Practices Summary

Golf Course Design – Wetlands

Best Management Practices for protection of Wetlands in golf course design include:

- Avoidance of wetland areas, and where this is not feasible, minimal intrusions, especially in marsh/wet meadow habitats.
- Development of a water budget to ensure the golf course will not severely shift the water levels to maintain pre-development plant composition.
- Minimizing the potential for water budget changes by not altering catchment sizes, maintaining wetland buffers, and maintaining natural vegetation within the requirements of the golf course design.
- Not altering turbidity patterns in wetlands by using sediment control during construction and maintaining vegetated buffers during ongoing operations.

Best Management Practices Summary *Golf Course Design – Wetlands*
➢ Maintaining suitable buffer zones where development is proposed within 120 m of a wetland. A minimum buffer of 30 m is recommended but 120 m may be warranted to protect specific bird or wildlife functions. A buffer strip of 50 m may represent an effective average width. ➢ Minimizing disturbance of the buffer by clearly marking edge areas and discouraging intrusion by golfers and maintenance personnel.

4.4.2 Significant Vegetation

Botanical inventories undertaken during the pre-design stage, supplemented by secondary source information regarding the status and distribution of locally and provincially rare flora, must be of sufficient scope to identify locations of significant vegetation on the prospective golf course site. ***When siting the course layout, avoidance of areas supporting Vulnerable, Threatened and Endangered (VTE) plant species is the most appropriate means to address this impact.*** For more information on VTE species and the applicable provincial policy direction, refer to section 4.5.

4.5 Wildlife

Golf courses must consider their impact on Vulnerable, Threatened or Endangered Species of wildlife (VTE), direct encroachment on wildlife habitat, changes to wildlife movement corridors or core habitat areas and the interaction of humans with wildlife during course operation.

4.5.1 Significant Wildlife

One of the primary considerations in siting a golf course in Muskoka should be whether the subject lands provide habitat for wildlife species of conservation concern. These include those animals that, by virtue of low populations, restricted distribution in Ontario and sensitivity to habitat alteration are considered Vulnerable, Threatened or Endangered at the provincial level. The status of VTE species in Ontario is assigned by the OMNR's Committee on the Status of Species at Risk in Ontario (COSSARO) based on records kept by the Natural Heritage Information Centre (NHIC) in Peterborough. Endangered species and their habitats are protected by the Provincial *Endangered Species Act*. The Provincial Policy Statement prohibits development and site alteration in the "significant portions of the habitat of endangered and threatened species". Furthermore, any development contemplated within adjacent lands to these habitats (a distance of 50 m, as recommended by the OMNR) requires the preparation of an EIS demonstrating no loss of the feature or its function. Therefore, the layout of any golf course design contemplated in Muskoka must avoid known locations of any VTE wildlife and the significant portions of their habitat. This information can be obtained through the NHIC and the local OMNR office.

4.5.2 Habitat Loss

Loss of forest cover and its implications to woodland-dependent wildlife is also a major consideration in the design of a golf course. Given the extent of forest cover throughout Muskoka, it is assumed that most prospective golf course sites are at least partially wooded and will require considerable tree removal. If the size and shape of woodlands are considerably reduced or fragmented by fairways, they lose their ability to sustain viable populations of forest interior bird species. There may be greater opportunity to retain large, functional blocks of woodland habitat on the Shield where, in many cases, a more abundant supply of land may be available within which to site a golf course. In these cases the preferred golf course design may be that of a "links" style layout, whereby the holes are laid out end for end, rather than parallel to one another. This latter style is more typical of compact course layouts one finds south of the Shield, where smaller sites offer less opportunity or flexibility to avoid forested areas.

As a general rule, the minimum size required to develop a golf course is 80 ha (200 acres). An area of this size will accommodate a full-sized 18-hole course, plus sufficient room for a driving range, clubhouse and other ancillary facilities. An 80 ha site also assumes that very little in the way of woodland vegetation is preserved and integrated into the golf course design. Any such vegetation retention opportunities would not produce any tangible ecological benefit, but instead would essentially be of aesthetic value. By virtue of its more linear orientation, a links style course would require substantially more than 80 ha of land, but provides greater opportunity to retain larger blocks of woodland that will still function as viable wildlife habitat areas following development of the golf course. Where blocks of forest are to be retained, it is important to ensure that the tree cover (overstorey), as well as the understorey and ground cover layers, are left in their natural state. The developer should not attempt to remove snags or standing dead tree in forest blocks as these offer a diversity of habitat to species such as woodpecker, sapsucker and flying squirrel.

In the case of a site that is heavily wooded, it is difficult to provide a quantitative estimate as to what percentage of the forest should be retained. This is largely dependent on the amount of land available to the golf course architect. As a general guideline, however, the objective should be to retain intact blocks of forest that exhibit one or more of the following characteristics:

a) 10 ha or more in size (to provide habitat for area sensitive animal species);

b) more than 200 m wide (to provide habitat for forest interior species);

c) circular, square or rectangular in shape (to minimize the ratio of forest edge to interior);

d) a broad range of terrain conditions and vegetation community types;

e) a diverse mix of forest stand age, height, structure, quality, etc.; and

f) connectivity to other forest blocks situated off-site (to maintain landscape connectivity).

4.5.3 Corridors

Functional corridors are usually a minimum width of 50 m and link core areas. This width represents an approximate threshold above which these corridors not only facilitate the dispersal of animals but also provide breeding and feeding habitat for some birds, small mammals and amphibians. Obviously, the wider the corridor, the more benefit it provides to wildlife. In some circumstances, wider corridors may be warranted, perhaps as much as 200 to 300 m. Examples include golf course developments that have an adjacent residential housing component (which has a relatively higher potential impact on wildlife than areas of rough) or cases where the area has been identified by the OMNR as a significant wildlife movement area (e.g., major deer dispersal route to wintering areas). Conversely, where retention of a 50 m corridor is not achievable due to site size and character, narrower corridors (connectors) can still perform a valuable ecological function for movement of some animals (e.g., songbirds, medium-sized mammals, etc.).

Therefore, one of the guiding principles in the design of an environmentally sensitive golf course should address the extent to which the layout maintains and enhances connectivity between core natural areas. This requires more than just a detailed examination of the future golf course property, but rather an analysis of its role and relationship in a broader landscape context.

Best Management Practices Summary ***Golf Course Design – Wildlife***
Best Management Practices for protection of Wildlife in golf course design include: ➢ Course layout which avoids any alteration of habitat of vulnerable, threatened or endangered wildlife species. ➢ An Environmental Impact Statement demonstrating no loss or effect of the development on vulnerable, threatened or endangered wildlife if the course is within 50 m of VTE habitat. ➢ Maintenance of functional wildlife corridors (minimum of 50 m in width) linking core habitat areas. ➢ Course design to allow for maximum habitat block size. ➢ retention of the tree cover (overstorey), understorey and ground cover layers in their natural state to promote habitat diversity where blocks of forest are to be retained.

4.6 Soils

Soils requirements of golf course construction can be viewed in several ways. Soils on-site offer a resource, the medium for construction of the course. Where soil depths are insufficient, large volumes may have to be imported, making the operation cost-prohibitive. Where costs are not an issue soils can be imported and deposition can be tailored to the exact course requirements, selected water retention or other characteristics. In all cases, "cut and fill" plans for the course will ultimately be necessary which clearly delimit volumes and locations of alterations to the soil profiles on-site. These should be done at the design phase, but the early baseline analyses must determine the nature, distribution and characteristics of soils on-site. The imported soil should not adversely alter the water balance of the property (i.e., infiltration and flow patterns) and should be tested for contaminants before importing.

Once the soils for the golf course are in place, nutrient content of soils must be established and monitored regularly to ensure optimum growth conditions are maintained. Nutrient requirements and application rates will depend on the soil types on-site, the golf course feature for which they are used (i.e., tees, greens, fairways), the season and the phase of development ("greening up" vs. maintenance). These must be established for each site by soil testing on a regular basis and documented in the golf course management plan. The review process should ensure that soils and nutrient requirements are explicitly addressed in the EIS and Management Plan and that adequate mitigation is developed, consistent with site sensitivities to minimize off-site movement.

The use of sands to promote infiltration or drainage will not provide for substantial attenuation of contaminants or nutrients. Specialty soils, however, can be incorporated into the golf course design as "nutrient sinks", to mitigate the movement of phosphorus or nitrogen compounds off-site. Adsorption of phosphorus onto charged soil surfaces, or mineralization into the soil matrix are both well-known mechanisms of phosphorus retention in soils, which can be adopted by the manager to ease concerns over nutrient losses to surface water. Any intent to use soils as nutrient management features must be supported by a thorough understanding of the literature on phosphorus attenuation and backed up by site specific measurements of phosphorus adsorption capacity and thorough description in the management plan. Although these features can reduce phosphorus movement there is no evidence that all phosphorus can be removed over the long term by reaction with soil.

A general discussion of the mechanics of phosphorus attenuation can be found in Tofflemire and Chen (1977). They used a variety of adsorption tests to establish that phosphorus was better attenuated in acidic than in calcareous soils, in glacial till than in outwash and that the B horizon had high attenuation. Retention was higher when tested in situ than it was in column studies (in this case for septic effluent). Two mechanisms which are of most importance are:

a) rapid removal or adsorption of phosphorus to charged soil surfaces (2 to 5 days); and

b) slow mineralization and insolubilization (> 5 days) to form the minerals variscite and strengite, vivianite and hydroxyapatite by reaction with Fe, Al and Ca ions.

Adsorption varied from 2.8 to 278 mg/100 g (average = 38.2) for 35 soils from New York State. The means were 42.9 for B horizon soils and 18.9 for C horizon soils. Statistical analysis showed that acid tills were best at removing phosphorus and that a beach sand sample was worst. The latter finding has implications for Muskoka, where large volumes of sand are the preferred fill medium for golf course construction but may not offer sufficient attenuation. Adsorption was positively correlated to the percentage of leachable Fe and Al and the percentage of silt, clay and mixed rock fragments. Higher diversity in the soil parent materials provided better adsorption. Adsorption capacity was also restored when soils were allowed to "rest" between applications.

Information on the mechanisms of phosphate removal in soils is provided in a paper by Isenbeck-Schroter et al. (1993). Robertson et al. (1998) also provide a detailed account of phosphate attenuation from septic systems in Muskoka soils. Although their research is based on phosphate in septic systems the principles and mechanisms are well laid out and should be consulted in the design of phosphorus attenuation as well as in the review of any proposals to reduce phosphorus movement from golf courses.

One final aspect of the soils environment is the early establishment of turf to minimize losses of soil. The golf course plans should provide specific advice on where sodding may be required to speed up turf establishment in sensitive soil areas or slopes.

