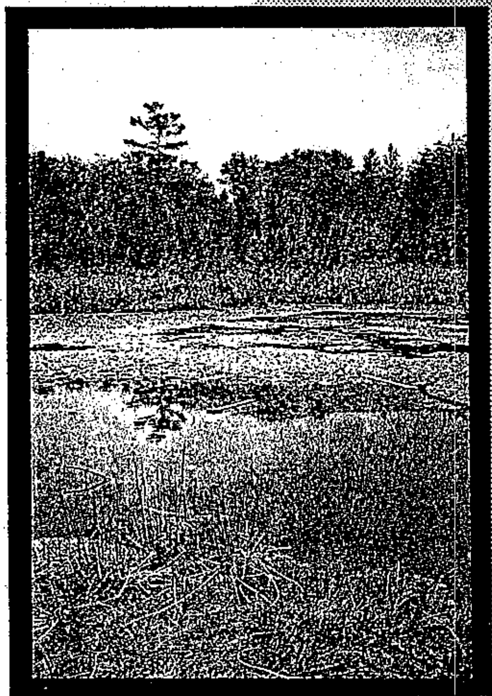
PARKS PLANNING

SIFTON BOG

INTEGRATED RESOURCE MANAGEMENT STUDY

SUMMARY REPORT
NOVEMBER, 1992
UPPER THAMES RIVER CONSERVATION AUTHORITY



PROJECT SPONSORS:

UPPER THAMES RIVER CONSERVATION AUTHORITY

LONDON PUBLIC UTILITIES COMMISSION

PLANCAN ASSOCIATES

(on behalf of private sector participants)

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SUMMARY

The Sifton Bog is unique from many perspectives. This 53 hectare provincially-significant wetland complex, located in the City of London, consists of bog and fen vegetation communities surrounded by deciduous-conifer swamp, upland deciduous forest, and a variety of anthropogenic vegetation communities.

This study was undertaken co-operatively by government agencies and private sector interests to determine how the site has responded to cultural impacts since European settlement, and determine how it might react to future ones. More specifically, this report provides an historical and contemporary context for future site-specific impact assessments that will be required by municipal and provincial regulatory agencies for any individual proposals involving urban intensification, and attendant landform alterations, in the vicinity of the Bog's hydrological catchment.

Hydrogeological, water chemistry and life science specialists studied the Bog between 1990 and 1992. Their findings are briefly summarized in this report; the complete work of each specialist is bound in individual reports.

The study was prepared in consultation with a Technical Committee composed of institutional and community stakeholders. Two public forums were held during the study to share information with the broader community in the City of London that is passionately interested in the site and its future.

The Sifton Bog has been exposed to many deleterious impacts from the time of European settlement. It has proven resilient, however, and this resiliency gives rise to a sense of optimism regarding the Bog's ability to sustain its wetland ecosystems in the future. This optimism is tempered by the fact that despite all of the site-related knowledge that has been gained during the last 40 years, very little is understood about the specific ecosystem inter-relationships that are governing the Bog.

This acknowledgement does not imply that all decisions relating to the management of lands within the hydrological catchment of the Bog and along its perimeter should be postponed. In many respects, the focus on all that is not understood about this site clarifies the understanding that has been obtained. Within this context, certain decisions are possible.

Resource-related recommendations are provided in Section Four of this report. These provide direction for the management of the Bog's hydrogeological, hydrological, biological and recreational resources in the future. In addition, the recommendations provide specific information relating to the capability of specific perimeter properties to support future urban land use in a manner that is compatible with the wetland functions of the Bog.

The ability of Planning Units PR 2.2 and PR 4.2 (Figure 10) to support urban use is restricted by their geological characteristics. The ability of Planning Unit PR 4.3 to support urban use in a manner compatible with the wetland functions of the Bog is restricted by its proximity to the Class 2 wetland in Planning Unit PR 5.

Vegetation communities in Planning Units PR 2.1, PR 5 and PR 6 should be left in their biologically-evolving condition.

The extent of land assembly for the Natural Area in Planning Unit PR 2.2 that is required to protect the wetland ecosystems of the Bog should be determined in a future proposal-specific assessment. This assessment will recognize the presence of Crataegus dodgei, a nationally and provincially rare plant species on adjacent land in Planning Unit PR 2.1.

The alteration of Planning Units PR 2.3, PR 3 and PR 4.1 to regulated urban uses might be achieved in a manner that would not alter the wetland functions of this regionally significant bog ecosystem. This statement assumes that specific site plans reviewed by regulatory agencies in the future address the concerns relating to hydrological and ecological function and contaminant levels identified in this report, and that these site plans satisfy the concerns of those regulatory agencies within the permitting process.

1.0 INTRODUCTION

1.1 LANDSCAPE CHARACTER

The Sifton Bog is actually much more than a bog; it's an intricate mosaic of land and water-oriented vegetation communities. The surface catchment that drains into the Sifton Bog includes:

- Peatlands, including bog and fen communities
- Wetlands, including peatlands, marsh and swamp communities
- Upland forests, ranging from early successional communities to mature upland hardwood sites
- Previously disturbed vegetation communities, including a gravel pit and abandoned agricultural fields
- Anthropogenic (human-influenced) vegetation communities, including agricultural fields and maintained lawns.

Sifton Bog is one of the most southerly peatlands in Ontario (Figure 1a). It has been designated as a Class 2 wetland by the provincial Ministry of Natural Resources, and is one of five "Significant Natural Areas" identified in the City of London Official Plan (Figure 1b).

Property west of the study area (defined in Section 1.3) was subdivided for low density residential use in the 1960's. Land south of the Bog is being developed for low and medium density residential use at the present time. The northern limit of the Sifton Bog is bordered mostly by single family homes that front onto Oxford Street, one of London's primary arterial roads. Several properties east of the site, presently in agricultural use, may be urbanized in the future.

The site's aquatic and terrestrial ecosystem have been altered by various management practices during the past 175 years:

- Upland Forest Cutting	1820-1860
- Agricultural Land Development	1840-1880
- Kirk Drain Installation	1905-1910
- Peat Extraction	1910-1930
- Wetland Forest Cutting	
Black Spruce Removal	1930's
Glossy Buckthorn Removal	1939-1945
- Municipal Road Development	1940's-1960's
- Adjacent Residential Development	1950's-1990's
- Aggregate Extraction	1950's+
- Perimeter Parking Lot Construction	1960's
- Trail and Boardwalk Development	1960's-1980's
- Kirk Drain Connection	1986
- Kirk Drain Capping	1991

1.2 STUDY RATIONALE

Several factors precipitated this study:

In 1980, the Upper Thames River Conservation Authority and the City of London prepared a proposal to the Province of Ontario regarding the establishment of the Sifton Botanical Bog Conservation Area. This proposal was never submitted to the province.

In November 1989, the City of London Planning Committee rejected several applications for high-density residential development on three parcels adjacent to the boundary of lands in public ownership. The municipality (and several other agencies) realized that there were certain concerns relating to the impact of future development on the site's earth science and life science features that should be satisfied prior to the consideration of future applications for urban land use on properties within the surface catchment of the Bog.

By 1990 there was a general consensus in both the public and private sectors that impact assessments concerning future land use changes around the Bog would be more meaningful if they were placed within the context of the impact that human use, prior management practices, and biological development have had on the site during the last 175 years.

1.3 STUDY AREA

The physical boundaries of this study are defined by three parameters:

- The hydrological catchment of the Bog
- Its hydrogeological catchment
- The legal description of public and private lands adjacent to the centre of the Bog

The hydrological (surface) catchment of the study area is defined by the watershed divide surrounding the undrained depression known as Redmond's Pond (Figure 4). This area occupies 44 hectares.

The hydrogeological (subsurface) catchment is generally known to extend beyond the north and east limits of the hydrological catchment. Its specific extent ~~extent~~, however, has never been quantified.

At the present time 29.5 ha defined by five legal titles are in public ownership (Figure 2). Of this property, Class 2 wetland covers 21.70 ha (Figure 7).

Three private sector properties within the hydrological catchment abut the legal boundary of public land within the study area. (Figure 2). These are:

- PR 2 (15.88 ha; approximately 2.70 ha in Class 2 wetland)
- PR 4 (1.62 ha)
- PR5 (1.62 ha; approximately 0.55 ha in Class 2 wetland)

Two additional private sector properties beyond the hydrological catchment were included in the study area. These are:

- PR 3 (0.37 ha)
- A part of PR 6 (2.2 ha)

These two properties are potentially developable for urban purposes. PR 3 is immediately adjacent to a steep slope within the study area; a part of PR 6 is located between two separated public properties within the study area. These two units were included so that an adequate assessment of the earth and life science resources within the study area could be undertaken.

1.4 TERMS OF REFERENCE

A detailed 17 point Terms of Reference was prepared in January, 1990. (Appendix A)
This report will:

- Describe the site's hydrogeological, hydrological and biological systems
- Determine how these systems function
- Assess the impact of prior management practices
- Assess the impact of future management practices
- Identify long-term monitoring required for adequate resource management

This study does not address the specific impact on the Sifton Bog of development proposals that may be generated by the private sector in the future. It does, however, provide a context for subsequent evaluations (which will be the responsibility of proponents and their consultants), and defines areas of consideration that should be addressed within these evaluations.

1.5 PROCESS

Institutional stakeholders have been meeting on a regular basis since 1990 to monitor the background studies that were commissioned as part of this project. The institutional stakeholders include:

Project Managers
- Upper Thames River Conservation Authority

Project Sponsors
- London Public Utilities Commission
- Upper Thames River Conservation Authority
- Private Sector Landowners
- McIlwraith Field Naturalists (Life Science component)

Technical Committee
- Representatives from above organizations
- City of London Planning Department
- Ministry of Natural Resources
- Ministry of the Environment

A public meeting was held in December 1991. The project manager (with the assistance of technical consultants), reviewed the biological, hydrogeological and hydrological factors that could influence future management strategies with individual stakeholders.

Continued contact with these stakeholders following December's meeting led to the realization that more dialogue was needed so that the implications of long-term management strategies for the study area would be fully understood by all of the people concerned with the future of the Bog and the properties within its surface catchment. As a result, an open house to review the technical findings of this study with individual stakeholders was held in June, 1992.

1.6 APPLICATIONS

The Sifton Bog Integrated Resource Assessment will be used as a background document in a wide range of land planning processes. These include:

Municipal Land Use Planning
- Official Plan & Amendments
- Zoning Bylaws & Amendments
- Development Agreements

Provincial Resource Planning
- Wetland evaluations
- Conservation Authority fill line regulations
- Ministry of Natural Resources municipal plan input regarding wetlands
- Ministry of the Environment municipal plan input regarding water quality and quantity management

Site Management Planning
- Vegetation management for floral and faunal objectives
- Site management for resources protection and enhanced recreational opportunities

The City of London Planning Department indicates that following internal review, the study will be forwarded to the City Planning Committee as an information item, and utilized as a background document in the assessment of applications for plans of subdivision, Official Plan amendments and Zoning By-law amendments on lands adjacent to the Bog.

Several properties within the hydrological catchment of the Bog, adjacent to the eastern boundary of lands in public ownership, are presently designated for "Multi-family high density residential" use in the City of London Official Plan. The owner of Planning Unit PR 2 has appealed the "Urban Reserve" zoning by-law designation proposed by the City to the Ontario Municipal Board. It is anticipated that a hearing on the proposed zoning by-law will be held during the 1993 Spring season.

2.0 RESOURCE INVENTORIES

Three background studies were commissioned as part of the integrated resource assessment:

- Hydrogeological Evaluation, by consultant Golders Associates Limited
- Life Science Inventory by, consultant David McLeod
- Water Chemistry Report, by the Upper Thames River Conservation Authority, with laboratory support from the Ministry of the Environment

Edited excerpts from these technical documents appear in the following text for the reader's convenience. They are relevant to the content of this report, however, only within the context of a primary source review by the reader.

2.1 HYDROGEOLOGY

2.1.1 METHODS

In the initial stage of the study, existing data, maps and reports relevant to the hydrogeological catchment of the Bog were compiled and reviewed.

A borehole drilling program was carried out in August, 1991 during which time a total of eleven boreholes were drilled at six locations. At each drilling location, with the exception of one borehole, a groundwater monitoring well was installed in one borehole and a piezometer was installed in an adjacent deeper borehole. (Figure 4)

Water levels in the monitoring wells and piezometers were measured at approximately monthly intervals from September 1990 to August 1991. Surface water elevations were monitored in Redmond's Pond, located near the centre of the bog. Groundwater levels were also monitored in a shallow private well located southwest of the bog.

In December 1990, the project manager requested that the flow rate in the Kirk Drain be monitored as part of this study. The Kirk Drain is a clay tile drain running southwest from the bog and was reportedly constructed in the early 1900's in an attempt to drain the bog. In 1986, this drain was intercepted during the construction of the Riverside West subdivision, located north of Riverside Drive and east of Sanatorium Road, and was connected into the municipal storm sewer.

