LANDS DIRECTORATE

DIRECTION GÉNÉRALE DES TERRES

LAND USE MONITORING ON WETLANDS IN THE SOUTHWESTERN FRASER LOWLAND, BRITISH COLUMBIA.

WORKING PAPER No. 34

Environment Canada Environnement Canada

Canada

LAND USE CHANGE ON WETLANDS IN THE SOUTHWESTERN FRASER LOWLAND, BRITISH COLUMBIA

Paul Pilon and M. Anne Kerr

March 1984

CANADA LAND USE MONITORING PROGRAM

Lands Directorate
Pacific and Yukon Region
Environment Canada
Vancouver, B.C.

Working Paper No. 34

ABSTRACT

Wetlands have, historically, had a diverse range of functions, from providing feeding grounds for migrating birds to acting as sediment and pollutants traps for improved water quality. Increasingly, wetlands are facing land use pressures which threaten their ability to perform these functions.

This paper reports on a study of land use change on wetlands within a portion of British Columbia's Southwestern Fraser Lowland. Wetlands were identified on the basis of soil and habitat characteristics. A map of these wetland areas was superimposed on land use maps for 1967 and 1982 to obtain change data. This analysis focusses on the dynamics of land use change on wetlands for built-up, agricultural, recreational and extractive land uses, as well as 'natural' wetlands. It reveals that 28% of natural wetlands in the study area were converted between 1967 and 1982. Much of this, however, was actually a change to recreational and conservation uses of these natural wetlands. Still, wetlands did undergo significant changes. Built-up uses on wetlands almost doubled during this same period, resulting in a permanent wetlands loss. Further study would determine whether other types of land are facing as much or more pressure for land use change as wetlands within the Southwestern Fraser Lowland.

RÉSUMÉ

Historiquement, les terres humides ont présenté une gamme diversifiée de fonctions: aires d'alimentation pour oiseaux migrateurs et zone d'accumulation des sédiments et des polluants pour l'amélioration de la qualité de l'eau. De plus en plus, les pressions relatives a leur utilisation menacent leur capacité de remplir ces fonctions.

Les changements touchant l'occupation des terres humides dans le sud-ouest des basses terres du Fraser en Colombie-Britannique ont été étudiés. Les terres humides ont été déterminées en fonction des caractéristiques du sol et de l'habitat. Une carte de ces terres a été superposée sur des cartes de 1967 et de 1982 de l'utilisation des terres pour obtenir les données sur les variations. L'analyse porte principalement sur la dynamique des changements d'utilisation des terres humides ayant un potentiel pour la construction, l'agriculture, les loisirs et les activités d'extraction, de même qu'en temps que lieux naturels. Elle révèle que 28% des terres humides naturelles de la zone étudiée avaient été converties entre 1967 et 1982. Il s'agissait dans bien des cas, toutefois, d'utilisations pour les loisirs ou la conservation. Néanmoins, les terres humides ont subi des changements importants. La construction sur ces terres a presque doublé au cours de la période considérée, entraînant une perte permanente des terres en question. Une étude plus approfondie permettrait de déterminer si d'autres types de terres subissent des pressions aussi élevées pour leur changement d'affectation dans les basses terres du sud-ouest du Fraser.

Cat. No. En 73-4/34E
ISBN. 0-662-13142-8

ACKNOWLEDGEMENTS

Appreciation is extended to those who assisted in the completion of this report. H.A. Luttmerding, Surveys and Resource Mapping Branch, B.C. Ministry of Environment, provided valuable assistance in explaining and defining wetland soils. The constructive comments of Ken Redpath and D.S. Lacate, Lands Directorate are also appreciated. Critical review of this paper has been undertaken by members of the CLUMP National Committee and their comments incorporated.

PREFACE

This paper reports on a study initiated through the Canada Land Use Monitoring Program's prime wetland project. It is one of a series of representative studies across Canada identifying methodologies for and the significance of the conversion of wetlands due to external and internal land use pressures. The figures and statistics in this report refer only to the wetland areas examined, and may not be representative of the entire Fraser Lowland. The study and statistics reported also are confined to changes on potential wetland areas, based on soil and habitat conditions, on about 45% of the land within the limits of the overall study area.

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

LIST OF MAPS

1.0 INTRODUCTION

Wetlands are often regarded as mere wastelands rather than as a prime resource of national significance. Our national wetland resource is of vital importance, providing a diverse range of functions including: water absorption and storage to reduce the potential for flooding; regeneration of water supplies; improvement of water quality by reducing nutrient load; trapping sediment and pollutants and increasing oxygen content; protection of shorelines by providing a physical buffer to wave energy impact; provision of breeding, nesting and feeding grounds for many species of mammals and birds; provision of spawning and nursery grounds for fresh water fish and salt water shellfish and finfish; providing outdoor education exhibits and scientific laboratories; and a host of recreational uses (Lynch-Stewart, 1983).

The value of these natural functions is often overlooked because of the potential for conversion of wetlands to alternative "productive" uses. Agriculture dominates the list of such alternative uses of wetlands. More recently, however, in areas of southern Canada, urbanization has also become a serious threat to the wetland ecosystem.

Evidence of decline in the amount of natural wetlands, and the increasing number and intensity of wetland-related land use conflicts suggests that these areas require closer study and greater consideration in land use planning. In this regard there is a need to monitor the nature and impacts of land use changes within, and adjacent to these wetland areas.

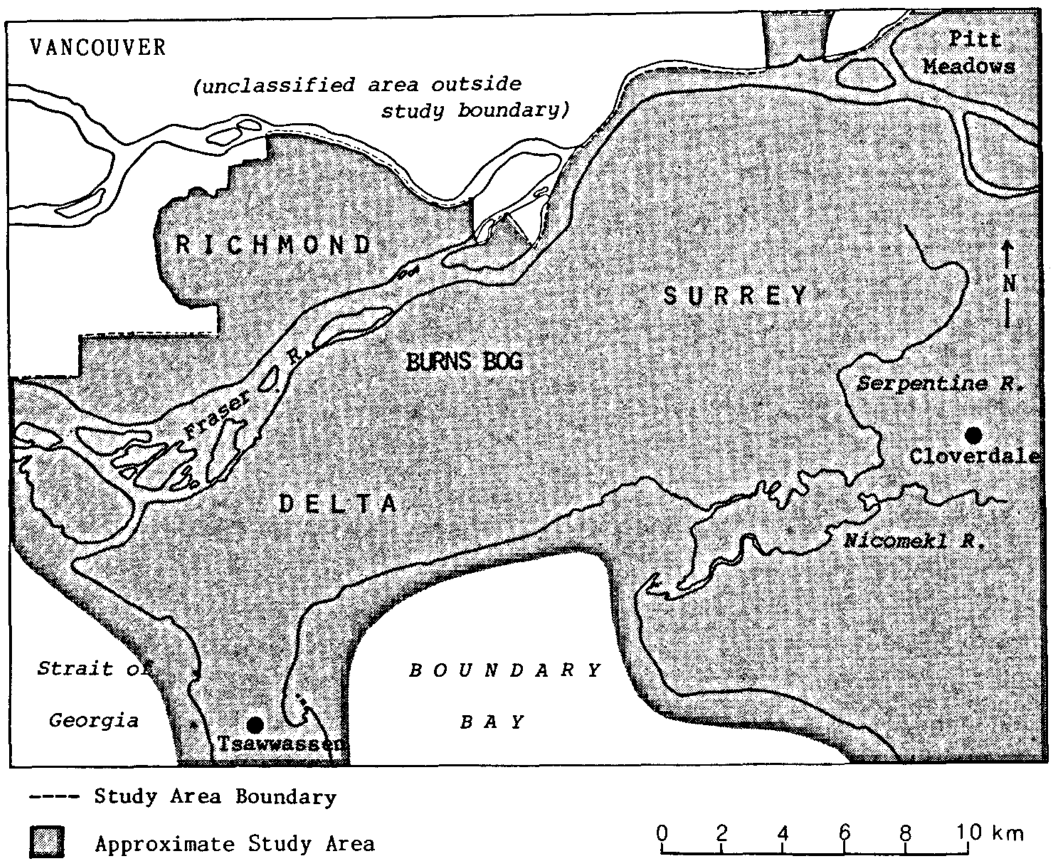
The following project focusses on land use change on and adjacent to potential wetlands in a portion of British Columbia's Southwestern Fraser Lowland over a 15 year period (1967-1982). The study boundary extends from approximately Sea Island east to the Surrey/Langley border, covering most of the land south of the north arm of the Fraser River (see Map 1). Because of their close proximity to Vancouver, these lands are subject to pressures for agricultural use, urban and industrial development, energy related development, and recreational uses. The study focusses only on land use changes on potential wetlands (or about 45%) of the total "study area" described above.