Best Management Practices Summary ***Golf Course Design – Soils***
Best Management Practices for Soils in golf course design include: ➢ The establishment and monitoring of nutrient contents of soils to ensure optimum turf growth is maintained. ➢ A "cut and fill" plan showing sources, locations and volumes of soils to be altered. ➢ Explicit consideration of soil and nutrient requirements in the EIS and Management Plan. ➢ Adequate mitigation measures to minimize off-site nutrient movement. ➢ Avoidance of coarse sandy fill where nutrient or contaminant attenuation is important. ➢ Use of specialty soils, where possible, to act as nutrient sinks or promote mineralization of phosphorus and nitrogen. ➢ Assurance that any imported soils (if required) do not adversely alter the water balance of the site and are free of contaminants. ➢ Establishment of turf as early as possible to minimize soil losses.

5. Construction

The construction stage is that at which the golf course site is most sensitive to environmental impact. Vegetation is removed, soils are exposed, removed, imported and compacted and a tight time schedule is followed. Erosion is the single most important sensitivity of the construction process. The site is most vulnerable to extreme storm events during construction and even the best-planned mitigation cannot cover all eventualities.

The environmental goal of golf course construction is to prevent impairment of wetland areas, sensitive vegetation and wildlife habitat, groundwater, surface water and aquatic biology. Direct encroachment on terrestrial features and surface water is managed in the design of the course by avoidance of sensitive features and placement of buffers and so BMPs for construction-related effects also include avoidance and buffers, as described previously.

Construction activities cannot be entirely mitigated, however, by avoidance and buffering around sensitive environmental features. Even where direct encroachment of sensitive features is avoided, site disturbance may increase the volume and velocity of stormwater, eroding portions of the terrestrial environment and impairing the aquatic environment through deposition of solids, increased turbidity and scouring of aquatic sediments. The construction phase must therefore include management of stormwater to prevent impacts on and off-site.

Construction effects should therefore be mitigated by:

a) ensuring on-site supervision by environmental professionals with a familiarity of the site gained through the baseline and design stages, to identify environmental sensitivities and adopt and ensure the use of appropriate BMPs for mitigation of construction impacts;

b) maintaining a diligent schedule of inspection of activities and mitigation structures by qualified personnel;

c) clearly delineating buffer strips identified in the design phase to protect sensitive areas before construction commences to ensure that they are effective throughout construction and are not disturbed by construction activities;

d) scheduling construction activities to reduce environmental effects (i.e., tree cutting in winter when soils are protected, exposing soil in late summer when the risk of runoff and extreme storms is lower);

e) phasing golf course development so that all areas are not disturbed at once;

f) phasing development so that areas adjacent to watercourses or at the bottom of steeper slopes are filled in and stabilized before work commences on areas up gradient;

g) timing the construction of works adjacent to water to avoid sensitive periods in the life cycle of aquatic life in the stream or lake (to be determined based on the aquatic baseline surveys);

h) promoting rapid stabilization of disturbed areas;

i) diverting storm flow away from disturbed areas by vegetated or armoured swales; and

j) using sod on steep slopes and sensitive areas to promote rapid establishment of turf.

BMPs for the construction phase are therefore best elaborated for stormwater management and phasing of development.

5.1 Stormwater Management

Proper erosion and sediment control during the construction phase is crucial for environmental protection, regardless of the type or location of a given development. Development on the Precambrian Shield is even more susceptible to environmental damage during construction due to the erodible nature of the soils, the rolling topography, and the prevalence of sensitive lakes, rivers and wetlands.

5.2 Sediment and Erosion Control

In order to protect significant natural features from negative impacts due to sedimentation during construction, it will be necessary to prepare a sediment and erosion control plan that illustrates the measures that are to be taken. This plan should include the following features:

a) temporary sediment basins to collect and store sediment-laden runoff during construction. These should be sized with 125 m^3 of storage per hectare of disturbed area draining to the basin. Temporary sediment basins should be inspected after each runoff event to determine whether the removal of accumulated sediment is necessary. The sediment and erosion control plan should ensure that all disturbed areas drain to a temporary sediment basin;

b) any disturbed area upstream of a designated buffer zone surrounding a significant natural feature should be separated from the buffer with properly installed erosion control fencing;

c) drainage pathways downstream of disturbed areas should include temporary flow check dams (either straw bale or rock flow check dams) at regular intervals in order to intercept sediment before it reaches the temporary sediment basins;

d) disturbed areas upstream of steep slopes should include interceptor swales to avoid the discharge of concentrated runoff onto the slopes. The stabilizing vegetation should not be removed from steep slopes;

e) all sediment and erosion control measures should be installed prior to the commencement of construction, be actively maintained and remain in place until all disturbed areas have been stabilized. Sediment and erosion control measures that are designed to control runoff from specific areas must be installed prior to any disturbance of that part of the site. All sediment and erosion control measures should be inspected at least once per week and after every rainfall event. Corrective actions should be undertaken immediately to ensure preparedness for the next runoff event;

f) the limits of disturbance should be shown on the sediment and erosion control plan and clearly delineated with barrier fencing or flagging tape during construction. Construction activities should remain within these limits and minimize the area of soil exposed during the construction period;

g) materials should be available on-site to repair sediment and erosion control measures in the event of unforeseen conditions such as extreme rainfall events;

h) tree clearing should be carried out in winter, so that skidders and other equipment do not scar soil and surface vegetation features and erosion is minimized; and

i) course construction, cutting and filling should not be undertaken when conditions of extended rainfall are anticipated and should always be preceded by installation of silt mitigation.

The site construction should be planned in phases to ensure that construction adjacent to sensitive areas such as streams or wetlands coincides with those times when risk of runoff events are minimized: following the spring freshet, if possible; or under frozen conditions. Further, stabilization of haul roads and access control is important before moving on to subsequent phases of construction. Other stabilization methods such as sand capping and sodding are key mitigation measures in certain circumstances near watercourses and in sloped conditions.

All of these measures should be designed and verified to standard levels of demonstrated engineering diligence, monitored and repaired routinely during construction (see Section 5.7).

Best Management Practices Summary ***Construction – Stormwater Management***
Best Management Practices for Stormwater Management during golf course construction include: ➢ A sediment and erosion control plan that addresses: • temporary sediment basins to collect and store sediment-laden runoff; • a minimum basin size of 125 m^3 per hectare of disturbed area; and • basin inspection after each runoff event and maintenance as required. ➢ Separation of disturbed areas upstream of buffer zones from the buffers with erosion control fencing. ➢ Installation of temporary flow check dams in drainage pathways downstream of disturbed areas. ➢ Installation of interceptor swales in disturbed areas upstream of steep slopes. ➢ Maintenance of stabilizing vegetation on steep slopes. ➢ Installation of all sediment and erosion control measures prior to the start of construction. ➢ Limits of disturbance clearly shown on the erosion control plan and clearly delineated in the field with fencing or flagging tape. ➢ Materials kept on site to repair sediment and erosion control structures. ➢ Tree clearing carried out in winter to minimize erosion and vegetation and soil disturbance. ➢ Construction phased to ensure that disturbance near sensitive areas occurs when risk of runoff events is lowest. ➢ Frequent monitoring and required maintenance throughout the construction period.

5.3 Wetlands and Vegetation

Although wetlands are frequently characterized by coloured waters with low light penetration, they are still sensitive to alterations of the light regime induced by suspended sediments. Chow-Fraser *et al.* (1999) showed that turbidity values greater than 25 NTU (Nephelometric Turbidity Units, a standard measure of turbidity) caused the submergent wetland plant community to become depressed in number. Standard sediment control procedures during construction and maintenance of vegetated buffers are therefore required to ensure golf courses do not alter the turbidity patterns in wetlands.

5.4 Buffer Establishment

Prior to commencing construction of the golf course, it is important that the "as built" construction drawings contain specifications regarding the establishment of buffer areas in sufficient detail to ensure that they are implemented in the proper location. At a minimum, these plans should include:

a) overall plan view drawings of the entire course layout, indicating the extent of all natural areas to be removed, preserved, restored or created;

b) specific plan view drawings showing details of the buffer areas, including where vegetation will be preserved, planted or restored;

c) specific locations of protective features such as temporary snow fences, silt fences, signage, etc.;

d) location of any structures within buffers, where appropriate (e.g., underdrains, irrigation pipes, cart paths/boardwalks);

e) contour elevations at 0.5 m intervals and spot elevations at appropriate spacing;

f) hydrological features associated with the buffers, such as watercourses, wetland edges, seasonal high and low water levels;

g) landscape notes, including the list of native species to be planted, their densities and sizes; and

h) details on the removal and control of exotic and/or invasive plants such as purple loosestrife.

5.4.1 Fencing

Protective fencing, whether it be a snow fence, a silt fence or hoarding, must be properly installed along the perimeter of natural areas to be protected, as well as the buffers to these areas. It is essential that this fencing be in place and functioning properly prior to any construction activity involving the vegetation removal or earthworks (grading, topsoil stripping and stockpiling). These physical barriers to intrusion by construction equipment should be accompanied by signs advising personnel as to the high degree of sensitivity associated with the protected area and the need to keep people and vehicles out of it.

5.4.2 Pre-Stressing

In situations where the removal of tree cover will result in the creation of a new forest edge, "pre-stressing" of the trees should occur. This is a common technique that ideally begins at least one, but preferably several growing seasons prior to full scale clearing. It involves progressively thinning out the trees along the newly created edge, thereby allowing the retained vegetation the opportunity to gradually adapt to the more exposed conditions that will prevail following completion of the golf holes. Without this gradual “pre-stressing”, exposed trees are more susceptible to windthrow and sunscald, which in turn may result in a higher incidence of toppling and dieback.

5.4.3 Construction Supervision

In cases where the golf course is to be constructed in and adjacent to extremely sensitive natural features, such as a fen community, it may be appropriate to have a qualified ecologist on-site at specific times and/or during certain construction activities to supervise the construction crew. One of the responsibilities that should be assigned to this individual is to inform/educate the contractors and their work crews so that they appreciate the importance of staying out of certain areas.

5.5 Wildlife

Impacts on wildlife can be addressed during the design phase of the course, through maintenance of habitat characteristics and buffer strips. These features must be explicitly addressed during construction, however, to ensure that construction activities will not impair their function. In addition, the timing of construction activities must carefully consider the requirements of wildlife.

5.5.1 Timing

An inevitable consequence of golf course construction is the removal of vegetation and the displacement of the wildlife dependent on these areas as cover, feeding and nesting habitat. However, if construction activities are carefully planned and co-ordinated, the critical stages in the life cycles of various animals can be avoided. In Muskoka, amphibians (frogs, toads, salamanders) breed in shallow woodland ponds and wetlands, principally in April and May. Amphibian breeding ponds are often ephemeral, meaning that these features hold water in the spring following snowmelt, but dry out completely by the summer. Therefore, any golf course construction activity that will result in the removal or alteration of the micro-drainage conditions surrounding a breeding pond should ideally be scheduled to take place in the summer or fall, after breeding has occurred. This timing may be preferable anyway, given that the ground will be drier and more easily negotiated by construction equipment during the summer/fall period.