2.1.2 DISCUSSION

The Bog is situated in a kettle depression in a deltaic deposit of sands and gravels. Underlying the sands are silty and sandy glacial tills of a moraine formation which outcrops northwest of the bog. (Golders Associates, 1991)

The immediate area of the Bog has been drilled extensively for water wells, particularly to the southeast. Records for these water wells indicate that the glacial overburden extends to bedrock at a depth of approximately 45 to 60 metres.

Based on the results of a field drilling programme carried out in 1978, Gartner Lee (1979) determined that the organic soils of the Bog extended to a maximum depth of approximately 10 metres, thinning towards the perimeter. These organics were found to be underlain by a stratum of fine to medium sand which was considered to be continuous with a stratum of surficial sands and gravels on the property immediately south of the Bog. These sands and gravels were, in turn, underlain by silty sand till at a depth ranging from 9 to 14 metres below the existing ground surface.

In a field drilling programme carried out in 1980, in an area generally southeast of the Bog, Golder Associates reported soil conditions encountered in the boreholes to be highly complex but consisting generally of layers of sand and sand and gravel overlying a stratum of silty clay till.

The subsurface conditions encountered in the contemporary study are considered to be similar to those encountered in previous studies of the Sifton Bog, although the greater depth to which sand was encountered in boreholes located generally northeast and east of the bog was somewhat unexpected. The downward vertical hydraulic gradients encountered in the monitoring wells indicate that the area is a groundwater recharge zone, consistent with the findings of previous studies. Horizontal hydraulic gradients indicate that groundwater flow is radially outward from the centre of the bog, however, while the Gartner Lee report of 1979 indicated groundwater flow was generally to the south and southwest across the bog.

These two differing results are not irreconcilable. Regionally, groundwater flow in this area is considered generally to be in a southerly direction, towards the Thames River. The Sifton Bog watershed is a very large catchment area with groundwater outflow as its primary outlet. As a result, it is reasonable to assume that a slight groundwater mound could develop beneath the bog causing groundwater to flow radially outward from this location. Beyond the limits of the bog, it is expected that groundwater would turn and flow south, in the direction of regional groundwater flow.

Given the very small horizontal hydraulic gradients in the bog, it is not unreasonable to assume that the direction of groundwater flow in the bog area may shift, producing flow that was radially outward in this study and flow in a southerly direction in the Gartner Lee study. In this scenario, the groundwater flow direction would likely be controlled by the rate of water input to the bog. At this time, there is insufficient data to fully evaluate this possibility. The current study was carried out in a year of record rainfall, 1990, and a year of expected above average rainfall, 1991, and was preceded by three years of below-average rainfall. The Gartner Lee study was carried out in a year of below average rainfall, 1978, and a year of average rainfall, 1979, and was preceded by two years of above-average rainfall. A comparison of water elevations shows that groundwater elevations measured around the perimeter of the bog in the current study are very close to the levels measured in the previous Gartner Lee study while the average water elevation measured in Redmond's Pond was approximately 0.3 metres higher than the average level reported previously. (Golders Associates, 1991)

In summary, the preceding paragraphs indicate that under certain conditions groundwater may enter the hydrogeological catchment of the Bog from the east. Of greater significance in the formation of long-term strategies, however, is the fact that surface flow management is the critical factor in protecting the integrity of the Bog's water resources in the future. Future surface water management strategies must incorporate two factors: Water running overland within the catchment, and water that has infiltrated the upper soil horizons to become shallow groundwater, also known as interflow. (Pers. comm. S. Thornley, Ministry of the Environment, 1992)

Both sources have the potential to influence water quality and quantity within the hydrologic regime of the Bog and, by definition, its flora and fauna. (Ministry of the Environment, 1992)

A preliminary analysis of contemporary and historical data indicates that the connection of the Kirk Drain into the municipal stormwater collection system in 1986 has not affected the hydrologic regime of Redmond's Pond. However, this preliminary opinion requires further clarification within the context of a long-term monitoring program, which will also consider the impact of the subsequent disconnection of this outlet from the municipal system in 1991.

For a complete review of the hydrogeological data discussed in this report, readers are directed to the Sifton Bog Hydrogeological Evaluation, Golders Associates, March 1992.

2.2 SURFACE WATER CHEMISTRY

The following text summarizes the surface water quality data collected from July 1990 to June 1991 that is presented in the Sifton Bog Water Chemistry Report, Upper Thames River Conservation Authority, S. Johnson, 1992. Subsurface water quality data is presented in the Sifton Bog Hydrogeological Evaluation, Golders Associates, March 1992.

2.2.1 METHODS

Staff performed an investigation of the site in the spring of 1990 to determine areas for surface water collection. Three open water areas were identified at this time: Redmond's Pond, and two other small depressions south west of the hydrological catchment. (Figure 4)

A site investigation during a rain event in the summer of 1990 led to the location of 5 sites for runoff collection along the edges of the watershed. (Figure 4) Runoff was only observed during substantial rain events, and due to staff and laboratory constraints some, but not all of these runoff events were sampled.

Surface water samples were collected biweekly from July of 1990 through June of 1991.

Water samples were initially analyzed for 10 parameters. The Ministry of the Environment increased the number of parameters to 19 in 1991.

Heavy metal samples were collected from the three surface sampling sites and from the subsurface wells in April of 1991.

A sample was collected from each of these same locations in June of 1991 to be analyzed for pesticide concentrations.

Conductivity measurements were determined within the open area of the Sphagnum mat surrounding Redmond's Pond in July and November of 1990. A hole was made through the Sphagnum mat at each point on a 30 meter grid using a 2 inch diameter screened PVC pipe, into which the probe was lowered to a depth of 2 inches below the surface of the mat.

2.2.2 DISCUSSION

Consistent, quantitative data describing the water quality of the Sifton Bog is scarce. This makes it difficult to determine the impacts which prior anthropogenic influences may have had on the water quality of the Bog. (Upper Thames River Conservation Authority, S. Johnson, 1992).

Due to surrounding land development and the corresponding installation of storm sewers, it is likely that the volume of runoff flow into the wetland has been greatly reduced. There are only two sites where surface runoff can be observed to flow onto the edges of the wetland during substantial rain events. One of these is a ravine, the other an agricultural tile outlet.

The reduced flow of runoff into the wetland, combined with parts of the area being ombrotrophic, causes the main water inputs to the Bog to be from atmospheric precipitation and subsequent surface runoff.

Mean water chemistry concentrations for bogs were found in the literature. Redmond's Pond is within the expected range for five of eight parameters compared in this report. Total Kjeldahl and chloride concentrations are higher than expected, possibly due to atmospheric precipitation inputs, or inputs from surrounding urbanization that are not adequately filtered by the wetland vegetation.

Levels for conductivity, total phosphorus, nitrate, dissolved organic carbon and calcium measured within the Bog are similar to concentrations reported in the literature for bog wetlands.

With respect to pH the geometric mean within Redmond's Pond was 5.8, not an acidic as expected. The pond appears to have become less acidic since 1950.

The fact that sufficient historical data on the water quality of Redmond's Pond does not exist precludes any determination of the impacts which prior anthropogenic influences around the wetland, noted in Section 3.6, have had on the surface water quality of Sifton Bog. The less acidic pH of the pond in comparison with the value of 1950 implies that there has been some change in bog chemistry.

Sifton Bog is partially an ombrotrophic bog, and derives much of its water inputs from atmospheric precipitation. Therefore the chemistry of the precipitation must be known in order to gauge the effects it may be having on the bog water chemistry. The volume of precipitation during the study period was 45 percent above normal, so that the precipitation chemistry would have had greater impact on the bog surface waters than in years with more average precipitation.

There are many instances in the literature where bogs are described as nutrient poor. The open water nutrient concentrations of Sifton Bog are quite high for several parameters, and so contradict the literature. This high nutrient status may indicate that nutrients are entering the bog and changing its chemistry; it is also possible that the bog, through biological development triggered by human influences, is succeeding to a fen.

The surface water sampling program which occurred between 1990 and 1991 should be continued in some form to determine whether the parameters measured within the surface water are changing over time.

Future analysis of the Bog should include testing the pH of Redmond's Pond at different depths and locations, and determining the pH of the Sphagnum mat by the use of a soil probe. Conductivity measurements within the peat mat should be repeated at sufficient intervals to determine any changes in ionic concentrations.

The lack of historical data on the surface water chemistry of the wetland precludes any definite conclusions relating to the impacts existing development may have had on the Bog, or the impacts of future development near the Bog. The less acidic pH measured in 1990-1991 indicates that there is some diversion from normal bog chemistry. This data can be compared to future analyses to determine any further changes in water chemistry. The chemistry of atmospheric precipitation reaching the wetland must be determined as this is a major source of nutrient inputs to the Bog. (Upper Thames River Conservation Authority, S. Johnson, 1992)

2.3 LIFE SCIENCE RESOURCES

2.3.1 METHODS

A life science inventory that included the description and mapping of vegetation communities was conducted at the Sifton Bog with field work spanning a period from September, 1989 until August 1991. Field work for this study extended over a period of close to two years in an attempt to get adequate seasonal coverage. The mapping and description of vegetative communities was a major focus of the study. Another was to compile as comprehensive a list as possible of the vascular flora and vertebrate fauna. A determination was also made of the bog's status within the Ontario Ministry of Natural Resources' ANSI program.

2.3.2 DISCUSSION

A central pond, known as Redmond's Pond, is surrounded by concentric rings of low shrub, tall shrub and treed bog communities on a floating Sphagnum mat. Both deciduous and mixed swamp communities occupy the remaining outer lowland areas and these are surrounded by low deciduous forest slopes. The central bog communities are relatively undisturbed and are the most significant feature of the area. (Figure 3)

Of the 477 vascular plant species reported from Sifton Bog, fifty-six are significant since they are considered rare nationally, provincially or regionally. 48 species are associated with the Sphagnum bog community. Five of these species are considered to be rare nationally (Argus and Pryer 1990), and provincially (Argus et al. 1982-87). The remainder are regionally rare (occurring at fewer than five locations in Middlesex County, Oldham et al., 1991.) Of these, twenty six are found nowhere else in Middlesex County. (McLeod, 1991)

Of the 124 bird species reported from the site, six are considered to be provincially rare breeders. Nine others are regionally rare either as breeders, migrants or winter visitors. Other significant fauna include the Southern Bog Lemming (pre-1933 record), Spotted Turtle (1966 record), Butler's Garter Snake, Smooth Green Snake and Eastern Hognose Snake. This site also has a large number of plants and animal species of both northern and southern affinities.

The Bog is a provincially significant Class 2 wetland. It is recommended that it should also be recognized as a provincially significant Area of Natural and Scientific Interest (ANSI).

The 3.6 hectare central portion of the Bog is its most important plant community. Within this area are excellent examples of vegetation communities found nowhere else in Middlesex County. These have developed on deep peat deposits and produced a floating mat characteristic of typical kettle bog succession in a concentric ring pattern around the open water of the central pond. The quality of these plant communities, in terms of the absence of alien species, is exceptional.

Although the surrounding swamp, slope and upland forest communities are not especially significant regionally, but are rather typical for the area, they do harbour most of the southern/Carolinian species recorded for the site. In conjunction with the bog communities containing a large number of boreal species, however, the result is an unusual interface between these two floristic elements.

On a provincial basis, the Bog provides better representation of species diversity across the continuum from bog to fen communities than any other site it was compared with in Southwestern Ontario. (Figure 1a). This is significant when the extreme location of the site relative to other kettle-hole sites in southwestern Ontario is considered.

On a regional basis, the Bog has a larger array of typical bog species than any other area it was compared to in Middlesex County.

The large number of significant plant species present at the Bog is especially interesting, given its relatively small size. It is of critical importance to understand that the protection of individual species is accomplished only through the protection of the required habitat, and that the necessary knowledge must be sought and the appropriate action taken to realize this goal.

With respect to invasive species, almost 27% (130) of the 484 taxa recorded for the study area are alien. Fortunately, most of these do not pose a threat to populations of native species at the Bog, but are present only as isolated individuals, usually near the periphery of the Bog. Some may have been originally planted where they are now found growing on abandoned sites. Most of these will eventually die out as successional processes proceed, since they lack the aggressive characteristics necessary for survival and the capability to adapt to the changing conditions of an unmanaged, natural environment. However, there are a few that will find the conditions of the site very favourable and these will eventually have to be dealt with.

Three such alien plants have been identified within the study site that have already become well established or could pose future problems for the indigenous species if not effectually controlled. They are Garlic Mustard (Alliaria petiolata), Glossy Buckthorn (Rhamnus frangula) and Purple Loosestrife (Lythrum salicaria). A fourth species, the native Common Cattail (Typha latifolia), present since at least 1926, is also showing over-aggressive tendencies within the most sensitive and significant central portion of the Bog.