The study is based primarily on existing data sources such as CLUMP (Canada Land Use Monitoring Program), CLI (Canada Land Inventory) and soil and habitat surveys. The approach taken towards analyzing wetlands within the study area is determined by the nature of these existing sources. An initial determination and mapping of these potential wetlands is followed by an examination of land use change on these defined wetland areas. The discussion is supported by tabular and mapped land use data for 1967 and 1982.

This project is not a study of all wetland areas in the Lower Fraser Valley. Rather it is designed to aid in the development of research methods for monitoring land use change on wetlands. Hopefully, it will form the groundwork for more comprehensive wetland studies in the future.

2.0 STUDY AREA

The area defined for this project lies within the National Topographic System Maps 92G/2 and 92G/3 (1:50,000 scale). It



Map 1: Study Area

encompasses a land area of approximately 52 400 ha (see Map 1). The boundaries for the study area were arbitrarily chosen and were not meant to include all wetlands within the Lower Fraser Valley.

The study area is, however, relatively complex in terms of the diversification of land use and land use change on and adjacent to wetlands. Therefore it reflects the wide range of concerns that are being raised about the future of Canada's southern wetland areas. The Southwestern Fraser Lowland is one of the most agriculturally productive areas in Canada for small fruits, vegetables and forage crops. The adjacent Fraser estuary also supports extremely high rates of biological activity, accommodating one of the largest salmon runs in the world; providing home for the largest population of wintering waterfowl in Canada; and providing one of the most important stopping points for migrating birds on the Pacific Flyway (Cameron and Obee, 1981; Lynch-Stewart, 1983).

3.0 <u>METHODOLOGY</u>

3.1 Wetlands Definition

The basic definition of wetlands adopted for this study is that of the Canada Committee on Ecological Land Classification as described by Tarnocai (1980). For the purpose of the Canadian Wetland Registry, wetland areas were defined as land having a water table at, near, or above the land surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soils, hydrophylic vegetation and various types of biological activity that are adapted to the wet environment.

Under this definition the following types of land are considered wetlands:

1. peatland which is formed by the accumulation of plant material and is associated with organic soils;

2. areas influenced by excess water, but which produce little peat and are therefore often associated with Gleysolic soils;

3. areas which are modified by water control structures, or which are tilled and planted but which if allowed to revert, would again become saturated. These areas are often associated with Gleysolic soils (Tarnocai, 1980).

3.2 Determination of Wetland Areas

The potential wetlands outlined in this study can be categorized into two basic subgroups defined on the basis of soil or habitat characteristics The delineation of wetland soils was the primary criteria in determining wetland areas, supplemented by habitat zone delineation on land beyond dyked areas where soil characteristics have not been mapped. Although vegetation is often considered an important aspect in defining wetlands, in the Lower Fraser Valley the majority of vegetation cover has been altered by logging, fire or clearing. As a result its use in determining wetland areas is limited.

Areas that were not classified or mapped for soil characteristics or habitat zones could not be included in the study area (see Map 6, back pocket). These are mainly areas which were already completely urbanized (or industrialized) at the time of the field survey* by the B.C. Ministry of Environment (Luttmerding, 1980).

3.3 Wetland Areas Defined by Soils Mapping

Initially, with the assistance of Mr. Herb Luttmerding, B.C. Ministry of Environment Soil Specialist, those soils within the study area that had characteristic wetland features were identified (e.g. floodplain or deltaic deposits with poor drainage or high water table) (Luttmerding, pers. comm.).

These soils were then subdivided into three general classes: deep organics, shallow organics and mineral soils** Shallow organic soils range between 40 and 160 cm in depth while deep organic soils are greater than 160 cm in depth. Of the mineral soils identified, twenty-three soil series with poor to very poor drainage and high water tables, classed as Rego Gleysols and Rego Humic Gleysols (including saline and peaty phases) were considered wetlands for the purposes of this pilot study.*** Where soil map units were composed of several soils with different characteristics, only those units with dominant wetland characteristics, as defined by drainage and water table, were classed as "wetlands" in this study.

---

* The soil survey of the Vancouver-Langley map area was initiated in the late 1950's and field mapping was completed in the early 1970's. The report containing the maps was published in 1980.

** See Appendix 1 for soil series chosen.

*** It is recognized that in a comprehensive study of wetlands in the region, soils such as Orthic Gleysols and Orthic Humic Gleysols, with characteristic poor to moderately poor drainage and high or perched water tables, might also be included in a 'wetlands' category.

3.4 Wetland Areas Defined by Habitat Zones

The habitat zones chosen to represent potential wetland areas were those which were only periodically inundated by tides, thus allowing establishment of characteristic hydrophylic wetland vegetation. These habitat zones are outlined in the Habitat section of the Fraser River Estuary Study (1978), a joint federal and provincial government project.

Areas of wetland soils which overlapped with wetland habitat zones were included in the wetland soils grouping as discussed earlier. The habitat zones which were considered wetlands included: Salt Marshes, Intertidal Brackish and Fresh Water Marshes, and Riparian Communities (Fraser River Estuary Study Steering Committee, 1978).

3.5 Procedures for Mapping and Analysis of Land Use Change on Wetlands

The potential wetland areas defined on the basis of soil classification were transferred to a mylar stable base map from existing 1:50,000 scale soil maps of the Lower Fraser Valley. These wetland areas were distinguished by the three basic soil types: deep organic, shallow organic and mineral (Rego and Rego Humic Gleysols). Using a polar planimeter and grid square, the wetland area in each soil type was determined (Table 1).

The boundaries for the habitat zones were transferred to a mylar stable base map from a 1:50,000 scale base map prepared for the Fraser River Estuary Study (1978). The area in each habitat zone was determined in a manner similiar to that described above. Wetland soils and habitat zones were combined to

TABLE 1

WETLANDS WITHIN THE STUDY AREA
(hectares)

Wetlands based on soil type within study area	
Deep Organic (TY)	8 907 ha
Shallow Organic (T)	4 396 ha
Rego and Rego Humic Gleysols (W)	8 702 ha
TOTAL WETLAND AREA BY SOIL TYPE	22 005 ha
Intertidal wetlands based on habitat zones within study area	
Salt Marsh (SM)	168 ha
Intertidal brackish and fresh water marsh (IB)	1 069 ha
Riparian Communities (R)	237 ha
TOTAL INTERTIDAL WETLAND AREA	1 474 ha
TOTAL WETLAND AREA WITHIN THE STUDY BOUNDARY* excluding areas where soil type was not classified	23 479 ha

* The total study area comprises 52 400 ha; hence potential wetlands based on soil and habitat characteristics over 44.8% of the total studied area.

to produce a wetlands base map (Map 6, back pocket).

This wetlands base map was then superimposed on an existing CLI (Canada Land Inventory) land use map of the area (1967). Land use polygons coinciding with wetland areas were transferred to a mylar overlay. The area in each land use was determined by potential wetland type. Similiarly a 1982 CLUMP (Canada Land Use Monitoring Program) land use map (1:50,000 scale) was overlaid, land use polygons were plotted and the area in each land use was determined by wetland type. Because of the differences in the two classification systems (CLI versus CLUMP) an equivalency table was established to allow generalization of the CLUMP system to the level of the CLI classification (Appendix 2). In the final stage, the two plotted land use maps for 1967 and 1982 were superimposed and a land use change overlay map was derived.

4.0 LAND USE

The composition of land use in the study area for 1967 and 1982 as well as percentage changes between the two years are given in Table 2. The most dominant land use on wetlands within the study area is improved agriculture (forage and crops). In 1982 this land use class accounted for 41% of the total wetland area. Other major uses were, natural wetlands (20%), and built-up (12)%.

For the purposes of this study, all land with relatively undisturbed "natural" cover (woody vegetation or bare ground) and no perceived activity or idle land (under the CLUMP classification) is considered natural wetland. This term is used throughout this report distinctly from "potential" wetland i.e.those areas identified on the basis of soil and habitat conditions as described in previous sections of the report.

The largest net change occurred on natural wetlands where 1 775 ha left the 'natural' wetlands category between 1967 and 1982. Recreation and built-up uses gained the most within this period: recreation increased by 1 432 ha and built-up by 1 370 ha. All other land uses on defined wetland areas declined during this 15 year period, with the exception of horticulture which remained relatively constant as shown in Table 2. These statistics reveal only the net changes in land use over time; they do not disclose the dynamics of this change. The changes among land uses between 1967 and 1982 are discussed in the following section.