The peak of the bird nesting season in Muskoka, particularly for forest dwelling song birds, typically extends from mid-June to mid-July, by which time most young will have fledged and moved away from the nest site. Therefore, the timing of forest removal should coincide with the period from August 1st onwards in order to avoid interference with the peak forest breeding bird season. For other wildlife, such as small mammals, timing for protection of bird breeding will also protect critical life stages. Large mammals are mobile and will leave the area during the construction period. Construction timing should respect the presence and usage of breedng habitat and should be developed following consultation with MNR.

Best Management Practices Summary ***Construction – Wildlife and Terrestrial Features***
Best Management Practices for protection of Wildlife and Terrestrial Features during golf course construction include: ➢ Preparation of "as built' drawings of sensitive features and buffer strips to guide contractors. ➢ Protective fencing along the perimeter of natural areas to be protected as well as the buffers to these areas and signs to warn against intrusion by construction crews. ➢ "Pre stressing" of new forest edges against windthrow and sun-scald by the gradual removal of vegetation along the edge. ➢ The presence of a qualified ecologist on-site during sensitive periods or aspects of construction to guide contractors. ➢ Not disturbing the habitat or water balance/water quality of amphibian breeding sites during April and May. ➢ Avoiding forest removal activities during breeding bird season (mid-June to August 1). ➢ Verification that cut lines for vegetation and fill follow the EIS and the Golf Course Management Plan.

5.6 Construction Monitoring

All developments must be supported by monitoring the effectiveness of all mitigation during the construction and "greening up" phases. This is generally undertaken by reputable developers as a matter of due diligence and should include:

a) ensuring the integrity of silt and sediment control devices at all times and all points on-site;

b) follow-up after storm events to ensure controls are in place and operating as expected;

c) verification that cut lines for vegetation and fill removal follow the EIS and Golf Course Management plan, to minimize losses of vegetation;

d) assurance that naturalized areas are not disrupted by heavy machinery; and

e) ensuring the integrity of buffer strips around watercourses and sensitive wetland or natural features.

These monitoring results can be documented by photograph and compared with predictions or guidance given in the EIS or Golf Course Management Plan, to ensure that the site is developed as planned. The developer should maintain these records, as a demonstration of due diligence.

Water quality monitoring programs developed during the environmental baseline studies must be implemented throughout the construction phase. The schedule of monthly sampling frequency and wet vs. dry sampling must be maintained and samples analyzed for turbidity and suspended solids, total phosphorus, nitrate, ammonia and Kjeldahl nitrogen, pH, temperature, dissolved oxygen and dissolved organic carbon. If pesticides are used during the construction and turf building phase, then these must be included in the sampling suite.

Sampling should focus on key areas to determine the response of the aquatic system:

a) a reference stream either off-site and similar to on-site streams or onsite and upstream of any activities;

b) all on-site streams at the downstream boundary of the site or where they enter a lake adjacent to the site;

c) immediately downstream of any disturbed areas (i.e., stream crossing); and

d) any standing or moving waters in an on-site wetland.

Benthic invertebrate monitoring of any streams on-site was a required element of the environmental baseline program. The benthic monitoring should be repeated annually during the autumn in the construction phase to ensure that the mitigation programs have been successful. The fish community monitoring and aquatic habitat survey should also be repeated at the end of the construction phase to ensure no loss of habitat and no effects on fish, and to provide a baseline for operational-phase monitoring.

The sampling program must be reviewed with a qualified environmental professional prior to initiation of construction to ensure that the program reflects all environmental sensitivities.

Best Management Practices Summary ***Construction – Monitoring***
Best Management Practices for Monitoring during golf course construction include: ➢ Development and implementation of a monitoring plan for the construction phase. ➢ Ensuring the integrity of all sediment control devices on-site. ➢ Increased inspection activities prior to significant storm events. ➢ Follow-up after storm events to ensure devices are in place and operating. ➢ Verifying that cut lines for vegetation and fill follow the EIS and the Golf Course Management Plan. ➢ Ensuring that naturalized areas are not disrupted by heavy machinery. ➢ Ensuring the integrity of all buffer strips. ➢ Maintaining a water quality sampling program during the construction phase. ➢ Surveys of benthic invertebrates, aquatic habitat and fish community at the end of the construction phase.

6. Operations

In general, a golf course which has been investigated, designed and built with attention to environmental sensitivities and implementation of BMPs should have limited impacts during the operations phase. Although there is ample documentation of the environmental effects of golf courses, these studies have focussed on documenting impacts and advising on BMPs where no BMPs were in place (Klein, 1994), where their status was unclear (Winter et al. 2000) or where the intent of the study was to develop BMPs to address known concerns (Davis and Lydy, 2000).

Of these, the study by Winter et al. (2000) is the only one which is specific to the Precambrian Shield or Muskoka. The authors reported enhanced export of nitrate, potassium and phosphorus on operational golf courses and export of mercury where it had been applied before a ban in 1999. Surveys of attached algae (periphyton) showed changes consistent with nutrient enrichment and the benthic invertebrate community showed a shift to a community more tolerant of siltation and enrichment. The intent of this study was to document existing conditions and to suggest BMPs for future use.

The study by Davis and Lydy (2000), on the other hand, was focussed on BMPs at a golf course which had impaired the aquatic system. The study showed that implementation of buffer strips, dredging activities and changes in fertilizer management reduced nitrate concentrations and produced improvements in the benthic invertebrate community.

One cannot, therefore, offer advice which will ensure that golf course operations will prevent environmental impacts. Attention to environmental constraints during design, sensitive design and diligent attention to implementation of BMPs will reduce the effects of the construction and operations phases.

This section of the manual outlines considerations which are specific to the operations phase, with the recognition that specific practices must be developed for individual courses. Turf management (fertilization and pest control), stormwater management and management of the activities of the golfers themselves are the focus of the operations phase, as well as maintenance of buffer strips and adoption of a monitoring and reporting structure to ensure that contingencies exist for any departure from expected conditions.

6.1 Operations Manual

Preparation and use of an "Environmental Management System" or "Operations and Monitoring Manual" must be part of the operational BMPs for a golf course. The manual will:

a) document operational procedures for routine and non-routine maintenance (i.e., turfgrass, pesticide and fertilizer management);

b) identify a management and reporting structure;

c) document emergency response procedures;

d) describe details of the monitoring program;

e) describe "triggers" for management action; and

f) describe contingencies to deal with departure of environmental and management conditions from expected values.

The manual serves as a standard of diligence for operation of the course and provides ready documentation of operational requirements for employees and reviewers. The process of preparing it will reinforce environmental protection and management techniques among golf course personnel and encourage scrutiny of activities and responsive management actions.

6.2 Operations at Older Courses

The focus of this manual has been on the development of new golf courses in Muskoka, to ensure that they have been designed and built to the BMP standards. Among the most important BMPs recommended are those ensuring no encroachment on sensitive terrestrial or aquatic habitat through careful course layout and incorporation of buffer strips.

Older courses will not meet these standards and may not have sufficient area to implement the same BMPs recommended for new courses. Nevertheless, they can be managed during operations to improve their environmental performance and some BMPs can be implemented, subject to restrictions imposed by the existing layout. Suggested actions include:

a) naturalization of a minimum 5 m buffer strip along any watercourse through implementation of a “no mow” policy, to allow invasion by local species;

b) adopting a policy of no application of pesticide or fertilizer in these naturalized areas;

c) revegetation of any eroded areas using native plant species;

d) removing any direct discharge of stormwater to surface waters or wetlands in favour of discharge to vegetated filter strips or swales;

e) reassessment of play and out of play areas, to see where mowing may be discontinued or plantings of native species may enhance habitat; and

f) review of turf management plans to see if alterations of cutting, pesticide or fertilizer applications can be altered to reduce environmental effect.

It must be recognized, however, that these programs can only be voluntary in the absence of planning controls or demonstrated environmental effect as shown through the Fisheries Act, the Environmental Protection Act, the Water Resources Act or any other legislation.

6.3 Integrated Pest Management

The Environmental Management System should address Integrated Pest Management Practices as BMPs during the operational phase of the course. The term ‘pests’ includes diseases, fungi, weeds, insects, and animals that destroy or reduce turfgrass quality. The goal of Integrated Pest Management (IPM) is to limit pest populations to sufficiently low thresholds to avoid economic damage to golf course operations with the least possible hazard to people, property, and the environment. Although IPM favours natural pest manipulation by selecting proper turfgrass, seeding, irrigation, and fertilization practices, it does not exclude chemical controls when required.

IPM is a four step process:

1. <u>Understand Factors affecting Pest Control</u>

Factors which affect pest control include turfgrass type, cultural practices, and pest biology.

The turfgrass seed selected should be appropriate for the soil type of the golf course and the weather conditions it experiences, and the source should be certified as 'weed free' to minimize the introduction of undesired species during turf establishment.

Cultural practices include turf maintenance (mowing, aeration), fertilization, and irrigation. The purpose of manipulating cultural practices is to minimize the survival of pest populations and promote healthy turf development. Cultural controls are preferable as they are natural ways of controlling pest populations that do not involve using potentially harmful chemicals (pesticides).

Understanding pest biology is a key factor to controlling pests on a golf course. To effectively control pests, their identification features, regional life cycles, and factors favouring their development and propagation must be known so that the proper cultural controls and treatment methods (if required) can be implemented.

2. Define Treatment Thresholds

Treatment thresholds must be clearly established to assure that pest problems are kept under control, but also to prevent treatment when it is not required and not economical.

Golf course managers must define treatment thresholds, and in doing so, they must consider the populations threshold for the pest in question, the damage thresholds for each area of the course (greens, tees, fairways, and rough), and the unit cost of the cultural and non-cultural control methods.

3. Develop a Monitoring Strategy

The purpose of a monitoring strategy is to combine routine weekly inspections with increased monitoring, as required, to identify pest conditions at early stages and evaluate pest treatment effectiveness. Populations can then be compared to established threshold levels to determine appropriate action and treatment, if required.

An effective scouting program should be designed around known regional pests with regular, systematic inspections to identify problems. Treatment success for problems depends on correctly identifying pests and accurately diagnosing the stage and severity of the problem. Although regular weekly scouting may be enough for routine maintenance, daily inspections may be required during outbreaks to determine effective treatment requirements or to evaluate areas of specific concern.

6.4 Turf Management

Fertilizers and pesticides are an integral part of golf course turf management. Their use, turf grass types and cutting requirements will vary with the site, the use of site areas, the season and the management objectives for the development. The main objective for fertilizer and pesticide management is to ensure that they are used in response to needs demonstrated by a monitoring program and not used in broad application as a "preventive" measure.