In terms of surface water quality, the increased amount of nitrogen and phosphorus enriched waters reaching the centre of the Bog and flowing through is manifested in the increased cattail growth. If future surface water quality analysis verifies this, then some method will have to be devised to correct the problem. Otherwise a fen will result and many bog species will die out because of the increased competition from invasive species. (McLeod, 1991)

For a complete review of the life science data discussed in this report, readers are directed to Sifton Bog Life Science Inventory, McLeod, 1992.

3.1 CONSTRAINT CONSIDERATIONS

Figure 5: Subsurface Hydrology illustrates the horizontal extent of an elevation one metre above the upper limit of the subsurface aquifer (255 metres geodetic). Literature reviews suggest that the disturbance of this zone through excavation or other cultural practices can affect the inter-relationship of hydrogeologic and biotic systems in wetland complexes. (Grand River Conservation Authority, 1991)

Figure 6: Surface Hydrology illustrates:

- Restrictive slopes within the hydrological catchment that are sensitive to disturbance because of gradient and soil texture inter-relationships. Slope disturbance could potentially deliver sediments to lower elevations in the catchment, affecting wetland ecosystems. (Ministry of Natural Resources et al, 1987)

- The limit of potential municipal servicing constraints, referenced as the geodetic elevation of 259.15 metres, below which the installation of storm and sanitary sewers may not be possible using normal techniques. (Cole, Sherman 1981)

Figure 7: Life Science Features illustrates;

- The extent of the Sphagnum mat representing the greatest concentration of significant plant species within the study area, and the location of significant plant species beyond the Sphagnum mat. (McLeod, 1992)

- The extent of the Class 2 wetland. (Ministry of Natural Resources, Aylmer District, 1988)

Figure 8: Additional Zones of Consideration illustrates:

- The property acquisition line proposed in the 1980 proposed submission by the City of London and the Conservation Authority to the Province of Ontario.

- The extent of the Class 2 wetland, as previously referenced.

- The 120 metre negotiable buffer established in the contemporary Ministry of Natural Resources Wetlands Policy Statement.

- The Conservation Authority registered fill line.

The 120 metre negotiable buffer does not preclude land use alteration. It does, however, provide for the review of potential alterations adjacent to provincially significant wetlands by the Ministry of Natural Resources so that wetland functions can be preserved. (Ministry of Municipal Affairs, 1991)

The registered fill line is based on criteria designed to protect the integrity of receiving watercourses from sedimentation and physical encroachment, and to restrict development on erosion-prone slopes and other areas where hazardous conditions may exist, or where these conditions may be created.

In the context of this assessment two factors relating to the registered fill line should be considered. It does not necessarily preclude development. It does, however, allow the Conservation Authority to regulate development within the fill line, and comment on the effect that development outside of the fill-regulated area may have on receiving watercourses and wetlands within the regulated areas.

The registered fill line cannot be used, on its own, for the protection of natural areas that are not susceptible to the adverse effects of erosion and sedimentation, or threatened by the creation of a hazardous condition.

The fill line within the study area is known as an "ancient line", and in accordance with the conditions of provincial registration, can be altered as more detailed information becomes available for specific properties. The Conservation Authority is reviewing the location of fill lines within the City of London at the present time.

3.2 MANAGEMENT UNIT DESIGNATIONS

Vegetation communities have been clustered into management units so that the impact of specific resource management practices, passive recreational use and potential perimeter land use alterations can be evaluated in the future. These management units, which relate sites of similar hydrogeological and biological characteristics to broader morphological patterns within the study area, are used in the description of historical, contemporary and future impacts. (Figure 9)

The following steps were taken in the development of the management unit designations:

- Surface landforms, soil moisture, soil texture watershed catchments, and drainage patterns were defined.

- These features were related to specific vegetation communities.

- Areas with similar physical features were grouped into management units.

On the basis of this definition, lands within the hydrological catchment (and certain properties adjacent to it) have been assigned one of the following management unit designations.

Type 1

This designation has been given to communities that are either underlain by predominantly organic soils, contain clusters of significant life science features, or have limited representation within the study area.

These areas are sensitive to the effect of hydrogeological alteration, hydrological alteration and recreational use. Accordingly, future management programs should control and ameliorate impact in these units. These units should not be disturbed except for the management of alien plant species, where studies indicate that this is necessary or desirable. If the introduction of new resource management initiatives is considered, a site-specific evaluation of the impact that the particular initiative would have on biotic and abiotic features in the affected management unit should be undertaken.

This designation applies to pond, bog, conifer-deciduous swamp, certain deciduous swamp communities and most marsh communities.

Type 2

This designation has been given to communities that exhibit a high degree of biotic diversity in a relatively advanced successional state, generally found on flat, poorly-drained kettle lowlands. Future management programs should maintain successional dynamics that contribute to these conditions. On a combined basis these management units exhibit a high degree of biological diversity reflecting their ephemeral status as a vernal pool. In most instances, vegetation management programs are not required to maintain biotic diversity. These units are capable of supporting limited low-impact recreational use.

This designation applies to deciduous swamp, deciduous-conifer swamp, dry mesic upland deciduous forest and mesic slope deciduous forest communities.

Type 3

This designation has been applied to communities that are recovering from prior cultural disturbance; most are in an early successional state. These areas, generally located on slopes exceeding five percent gradients, feature relatively permeable surface soils, or are underlain by permeable strata.

All of these units play an important role in the broader context of habitat patterning within the site. They serve as a woodland buffer, protecting interior species from the impact of development and human use. They also act as a food source and provide vegetative cover for foraging species that favour a mixture of habitat or edge types. They also have the potential for natural development, through succession, to more mature woodland communities.

Two alternatives can be considered in future management programs:

- The existing habitat cover could be left unaltered, except for those changes that occur through natural processes.

- The existing habitat cover could be artificially manipulated to prevent normal successional processes from occurring.

These communities are somewhat tolerant of impacts to their hydrological and geological resources. In certain instances, the direction of specific activities to these management units will relieve pressure exerted on more sensitive communities.

This designation applies to Purple Loosestrife-infested marshes, tall-shrub swamp, early successional deciduous slope forest, dry mesic slope thicket, dry mesic old field, most anthropogenic communities and a mid-successional dry mesic upland deciduous community south-west of the Bog's hydrological catchment.

Type 4

This designation describes upland sites adjacent to municipal roads. Future management programs could accommodate the potential alteration of habitat within these units.

Some of these communities, in terms of habitat patterning and species diversity, perform a valuable function in their present state. Others do not, and could be subjected to habitat alteration programs, including natural or directed successional changes.

This designation has been applied to dry mesic forb/graminoid old field communities.

Type 5

This designation has been applied to two sites:

- Cultivated farmland that straddles the north-east limit of the hydrological catchment.

- Maintained parkland adjacent to the south-west limit of the hydrological catchment.

Both sites are of little ecological value in their present condition with respect to species diversity and habitat patterning. The implications of site-specific land management techniques at both sites, and their impact on interior hydrological and biological functions, should be addressed in future management programs.

3.3 PLANNING UNIT DESIGNATIONS

Various management units have been clustered into planning units so that schemes for recreational use, resource management and resource impact analysis can be tied to specific land parcels within the study area. Generally speaking these units consist of individual properties, varying in size, that have been identified on the basis of legal description and other distinctions such as a municipal road. (Figure 10)

Sub-units have been defined within Planning Units 2 and 4 for greater clarification. These sub-units were distinguished on the basis of geodetic elevation, slope gradient, soil texture and vascular canopy vegetation.

3.4 IMPACT DEFINITION

For the purposes of this report, impact is defined as any alteration to the hydrological, hydrogeological or biological systems with the surface and subsurface catchments of the Sifton Bog that impairs the ability of the Sifton Bog to function as a regionally-significant wetland.

The planning unit and management unit designations described in the previous text were developed so that impacts could be assessed on a site-specific basis.

3.5 IMPACT ASSESSMENT MODEL

Resource-related impacts are comprised of four components:

- The target area susceptible to impact
- The zone of impact origin
- The mechanism that connects origin and target areas
- The systems affected by this connection

For example, the potential impact being addressed might be the effect of surface flows on significant biological features within the catchment of the Sifton Bog. In this example, the *target area* susceptible to impact includes the Sphagnum mat in Planning Unit P 3 (Figure 2). The *zone of impact origin* would be defined as all of the land that drains into the lower point of the catchment; and in this instance would include Planning Units PR 2, PR 3 and PR 4. One *mechanism that connects origin and target areas* is sheet flow from storm event run-off. The *systems potentially affected by this connection* include vegetation communities sensitive to the elevated nutrient loadings usually associated with agricultural and urban land use.

The following analysis provides a general context for future site-specific envrionmental impact statements that will be required by regulatory agencies prior to land use intensification on properties adjacent to the Sifton Bog, as specified in the Draft Wetlands Policy Statement Implementation Guidelines (Ontario Ministry of Natural Resources, 1992).

Four chronological eras can be used to categorize the impacts that the Bog has been subjected to in the past. The effect of these prior impacts, and potential future ones, are described in the following text and summarized in Tables 1-4 following Page 20, and Figures 7 and 10.

3.6 IMPACT ERAS

As noted in Section 1.1 of this report the ecosystems within the hydrological catchment of the Bog have been altered by human and natural phenomena during the period dating from the Wisconsin glacial era.

Impacts have been clustered into four eras:

- Pre European (Table 1)
- Pre-Urban: 1820-1945 (Table 2)
- Urban: 1945-1992 (Table 3)
- Future (Table 4)

The probable effect of prior cultural impacts is summarized in these tables. There is much that is not known, however, about the relationship between these impacts. These areas of uncertainty are briefly discussed in the following text.

Traditional theory suggests that the flora of the Bog represents early post-glacial remnants that accumulated in the poorly drained kettle hole following the Wisconsin glacial era approximately 11,000 years ago. A contemporary hypothesis, however, holds that the Sphagnum mat and its associated floral diversity may be the result of land use changes within the hydrological catchment of the Bog during the pre-urban era.

Warner (1989) suggests that the deforestation which followed European settlement altered the hydrological regime by increasing surface runoff while simultaneously reducing moisture uptake by woody vascular plants. The resulting sedimentation and elevated nutrient loading rapidly changed the nutrient status of the water in the kettle hole, influencing the development of the vegetation communities that are presently observed around Redmond's Pond. Although the contemporary hypothesis is open to debate, it does point out the need for careful monitoring and management of surface flow within the Bog's hydrological catchment in the future.

The historical existence of a wetland during the nineteenth century on the site currently occupied by the Bog is well-documented. Steevens (1850), Tremaine (1862) and Peters (1863) all mapped its presence; the Peters illustration coincides almost exactly, in terms of location and shape, with the contemporary outline of the wooded swamp that surrounds the Sphagnum mat at Redmond's Pond.

Given the absence of comparable historical life science data, however, it is difficult to specifically assess the impact of peat extraction, wetland forest removal and the Kirk Drain installation during the pre-urban era. A review of literature describing the historical water levels in Redmond's Pond further complicates this assessment. The depth of water in Redmond's Pond in 1896 was reported to be 24 feet, underlain with 20 feet of muck on a bottom of white sand (Crawford, 1926). The pond measured 40 acres at that time. The depth of water in Redmond's Pond in 1900 was reported to be 60 feet (Judd, 1985). By 1926, the pond measured "not more than an acre." (Crawford, 1926). In 1978, the depth of the open water in Redmond's Pond surrounded by Sphagnum mat was measured at 13 feet. This water was underlain by organics 22 feet deep, which were in turn underlain by a till stratum in continuity with the glacial overburden surrounding the kettle hole. (Gartner Lee, 1978). Contemporary measurements indicate that Redmond's Pond is 5 fee deep at the centre (Ministry of the Environment, 1992).

Additional topographic investigation and soil core analysis in the future may clarify this apparent contradiction. This evidence, coupled with known alterations in the hydrological catchment during the urban era and the unknown impact of the Kirk Drain during the pre-urban era, suggests that the contemporary hydrological catchment of the Bog may bear little resemblance to its historical extent. Consequently, it may be difficult to establish meaningful specific water quantity objectives in the near future. Evidence does suggest, pending further investigation, that the augmentation of contemporary surface water volumes may be a reasonable long-term objective.

It seems prudent that any landform alterations contemplated within the hydrological catchment of the Bog in the meantime should mimic, from a quantitative standpoint, existing patterns of surface water delivery with respect to flow volume, time of concentration and method of delivery.

The absence of comparative historical water quality data precludes a specific assessment of cultural impacts that occurred during the pre-urban and contemporary eras. Continued monitoring and assessment of several parameters is required to clarify certain phenomena that were observed during the initial monitoring period, including:

- The apparent alkalinity of Redmond's Pond.