5.0 LAND USE DYNAMICS

Land use dynamics refer to the study of change in land use with time, including both quantity and nature of change. Figure 1 is a

TABLE 2

1967 and 1982 LAND USE ON AREAS DEFINED AS WETLANDS AND PERCENTAGE CHANGES

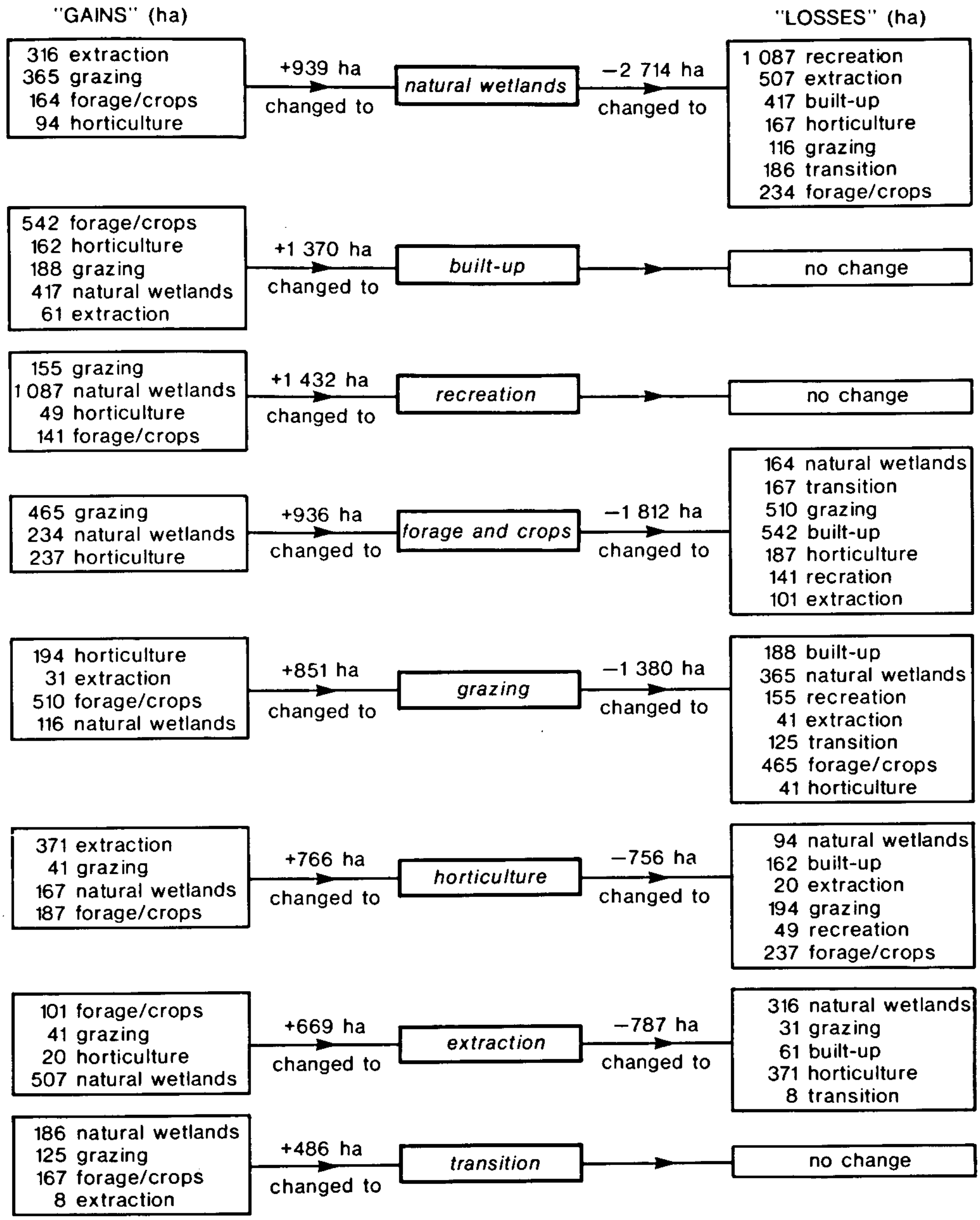
Land Use Class	1967 Area (ha)	1967 Potential Wetlands % Area	1982 Area (ha)	1982 Potential Wetlands % Area	1967-1982 Change (ha) Within Class
Natural Wetlands	6 571	27.9	4 796	20.4	-1775
Recreation	125	0.5	1 557	6.6	+1432
Built-up	1 507	6.4	2 877	12.2	+1370
Extraction	1 449	6.2	1 331	5.7	-118
Improved Agriculture (forage & crops)	10 456	44.5	9 580	40.8	-876
Improved Agriculture (horticulture)	1 260	5.3	1 270	5.4	+10
Unimproved Agriculture (grazing)	2 111	9.0	1 582	6.7	-529
Land in Transition	no data	no data	486	2.1	unknown
TOTAL WETLANDS	23 479 ha	100%	23 479 ha	100%	

* Represents net change within each specific land use class, based not only on gains but also losses from 1967-82 (see Figure 1).

Figure 1

WETLANDS STUDY: LAND USE DYNAMICS

(1967-1982)



TOTAL AREA
7 449 ha

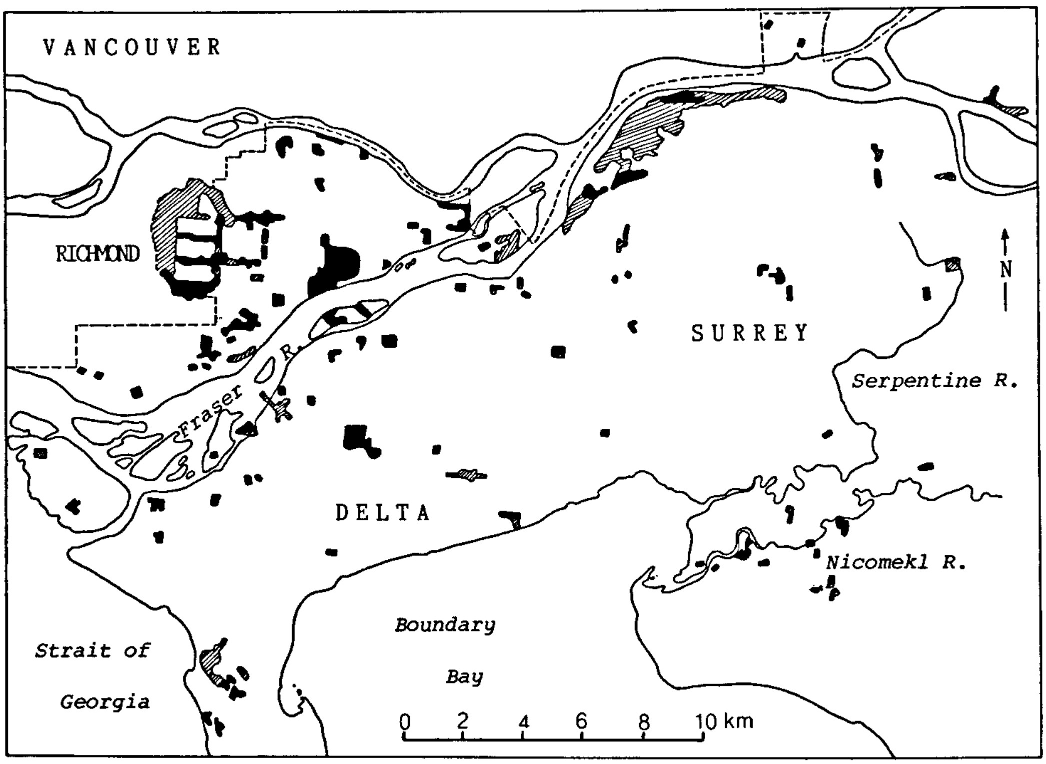
graphic summary of land use changes on wetlands within the study area. During the period 1967-1982, 7 449 ha or one-third of the wetlands within the study area underwent some form of land use change. For example, between 1967 and 1982, 939 ha (316 from extraction, 365 from grazing, 164 from forage and crops and 94 from horticulture) reverted to 'natural' wetland (i.e. natural-type cover on areas defined as wetlands). However, during the same period, 2 714 ha of natural wetlands went to other land uses: 1 087 ha to recreation, 507 ha to extraction, 417 ha to builtup, 186 ha in transition and 517 ha to a combination of agricultural uses. As a result there was, in fact, a net reduction of 1 775 ha of lands classed as 'natural' wetlands.

5.1 Urbanization

The amount, location and nature of urban encroachment occurring on wetlands is a subject of major concern within the study area. Over the last few decades activities such as dredging, draining and infilling wetland areas for urban-related development has severely reduced the wetland base. Table 3 indicates that built-up uses on wetlands have increased considerably during the 1967-1982 period.

Although more improved forage and cropland went to built-up uses than any other land use between 1967 and 1982, these wetlands would already have been modified quite significantly for agricultural purposes. Of note

Map 2: Urbanization of Wetlands



▨ - WETLAND AREA IN URBAN USES IN 1967
■ - WETLAND AREAS THAT BECAME URBANIZED BETWEEN 1967 AND 1982
----- Study area boundary

TABLE 3

RATES OF URBANIZATION ON WETLANDS:
LAND THAT BECAME BUILT-UP 1967-1982

Land Use	1967-1982 hectares/year	
Improved Agriculture (horticulture)	11	60
Improved Agriculture (forage and crops)	36	
Unimproved Agriculture (grazing)	13	
Extraction	4	
Natural Wetlands	28	
All Land Uses (Total)	91 ha/year	
TOTAL AREA BUILT-UP 1967-1982 = 1 370 hectares		

is that 417 ha of natural wetlands were converted to built-up uses (Figure 1). This represented 30% of all land changed to built-up in this period in the area of study.