A management plan should be developed:

a) to ensure that the operator is aware of management requirements;

b) to outline procedures for monitoring and application to ensure minimal loss of these chemicals to the environment;

c) to ensure that their application will be directed site specifically only where needed; and

d) to outline management procedures in the event of spills or accidents.

General recommendations follow with the caution that review of a site specific management plan is the preferred medium to address turf management.

6.4.1 Turf Maintenance

One of the key issues of turf maintenance is the proper turfgrass selection. The species selected must be suited to the local climate and growing conditions, and native species of the golf course region are preferred. A poorly adapted species will require far more maintenance and be more stress prone than a well-adapted species, thus costing more to maintain over time. Other factors to consider when choosing a turfgrass species include efficient water use and drought resistance and minimal nitrogen loss through volatilization, leaching, and surface runoff.

Routine maintenance practices should also be adapted to promote healthy turf growth. Mower heights should be raised slightly and the frequency of cutting should be reduced. Slightly higher turf helps improve infiltration and soil moisture retention, reduces surface runoff, encourages deeper root systems, and discourages weeds. No more than one third (1/3) of the turf's height should be removed at one time, and using sharp mower blades will encourage speedy recovery after cutting and decrease susceptibility to disease.

Wherever possible, grass clippings should be returned to grass areas. Clippings are a natural source of organic matter and nutrients, and can potentially reduce the need for fertilizers. As such, they could be considered as nutrient sources and so should be left only in areas which would normally be fertilized. If clippings cannot be left on certain course areas, they should be collected and composted in a covered area\on-site or disposed of off-site as waste. Clippings should, however, be removed during disease outbreaks to prevent further spreading.

Best Management Practices Summary ***Operations – Turf Grass***
Best Management Practices for Turf Grass Maintenance during operations include: ➢ Choice of grasses suited to the local climate and growing conditions, preferably species native to the region. ➢ Choice of grasses for efficient water use and drought resistance, minimal nitrogen loss through volatilization, leaching, and surface runoff. ➢ Mowers set to remove no more than 1/3 of the grass height at each cutting to improve infiltration and soil moisture retention, reduce surface runoff and encourage deeper root systems. ➢ Use of sharp blades to maintain healthy turf. ➢ Retention of clippings on the course, consistent with good fertilizer practices, to encourage better thatch, and moisture retention.

6.4.2 Fertilization

Fertilizers are normally made up of three main nutrients: nitrogen, phosphorus, and potassium. Nitrogen is essential for maintaining both growth and colour. Potassium results in improved root growth, increased tolerance to heat, cold, drought, and reduced tolerance to disease. Phosphorus promotes plant growth especially during establishment from seed. The concentration of nitrogen, potassium, and phosphorus within fertilizers will vary depending upon the desired effect upon the plant and the amount of filler material utilized in its production. Although they may be required to maintain healthy turfgrass, excess application amounts and rates could be detrimental to the turf as well as to the surrounding surface and groundwater systems.

One of the major concerns of excess fertilization is nitrogen and phosphorus migration by surface runoff. Newly seeded and erosion sensitive areas as well as damaged turf areas have the highest potential for elevated nutrient concentrations in runoff. Thus, fertilization should be minimized in these areas. As well, slow-release nitrogen fertilizers should be used where possible as this will minimize the potential for increased concentrations of nitrogen in surface runoff.

Fertilizers should only be applied when required and in appropriate quantities for the area selected. Different areas of the golf course have different uses and amounts of traffic, thus they will require different amounts and rates of fertilization. Periodic soil testing should be done to determine nutrient requirements of the soils. Fertilizers should not be applied during dry soil conditions and/or prior to major rainfall events, and never around water bodies or adjacent to watercourses. Light fertilization in late fall or early winter will promote good greening in the spring and reduce the need for early spring fertilization.

The loss of phosphorus in solution to subsurface flow is generally quite low. Nutrients are adsorbed more strongly in fine grained soil whereas they are more readily leached from coarse textured soil (Balough and Walker 1992). The soils of Muskoka are typically coarse textured and would therefore tend to require relatively more fertilization than organic or fine textured soil. Acidic soils inhibit nutrient uptake and so soil amendments (lime) should be used as an alternative to increased fertilizer application rates. The golf course design should take into account the maintenance requirements for the selected type of turf grass and should attempt to minimize the requirements for fertilization. This could be achieved through the preferential use of soils that require fewer nutrients where such soils are available, selection of turf grass with lower nutrient requirements and through the use of appropriate fertilizers for the given soils and turf grass types.

The amount of watering or irrigation of turf grass has a significant impact on the degree of leaching of nutrients, especially nitrogen. Irrigation management therefore plays an important role in reducing groundwater impacts from fertilizers. Golf course management plans will therefore need to address the potential for groundwater quality impacts from irrigation as well as the application of fertilizers. In general, however, an irrigation plan which does not generate runoff is less likely to result in significant losses of fertilizer off-site.

Fertilization should only be conducted after soil testing, plant testing, or when visual observations by the golf course superintendent indicate it is warranted. The weather conditions at the time of application should be selected to prevent drift and subsurface or volatilization losses. For example, wind speeds less than about 7 km/hour will help prevent drift. Fertilizers should be applied only at times when they can be lightly watered into the ground, and therefore may be applied during a light rain, or when a light rain is forecast but not during hot, dry or sunny weather or in conjunction with major precipitation events, i.e. if a significant rain is forecast within the next 24 to 48 hours. The criteria for fertilization should be specified in an Operations Manual or other protocol.

Best Management Practices Summary *Operations – Fertilization*
Best Management Practices for Fertilizer Management during golf course operations include: ➢ Ensuring fertilizers are used in response to demonstrated needs and not as a preventative measure. ➢ Development of a management plan to: • ensure the operator / superintendent is aware of application procedures and requirements; • minimize the amounts of fertilizer applied to the course; • outline an irrigation plan that does not generate runoff; and • specify that fertilizers should only be applied when required and only at times when they can be lightly watered into the ground.

6.4.3 Pesticides

Pesticides applied to turf grass can be lost through volatilization, surface runoff and leaching into the underlying soils. Well-irrigated sandy soils can provide ideal conditions for leaching pesticides. The retention of pesticides is strongly influenced by soil organic content and the degree of soil saturation. Case studies have shown that only small amounts of pesticides in the order of 1 to 2% are lost to groundwater and that the thatch layer was found to act as an effective trap for pesticide residues. Significantly higher amounts of pesticides of up to 90% of that applied can be lost during storm events (Balough and Walker 1992).

The terrain (thin soils) conditions found within the District of Muskoka provide conditions that would favour the leaching of pesticides into the groundwater. Golf course design and operations should take these conditions into account and provide measures that would reduce the potential for pesticide loss. This would include such measures as the creation of a thatch layer at surface and stringent controls over the timing and application rate of pesticides. Details would be provided in the design and operations documents provided in support of the application.

Ongoing monitoring of the turf grass and associated golf course vegetation will be an important part of the management plan. Non chemical methods of pest control and management should be considered as the preferred approach to pesticide management.

The overall environmental management objectives at the course should act to minimize the need to apply pesticides. The selection of pesticides should consider the potential for off-site movement, fate, non-target toxicity and persistence. The management plan should define the onsite requirements or conditions that must be met in order to trigger the use of a pesticide. For example, pesticide use may only be warranted when observations of high temperature and humidity are made which are known to be strongly correlated with the outbreak of soil fungi. Pesticides may also be warranted when weeds are observed at a specified density, when soil monitoring results indicate pesticide application is warranted, or when site-specific information, gathered by monitoring over time, indicates that the lifestage of a specific pest is likely to cause harm to the turfgrass. The decision to apply a pesticide should be the sole responsibility of the qualified golf course superintendent. The criteria to trigger the application of a pesticide should be specified in an Operations Manual or other protocol.

The operational objectives for the golf course should include curative applications of pesticides rather than preventive. Preventive applications may be necessary, however, as a significant component of the fall/winter preparation of the course. The use of alternative methods of disease control should be explored. For example, applications of compost in top-dressing may be an effective means in suppressing gray snow mold. It is acknowledged, however, that fungicides can be most effective and can be applied at lower rates if diagnosis and treatment occurs prior to an outbreak of infection. Therefore, the risk of encountering snow molds should be assessed using established criteria prior to applying the autumn fungicides.

The manager should select a pesticide that is legal and is the least toxic, least persistent, least mobile, and most target-specific pesticide available. Pesticides that bioaccumulate and/or are toxic to birds and wildlife should be avoided, and those that are toxic to aquatic life should not be applied where there is potential runoff or leaching to surrounding water bodies.

Pesticides must be mixed and applied by well-trained, licensed staff. Product labels should be read carefully to assure the proper pesticide has been selected and to determine the recommended application rate. Sprayers must be properly calibrated before use and must be supervised while being filled. Sprayers should not be filled near watercourses or drains, and any spills should be contained and cleaned up immediately.

The application of a pesticide should be triggered only when alternative non-chemical controls or proven biological controls are not available for the same purpose. Weather conditions should be consulted to ensure that no rain is forecast for a period of at least 24 hours. Local wind velocities should be less than about 7 km per hour to ensure drift is minimized, and application methods should be selected to ensure that pesticides are not transferred to non-target areas. The turfgrass should be in a healthy state prior to pesticide application to ensure maximum effectiveness of the pesticide and to reduce the opportunity for leaching or other losses.

Pesticide-free zones of at least 10 m should be maintained along all watercourses, however, this zone may be larger depending on the sensitivity of the watercourse. Pesticides should not be used within the buffer zones prescribed elsewhere in this manual. Water used to rinse and clean the application equipment should be disposed of in the application area, and treated and handled as if it were full-strength pesticide.

Both pesticides and fertilizers should be stored in a separate locked facility away from other maintenance equipment with all containers clearly marked with warning signs. A covered area should be designated for pesticide mixing and storage, and the manager should keep a current inventory of all pesticides and fertilizers in stock. Unused pesticides and empty containers should be disposed of according to local hazardous waste regulations.

Best Management Practices ***Operations – Pesticides***
Best Management Practices for Pesticide Management during golf course operations include: ➢ Measures to reduce the potential for pesticide loss by: • creating a thatch layer at surface; • specifying stringent controls over timing and application rate of pesticides; • using non-chemical or proven biological control methods as the preferred alternative to chemical pesticides, where possible; • specifying detailed trigger mechanisms for pesticide use, such as: ❖ high temperature and humidity to control soil fungi outbreaks; ❖ weed observations at a pre-determined density; ❖ soil monitoring results indicating pesticide application is required; and ❖ site-specific information that indicate a lifestage of a specific pest is likely to harm the turfgrass; • applying pesticides only when no rain is forecast for at least 24 hours, wind speed is less than 7 km/hr, and the turfgrass is in a healthy state; • storage, mixing and disposal of pesticides only in secure areas; and • implementation of plans to prevent and mitigate spills.