- The impact, if any, of elevated chloride loadings from diffuse sources along the northern perimeter of the Bog on wetland flora.

- The elevated nutrient status of Redmond's Pond, and the potential correlation to elevated nutrient levels in some of the surrounding observation wells.

Considerations relating to use of the Bog for educational purposes and passive recreation in the future are described in the conclusion of this report. These considerations acknowledge the fragility of the Bog's most interesting visual, biological and hydrological areas, and define a visitation strategy based on controlled access leading to enhanced stewardship through responsible user presence.

A review of literature relating to setback requirements for urban intensification adjacent to natural areas was carried out. These setbacks vary, depending on the resource that is being protected and the jurisdiction in which the setback is being enforced. Setbacks designed to protect one resource, for example, can range from 10 metres adjacent to upland hardwood forest communities to 300 metres for the protection of significant wildlife habitat. Wetland-specific setbacks reviewed for this report generally fall in the 15-30 metre range, although one American jurisdiction enforces a 90 metre setback adjacent to freshwater wetlands.

A definition of impact review zones that should be used in determining the compatibility of potential urban uses adjacent to the site in the future is provided in Table 4.

Table 1

Pre-European Impact Era

Impact Agent	Resource System	Impact Target	Impact Origin	Impact Description Zone	Impact Result
Glaciation	Geological	Catchment Internal	Catchment External	■ Surface catchment: - Variable orientations - Variable elevations	■ Kettle Hole
	Hydrogeological			■ Subsurface catchment: - Soil texture variation - Soil moisture variation	
	Hydrological				■ Ombrotrophic setting ■ Discharge zone ■ Acidic, aquatic environment
	Biotic				■ Wet, cold, nutrient deficient setting strikingly different from adjacent upland setting

Table 2
Pre-Urban Impact Era (1820-1945)

Impact Agent	Affected Resource System	Impact Target Zone	Impact Origin Zone	Impact Description	Probable Impact Effect
Upland Forest Removal	Biotic	Catchment Internal	Catchment Internal & External	■ Biomass reduction	■ Change in floristic elements ■ Reduced faunal habitat ■ Altered faunal habitat
	Hydrological	Catchment Internal	Catchment Internal & External	■ Biomass reduction	■ Reduced moisture uptake ■ Increased surface flows ■ Increased water levels ■ Increased water level fluctuations ■ Increased sedimentation and nutrient loading
Agricultural Land Development	Biotic	Catchment Internal	Catchment Internal	■ Alien species introduction	■ Contamination of native flora
	Hydrological	Catchment Internal	Catchment Internal	■ Increased sediment loading	■ Altered trophic status
Kirk Drain Installation	Hydrological	Catchment Internal	Catchment Internal	■ Increase in flow exit from watershed catchment	■ Impact unknown due to absence of historical baseline data for comparison purposes
Peat Extraction	Biotic	Catchment Internal	Catchment Internal	■ Soil & biomass reduction	■ Impact unknown due to absence of historical baseline data for comparison purposes
Wetland Forest Removal	Biotic	Catchment Internal	Catchment Internal	■ Black Spruce cutting ■ Buckthorn coppicing	■ Impact unknown due to absence of historical baseline data for comparison purposes

Table 3

Urban Impact Era (1945-1992)

Impact Agent	Affected Resource System	Impact Target Zone	Impact Origin Zone	Impact Description	Probable Impact Effect
Aggregate Extraction	Biotic	Catchment Internal	Catchment Internal & External	■ Biomass reduction	■ Reduced vegetation habitat ■ Altered species composition ■ Reduced faunal habitat
Perimeter Municipal Road Construction	Hydrological	Catchment Internal	Catchment Internal & External	■ Increased sediment + chemical loading	■ Altered trophic status
Perimeter Residential Construction	Hydrological	Catchment Internal	Catchment Internal & External	■ Increase in flow exit from watershed catchment	■ Reduced moisture availability ■ Decreased surface flows ■ More consistent hydroperiod ■ Altered chemical loading
	Biotic	Catchment Internal	Catchment Internal & External	■ Increased recreation pressure ■ Adjacent residences	■ Soil compaction ■ Altered vegetation community edges ■ Increase in alien plant species ■ Increased faunal disturbance and predation by domestic species
Internal Parking Lot Construction	Hydrological	Catchment Internal	Catchment Internal	■ Increased sediment loading	■ Altered nutrient status
Internal Trail Development	Biotic	Catchment Internal	Catchment Internal	■ Selective vegetation removal ■ Increased opportunity for human use	■ No evidence of reduced biodiversity ■ Soil compaction ■ Increased alien plant species ■ Increased faunal disturbance

Table 4

Future Potential Impacts

Impact Agent	Affected Resource System	Impact Origin Zone	Potential Impact Description	Potential Impact Effect	Impact Review Zone
Perimeter Land Use Intensification	Hydrological	PR 2.3	Surface flow alteration	■ Reduced moisture availability	PR2+P3
		PR 2.3	Surface chemistry alteration	■ Altered trophic status	PR2+P3
	Biotic	PR 2.2	Vegetation removal	■ Reduced buffer function	PR2+P3
	Hydrological	PR 2.2	Vegetation removal	■ Increased runoff	PR2 +P3
	Geological	PR 2.2	Slope alteration	■ Increased sediment loading	PR2+P3
				■ Altered nutrient status	PR2+P3
	Biotic	PR 2.1	Vegetation removal	■ Reduced buffer function	PR2+P3
	Hydrological	PR 4.1	Surface flow alteration	■ Increased runoff	PR2+PR4+PR5
				■ Reduced moisture availability	PR2+PR4+PR5
			Increased sediment loading	■ Altered trophic status	PR2+PR4+PR5
	Geological	PR 4.2	Slope alteration	■ Increased sediment loading	PR2+PR4+PR5
				■ Altered nutrient status	PR2+PR4+PR5
	Hydrogeological	PR 4.3	Foundation excavation	■ Subsurface contamination	PR2+PR4+PR5
	Hydrogeological	PR 4.3	Service excavation	■ Subsurface contamination	PR2+PR4+PR5
	Hydrogeological	PR 4.3	Grade elevation	■ Subsurface contamination	PR2+PR4+PR5
	Hydrogeological	PR 5	Foundation excavation	■ Subsurface contamination	PR2+PR4+PR5
	Hydrogeological	PR 5	Service excavation	■ Subsurface contamination	PR2+PR4+PR5
	Hydrogeological	PR 5	Grade elevation	■ Subsurface contamination	PR2+PR4+PR5
	Biotic	PR5	Vegetation removal	■ Reduced wetland buffer	PR5
	Biotic	PR6	Vegetation removal	■ Reduced biodiversity	P1 + P2
Redesign Internal Parking Lot	Hydrological	P3	Reduced sediment loading	■ Altered chemical status	P3
Internal Trail Improvements	Biotic	P3	Boardwalk extension	■ Reduce vegetation trampling	P3
		PR 2.2	Access improvements	■ Reduce soil compaction	P3+PR2
				■ Reduce vegetation trampling	P3+PR2
Exotic Species Management	Biotic	P1+P2+P3+ PR2+PR4+ PR5	Selective elimination	■ Maintenance of biodiversity	P1+P2+P3+ PR2+PR4+PR5

The following considerations should be incorporated into future management plans for the Sifton Bog and lands within its hydrological catchment. These strategies are intended to:

- Ensure that there is no loss of wetland function or wetland area.
- Reconcile 175 years of human impact with the biological, hydrological, hydrogeological and physical interactions that contribute to the Sifton Bog's status as a Class 2 wetland complex and a Significant Natural Area in the City of London.
- Enhance wetland function and wetland area.
- Provide a context for the future assessment of proposal-specific impacts on the biological, hydrological and hydrogeological systems of the site.

4.1 EARTH SCIENCE CONSIDERATIONS

ES.1 With respect o Planning Units PR 2.3 and PR 4.1:

a) Near-term surface water management strategies should minimize any deviation from the character of the existing hydrologic regime until additional data collection and analysis, as outlined in Section 3.6 of this report, is carried out.

b) Identify, through any proposal-specific environmental impact studies required in the future by regulatory agencies:
- Potential post-development surface flows that are compatible with the wetland features of the Bog
- Incompatible post-development surface flows

c) Retain any compatible post-development surface flows within the existing hydrological catchment of the Bog.

d) Modify, as required, the qualitative and quantitative characteristics of surface flows retained within the catchment.

e) Divert incompatible post-development surface flows from the hydrological catchment of the Bog.

ES.2 Determine the extent of land assembly for the Natural Area in Planning Unit PR 2.2 (presently occupying 2 hectares) on the basis of the hydrogeological, hydrological and biological constraints identified in Section 3.1, and the impact of any proposed landform alterations on the wetland function and special features of the Bog.

This assessment will also recognize the presence of Crataegus dodgei, a nationally and provincially rare plant species on adjoining land at the north end of Planning Unit PR 2.1.

ES.3 Retain Planning Unit PR 2.1 in its biotically-evolving condition.

ES.4 The alteration of Planning Unit PR 3 to a regulated, intensified urban end use would not impact negatively on the hydrogeological, hydrological and biological systems of the Bog.

In the future, following a proposal-specific assessment, potential post-development surface flows of compatible quality from this unit might be directed into the hydrological catchment of the Bog to compensate for the loss of surface volumes from within the historical catchment.

ES.5 Regulate intensified urban end uses in Planning Units PR 2.3 and PR.4.1 with respect to compatibility with biological resources.

ES.6 Decisions relating to landform alterations in Planning Units PR 2.2 and PR.4.2 should be considered within the context of the Conservation Authority's fill line regulation. The ability of these units to support urban use is restricted by their geological characteristics.

ES.7 The ability of Planning Unit PR 4.3 to support urban use in a manner compatible with the wetland functions of the Bog is restricted by its proximity to the Class 2 wetland in Planning Unit PR 5.

ES.8 Retain Planning Unit PR 5 in its biotically-evolving condition, since it consists almost entirely of Class 2 wetland.

ES.9 Re-engineer or close the parking lot immediately south of Oxford Street in Planning Unit P3 to incorporate biotic and abiotic filters to eliminate the surface entry of chlorides and other municipal road-related contaminants into the aquatic environment of the site.

ES.10 Conduct long-term monitoring of both the hydrologic and hydrogeologic regimes, according to the protocol established in the accompanying Hydrogeological and Water Chemistry reports, for resource planning and management purposes. The recommendations in the reports should be critically reviewed and prioritized as additional data becomes available so that specific questions regarding the hydrology and water chemistry can be answered.

ES.11 Consider the feasibility of road surface removal and vegetation community restoration within the road easement of Old Hyde Park Road when it is legally-closed in the future.

4.2 LIFE SCIENCE CONSIDERATIONS

LS.1 Prepare a trail management plan consistent with the accompanying concept that encourages user exposure to the site's diverse biota if detailed study determines it is compatible with the fragility of certain portions of the site (Figure 11).

LS.2 Prepare a vegetation management strategy consistent with the accompanying Management Unit Classification (Figure 9).

LS.3 Prepare a vegetation rehabilitation strategy for previously-disturbed portions of the site.

LS.4 Prepare a strategy for the management of alien species consistent with the recommendations of the Life Science report. Purple Loosestrife control should be considered an immediate priority.

Alien species control programs should be carefully planned, rigorously monitored and re-evaluated within the context of new information as it becomes available.

LS.5 Conduct long term monitoring of biotic conditions within the core pond, marsh and peatland communities for the purposes of monitoring successional influences and the effects of changes in chemical and biological regimes.

LS.6 Retain all the deciduous forest community and wetland of Planning Unit PR 6 in the southwest corner of the site in its biotically-evolving condition for purposes of habitat connectivity and habitat diversity.

LS.7 The rear portions of institutional and residential lands presently fronting on Oxford Street are not considered a land assembly priority from a resource management standpoint. Vegetation and nutrient management strategies should be discussed with all adjacent landowners.

LS.8 Prepare an information package that:
- Describes the site's fragility
- Identifies the manner in which prior human activities on the site's perimeter have impacted its hydrological and biological systems
- Explains future management practices designed to protect the site's critical features.
- Seeks community co-operation in the ongoing protection of the Sifton Bog.

4.3 RECREATIONAL RESOURCE CONSIDERATIONS

RR.1 Retain the minimum maintenance interior trail in its existing location.