In total, 1 370 ha (6%) of the potential wetlands within the study area were converted to built-up uses between 1967 and 1982. Most of this urbanization occurred adjacent to existing built-up areas mainly in the Richmond area (Map 2). In addition, a large proportion of the land converted to built-up uses in more isolated areas, such as Burns Bog, has been devoted to industrial development and waste disposal activities.

Trends in urbanization can be examined by considering annual rates of urbanization. Table 3 shows that land was being converted to built-up uses, over the period 1967-82, at a rate of 91 ha per year. The most dramatic rates of urbanization are from the conversion of agricultural land (60 ha/yr) which accounts for 65% of the land that has been urbanized during this period. The largest portion of this conversion was from improved forage and crop land to built-up uses (36 ha/yr).

Loss of natural wetlands to built-up uses was also significant (28 ha/yr) accounting for 30% of the wetland area that had become urbanized by 1982.

5.2 Agricultural Uses

Agriculture is the most dominant use of potential wetlands in the study area. It was also the land use that declined the most during the study period through conversion to other uses. In 1967 agricultural uses occupied a total of 13 827 ha (59% of wetlands in the study area). Between 1967 and 1982 these uses declined by 1 395 ha.

5.2.1 Improved Agricultural Land (Forage, Crops and Horticulture)

Improved agriculture includes all land used for forage or cash crops, agricultural site activities, berries, market gardens and nurseries. Forage and cropland production are the most dominant, accounting for 89% of the area in this land use class in 1967.

Over the period 1967-1982 improved agriculture uses on potential wetlands suffered a net decline of 866 ha. In 1967, 11 716 ha or 50% of the potential wetland area was in improved agriculture. By 1982, 18% of this land had been converted to other uses. Of this amount, about 8% had gone to urban-related uses (including built-up, extraction and land in transition), about 8% had reverted to rangeland and natural wetlands, and just under 2% had changed to recreation-related uses.

Between 1967 and 1982, 936 ha were converted to forage and cropland (Figure 1). The majority of this (75%) was converted from existing agriculture (grazing and horticulture) while 25% was converted to forage and cropland from natural wetlands.

5.2.2 Unimproved Agriculture (unimproved pasture and rangeland)

Unimproved pasture and rangeland includes natural grassland, rough grazing land and idle or abandoned farmland. In 1967 this land use occurred on 2 111 ha (9%) of the potential wetlands within the study area.

Over 1 300 ha of unimproved pasture and rangeland were converted to other uses between 1967 and 1982; 37% was upgraded to improved agriculture, 26% reverted to natural wetlands, and 14% changed to built-up uses.

During the same period, 851 ha changed to unimproved pasture and rangeland (Figure 1). The majority (82%) came from improved agriculture, with the remainder primarily from conversion of natural wetlands.

5.3 Natural Cover Classes

Natural wetlands include the following CLI land use classes: productive and non-productive woodland, swamp, marsh or bog and non-vegetated rock surfaces as well as two CLUMP classes: no perceived activity and idle land (Appendix 2). In the CLI and CLUMP classification systems these areas are defined primarily on the basis of their natural cover rather than their use. In 1967, "natural" wetlands occupied approximately 6 571 ha (28%) of the "potential" wetlands in the study area. At least one-half of this land was located in Burns Bog and the adjacent area. By 1982 the area in natural wetlands had been reduced to 4 796 ha (Map 3).

TABLE 4

RATES OF NATURAL WETLAND LOSS THROUGH CONVERSION TO OTHER USES 1967-1982

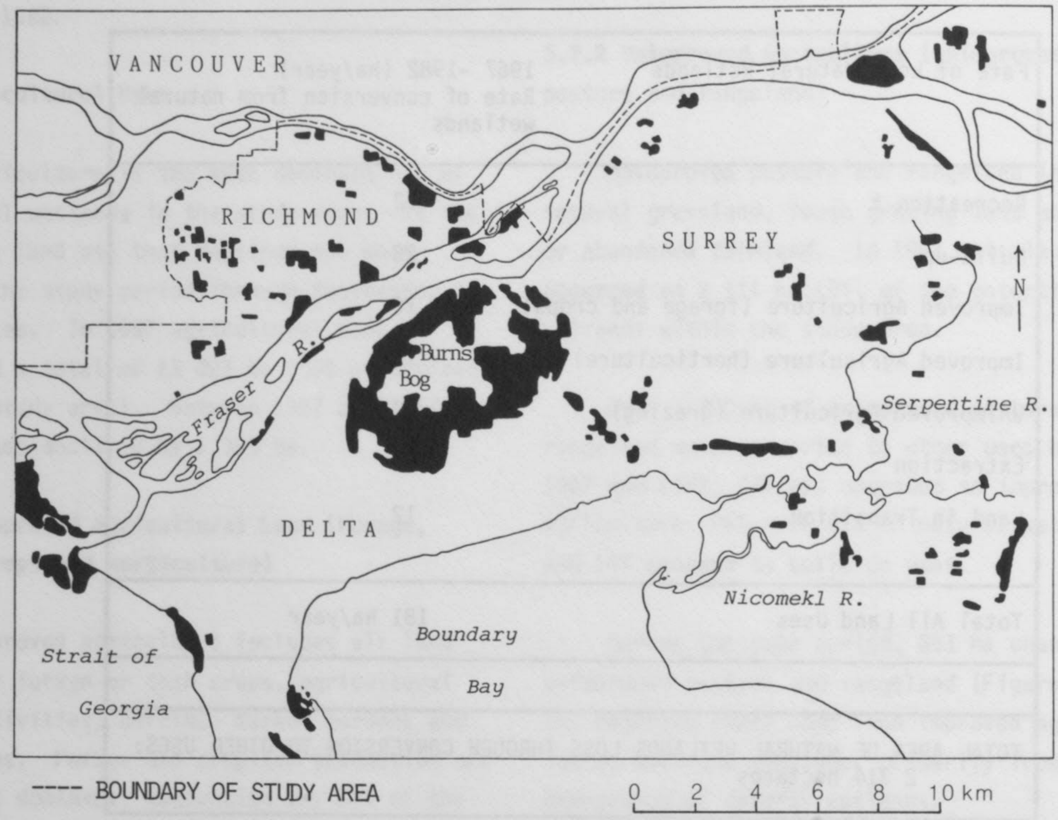
Fate of Lost Natural Wetlands	1967 -1982 (ha/year) Rate of conversion from natural wetlands
Recreation *	72
Built-up	28
Improved Agriculture (forage and crops)	16
Improved Agriculture (horticulture)	11
Unimproved Agriculture (grazing)	8
Extraction	34
Land in Transition	12
Total All Land Uses	181 ha/year
TOTAL AREA OF NATURAL WETLANDS LOSS THROUGH CONVERSION TO OTHER USES: 2 714 hectares	

* It should be noted that 53% of the so called 'loss' of natural wetlands went to recreational uses. Some of this loss reflects a change in designation to 'wildlife' or 'conservation' area and an acknowledgement of previous unofficial recreation land rather than an actual conversion from natural cover wetlands.

A large proportion (40%) of the potential wetlands area which converted to other uses between 1967 and 1982, as noted in Figure 1 went to recreation uses. Thirty-four percent (924 ha) also was converted to a combination of built-up and extractive uses, while 19% went to improved and unimproved agricultural uses.

A smaller amount of the potential wetlands in the study area (939 ha) reverted to natural wetland cover between 1967 and 1982. About two-thirds (623 ha) were previously agricultural uses, primarily grazing which occupied 365 ha. Thirty-four percent (316 ha) were formerly in extractive uses.