6.5 Surface Water / Aquatic Biology

Management of golf course-related stressors will effectively manage stress to the aquatic community. Attention to the process described in this document and the use of mitigation procedures and buffer strips are intended to eliminate any impacts to the aquatic community. No further management actions are required, beyond verification that buffers are maintained and that water quality or the aquatic community has not changed, as discussed in the section on monitoring.

In addition, the Canada Fisheries Act prevents the deposition of deleterious substances to water frequented by fish (see Section 2.3). It is important that the course minimize the discharge of chemicals, such as silt or pesticides to surface waters. Keeping records of amounts used, methods of application or measures taken to prevent the entry of the substance into the water, for example, may be important to establishing due diligence in the event of a spill. There is no approval process for such deposits, rather the spill may be considered an offence under the Fisheries Act, the Ontario Water Resources Act or the Environmental Protection Act.

In the event of spills, measures shall be undertaken promptly to:

a) report to local authorities and/or through the spills action hotline of the Ministry of the Environment;

b) document effects (water samples, photographs, inventory dead organisms);

c) correct the contribution;

d) contain the material; and

e) remove the material, if possible.

Removal should only be done under the supervision of a specialist, or the agency investigating, as additional damage may occur during cleanup.

Best Management Practices Summary ***Operations – Aquatic Biology***
Best Management Practices for protection of Surface Water and Aquatic Biology during golf course operations include: ➢ Verification that buffers are maintained and water quality has not changed. ➢ Repeating fisheries and benthic surveys on a three year schedule or in response to major unforeseen stresses or spills.

6.6 Wetlands and Vegetation

6.6.1 Signage

The principal sources of disturbance are likely to include the potential for human intrusion into the edge of the wetland feature in search of lost balls, resulting in trampling, and mechanical mowing to maintain the plants growing in rough areas at a specific height. Both of these activities may also adversely affect some wildlife (e.g., frogs, snakes and ground-nesting birds) through disturbance or actual displacement. Sensitive/significant edge areas should be clearly marked as “Out of Bounds – Natural Regeneration Area” and/or “Do Not Enter – Environmentally Significant (Sensitive) Area” to discourage intrusion by golfers and maintenance personnel alike. This approach is often successfully carried out at golf courses where the signage is prominently displayed and the wording is designed to educate the reader as to the significance/sensitivity of the natural area. Signs that are purely admonitory (e.g., “KEEP OUT” or “PROHIBITED ENTRY”) rarely work as effectively.

Best Management Practices Summary ***Operations – Vegetation and Wetlands***
Best Management Practices for the protection of Vegetation and Wetlands include: ➢ Minimizing intrusion into non-play areas. ➢ Minimizing mowing of rough areas which are out of play. ➢ Clearly posting signage warning golfers and staff to avoid sensitive or significant areas. ➢ Ensuring signage is explicit and clear.

6.7 Wildlife

Wildlife concerns are best addressed by avoiding encroachment and maintaining adequate sized habitat blocks and corridors during course design and layout. During course operations the management objectives include preservation of existing habitat and avoiding player interference with natural areas (as described above), reducing conflicts between humans and wildlife and providing various improvements to promote wildlife (such as birds) as course amenities or biological control agents. Course operators should therefore:

a) collect garbage regularly, store it in secure areas and dispose of it promptly;

b) initiate programs of wildlife awareness among staff and players;

c) promote the use of tree guards to avoid damage to vegetation from beavers and porcupines;

d) if removal of nuisance animals is required, consult with MNR over the best methods to do so; and

e) maintain suitable habitat for raptors and foxes to control rodents.

6.7.1 Biting Insects

Biting insects (mosquitoes and blackflies) are a fact of life in Muskoka and can make outdoor recreation unpleasant from late May to early July, when the summer drought and heat reduce their incidence. Course operators should not attempt to control biting insects through modifications of natural aquatic breeding habitat or pesticide application. Mosquitoes lay eggs in stagnant water and blackflies in running water and so control of the habitat of one may increase incidence of the other. In addition, modifications of aquatic habitat for insect control may have undesirable consequences for fish and implications under the Fisheries Act. The course operator can, however, ensure that stagnant water in structures does not contribute to mosquito populations by ensuring that water receptacles are emptied frequently or by installing aerators in stormwater ponds to induce turbulence. The use of propane burners to generate carbon dioxide as an attractant is emerging as a potential control method. The effectiveness of these methods is not proven in the Muskoka environment. In the end, control of biting insects also involves management of human expectations. Golfers and staff should be encouraged to use personal insect repellents and to wear light coloured clothing which covers arms and legs.

Best Management Practices Summary ***Operations – Wildlife and Insects***
Best Management Practices for minimizing conflict between humans and wildlife include: ➢ Collecting garbage regularly, storing it in secure areas and disposing of it promptly. ➢ Initiating programs of wildlife awareness among staff and players. ➢ Promoting the use of tree guards to avoid damage to vegetation from beavers and porcupines. ➢ If removal of nuisance animals is required, consult with MNR over the best methods to do so. ➢ Maintenance of suitable habitat for raptors and foxes to control rodents. ➢ Non - chemical control of biting insects. ➢ Not modifying aquatic habitat to control biting insects. ➢ Promotion of personal control techniques among golfers and staff.

7. Monitoring

Monitoring programs, in particular, are considered the "last line of defense" in demonstrating zero impact or triggering the need for enhanced mitigation. They do not, on their own, prevent environmental impact or substitute for BMPs, but are a necessary and integral component of golf course development.

Design of a monitoring program and interpretation of monitoring results must be done carefully, with a good understanding of the background system, the effects of concern and of the regulatory basis for any follow-up. There are two types of operational-phase monitoring:

a) The first is operational monitoring, in which the operator tracks water usage, fertilizer and pesticide application, turf grass management (seeding, cutting) and other routine management actions as feedback to improve course management and as a record of diligence. The operational monitoring plan is documented in the "Environmental Management System" and should:

- clearly identify responsible employees and government agencies so that environmental problems can be dealt with quickly;
- define specific management requirements for each area of the golf course (tees, rough areas, wetlands, buffers, fairways, etc.) such as watering rates, pesticide and fertilizer application triggers and rates, and related environmental sensitivities such as required climate conditions for applications; and
- include emergency contingency plans (i.e., for spills) and triggers for implementation.

b) The second is “Environmental Effects Monitoring” (EEM), a post-development monitoring system developed where sensitive resources are at risk, where mitigation is not assured, or where other conditions such as public concern warrant it. Although EEM cannot be ensured, it is recommended as a BMP to ensure that environmental safeguards are effective and to identify unforeseen impacts. Specific advice on EEM is given in subsections below. The EEM should also be explicitly documented as part of the “Environmental Management System” document for the course.

The rapid time scale of golf course development frequently precludes obtaining adequate baseline data with which to compare results obtained during construction and operation. This forces selection of a valid reference site, in order to separate golf course results from natural trends in the area and to interpret monitoring data against natural variation. Criteria for selecting reference areas were addressed in Section 3 of the document.

A monitoring program must have a clearly defined time line and purpose. The developer should not be required to monitor all impacts indefinitely and so guidance is required to determine when monitoring is warranted, what type is warranted, how long it is required and the triggers stimulating greater or lesser effort. The following sections present guidance for the development and implementation of monitoring programs. These are not intended to supercede requirements that may be imposed by, for example, the Ministry of the Environment in support of a Permit to Take Water or a Certificate of Approval for Wastewater Discharge.

Monitoring programs should not (and can not) be enforced automatically in the absence of a reporting and enforcement structure to ensure compliance, review results and take actions where warranted. At present, monitoring programs appear to be either voluntary, required under a Permit to Take Water at the request of a residents’ association, or imposed under conditions or pressure arising from an OMB challenge. In the absence of an assured planning tool, specific legislation or an initiative from any level of government, there is no body which is required to receive or review monitoring results. In the absence of a regulatory requirement the major role for monitoring is therefore as a BMP to provide feedback to the enlightened operator and to inform local residents who have concerns over the course.

The following sections review approaches and requirements for monitoring during the operational stage of golf course development. A general discussion and overview of considerations is presented first. A summary table (Table 7.1) is then provided as an example of a very intensive monitoring program for aquatic effects which is recommended for golf course development in highly sensitive areas. This program was modified from that developed between the proponent, the resident's association, the municipality and a peer reviewer under the terms of a Holding Agreement required by the OMB for a Muskoka golf course. These serve as the most stringent requirements, with the understanding that they may be modified to reflect specific requirements and sensitivities. Nevertheless, fish and benthos monitoring were omitted, as the site is situated on an upland with intermittent drainage and no identified fish habitat on-site.

Best Management Practices Summary ***Operations – Monitoring***
Best Management Practices for Monitoring during golf course operations include: ➢ Development of an Environmental Management System to cover routine management requirements, internal reporting needs and demonstration of due diligence. The plan should include accurate records of water takings, applications of fertilizers and pesticides, maintenance activities and make routine observations of water courses and natural heritage features. ➢ Development and implementation of a suitable site-specific Environmental Effects Monitoring program based on site sensitivities. ➢ Development of triggers for contingency management actions based on the results of monitoring programs. ➢ Development of contingency management actions in event triggers are exceeded. ➢ Development of a process for implementing, enforcing and reviewing golf course monitoring studies among developers, the public. regulatory and planning bodies in the District of Muskoka.

7.1 Terrain

A terrestrial monitoring plan for vegetated areas and wetlands should be developed on the basis of the constraints identified in the EIS stages of the development. Post-construction monitoring must be developed on the basis of sensitivities identified in the EIS but should include the following considerations:

a) a detailed qualitative review in the spring and summer of years 1 and 3 to establish the conditions on-site;

Table 7.1 Comprehensive Monitoring Program for Golf Course Development

Activity	Monitoring Program/Location	Parameters	Frequency	Duration	Trigger for Follow-up	Reporting
Routine Surface Water Runoff from Site	• one reference tributary • major tributary leaving site	• total phosphorus, nitrogen species, pH, Total Suspended Solids, Dissolved Organic Carbon, turbidity, dissolved oxygen, temperature, flow	• eight per year – April – October, including spring freshet, post freshet and three rainstorm events	• one year pre-development • three years after play commences, unless trigger mechanism invoked	• exceedance of Ontario PWQO (or CCME Guideline for TSS) and exceedance of concentration in reference stream for three events in a year	• annually, or if exceedance
Pesticides in Runoff	• major tributary leaving site	• scan for all pesticides used on site in past year	• once in spring and once following summer rain	• three years after play commences, unless trigger mechanism invoked	• exceedance of Ontario PWQO, or detection if no PWQO	• annually, or if exceedance
Receiving Lake	• enhanced District of Muskoka Program	• temperature and Dissolved Oxygen profiles at deepest point of lake • Secchi depth • total phosphorus, dissolved organic carbon, total suspended solids. • nitrogen species if exceeded in site runoff	• end of summer or early fall • every three weeks, May to October	• one years pre-development • three years after play commences, unless trigger mechanism invoked • revert to regular DMM program thereafter	• turbidity or suspended solids plume in the lake • exceedance of PWQO or DMM water quality objective for total phosphorus for two years in succession • sustained loss of water clarity over three years	• annually
Groundwater / Surficial Interflow	• 20 cm beneath one tee and one green using 4 m^2 impermeable liner and collection system • to evaluate attenuation in turf	• total phosphorus, pH, nitrogen species • pesticides	• three occasions per year	• every year for first four years, Year 6, Year 8, Year 12, unless trigger mechanism invoked	• consistent increase in parameters denoting loss of attenuation	• annually
Stormwater	• excess water in any stormwater ponds	• total phosphorus, nitrogen species, pesticide scan. Temperature, pH	• twice per year (Spring and midsummer)	• three years following commencement of play.	• none • diligence monitoring	• annually