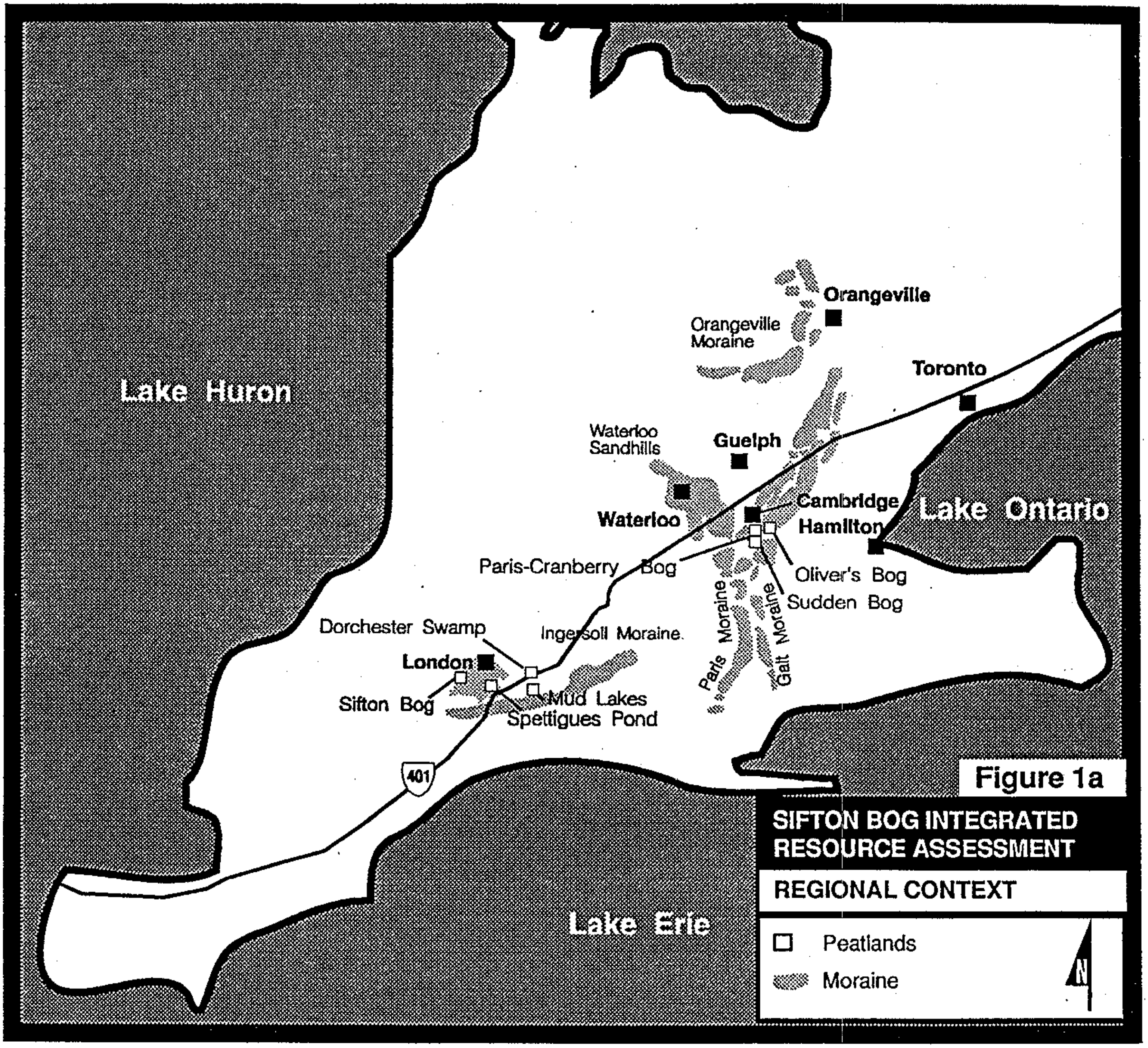
RR.2 Retain existing pedestrian access points.

RR.3 Extend a perimeter trail with a higher level of maintenance to access points on the south and east boundaries of the site.

RR.4 Connect the perimeter trail to the boardwalk.

RR.5 Connect the boardwalk to an access point near Oxford Street.

RR.6 Redesign or close the Oxford Street parking lot to minimize the impact of perimeter sediment loadings on interior vegetation communities.


Lake Huron
Orangeville
Orangeville Moraine
Toronto
Waterloo Sandhills
Guelph
Cambridge
Lake Ontario
Waterloo
Hamilton
Paris-Cranberry Bog
Oliver's Bog
Sudden Bog
Paris Moraine
Galt Moraine
Dorchester Swamp
Ingersoll Moraine
London
Sifton Bog
Mud Lakes
Spettigues Pond
401
Lake Erie
Figure 1a
SIFTON BOG INTEGRATED RESOURCE ASSESSMENT
REGIONAL CONTEXT
Peatlands
Moraine
N

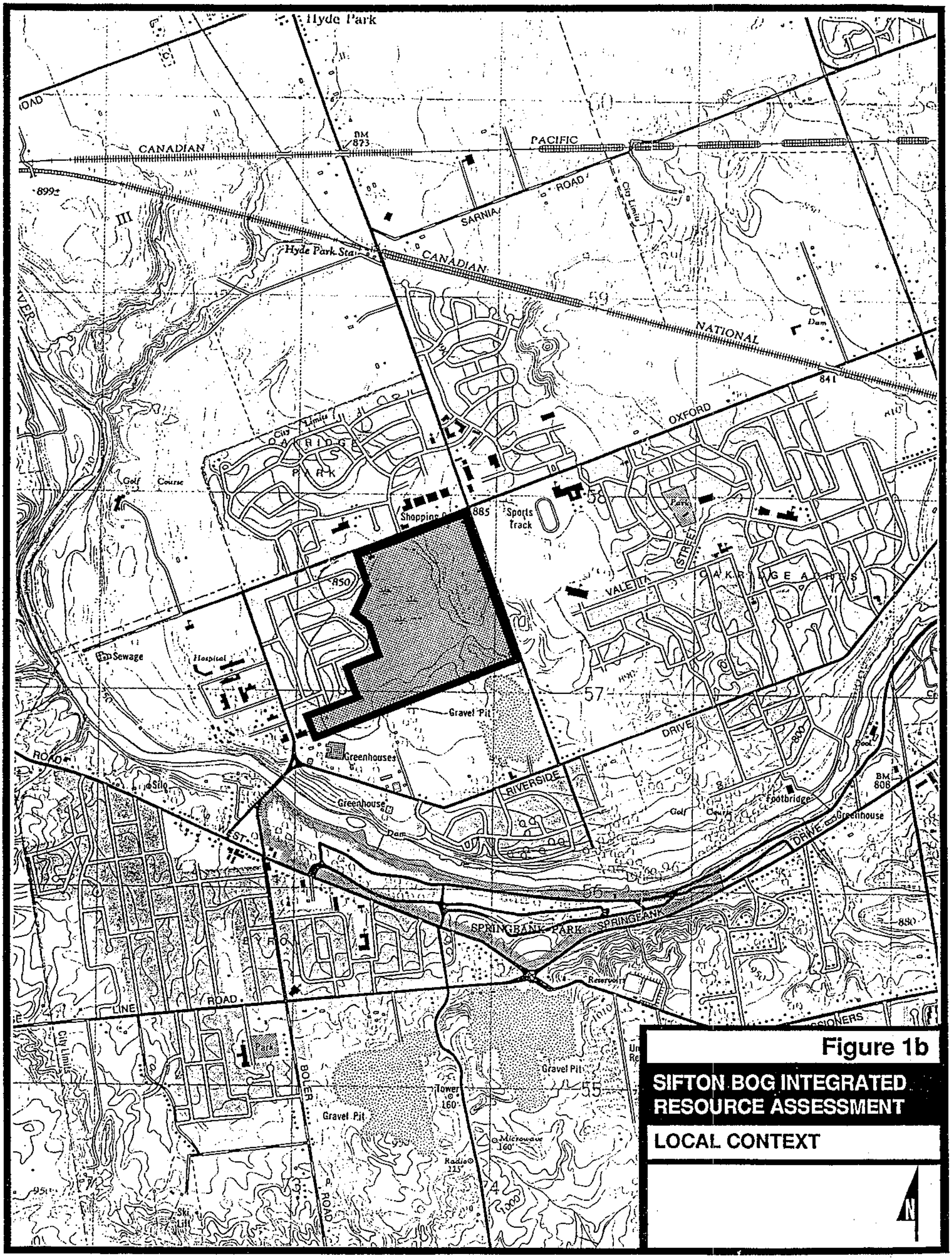


Figure 1b

SIFTON BOG INTEGRATED RESOURCE ASSESSMENT

LOCAL CONTEXT

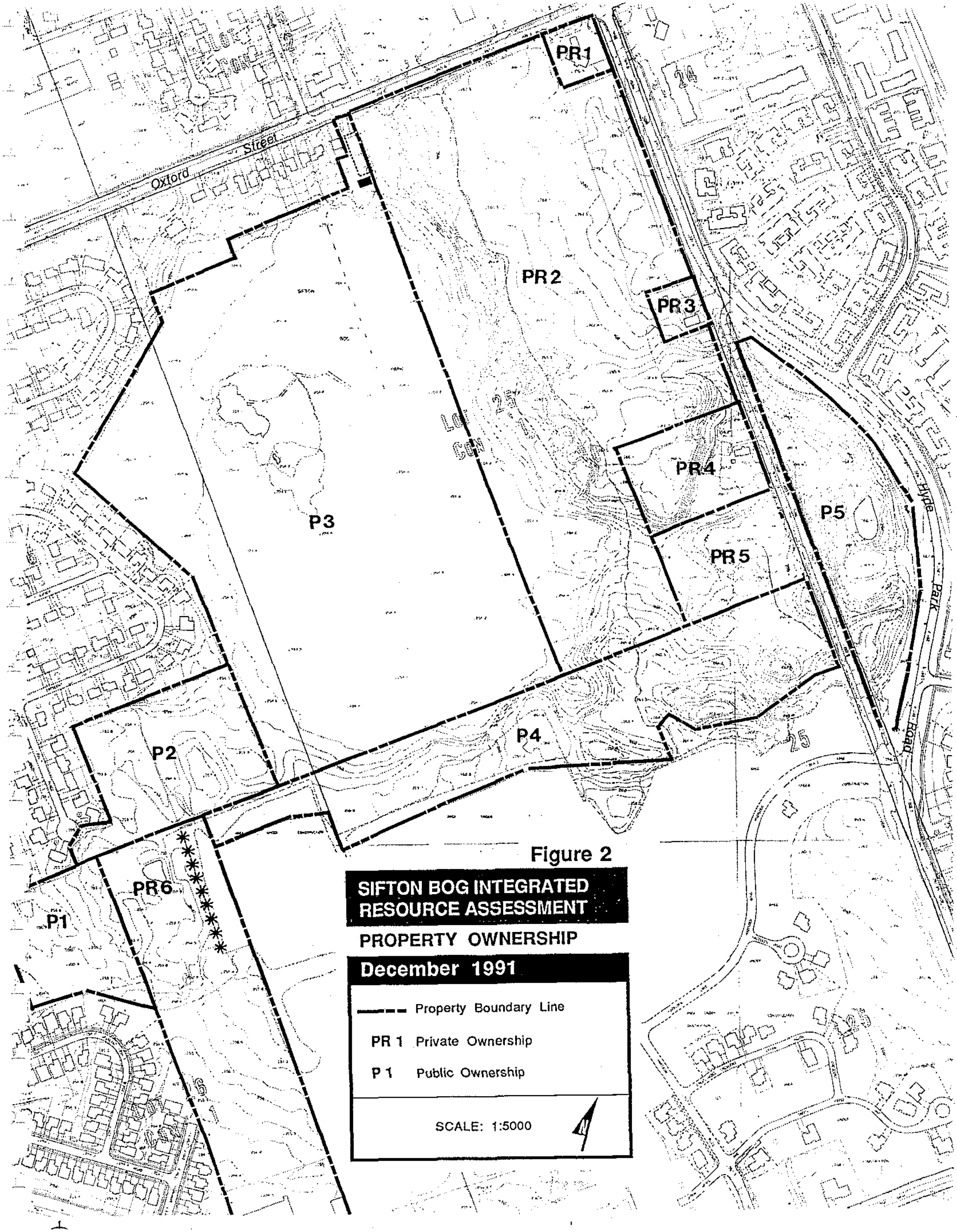


Figure 2

SIFTON BOG INTEGRATED RESOURCE ASSESSMENT

PROPERTY OWNERSHIP

December 1991

Figure 3

SIFTON BOG INTEGRATED RESOURCE ASSESSMENT

VEGETATION COMMUNITIES OF THE SIFTON BOG

- Vegetation Community Boundary
- Boardwalk
- Field House
- Parking Lot
- ✳✳✳ Fence row (Norway Spruce)