Map 3: Wetlands in Natural State in 1982

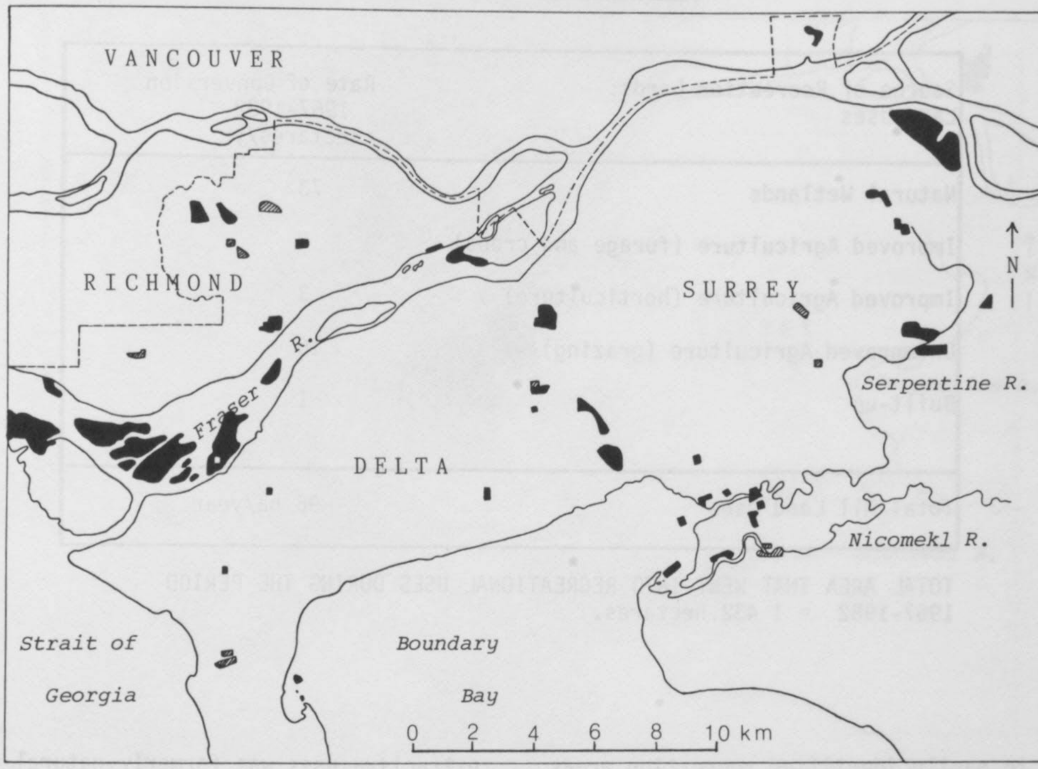


These net conversions of 1775 ha (losses and gains) to other uses represent only a 7.5% change in the total potential wetland base; they constitute over one-third of the total land use changes that occurred during the 1967-82 period. Table 4 summarizes the decline of natural wetland areas. An average of 180 ha of natural wetlands were converted to other uses every year between 1967 and 1982. Recreation and extraction were the dominant land uses to which natural wetlands were converted in this period.

5.4 Recreation

Recreation is one of the least disruptive uses of wetland areas. Activities such as fishing, birdwatching, hiking and nature photography take advantage of the abundant resources offered by wetland ecosystems, yet have minimal impact. These uses are relatively non-destructive except in instances of overuse or disregard for the fragile wetland ecosystem. Other recreational uses such as golf courses can disrupt a wetland ecosystem

Map 4: Recreation on Wetlands



through their development, installation of drainage systems, and use.

Recreational uses of potential wetlands within the study area increased dramatically over the 1967-1982 period (see Map 4), escalating from 125 ha in 1967 to 1 557 ha in 1982. Seventy-six percent of this increase in recreational area came from conversion of natural wetlands. The remainder was converted from improved and unimproved agricultural uses. Much of this expansion was the result of the establishment of numerous golf courses, wildlife and conservation reserves, and delineation of hunting and fishing areas.

Table 5 indicates that recreational uses on areas classed as potential wetlands increased by approximately 96 ha per year. These high rates of recreational expansion can be partially attributed to variations between the CLI and CLUMP classification systems. The comprehensive CLUMP system allows classification of areas designated for passive recreation and conservation purposes. By comparison, the CLI system was generally

TABLE 5

RATES OF RECREATIONAL EXPANSION ON POTENTIAL WETLANDS: LAND THAT WENT INTO RECREATION 1967-1982

Source of Recreation Lands: Land Uses	Rate of Conversion 1967-1982 hectares/yr
Natural Wetlands	73
Improved Agriculture (forage and crops)	9
Improved Agriculture (horticulture)	3
Unimproved Agriculture (grazing)	10
Built-up	1
Total All Land Uses	96 ha/year

TOTAL AREA THAT WENT INTO RECREATIONAL USES DURING THE PERIOD 1967-1982 = 1 432 hectares.

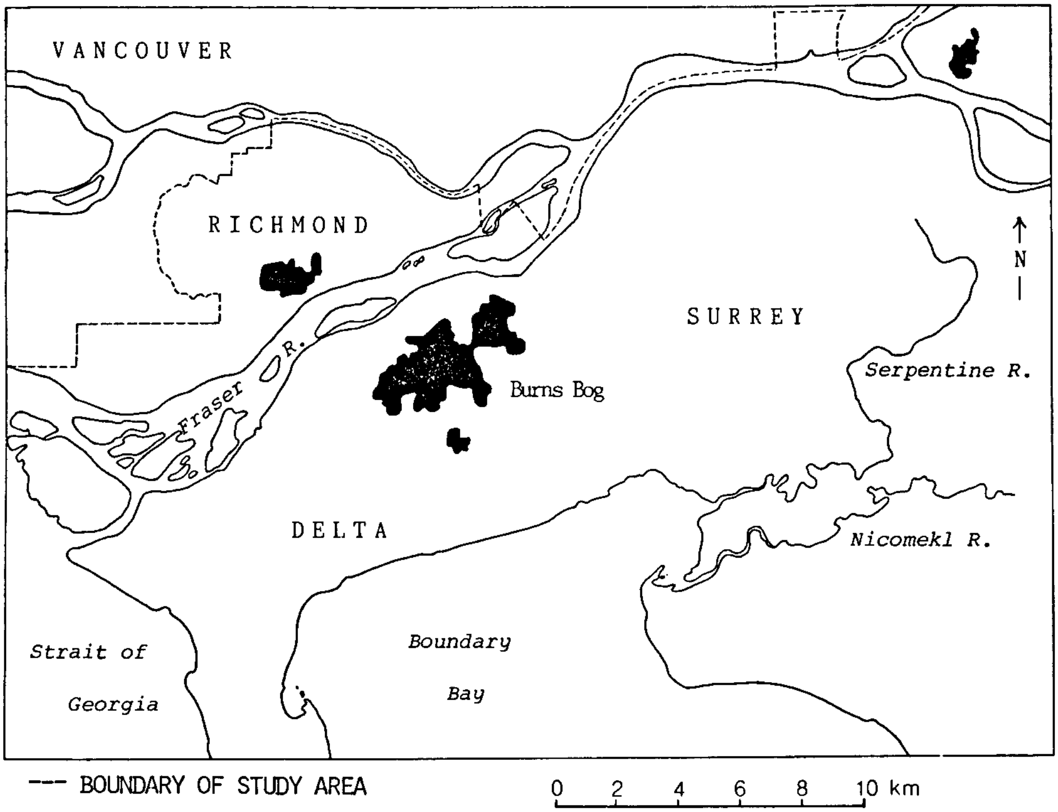
limited to easily identified recreation areas such as golf courses, city parks and beaches. Some of the conservation, fishing and similar designations cited above merely acknowledge previous 'unofficial' uses made of natural wetlands. Thus, it should be recognized that some of the conversion of natural wetlands to recreation occurred in name only. Nevertheless, such designations imply a certain commitment to maintaining and preserving natural wetlands.

5.5 Extraction

Extraction within the study area is primarily in the form of peat removal for agricultural purposes. Peat extraction occurs predominantly on deep organic soils in the Burns Bog area (see Map 5). Seventy-six percent (669 ha) of the land converted to extractive uses was formerly natural wetlands. The remaining 24% (162 ha) was converted from a combination of improved and unimproved agricultural uses.

During this same period, 787 ha of potential wetlands previously in peat extraction went to other uses. Of this amount, 316 ha (40%) reverted to a 'natural' wetland cover with no perceived activity, while 371 ha (47%) went into horticultural uses (Figure 1). This large conversion of land from extractive uses to horticultural uses was a result of a dramatic expansion of the area in cranberry production. This agricultural activity is particularly suited to such wet conditions, thriving in a "bog" type environment.

Map 5: Wetlands in Extraction (Peat) 1982



6.0 IMPLICATIONS

6.1 Land Use Limitations of Wetlands

6.1.1. Soil Type

Almost one half (4 122 ha) of the wetland areas on deep organic soils were in a natural state in 1967 (Table 6). In comparison only 13.6% of wetlands on shallow organic soils and 5.6% on Rego and Rego Humic Gleysolic soils existed in a natural state. This suggests that wetlands on deep organic soils are least favored for conversion to alternate uses.

However, many of the now shallow organic soils were originally deep. This shallowness may be due, in part, to subsidence and oxidation brought about by drainage and cultivation or to peat extraction (Luttmerding, pers. comm.). Deep organic soils have a very thick layer of organic peat and high water content. Such soils require extensive excavation, draining and infilling in order to support structures.