Table 7.1 Comprehensive Monitoring Program for Golf Course Development

Activity	Monitoring Program/Location	Parameters	Frequency	Duration	Trigger for Follow-up	Reporting
Silt and Sediment During Construction	• inspection and maintenance of mitigation features	• inspection and logging of erosion and sediment control measures	• daily by staff • weekly by site manager • monthly by site engineer or after significant events	• until course is 'greened up'	• turbidity or suspended solids plume off-site	• monthly
Fertilizer and Pesticide Application	• confirmation of applications	• maintain records of all applications	• daily as required	• for life of golf course	• feedback for changes in receivers	• annually
Water for Irrigation (subject to special conditions on Permit to Take Water)	• volumes taken from source • application rates to course	• maintain records of all applications • water levels in wells where groundwater source used	• daily as required	• for life of golf course	• feedback for changes in receivers, critical water levels	• annually
Naturalization of Constructed Wetlands, Riparian Areas and Buffer Strips	• landscape monitoring of naturalized features • demonstration of diligence	• photographic records and notes as appropriate	• spring and late summer	• immediately after planting • two years after 'green up' • as required thereafter	• loss of vigorous growth or detrimental community change	• one and three years after commencement of play • as required thereafter

b) special attention to vegetation communities of wetlands and naturalized buffer strips and stream corridors;

c) a qualitative review of the conditions and effectiveness of buffer strips and no-mow areas; and

d) procedures to follow-up on unexpected conditions and changes in the terrestrial environment.

Best Management Practices Summary ***Ongoing Monitoring and Reporting – Terrain***
Best Management Practices for Terrain Monitoring during golf course operations include: ➢ Outline of a post-construction terrestrial monitoring plan based on the constraints identified in the EIS and including: • a detailed qualitative review in the spring and summer of years 1 and 3; • special attention for vegetation, wetlands, and buffer strips; • a qualitative review of buffers and no-mow areas; and • procedures to follow-up on unexpected conditions and changes.

7.2 Surface Water / Aquatic Biology

The surface water monitoring program must adhere to the site constraints developed in the EIS stage, recognize the sensitivity of the receiving environment and include a reference site for seasonality, long term trends and natural water quality in the area. The frequency of monitoring must be sufficient to include seasonal changes in water quality and must include the relevant parameters identified during baseline studies to assess impact.

Water quality monitoring should be conducted for three years of operations on the same schedule, and measure the same parameters, as those used in the baseline and construction phases. A repeat survey of fisheries, fish habitat and the benthic community should be conducted after three years of operations, with the caution that a great deal of effort is required to produce statistically valid results for inferring changes. Repeat surveys are also advised in response to major unforeseen stresses, such as spills or severe storms. In these cases, the existence of baseline data will be a valuable resource to establish impacts or change. A periodic review of the monitoring program and data should be completed by a qualified aquatic ecologist to assess the need for changes to the program.

The program presented in Table 7.1 is a variant of that recommended for a Muskoka golf course, in response to concerns raised over the sensitivity of the adjacent receiver (a lake) and a review dictated under the terms of an OMB decision. It was agreed to by the proponent, the peer reviewer and those concerned about the development and so demonstrates an achievable and supportable level of monitoring detail. This represents an intensive level of monitoring effort, provides triggers for management action and identifies that the monitoring program must be "reset" if significant effects are found. It was developed because of the sensitivity of the lake and the concerns generated by public review of the proposal. Other recent golf course developments in the Muskoka area have had monitoring programs imposed for surface water as a condition of MOE's Permit to Take Water. In one case, a local residents' association instituted its own program of verification monitoring.

Best Management Practices Summary ***Ongoing Monitoring and Reporting – Hydrology / Surface Water***
Best Management Practices for Surface Water Monitoring during golf course operations include: ➢ A surface water monitoring program that adheres to site constraints defined in the EIS. ➢ A reference site for seasonality and natural water quality in the area. ➢ A monitoring frequency sufficient to include seasonal changes. ➢ Maintaining the program for a sufficient duration to determine the presence or absence of impact. ➢ Monitoring those parameters monitored during the baseline phase to assess changes. ➢ Periodic review of the monitoring program and data by a qualified aquatic ecologist to assess impacts and the need for any changes.

7.3 Stormwater

The design of the stormwater management system should include an indication of the ability of the drainage pathways to withstand erosion. As part of the routine monitoring program, the drainage pathways should be inspected in the spring after the freshet to determine the location and extent of any erosion. Significant erosion sites should be evaluated to determine how to repair erosion areas in such a way that the problem will not recur. This may include the installation of a channel lining with a greater erosion resistance, increasing the size of the channel cross-section, or increasing the length of the drainage path in order to decrease the channel slope. Monitoring programs must also determine the need for sediment removal from any storm control facilities.

Best Management Practices Summary ***Ongoing Monitoring and Reporting – Stormwater***
Best Management Practices for Stormwater Monitoring during golf course operations include: ➢ Inspection of stormwater drainage pathways after the spring freshet to determine the location and extent of any erosion. ➢ Determining the best methods to repair any erosion to prevent the problem from recurring, such as: • installing channel linings; • increasing size of channel cross-section; and • increasing length of drainage path. ➢ Determining the need for sediment removal as required from storm control facilities.

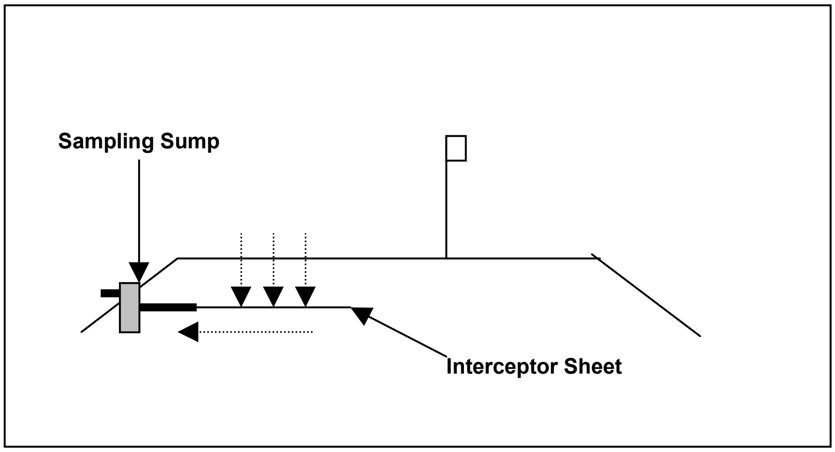
7.4 Hydrogeology

The impacts of the golf course construction and management will require monitoring to ensure that the quantity and quality of groundwater have not been adversely affected. Monitoring for selected nutrients and pesticides will be necessary to measure the impacts of turf management over time. Monitoring should commence prior to development to establish baseline conditions, should continue on a schedule sufficient to detect seasonal variations and should be adjusted over time to accommodate changing conditions. A periodic review of the monitoring program and data should be completed by a qualified hydrogeologist to assess any impacts and the need for changes to the program. The parameters tested should reflect the chemicals applied.

The most critical period is over the first few years when the turf grass is being established. The water quality monitoring should be tailored to the chemicals used as part of the golf course management plan. Groundwater levels may also require monitoring in cases where groundwater is used as a source of water. This will be necessary to ensure that the water taking is not having an adverse impact on groundwater levels and potentially on adjacent wells. Specific conditions for groundwater level monitoring will likely be a requirement of a Permit-To-Take-Water from the Ministry of the Environment and may include water level monitoring of on-site and off-site wells.

The patchy and thin distribution of soil in the Precambrian Shield produces heterogeneous flow conditions and preferential flow paths for groundwater. These conditions make it difficult to monitor groundwater by conventional means such as piezometers, which may not intercept a groundwater pathway unless many are installed. An alternative is to place groundwater interceptors beneath heavily managed areas such as tees and greens. These can take the form of horizontal plastic sheets of 4 m^2 area placed 0.5 m below grade. These will intercept seepage from areas of potential contaminant loss which can then be directed to a sump which can be accessed for sampling. Results can be compared to data collected in the same way from an undisturbed reference area in similar terrain. Figure 7.1 provides a schematic of an interceptor.

Figure 7.1 Schematic of Interceptor for Groundwater Sampling



Trigger levels should be specified in a groundwater monitoring plan along with a contingency plan to be implemented if trigger levels are reached or exceeded. Monitoring should also include water level from conventional piezometer installations.

Best Management Practices Summary ***Ongoing Monitoring and Reporting – Hydrogeology***
Best Management Practices for Groundwater Monitoring during golf course operations include: ➢ A groundwater monitoring plan that measures selected nutrients and pesticides that have been applied to the turfgrass, especially during the critical period (first few years of operation). ➢ Monitoring of groundwater levels (if required) to ensure that water taking is not having an adverse impact on the groundwater level or on adjacent wells.

7.5 Reporting

Although a monitoring program on its own will increase the level of environmental awareness among all parties it is not complete without a reporting structure and mechanism. The review of planning controls presented in Section 2.2.2 concluded, however, that there is no mechanism in place to enforce a reporting requirement for routine golf course developments. As a result, there is no obvious body or agency which can be identified to receive, review and follow-up on any monitoring program. The absence of regulatory authority or a responsible body means that, in the end, reporting is voluntary for most applications.

The high degree of public concern over golf course development in Muskoka suggests that some form of reporting structure be developed. Several recommendations follow:

a) in any case where local residents (for example a residents' association) have expressed concern, it is in the proponent's best interests to make regular reports to that association as a demonstration of commitment and diligence. This reporting should begin at the baseline or feasibility level, to ensure that public concerns are based on knowledge of the development and should continue through the entire life span of the course at a venue convenient to all parties; and

b) at the minimum, a monitoring program should provide for regular reporting to the local municipality or the District Municipality of Muskoka to allow for review against planning requirements, the dissemination to intended parties, or to act as a repository for public access.