SCALE: 1:5000

N

Community	Approximate Size (ha)	%
WETLAND/LOWLAND VEGETATION	24.9	40.9
1. AQUATIC/OPEN WATER	0.5	0.7
a. Floating & Submerged Aquatics: Water-shield - Bladderwort	0.2	0.3
b. Floating Aquatics: Duckweed - Water-meal	0.3	0.4
2. MARSH	0.4	0.6
a. Robust Emergents: Cattail - Spatterdock	0.2	0.3
b. Narrow-leaved Emergents: Lake Sedge - Reed Canary Grass - Purple Loosestrife	0.2	0.3
3. BOG	2.7	4.4
a. Low Shrub (Floating Mat or Sphagnum Lawn): Leatherleaf - Cranberry	0.7	1.0
b. Tall Shrub: Highbush Blueberry - Huckleberry - Willow	0.3	0.5
c. Treed: Black Spruce - Tamarack	1.7	2.9
4. SWAMP	21.4	35.1
a. Tall Shrub: Glossy Buckthorn - Willow	3.3	5.4
b. Tall Shrub: Willow - Dogwood	0.1	0.1
c. Conifer-Deciduous: Tamarack - Red Maple - White Birch	3.2	5.2
d. Deciduous-Conifer: Silver/Red Maple - Birch - White Pine	10.7	17.6
e. Deciduous: White Birch - Silver/Red Maple	0.5	0.8
f. Deciduous: Silver/Red Maple - Willow	1.8	3.0
g. Deciduous: Silver/Red Maple - Birch - Bur Oak	1.8	3.0
UPLAND AND SLOPE VEGETATION	20.8	34.2
5. FOREST	20.0	32.8
a. Mesic Slope Deciduous: Red/White Oak - Black Cherry - Sugar Maple	5.8	9.5
b. Wet Mesic Slope Deciduous: Black Cherry - White Ash - White Elm	0.3	0.5
c. Dry Mesic Upland Deciduous: Sugar Maple - White Ash - Black Cherry - White/Red Oak - Hop-hornbeam	3.9	6.4
d. Mesic to Dry Mesic Early Successional (Second Growth) Slope Deciduous: Hawthorn - Buckthorn - Grey Dogwood - Tartarian Honeysuckle	10.0	16.4
6. SHRUB		
Dry Mesic Slope Thicket: Staghorn Sumac - Hawthorn - Grey Dogwood - Buckthorn	0.8	1.4
ANTHROPOGENIC VEGETATION (Highly Disturbed Areas)	15.2	24.9
7. DRY MESIC FORB/GRAMINOID OLD FIELD	1.4	2.3
8. ABANDONED SAND AND GRAVEL PIT	3.7	6.0
9. PARKLAND AND ROADSIDE VERGES	2.4	4.0
10. CULTIVATED FARMLAND	7.7	12.6
	60.9	**100**

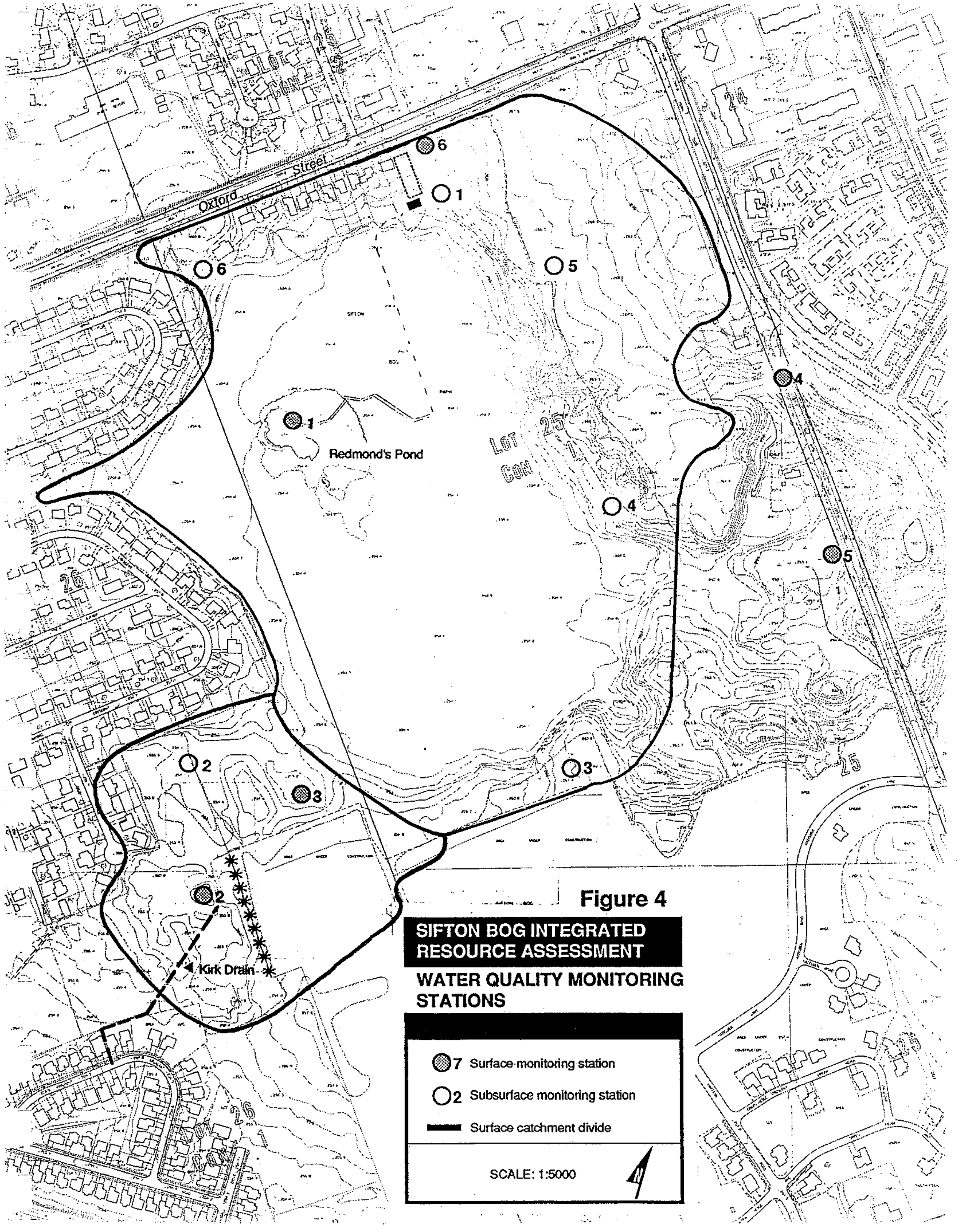
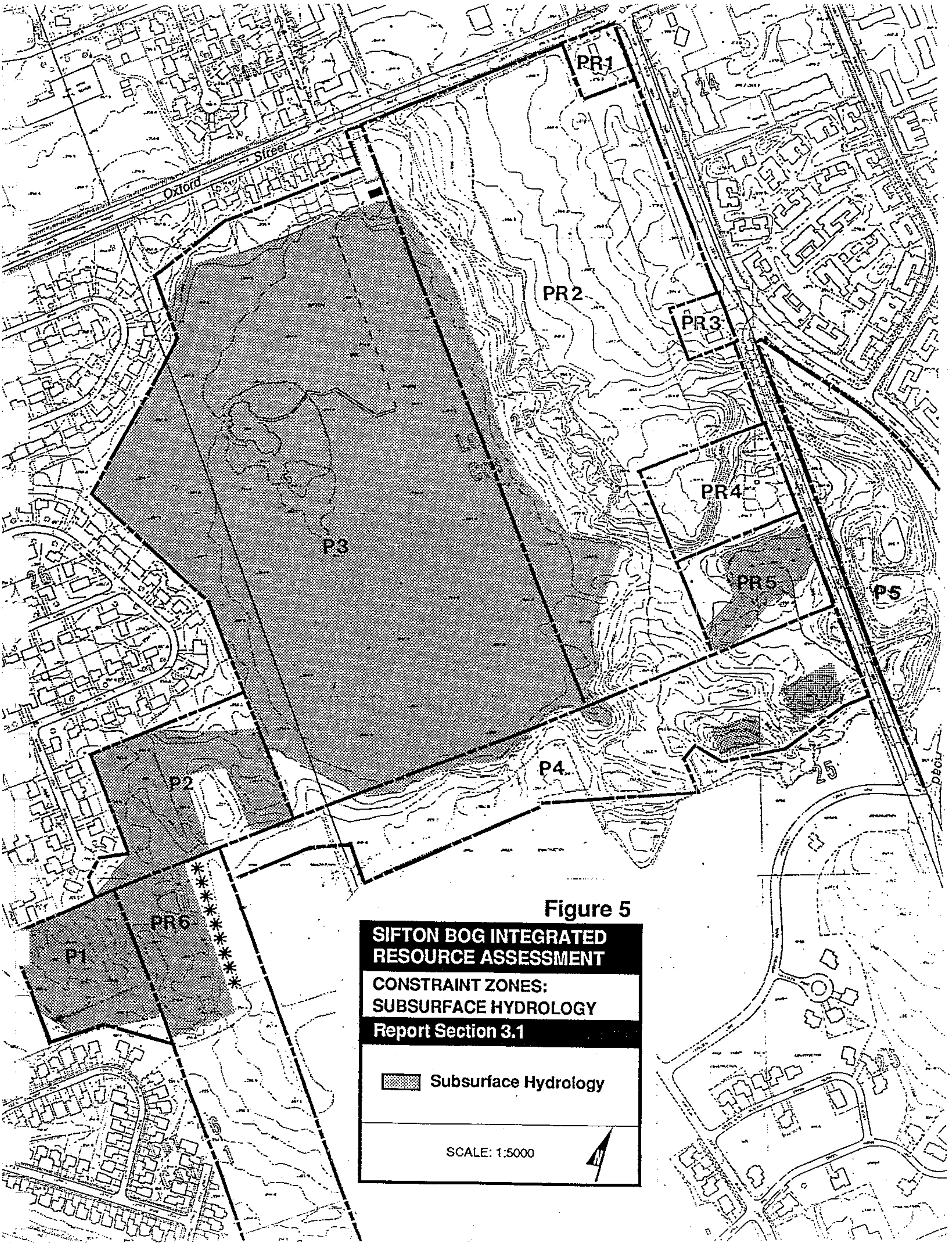
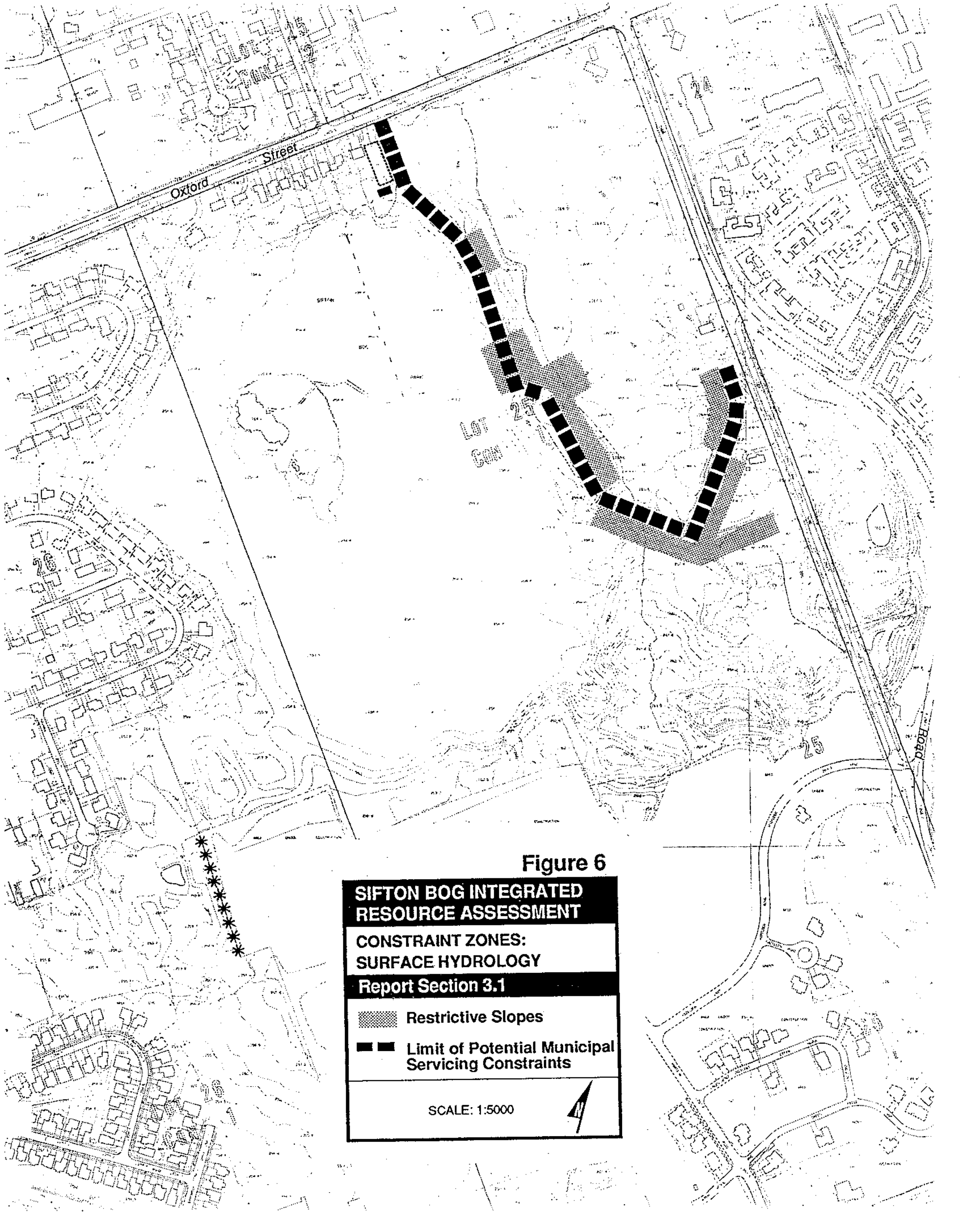