Between 1967 and 1982, natural wetlands on deep organic soils declined 23% (929 ha). By comparison, wetlands on shallow organic soils declined by only 82 ha, while natural wetlands on Rego and Rego Humic Gleysolic soils remained relatively unchanged (Table 6). The majority (63%) of these natural wetlands on deep organic soils that were converted to other uses during the 1967-1982 period went to

TABLE 6

LAND USE ON SOILS CLASSED AS WETLANDS
(hectares)

Land Use	Deep organics 1967	Deep organics 1982	Shallow organics 1967	Shallow organics 1982	Rego and Rego Humic Gleysols 1967	Rego and Rego Humic Gleysols 1982
Natural Wetland	4 122	3 193	598	516	487	503
Extraction	1 066	1 221	334	110	49	0
Recreation	20	325	11	140	94	413
Grazing	1 065	554	520	468	526	560
Forage/Crops	1 201	1 271	2 417	2 318	6 794	5 887
Horticulture	585	640	281	478	394	152
Built-up	848	1 417	235	358	358	990
Transition*	N/A	286	N/A	8	N/A	197
TOTAL	8 907	8 907	4 396	4 396	8 702	8 702

* Land in transition was not distinguished from other uses in the 1967 CLI land use; therefore, there is no information available (N/A).

built-up (primarily industrial development and waste disposal). In addition, about one-third went into recreation. This trend towards the use of wetlands for industrial purposes may be due to the decreasing availability and rising cost of more suitable land near urban centres and transportation corridors. Extractive activities in the study area (primarily peat removal) are limited mainly to organic soils, with 92% occurring on these deep organic soils in 1982.

Shallow organic soils support primarily agricultural activities. Improved and unimproved agricultural uses occupied 73% of the shallow organic wetland areas in 1967. The largest net changes within this soil type between 1967 and 1982 were a decline in extractive uses (224 ha) and an increase in horticultural uses (197 ha). This was represented by almost direct conversion of land in extractive uses to cranberry production. It should be noted that many new shallow organic areas have resulted from peat mining of once deeper organics. Thus, the conversion from extraction to horticultural activities may mean that these new shallow organics are no longer suitable for peat mining, rather than that shallow organics are preferred for agricultural activities (Luttmerding, pers. comm.).

Wetlands on Rego and Rego Humic Gleysolic soils also support primarily agricultural activities. Improved and unimproved agricultural uses occupied 89% of the Rego and Rego Humic Gleysol wetland area in 1967.

6.1.2 Habitat Zones

The wetland areas defined by habitat zones in this pilot study are situated along the foreshores of the Fraser River Estuary and Delta. Being outside the dyked area, the land use capability of these wetlands is greatly affected by tidal influences. Almost all (93%) of the habitat zone wetlands were in natural wetland cover in 1967 (Table 7). By 1982, however, 47% (689 ha) of these wetlands had been converted to recreational uses. This change is primarily the result of the establishment of numerous wildlife conservation areas, and the delineation of hunting and fishing areas.

6.2 Impacts of Adjacent Land Uses

Geographically, the Southwestern Fraser Lowland is a narrow corridor bounded by the Coast Mountains, the Canada-U.S.A. border and the waters of Georgia Strait. There are increasing pressures from the Greater Vancouver urban area for expansion onto nearby agricultural and natural areas, which include wetlands.

TABLE 7

LAND USE ON WETLANDS DEFINED BY HABITAT ZONES
(hectares)

Land Use	Salt Marshes 1967	Salt Marshes 1982	Intertidal Brackish 1967	Intertidal Brackish 1982	Reparian 1967	Reparian 1982
Natural Wetland	168	95	1 049	407	147	82
Recreation	0	13	0	642	0	34
Forage/Crops	0	60	10	10	34	34
Built-up	0	0	10	10	56	87
TOTAL	168	168	1 069	1 069	237	237

Wetlands within the study area are presently bounded by urban development, primarily residential and industrial uses. Although not directly encroaching on wetlands, adjacent land uses can place stress on natural wetland ecosystems. Contaminated urban surface runoff, landfill leachate and air pollution deposition are examples of possible impacts on wetlands emanating from nearby urban and industrial activities.

7.0 CONCLUSIONS

There is a need to dispel the fallacy that wetlands are not useful unless developed. Governments at all levels have an important part to play in this respect, and have done so through a variety of avenues including, flood plain zoning, water quality policies, and the enactment and enforcement of a variety of related legislation. One example of government intervention is the acquisition of wetlands for parks, sanctuaries, and reserves. Other examples include the updated Official Regional Plan for the Lower Mainland of British Columbia in which strategy for protecting environmentally sensitive areas is outlined. The plan recommends protection of sensitive natural assets such as wetlands from urban and industrial development. To accomplish this the plan suggests that urban growth be confined, if possible, to metropolitan areas and that future expansion be restricted to areas north of the Fraser River. The Fraser River Estuary Study (1978), a joint federal/provincial government project outlines specific guideline policy statements. These include recommendations for no future loss of wetlands and strict controls on any increase in toxic waste accumulation (see Appendix 3 for detailed description).

This wetlands study has begun the process of identifying and quantifying the extent of land use change on wetland areas within a portion of the Southwestern Fraser Lowland. Defining wetlands primarily on the basis of soil characteristics was practical, particularly since much of the natural vegetation and wetland processes have been drastically altered through dyking, drainage, clearing and infill associated with various types of development.

Substantial land use change has occurred on wetlands within the study area. Although the analysis in this study was confined to only a portion of the Southwestern Fraser Lowland, it focussed on some of the major land use pressures facing wetland areas throughout the Lower Fraser Valley. Analysis of land use change on wetlands in the study area indicates a trend towards both preserving and developing wetlands. Recreational uses on natural wetland increased by 1 087 ha between 1967 and 1982, largely through the creation of conservation and wildlife management areas and watershed reserves. Such designations indicate an awareness of the need to maintain the integrity of wetland ecosystems.

On the other hand, conversion to built-up, extractive and agricultural uses accounted for the loss of 1441 ha of natural wetlands. Land use conversion through drainage or infill not only reduces the natural wetland base, but may disrupt adjacent wetland environments as well. Bogs and other wetland areas are often regarded as prime landfill sites for waste disposal. For example, in the Burns Bog area controversy has arisen recently over a proposal to expand a major refuse disposal site for the Greater Vancouver Regional District. There are reports that the north side of Burns Bog is already polluted by leachates from an existing garbage dump in the area. In addition, adjacent farmers fear that leachates entering the high ground water of the bog may eventually contaminate their surrounding farmland (Einsiedler, 1983). An extension of the study area in future investigations would help to determine whether some of the major land use pressures outlined are valid trends of changes on wetlands throughout the Lower Fraser Valley. It would determine the areas where these trends are most prevalent.

This study is an aid in the development of research methods for monitoring land use change on wetlands. The methodology used would require testing before its applicability in other areas of the province or the country could be established. Future wetland research in these areas would require consideration of a variety of factors including: location and area of coverage, data management requirements, wetland definition, nature of encroaching land uses, historical land use, and soil and climatic characteristics of the region under study.

Further studies should also include a closer examination of land uses adjacent to wetlands. Such uses could be important indicators of future land use pressures on the wetland resource. This aspect of wetland study is time consuming and relatively difficult to quantify. For the purpose of this project, adjacent uses were only examined at a descriptive level, mainly due to time constraints. There is also a need, therefore, to research methodologies for determining the impacts of adjacent land uses on wetland areas.

Finally, land use change data have been produced for the Vancouver urban-centered region, under the Canada Land Use Monitoring Program, which encompasses the wetlands study area of this project. Future studies would establish whether, in this region, other types of land are facing the same types and intensities of land use change pressures as wetlands.

8.0 SELECTED BIBLIOGRAPHY

Agricultural Rehabilitation and Development Act (A.R.D.A.), Canada Land Inventory. 1967 "ARDA Present Land Use Project 1967 Land Use Maps 92G/2, 92G/3."(1:50,000 scale, unpublished manuscripts).

Cameron, R. and B. Obee. 1981. Special Report - The Lower Fraser: How well are we looking after B.C.'s front door? Wildlife Review. Ministry of Environment. 10(7):3-12.

Canada Department of Agriculture. 1974. The System of Soil Classification for Canada. Ottawa: Information Canada, revised edition.

Canadian Wildlife Service. 1980. Wetlands. Environment Canada, Ottawa. Phamphlet.

Einsiedler, O. 1983. "Facing the Change at Burns Bog", Surrey-Delta Messenger, July 6, 1983, pp. 4.

Environment Canada. 1982. "Vancouver Urban Centred Region 1982 Land Use Maps 92G/2 and 92G/3." (1:50,000 scale, unpublished manuscripts). Lands Directorate, Pacific and Yukon Region.

Fraser River Estuary Study Steering Committee. 1978a. Fraser River Estuary Study - Habitat. Report of the Habitat Work Group. Environment and Land Use Committee Secretariat. Victoria, British Columbia.

Fraser River Estuary Study Steering Committee. 1978b. Fraser River Estuary Study - Summary. Proposals for the Development of an Estuary Management Plan: Summary Report of the Steering Committee. Environment and Land Use Committee Secretariat. Victoria, B.C.