Best Management Practices Summary ***Ongoing Monitoring and Reporting***
Best Management Practices for Reporting during golf course operations include: ➢ Internal documentation of fertilizer, pesticide, and water use and routine inspections and management actions as part of an "Environmental Management System" for the development. ➢ Development of triggers for management action based on monitoring results. ➢ Development of management contingencies and follow-ups to implement where warranted. ➢ An Environmental Effects Monitoring Program to ensure that monitoring is undertaken, results meet expectations, and reports are submitted to the appropriate authorities. ➢ Regular reporting to local residents/associations who have expressed interest.

8. Guidelines for Review of Golf Course Proposals

The need for detailed review by outside parties will be dictated by the specific site, its sensitivities, and the amount of detail submitted by the developer. Tables 8.1 to 8.6 are matrices which were developed to facilitate the review of a golf course development from the environmental baseline studies (Table 8.1) through to Monitoring and Reporting (8.6). Individual matrices are provided to cover:

a) environmental baseline studies;
b) planning and approvals requirements;
c) design BMPs;
d) construction BMPs;
e) operations BMPs; and
f) monitoring and reporting BMPs.

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Golf Course Development in Muskoka : Review Checklist

8.1 Environmental Baseline Studies

	Consultation with Local Agencies	Qualified Ecological Expertise	Literature Review	Idenitified and Mapped	Site Visits	Seasonality Considered	Correct Locations Considered	Photographic Record	Integration with all Disciplines	Constraints Identified	Constraints Mapped	Constraints Linked	Preliminary Course Layout	Buffer Areas/Corridors / Blocks Identified	Approval of Proponent	Submitted to Agencies	Approval By Agencies
Terrain and Soils																	
Terrain features																	
Topography and Slope Analysis																	
Significant Natural Features																	
Human Features																	
Disturbed Areas																	
Soils																	
Types																	
Moisture Conditions																	
Test pits																	
Nutrient and chemical analysis																	
Hydrogeology																	
Groundwater Supply																	
Baseflow Analysis																	
Monitoring Program																	
Groundwater Requirements																	
Hydrology																	
Drainage Conditions																	
Hydrologic Linkage																	
Site Water Balance-Baseline																	
Site Water Balance-Conceptual																	
Document Irrigation Requirements																	
Water Quality																	
Monitoring Program -Streams																	
Monitoring Program-Ponds																	
Monitoring Program-Adjacent Lake																	
Reference Sites Considered																	
Lake Capacity Considered																	
Aquatic Biology																	
Habitat Survey																	
Benthic Survey																	
Fisheries Survey																	
VTE Species																	
Vegetation																	
Community Types																	
Significant Natural Features																	
VTE Species																	
Wetland Types																	
Wildlife																	
Significant Habitat																	
Habitat connectivity and size																	
VTE Species																	
Breeding Birds																	
Migratory Birds																	
Amphibian Breeding																	
Deer Yards																	

VTE = Vulnerable, Threatened or Endangered Species

Golf Course Development in Muskoka : Review Checklist

8.2 Planning and Approvals

	Required ?	Consultation with Local Agencies	Qualified Ecological Expertise	Approval of Proponent	Submitted to Agencies	Approval By Agencies
Pre-Development Environmental Baseline and Feasibility Study						
Terms of Reference for an EIS						
Project-Specific EIS						
Necessary legislated approvals						
Permit to Take Water						
Well Construction Permit						
Certificate of Approval for Sewage Works						
Pesticides Act						
Fisheries Act						
Necessary Planning Approvals						
Provincial Policy Statement						
Offical Plan Amendment						
Zoning By Law						
Holding By Law						
Lot Creation or Severance						
Site Plan						
Environmental Management Plan						
Ongoing Reporting						

8.3 Design Considerations

	Consultation with Local Agencies	Qualified Expertise	Explicit Consideration of Constraints	Environmental Impact Statement	Monitoring and Operations Manual	Approval of Proponent	Submitted to Agencies	Approval By Agencies
Terrain and Soils (4.0)								
Thick soils for tees and greens								
Layout avoids wetlands and surface water								
Layout avoids disturbing thin and organic soils								
Layout avoids clearing steep slopes								
Soils (4.0, 4.6)								
Natural cover on thin soils								
Consideration of nutrient attenuating soils								
Cut and Fill Plan								
Assessment of imported soils								
Hydrogeology (4.2)								
Maintain natural cover on fractured bedrock								
Avoid or buffer recharge/discharge areas								
Avoid or buffer permanently wet areas								
Groundwater Monitoring plan								
Storm Water Management (4.1.4)								
Delineation of catchment sizes								
Evaluation and documentation of flow paths								
Retention of one-year storm								
Encourage diffuse runoff and infiltration								
Overflow spillways for large storms								
Erosion control on any swales or channels								
No direct discharge to surface waters or wetlands								
No discharge to steep slopes								
Incorporation of nutrient/pesticide attenuation								
15m filter strip around storm water ponds								
Hydrology (4.1)								
No interruption of on site flow								
Maintenance of base flow in streams and wetlands								
Final water budget								
No alteration of catchment sizes								
Final irrigation plan								
Water Quality								
30m buffers around surface water (4.1.1)								
Minimize Channel crossings (4.1.2)								
Fairways parallel to surface water (4.1.2.)								
No on-line ponds (4.1.3, 4.3)								
Surface water monitoring plan								
Aquatic Biology (4.3)								
30m buffers around surface water (4.1.1)								
No alteration of stream channel or lake bed (4.3)								
Bridged channel crossings (4.3)								
Erosion control for channel crossings								
Stream crossings not "in play" (4.1.2)								
No barriers to fish passage (4.3)								
Biological monitoring plan								
Vegetation (4.4)								
Detailed maps of final course prepared								
Landscape plan prepared								
Protection of VTE species (4.5.1)								
Wetlands (4.4)								
Maintain water balance								
Minimum 30m buffer strip								
Larger buffer strip for sensitive attributes								
Edges clearly mapped								
Wildlife								
Protection of VTE species (4.5.1)								
Maintain minimum 50m corridors (4.5.3)								
Maintain habitat blocks (4.5.2)								
VTE = Vulnerable, Threatened or Endangered Species								

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Golf Course Development in Muskoka : Review Checklist

8.4 Construction BMPs

	Qualified Inspectors	Inspection Schedule	Monitoring Program	Construction Schedule	Construction Phased	Approval of Proponent	Submitted to Agencies	Approval By Agencies
Terrain and Soils (5.0)								
Detailed "as built" drawings prepared (5.3)								
Tree removal in winter (5.1.1)								
Avoid clearing in freshet (5.1.1)								
Avoid clearing steep slopes (5.1.1.)								
Avoid disturbance of buffer areas								
Storm Water Management (5.1.1)								
Sediment and erosion control plan								
Controls in place before disturbance								
Temporary sediment basins (size and location)								
Erosion fencing upgradient of buffers								
Flow check dams on drainage pathways								
Interceptor swales upstream of slopes								
No discharge to steep slopes								
Delineation of disturbed area limits								
Contingency plans and materials available on site								
Stabilization of haul roads and slopes								
Water Quality - see also Storm Water								
Buffer in place before construction								
Erosion control around stream crossings								
Qualified on-site inspection								
Aquatic Biology - see also Storm water								
Buffer in place before construction								
Qualified on-site inspection								
Erosion control around stream crossings								
Vegetation (5.3)								
Detailed maps of final course prepared								
Landscape plan prepared								
Fences and signs around natural areas								
Forest openings "prestressed"								
Qualified on-site inspection								
Wetlands (5.2)								
Buffer in place before construction								
Silt and erosion protection in place before construction								
Clearly marked edge areas								
Wildlife (5.4)								
Scheduling considers habitat requirements								
Clearly marked sensitive habitat								

VTE = Vulnerable, Threatened or Endangered Species

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Golf Course Development in Muskoka : Review Checklist

8.5 Operational BMPs

	Monitoring and Operations Manual	Inspection Schedule	Monitoring Details	Approval of Proponent	Submitted to Agencies	Approval By Agencies
Existing Courses (6.1)						
5m "no mow" along any surface water or wetland						
No fertilizer or pesticide application in "no mow" zones.						
Revegetation of eroded area						
No direct discharge of storm water to surface water						
Review play areas and vegetation plan						
Review turf management plans						
Turf Management Plan (6.2)						
Includes irrigation requirements						
Fertilizer Plan (6.2.1)						
Includes criteria for application						
Includes testing schedule						
Includes consideration of irrigation						
Pesticides Plan (6.2.2)						
Includes criteria for application						
Includes guidelines for safe application						
Considers alternatives to pesticides						
Requires licensed applicator						
Identifies spill contingencies						
Water Quality (6.3)						
Verify buffer maintenance						
Inspect and maintain erosion control around stream crossings						
Maintain monitoring program						
Aquatic Biology (6.3)						
Verify buffer maintenance						
Inspect and maintain erosion control around stream crossings						
Maintain monitoring program						
Vegetation (6.4)						
Minimize mowing of "out of [play" areas						
Maintain fences and signs around sensitive areas						
Wetlands						
Maintain buffers						
Monitoring program						
Wildlife (6.5)						
Secure and regular garbage management						
Wildlife awareness program						
Tree guards						
Nuisance animal management plan						
Maintain habitat requirements						
Biting Insects (6.5.1)						
No chemical control						
No modification of aquatic habitat						
Promote personal control						

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Golf Course Development in Muskoka : Review Checklist

8.6 Monitoring and Reporting

	Environmental Management System	Identify Responsible Employee	Environmental Effects Monitoring	Linkage to EIS Constraints	Triggers Developed	Contingencies and Follow Up	Idenitify Responsible Ageny	Approval of Proponent	Submitted to Agencies	Approval By Agencies
Document Routine inspections										
Water Takings										
Irrigation										
Other										
Pesticide Applications										
Type										
Date										
Location										
Amount										
Fertilizer Applications										
Type										
Date										
Location										
Amount										
Spills Action Plan										
Turf Grass Maintenance										
Environmental Effects Monitoring										
Develop rationale and purpose										
Vegetation										
Year 1 Post-construction										
Year 3 Post Construction										
Identify Suitable Reference (temporal or spatial)										
Water Quality										
Develop schedule										
Confirm locations										
Confirm parameter list										
Identify Suitable Reference (temporal or spatial)										
Aquatic Biology										
Confirm Year 3 schedule										
Benthic invertebrates										
Fish habitat										
Fish Community										
Storm Water										
Annual post-freshet										
Post large event										
Confirm regular schedule										
Sediment removal										
Hydrogeology										
Ground water quality										
Ground water quantity										
Reporting										
Identify local stakeholders										
Identify review/receipt responsibility										

The tables are intended primarily as "Tests of Conformity" to allow reviewers and proponents to record whether or not a proposal meets BMPs for various areas and to identify strengths and deficiencies. The tables are developed in spreadsheet format to allow consistency, ease of access, update and distribution.