Figure 4

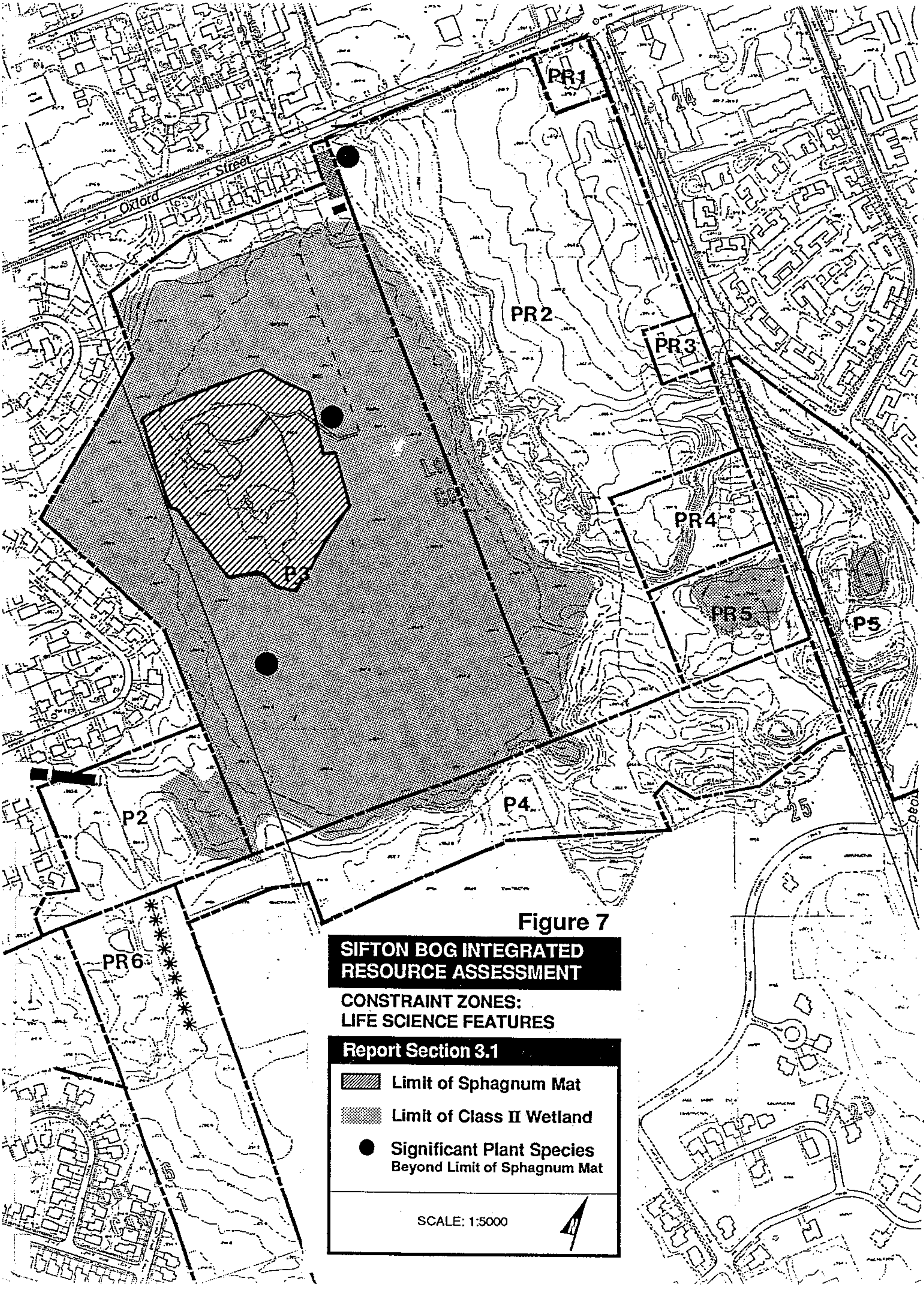
SIFTON BOG INTEGRATED RESOURCE ASSESSMENT

WATER QUALITY MONITORING STATIONS


Oxford Street
PR1
PR2
PR3
PR4
PR5
PR6
P1
P2
P3
P4
P5
Figure 5
SIFTON BOG INTEGRATED RESOURCE ASSESSMENT
CONSTRAINT ZONES: SUBSURFACE HYDROLOGY
Report Section 3.1
Subsurface Hydrology
SCALE: 1:5000



Oxford
Street
LOT
CON
Road
Figure 6
SIFTON BOG INTEGRATED RESOURCE ASSESSMENT
CONSTRAINT ZONES: SURFACE HYDROLOGY
Report Section 3.1
Restrictive Slopes
Limit of Potential Municipal Servicing Constraints
SCALE: 1:5000
N



Oxford Street
PR1
PR2
PR3
PR4
PR5
PR6
P2
P3
P4
P5
Figure 7
SIFTON BOG INTEGRATED RESOURCE ASSESSMENT
CONSTRAINT ZONES: LIFE SCIENCE FEATURES
Report Section 3.1
Limit of Sphagnum Mat
Limit of Class II Wetland
Significant Plant Species Beyond Limit of Sphagnum Mat
SCALE: 1:5000

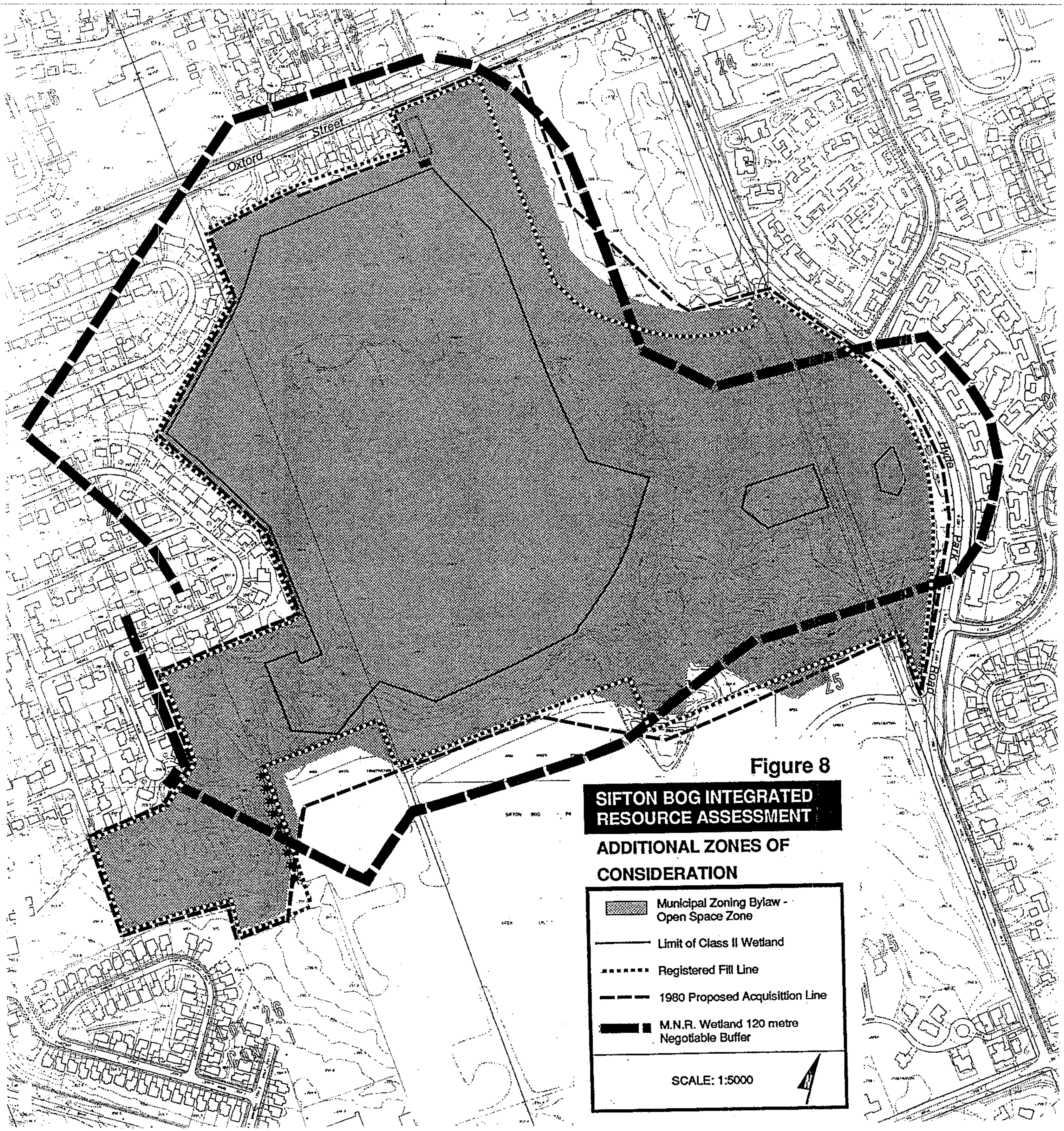
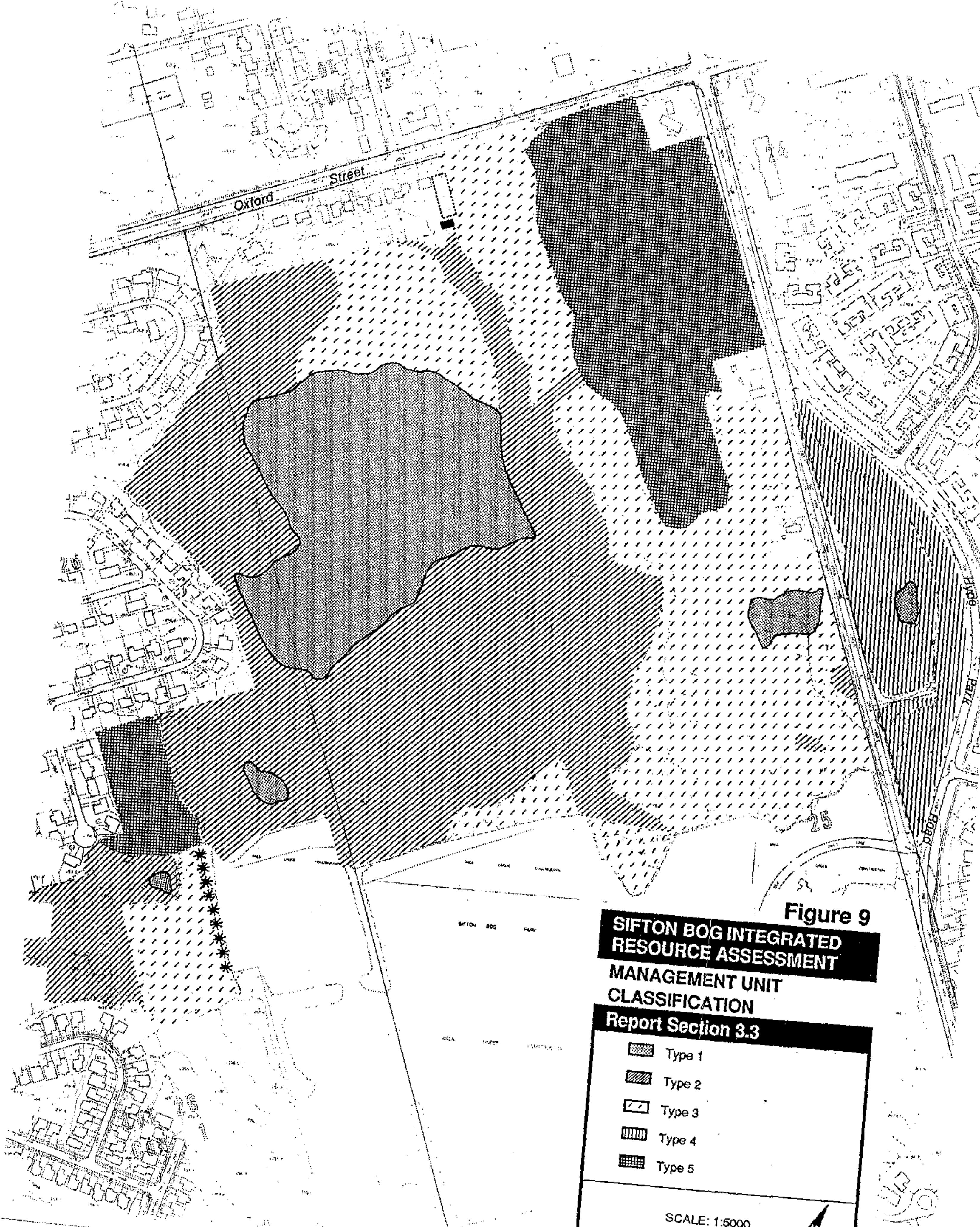