Greater Vancouver Regional District. 1980. Plan for the Lower Mainland of British Columbia.

Haigis, B. and W. Young. 1983. Methods of Preserving Wildlife Habitat. Working Paper No. 25. Lands Directorate, Environment Canada. Ottawa.

Halladay, R. 1972. A Commitment to the Future; A Proposal for the Protection and Management of Fraser Wetlands. Fish and Wildlife Branch, Dept. of Recreation and Conservation, Government of British Columbia.

Kerr, M.A. 1983. Canada Land Use Monitoring Program: Total Land Use Change in Urban Centred Regions, Victoria, 1966-1976, Report No. 13. Lands Directorate, Environment Canada. Vancouver.

Klingebiel, B. 1966. Soil Surveys and Land Use Planning. Soil Science Society of America.

Leach, B. 1974. Wetlands and River Management in the Fraser Valley. British Columbia Fish and Wildlife Branch.

Luttmerding, H.A. 1983. Surveys and Resource Mapping Branch, B.C. Ministry of Environment, Kelowna, B.C. May 16, 1983, and December 2, 1983. Personal Communications.

Luttmerding H. 1980. Soils of the Langley-Vancouver Map Area, Report No. 15 British Columbia Soil Survey RAB Bulletin 18. Volumes 1 and 3. B.C. Ministry of Environment. Kelowna.

Lynch-Stewart, P. 1983. Land Use Change on Wetlands in Southern Canada: Review and Bibliography, Working paper No. 26. Lands Directorate, Environment Canada. Ottawa 115p

North, M.E.A., M.W. Dunn, and J.M. Teversham. 1979. Vegetation of the South- western Fraser Lowland, 1858-1880. Fraser River Delta and Estuary Region Map Series. Lands Directorate, Environment Canada. Vancouver, British Columbia.

Rubec, C. 1983. Memorandum: "Status Prime Wetlands Project." Lands Directorate Environment Canada, Unpublished Internal Report.

Rubec, C.D.A. and F.C. Pollett. (eds.). 1979. Proceedings of a Workshop on Canadian Wetlands. Ecological Land Classification Series No. 12. Lands Directorate, Environment Canada. Ottawa, Ontario.

Rubec, C.D.A. and J.E. Moore. 1982. "Wetland Land Use Monitoring in Canada." Paper presented to an NRC Peat Forum Workshop. 9-10 March 1982. Ottawa, Ontario.

Tarnocai, C. 1979. "Canadian Wetland Registry." in Proceedings of a Workshop on Canadian Wetlands. Ecological Land Classification Series, No. 12. Lands Directorate, Environment Canada. Ottawa.

Ward, P. 1980. Explore the Fraser Estuary! Lands Directorate, Environment Canada.

APPENDICES

APPENDIX 1

SOILS CLASSIFIED AS WETLANDS IN THE SOUTHWESTERN FRASER LOWLAND

Soil Name	Classification
Addington	Rego Gleysol (peaty phase)
Annis	Rego Gleysol (peaty phase)
Annacis	deep organic
Benson	Rego Humic Gleysol (saline phase)
Banford	shallow Organic
Blundell	Rego Gleysol (saline & peaty phase)
Carvolth	Rego Humic Gleysol
Deas	Rego Humic Gleysol (saline phase)
Embree	Rego Humic Gleysol (saline phase)
Gibson	shallow Organic
Glen Valley	deep Organic
Goudy	shallow organic (saline phase)
Hammond	Rego Humic Gleysol
Hallert	Rego Gleysol
Heron	Rego Humic Gleysol
Hopedale	Rego Gleysol
Judson	shallow Organic
Lumbum	deep Organic
Lulu	shallow Organic
McElvee	Rego Gleysol
Niven	Rego Gleysol
Neaves	Rego Gleysol
Prest	Rego Gleysol
Richmond	shallow Organic
Ross	Rego Gleysol
Sandel	Rego Gleysol (saline phase)
Spetifore	Rego Humic Gleysol (saline phase)
Sturgeon	Rego Humic Gleysol (saline phase)
Seaview	Rego Humic Gleysol (saline phase)
Triggs	deep Organic
Vinod	Rego Gleysol (saline & peaty phase)
Westlang	Rego Humic Gleysol
Westham	Rego Humic Gleysol (saline phase)
Widgeon	shallow organic

Source: Luttmerding, H.A. (1980)

APPENDIX 2
GENERALIZED CLI/CLUMP EQUIVALENCY TABLE

Group Name	Land Use Class	Symbols (CLI)	Symbols (CLUMP)* (Activity/Cover)
Built-up	Residential	B	D000
	Commercial	"	C000
	Industrial	"	M000
	Institutional	"	J000
	Urban built-up	"	U007
	Transportation	X	H000****
Extraction	Quarries, sand and gravel pits	E "	E100
Recreation	Parks, golf courses	O	R000,D121
	Wildlife	"	G130
	Conservation	Not Mapped	P000
Improved Agriculture	Forage	P	A120/V210
	Cropland	A	A110**
Improved Agriculture	Agricultural site activities	H	A200***
	Berries	"	A133
	Market gardens	"	A110**
	Nurseries	"	A140,A170
	Orchards	G	A131,A132
Unimproved Agriculture	Unimproved pasture	K	A122/V220
	Idle grassland	"	B000/V220
	No perceived use/grassland	"	N000/V220
		"	L000/V220
Natural Cover	Woodland	T	N000/W000
	Woodland (unproductive)	U	B000/W000
	Swamps, Marshes, Bogs	M	L000/X000
	No perceived use/denuded	S,L	N000/X000
		"	B000/X000
			L000/W000
Land in Transition	Transition	Not Mapped	L000

* Most of these CLUMP symbols are at a general activity level and are meant to include further levels of complexity than are stated (eg. D000 includes: D100, D110, D111...). In the cases where two CLUMP symbols are separated by a (/) the first symbol represents activity and the second represents cover.

** The A110 activity in the CLUMP classification was equated to either the (A) or the (H) CLI classes depending on the size of the areas in question and/or the cover.

*** Excludes A211, A221, A231

****H150, H160 not mapped by CLI

APPENDIX 3

POLICY GUIDELINES, PROPOSALS, AND IMMEDIATE ACTION PROGRAMS: Fish and Wildlife Habitat Protection and Rehabilitation

- No further net loss of wetlands in the Estuary region should be permitted to occur.
- Only those land and resource uses which are compatible with continued ecosystem viability should be encouraged.
- No uses should be permitted whose harmful effects could be irreversible.
- Uses proposed for specific locations and which may have potentially harmful but not irreversible effects in specific locations should not be permitted:

    if reasonable alternative locations where the use would not be harmful can be found inside or outside the Estuary region, or

    unless it can be judged that the benefits to British Columbians and Canadians will be significantly greater and of longer duration than the social, economic and ecologic value of the resources being risked by such uses.

- Dredgeate/spoil operations, control, and procedures should encourage desirable land use in accordance with Estuary area designations, ...and, where possible, help to create suitable sites for additional habitat.

Source: The Fraser River Estuary Study Steering Committee. 1978b. Fraser River Estuary Study - Summary. Proposals for the Development of an Estuary Management Plan: Summary Report of the Steering Committee. Environment and Land Use Committee Secretariat. Victoria, B.C.

WORKING PAPERS SERIES

No. 1: "The Ecology of Reclamation of Land Disturbed by Mining: A Selected Bibliography". I.B. Marshall. En 73-4/1. ISBN 0-662-50724-X.

No. 2: "Analysis of the United States Experience in Modifying Land Use to Conserve Energy". W.R.D. Sewell and H.D. Foster. En 73-4/2E. ISBN 0-662-10867-1.

No. 3: "The Influence of Exurbanite Settlement on Rural Areas: A Review of the Canadian Literature". J.D. McRae. En 73-4/3E. ISBN 0-662-11085-4.

No. 4: "The Land Impact of Federal Program in the Cowichan Valley Regional District, British Columbia". L.R. Barr. En 73-4/4E. ISBN 0-662-11086-2.

No. 5: "The Impact on Agricultural Land Use of Federal Policies and Programs in Kings County, Nova Scotia". S.G. Ryle and P. Gervason. En 73-4/5E. ISBN 0-662-11087-0.

No. 6: "Energy Conservation Through Land Use Planning: A Synthesis of Discussions at a Symposium held in Montreal 26-28 March 1980". W.R. D. Sewell and H.D. Foster. En 73-4/6E. ISBN 0-662-90812-0.

No. 7: "Assessment Procedures in Canada and Their Use in Agricultural Land Preservation". J.D. McCuaig and H.J. Vincent. En 73-4/7E. ISBN 0-662-11089-7.

No. 8: "The Effects on Land Use of Federal Programs in the Windermere Valley". J.D. McCuaig and E.W. Manning. En 73-4/8E. ISBN 0-662-11117-6.