The tables should be used in conjunction with the summary boxes for BMPs presented in each section of the report. Reviewers should consult the report text and the documentation prepared for a development and then fill in boxes which apply for the particular review. As a general description, tasks occupy the rows of each matrix and steps occupy the columns. A reviewer or proponent works across the columns for each task as the project proceeds and fills in those tasks which are completed to satisfaction (in the best case) or addressed or not addressed (in other cases).

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9. Glossary

Adjacent Lands: Lands which share a common boundary with the study area.

Aggregate Deposits: A collection of mineral substances. (i.e., gravel, sand, rock).

Amphibian: Faunal species that require land and water to complete all life stages.

Aquifer: A subsurface body of sediment or rock that contains sufficient saturated permeable material to conduct groundwater and yield economically significant quantities of potable water to wells and springs.

Area Sensitive Species: Animal species that require large areas for territorial (i.e., nesting) or feeding strategy reasons (e.g., the Cerulean Warbler is an example of an area sensitive bird, as it may require up to 600 ha per territory).

Areas of Natural and Scientific Interest (ANSI): An area of land and water containing natural landscapes or features which have been identified as having values related to natural heritage protection, scientific study, or education.

Baseflow: The water contribution to streams from groundwater following infiltration of precipitation into the soil.

Benthic Invertebrates: Fauna living on the bottom of a watercourse or water body.

Best Management Practices (BMPs): Recommended approaches to minimize environmental impacts.

Bog: Peatlands with a high water table, generally unaffected by nutrient-rich groundwater, that are acidic and often dominated by heath shrubs and Sphagnum mosses and that may include open-growing, stunted trees.

Browse: Used as a term to describe vegetation used as food, or as the action of browsing.

Buffer: An area in reserve surrounding an environmentally sensitive feature, which protects the feature from outside impacts. It may take the form of undisturbed natural vegetation, or a planting of vegetation which is native to Muskoka.

Catchment: The area from which a surface water course or groundwater system derives its water.

CCME Guideline: A narrative or numeric specification of water quality developed for nation-wide use by the Canadian Council of Ministers of the Environment. CCME guidelines are intended to be used in those provinces or territories which have not developed their own water quality objectives, or for pollutants for which provinces or territories have not developed objectives (i.e., Total Suspended Solids in Ontario).

Coldwater Fisheries: In the context of fish habitat, water bodies that reach maximum summer temperatures of less than 23°C and generally support fish preferring cold water, such as salmonids or dace.

Colonial Nesting Species: Species known to use the same nesting area year after year.

Contaminant Attenuation: The reduction or slowing of contaminant migration by various physical or chemical processes.

Cumulative Effects: The combination of effects from different sources (i.e., noise, dust, wildlife) and the repetitive (by space or time) application of effects.

Deer Yard: An area, usually in mature stands of conifers, where herds of deer traditionally seek shelter from winter conditions.

Development: As defined by the Provincial Policy Statement means, the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the Planning Act; but does not include activities that create or maintain infrastructure authorized under an environmental assessment process; or works subject to the Drainage Act.

Discharge Area: That part of a drainage basin where groundwater flow is directed to the ground surface, as evidenced by seeps, springs or high water tables.

Ecological Land Classification (ELC): A Canadian system that classifies land from an ecological perspective; a Southern Ontario version of the ELC has recently been devised to provide a consistent and comprehensive approach to identifying ecologically similar areas.

Ecosite:	A subdivision of land that has a homogenous combination of soils and vegetation. Usually mapped at a scale of 1:50000 in Canadian systems.
Emergent Vegetation:	Aquatic plants that have roots below the surface of the water and leaves above it.
Environmental Impact Studies (EIS):	A scientific review of the potential environmental impacts of a particular action or project.
Environmental Management Systems (EMS):	A structured program to manage a process or project in an environmentally sound manner.
Ephemeral:	In the case of organisms, those with a short life cycle, lasting only a season or a few days (e.g., some species of spring flora). In the case of physical features, such as pools or stream flows, those which exist only for a short time (e.g., during spring thaws or after a major rainfall event).
Environmentally Significant Area (ESA):	ESAs are based on inventories of the biological and physical attributes of natural areas within a given geographic area (e.g., municipality, Conservation authority), evaluated against established criteria. Also known as Heritage Areas in Muskoka.
Fens:	Wetland with a peat substrate and nutrient-rich waters, and are covered by a dominant component of sedges, although grasses and reeds may be associated in local pools.
Fish:	As defined under the Federal Fisheries Act “includes parts of fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans, or marine animals, and the eggs, sperm, spawn, larvae, spat, and juvenile stages of fish, shellfish, crustaceans, marine animals.
Fish Habitat:	Is defined in the Federal Fisheries Act as “spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes”.
Forest Interior Species:	Bird species that typically nest at distances greater than 100 m in from a forest edge. These species are area-dependent and thus sensitive to the negative effects of forest fragmentation.

Forest Resource Inventory: An inventory completed to identify physical resources of a forest.

Glaciofluvial: Sediments or landforms created by meltwater streams escaping from a glacier.

Glaciolacustrine: Sediments or landforms of a lake formed due to glacial ice activity.

Gneiss: A geological term referring to coarse-grained, banded rocks that formed during high grade regional metamorphism.

Groundwater: Subsurface water, or water stored in the pores, cracks, and crevices in the ground below the water table; water passing through, or standing in, soil and underlying strata and free to move by gravity.

Harmful Alteration Destruction or Disruption (HADD) of Fish Habitat: Although not defined in the Fisheries Act, it is defined by DFO as "any change in fish habitat that reduces its capacity to support one or more life processes of fish". Implicit in this definition is that, as the result of the reduced capacity of the habitat to support the life processes of fish, there will also be a loss in the capacity of the habitat to produce fish.

Heritage Areas: Areas with some historical cultural heritage value, or environmental significance (see Environmentally Significant Area).

High Water Table: The upper surface of groundwater or the level below which an unconfined aquifer is permanently saturated water. A high water table is found closer to the surface level than is expected.

Hydraulic Conductivity: Ability of a geologic unit to permit fluid to flow through it.

Hydrostratigraphic: Geologic unit grouped on the basis of hydraulic conductivity.

Infiltration: Downward entry of water into soil.

In situ: Referring to the limitation of a substance, or test to a certain environment.

Marsh: A wetland with a mineral or peat substrate periodically or permanently inundated by nutrient-rich standing or slowly moving water characterized by emergent vegetation, and to a lesser extent, anchored floating plants and submergents.

mg/L: Units of milligrams per Litre of water, usually expressing concentration of a contaminant. Equivalent to parts per million (ppm).

Migratory Stopover: A geographic area known to provide some benefit to species migrating between breeding and wintering grounds.

Mitigation: Actions taken during the planning, design, construction, and operation of works and undertakings to alleviate potential adverse effects on the environment.

Moraine/Morainal Deposit: A prominent physiographic feature comprised of a mix of silts, sands and gravels deposited during the last glacial episode.

Native Species A species which is native to the Muskoka region.

Natural Heritage Areas and Features: As defined by the Provincial Policy Statement means, features and areas, such as significant wetlands, fish habitat, significant woodlands south and east of the Canadian Shield, significant Valleylands south and east of the Canadian Shield, significant portions of the habitat of endangered and threatened species, significant wildlife habitat, and significant areas of natural and scientific interest, which are important for their environmental and social values as a legacy of the natural landscapes of an area.

NTU: Units to describe turbidity, a measure of water clarity.

Organic Soil: Soil with a high content of organic matter and water. The term usually refers to peat.

Outwash Plain: Extensive accumulation of rock debris built up by outwash in front of a glacier.

Permit-To-Take-Water: A permit given by the Ministry of the Environment to allow for the taking of water from a water resource.

Physiognomy: The general appearance, character, form and feature of vegetation.

Piezometer: An observation well designed to allow monitoring of the hydraulic head of groundwater and to allow collection of water samples for analysis. It is generally of small diameter and designed to allow groundwater to enter at a specific depth instead of at all depths.

Precambrian Shield: A geological feature in Northern Canada attributed to the deposits of the Precambrian time.

Provincially Significant Wetlands (PSW): Any wetland that: 1) achieves a total score of 600 or more points; or 2) achieves a score of 200 or more points in either the Biological component or the Special Features component. A wetland is also considered a PSW if it has previously been evaluated under the first and second edition of the *Ontario Wetland Evaluation System* as Class 1, 2, or 3.

PWQO: A Provincial Water Quality Objective for the Province of Ontario. These are numeric or narrative specifications of water quality which are intended to protect aquatic life and recreational water use.

Recharge: The downward movement of surface precipitation to the water table and underlying saturated zone; this water eventually reaches one of more underlying aquifers or moves laterally within the unsaturated zone above the water table (interflow).

Reptile: A large and varied class of poikilothermic vertebrates. Reptiles have a body covering of ectodermal scales, sometimes supported by bony scutes.

Scats: Feces left by fauna, often sampled for use in scientific studies.

Site Alteration: As defined by the Provincial Policy Statement means, activities, such as fill, grading and excavation, that would change the landform and natural vegetative characteristics of a site.

Staging Area: An area where large numbers of animals congregate prior to embarking on or continuing migration (e.g., large water bodies such as lakes and ponds can be staging areas for waterfowl)

Submergent Vegetation: Aquatic plants that grow below the water surface.

Swamp:	Mineral-rich wetlands with 25% cover or more of deciduous or coniferous trees or tall shrubs.
Till Plain:	A smooth plain underlain by till.
Total Suspended Solids (TSS):	A measure of extent of suspended sediment in a water sample.
Turbidity:	A measure of dispersed sediments in a body of water which decrease water clarity by refraction of light.
Unevaluated Wetland:	A wetland that has not been evaluated based on the Ontario Wetland System (see also PSW).
Vascular Plants:	Herbaceous species which all have similar physical structure.
Voucher Specimens:	A collected sample of vegetation as a good example of a species.
Vulnerable, Endangered, Threatened species (VTE):	***Vulnerable species*** are any indigenous species of flora or fauna that is represented in Ontario by small but relatively stable populations, and/or that occurs sporadically, or in a very restricted area of Ontario, or at the fringe of its range; vulnerable species as defined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) ***Threatened species*** are any indigenous species of flora or fauna that, on the basis of the best available scientific evidence, is experiencing non-cyclical decline throughout all or a portion of its Ontario range, and is likely to become endangered if factors responsible for the decline continue unabated; threatened species as defined by COSEWIC. ***Endangered species*** are any indigenous species of flora or fauna that, on the basis of the best available scientific evidence, is threatened with immediate extinction throughout all or a significant portion of its Ontario range; identified in Regulations under the Endangered Species Act; endangered species as identified by COSEWIC.
Water Budget:	A method of assessing the size of the present and future water resources in an aquifer, catchment area, or geographic region, which involves an evaluation of all the sources of supply or recharge in comparison with all known discharges or abstractions. Also known as Water Balance.

10. References

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Appendix 1

Reference Material (submitted under separate cover)

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