Figure 8
SIFTON BOG INTEGRATED RESOURCE ASSESSMENT
ADDITIONAL ZONES OF CONSIDERATION
Municipal Zoning Bylaw - Open Space Zone
Limit of Class II Wetland
Registered Fill Line
1980 Proposed Acquisittion Line
M.N.R. Wetland 120 metre Negotiable Buffer
SCALE: 1:5000
Oxford Street
Hyde Park Road



Oxford Street
Hyde Park Road
Figure 9
SIFTON BOG INTEGRATED RESOURCE ASSESSMENT
MANAGEMENT UNIT CLASSIFICATION
Report Section 3.3
Type 1
Type 2
Type 3
Type 4
Type 5
SCALE: 1:5000

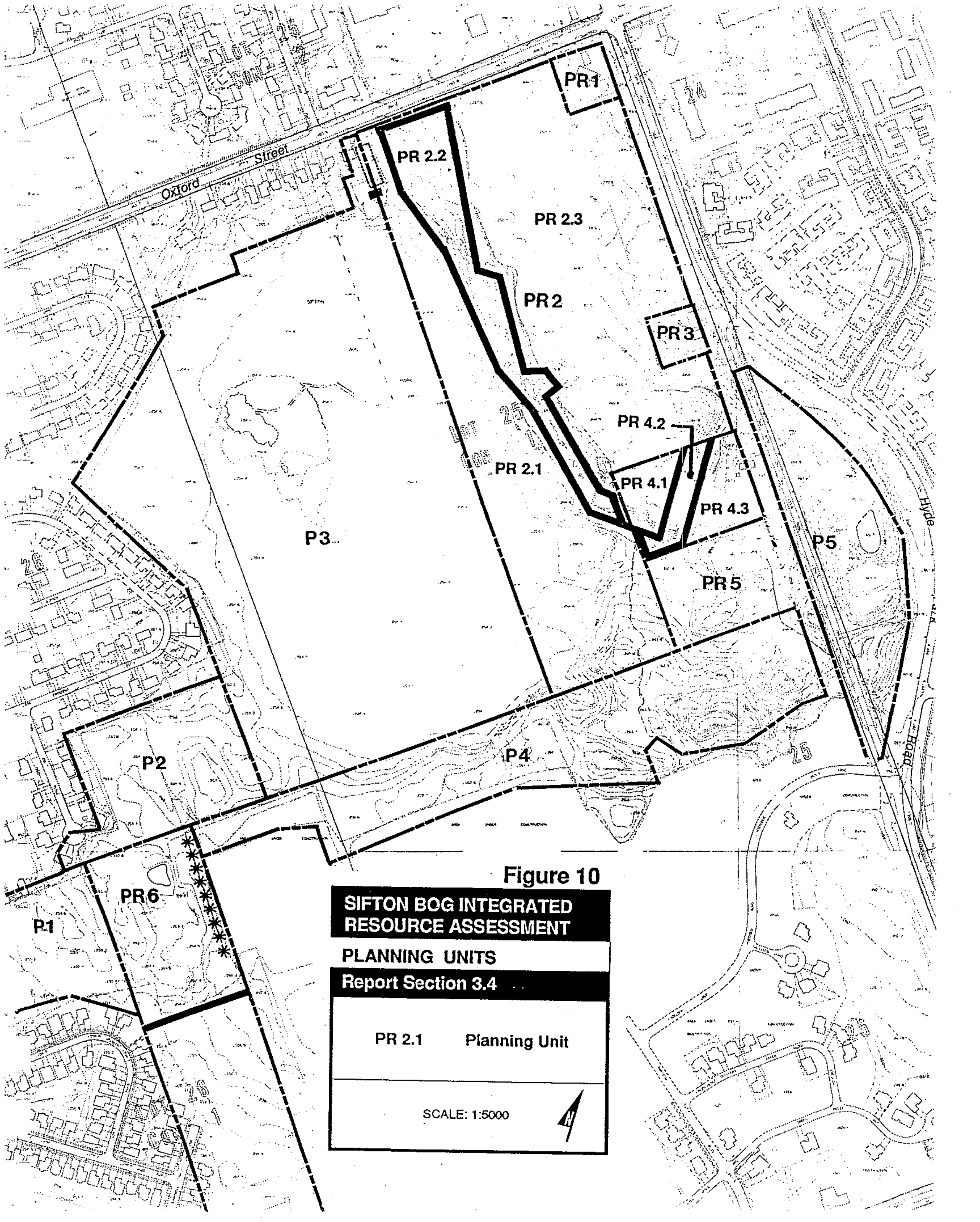


Figure 10

SIFTON BOG INTEGRATED RESOURCE ASSESSMENT

PLANNING UNITS

Report Section 3.4

PR 2.1 Planning Unit

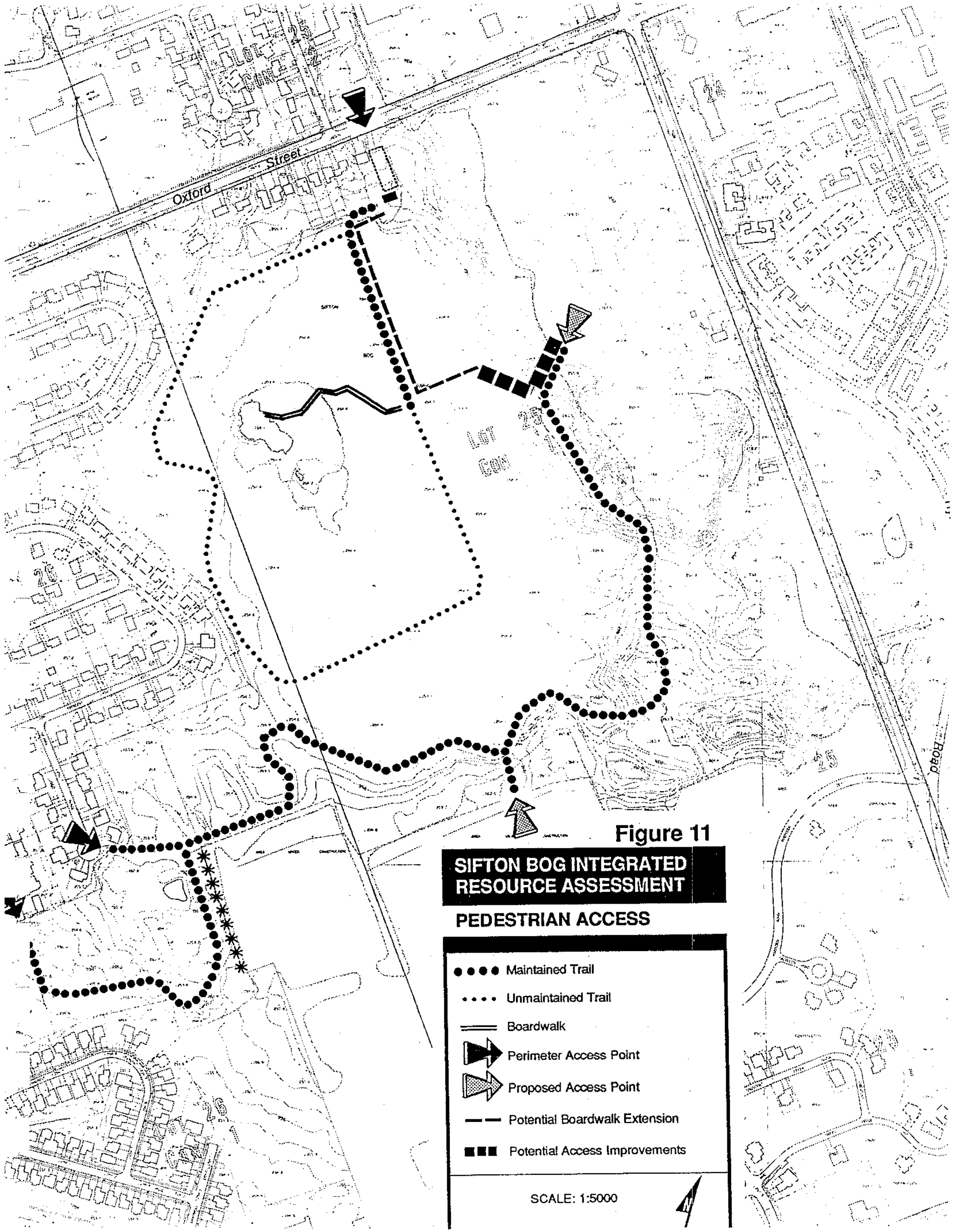


Figure 11

SIFTON BOG INTEGRATED RESOURCE ASSESSMENT

PEDESTRIAN ACCESS

ACKNOWLEDGEMENTS

The efforts of the following persons during the preparation of this document are sincerely appreciated.

Consulting Team

Hydrologeology:	Brad Benson, Golders Associates
Water Chemistry:	Susan Johnston, Upper Thames River Conservation Authority
Life Science:	David McLeod

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- Don Riley, Plancan Associates (on behalf of private sector participants Crich, Drewlo, Marsman, Gattyan and Yates)
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- Terry Grawey, City of London Planning Department
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APPENDIX A: TERMS OF REFERENCE SIFTON BOG INTEGRATED RESOURCE ASSESSMENT

PRIMARY SPECIALIST	COMPONENT
1. Hydrogeological Consultant	Establish overall hydrogeologic setting through review of existing data, maps and reports.
2. Hydrogeological Consultant	Delineate the study area through: a) Definition of the sub-surface aquifer with respect to soil type, depth and water permeability. b) Definition of the surface catchment with respect to soil type, depth andwater permeability.
3. Hydrogeological Consultant	Monitor water quantity in the surface catchment from Summer 1990 through Spring 1991 in periods of low, normal and high flow.
4. Hydrogeological Consultant	Monitor water quantity in sub-surface aquifer from Summer 1990 through Spring 1991 in periods of low, normal and high flow.
5. Surface Quality Evaluator	Monitor water quality in surface aquifer from Summer 1990 through Spring 1991 in periods of low, normal and high flow for phosphorous, nitrogen, chlorides, pH, pesticides, metals and other relevant parameters.
6. Hydrogeological Consultant	Provide one sample per season for the monitoring of water quality in the sub-surface aquifer from Summer 1990 through Spring 1991 in periods of low, normal and high flow for the parameters listed above.
7. Hydrogeological Consultant	Prepare a water budget for the hydrological catchment that considers: a) Surface and subsurface aquifers b) Water quantity during periods of low, normal and high flow c) Directional flow across the study area d) Total inflow vs. outflow through surface and sub-surface aquifers.
8. Hydrogeological Consultant	Summarize annual precipation in the London area during the last 50 years, and place the short-term monitoring results within this historical context.
9. Hydrogeological Consultant	Identify directional relationships between: a) Water quantity and water quality b) Water movement across surface and sub-surface aquifers c) Water budgets.
10. Hydrogeological Consultant	Establish locations and methodology for the long-term monitoring of water movement in the surface aquifer.
11. Hydrogeological Consultant	Establish locations and methodology for the long-term monitoring of water movement in the sub-surface aquifer.
12. Surface Quality Evaluator	Establish locations and methodology for the long-term monitoring of water quality within both aquifers.
13. Life Science Consultant	Review existing biological studies and species lists describing the life science features of the study area.
14. Life Science Consultant	On the basis of data review and field investigation, update species lists for flora and fauna within the study area.
15. Life Science Consultant	Accurately identify the location of all rare species on public and private lands within the study area.
16. Project Manager	On the basis of data provided by the project's hydrogeological consultant, life science consultant and surface quality evaluator, and other literature searches as required, assess impact on the life science features of the study area from: a) Water movement across surface and sub-surface aquifers b) Nutrient, pesticide and metal loadings c) Previous management practices d) Human use within the Sifton Bog e) Existing urban land use on the perimeter of the Site.
17. Project Manager	On the basis of the above assesment, evaluate the compatibility of multi-family residential development in the north-east quadrant of the study area with the earth and life science features of the Sifton Bog.