No. 9: "Issues in Canadian Land Use". E.W. Manning. En 73-4/9. ISBN 0-662-51142-5.

No. 10: "The Development of an Ecological Sensitivity Rating for Acid Precipitation Impact Assessment". Background Paper on Results of a Meeting on LRTAP Sensitivity Indices, Canada/United States Impact Assessment Working Group, Detroit, Michigan, December 2, 1980. D.W. Cowell, A.E. Lucas and C.D.A. Rubec. En 73-4/10E. ISBN 0-662-11451-5.

No. 11: "The Land Use Impacts of Small Craft Harbours: A Preliminary Investigation". J.D. McCuaig, E.W. Manning, V.P. Neimanis and E.M. Peterson. En 73-4/11E. ISBN 0-662-11453-1.

No. 12: "Land and the Automobile: A Selected Bibliography". W. Simpson-Lewis and R. McKechnie. En 73-4/12. ISBN 0-662-51259-6.

No. 13: "The Agricultural Use of Marginal Lands: A Review and Bibliography". K.G. Beattie, W.K. Bond and E.W. Manning. En 73-4/13E. ISBN 0-662-11454-X.

No. 14: "Land Use Classification Systems: An Overview". R.C. Scace. En 73-4/14E. ISBN 0-662-11434-5.

No. 15: "Survey of User Requirements for Land Use Data: Canada Land Use Monitoring Program". D.M. Gierman. En 73-4/15E. ISBN 0-662-11435-3.

No. 16: "Problems in Mapping Non-productive Woodland Using the CLI Present Land use Classification in Halifax County, Nova Scotia". P.N. Duinker. En 73-4/16E. ISBN 0-662-11436-1.

No. 17: "Land Use Classification for Land Use Monitoring". D.M. Gierman. En 73-4/17E. ISBN 0-662-11439-6.

No. 18: "Literature Review and Annotated Bibliography on the Earth Science of the Hudson Bay Lowland". D.W. Cowell. En 73-4/18E. ISBN 0-662-11539-2.

No. 19: "Characteristics of Terrestorial Ecosystems Affected by Acid Rain Accross Canada". C.D.A. Rubec, En 73-4/19E. ISBN 0-662-11562-7.

No. 20: "An Inventory of Federally Maintained Land Data. A. Petch and Sandy ' Macenko, 1982, En 73-4/20E. ISBN 0-662-11880-4.

No. 21: "The Impact of Federal Activities on Fruitland Use: Annapolis Valley". Paul D. Bircham, 1983. En 73-4/21E. ISBN 0-662-11959-2.

No. 22: "The Impact of Exurbanite Settlement in Rural Areas: A Case Study in the Ottawa-Montreal Axis". James D. McRae, 1982. En 73-4/22E. ISBN 0-662-11788-3.

No. 23: "A Method to Assess the Implications of Future Urban Expansion on Rural Land". Chris Cocklin and Barry Smit, 1982. En 73-4/23E. ISBN 0-662-12058-2.

No. 24: "Area Sampling Strategies in Relation to Land Use Monitoring Needs and Objectives". C.R. Bryant and L.H. Russwurm, 1983. En 73-4-24E. ISBN 0-663-12320-4.

No. 25: "Methods of Preserving Wildlife Habitat." Bill Haigis and Will Young, 1983. En 73-4-25E. ISBN 662-92035-X.

No. 26: "Land Use Change on Wetlands in Southern Canada: Review and Bibliography". Pauline Lynch-Stewart. En 73-4/26E. ISBN 0-662-12675-0.

No. 27: "An Overview of Crown Land Management in Canada". S.L. Macenko and V.P. Neimanis. En 73-4/27E. ISBN 0-662-92121-6.

No. 28: "The Land Planning Framework of Canada: An Overview". R. Audet. En 73-4/28E. ISBN 0-662-12793-5.

No. 29: "The Retreat of Farmland in the Gaspé The Causes and the Impacts on Land Use". En 73-4/29E. ISBN 0-662-12799-4. D. Lamoureux.

No. 30: "Foreign Land and Real Estate Ownership in Canada". E.N. Ward. En 73-4/30E. ISBN 0-662-13078-2.

No. 31: "Marginal Land Utilization and Potential, Kent County, New Brunswick". W. Bond. En 73-4/31E. ISBN 0-662-13079-0.

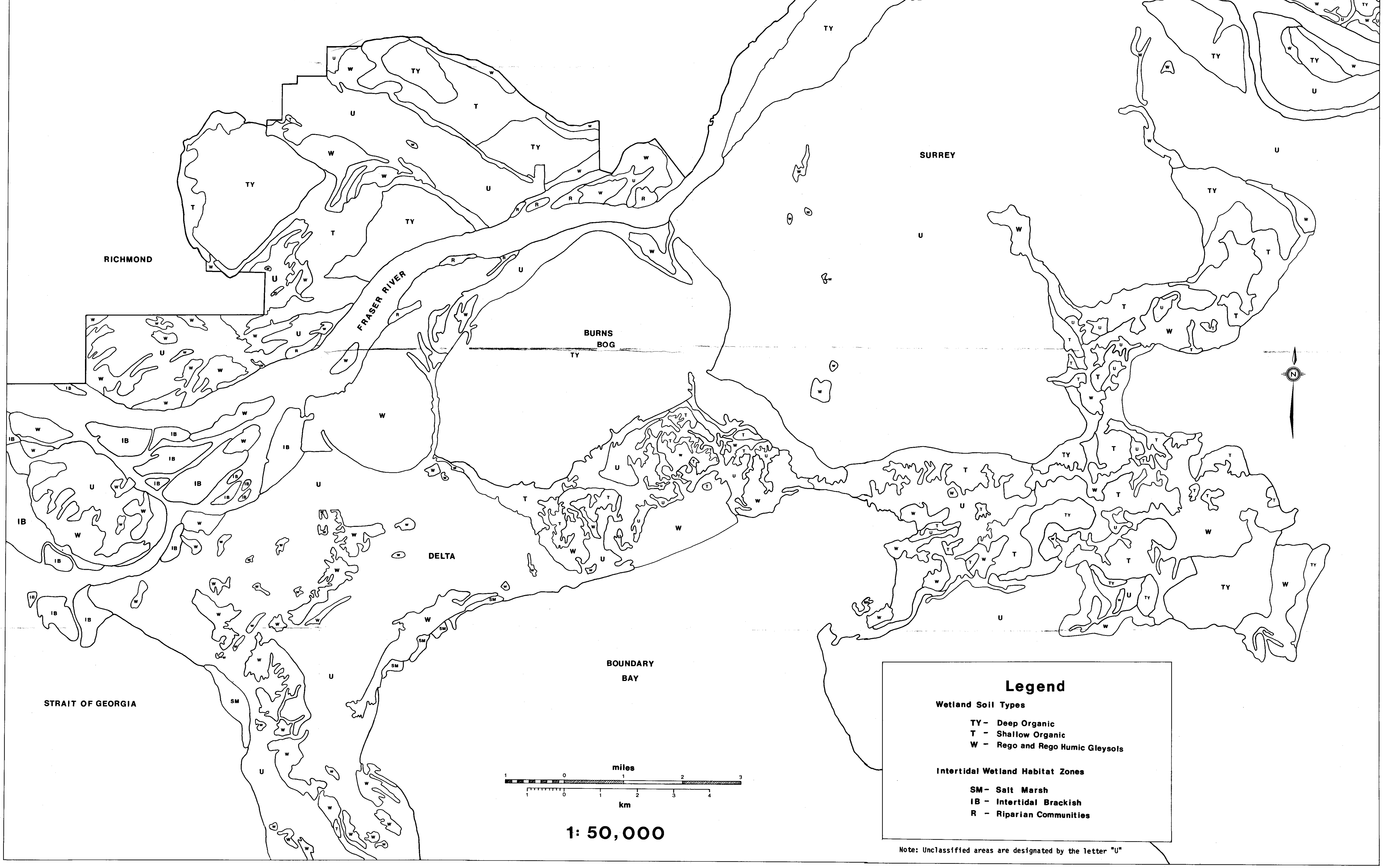
No. 32: "The Impacts on Land Use of CMHC's Municipal Infrastructure Assistance, 1961 to 1980". P. Bircham. En 73-4/32E. ISBN 0-662-92525-4.

No. 33: "The Impact of Federal Government Activities on Land Use in Renfrew County, Ontario". N. Lavigne. En 73-4/33E. ISBN 0-662-92534-3.

Map 6: Wetlands in the Southwestern Fraser Lowland, British Columbia

Designated Wetland Areas Defined on the Basis of Soil Type and Habitat Zones.

Compilation and Cartography by: Paul Pilon



Source: Pilon, P. and Kerr, M. A. 1984. Land Use Change Monitoring on Wetlands in the Southwestern Fraser Lowland, British Columbia. Map No. 6 in Working Paper No. 34 Lands Directorate, Environment Canada, Vancouver.