INTERIM REPORT ON THE PHYSICAL AND NATURAL RESOURCES OF THE UNIVERSITY OF BRITISH COLUMBIA ENDOWMENT LANDS

by

Helmut J. Urhahn

and

Janet Lee

July, 1974

TABLE OF CONTENTS

Helmut Urhahn and Janet Lee
4239 West 11th Avenue
Vancouver, B.C.

July, 1974

John Secter
Senior Ecologist
Special Services Division
Lands Service
Department of Lands, Forests and Water Resources
Harbour Towers
345 Quebec Street
Victoria, B.C.
V8V 1X5

Dear John:

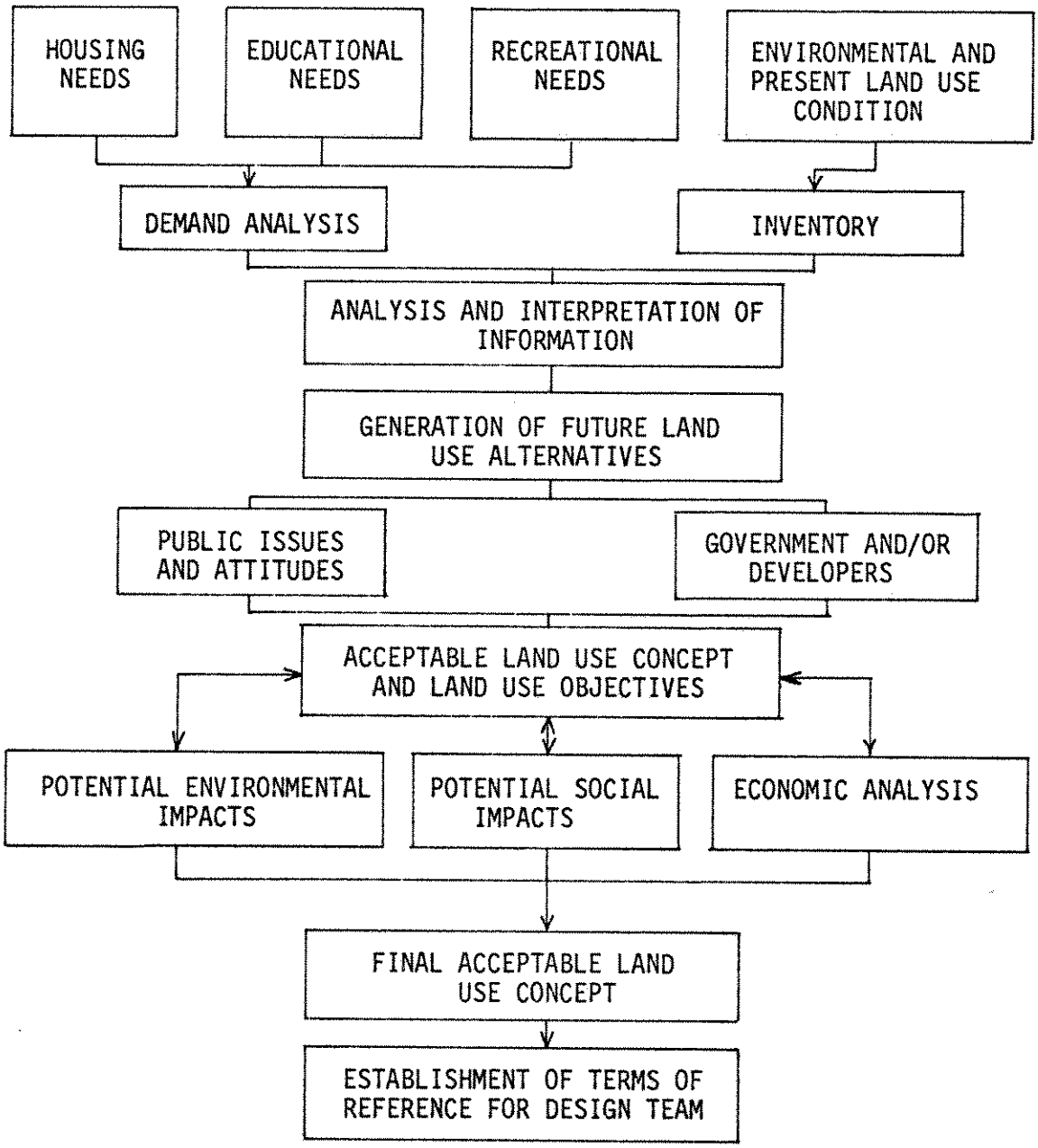
The following interim report outlines the physical and natural resources of the University of British Columbia Endowment Lands. This document is intended to assist in the generation of future land use concepts for the 1740 forested acres on the Endowment Lands.

The recent failure of many projects, due to the lack of public support, points to the need for providing a vehicle by which the citizen can express his/her opinion with regards to major land use developments, coupled with this is the need for an assessment of public positions taken by politicians, local interest groups and planners. Understanding attitudes of government, public and developers will greatly aid in weighting the technical data necessary to provide the foundation for the final selection of acceptable land use.

Before any design teams are appointed to derive at urban patterns for the Endowment Lands, the following technical information should be available. These are: housing needs, educational needs, recreational needs, as well as an understanding of the environmental and present land use conditions of the lands under consideration.

....2

SUGGESTED PROGRAMME FOR THE LAND USE ALTERNATIVES OF THE UNIVERSITY ENDOWMENT LANDS



John Secter
July, 1974

The total technical data should be subjected to a demand analysis of the land use requirements and a land use analysis of the physical and natural components.

The enclosed environmental and land use inventory furnishes some understanding not only of the physical holding capacity for urban developments, but as well of the many opportunities offered for recreation and outdoor education on the University Endowment Lands. This will generate future land use alternatives.

The critical step in any further land use designation lies in the testing of the proposed alternatives against public attitudes and opinions. Therefore, potential environmental and social impacts, and an understanding of the economic framework presented to the public, should generate an acceptable land use concept.

We would like to stress that the enclosed overview report is only the environmental component of an investigation which should include housing and recreational park needs. To re-emphasize, the composite map is derived only from pure environmental data and should not be construed as being definitive and must be viewed only in context with an understanding of housing, educational and recreational needs.

We hope, however, that the overview inventory and analysis of the resources on the Endowment Lands will furnish the necessary skeleton data to gain some understanding of the shear carrying capacity and many land use opportunities that the natural features of the Endowment Lands offer.

Yours truly,

Helmut Urhahn,

Janet Lee

HJU:jl
Encl.

INTRODUCTION

Separating the University of British Columbia from the metropolitan area of Vancouver are the U.B.C Endowment Lands. Because of their strategic location many natural science projects have been undertaken in the undeveloped portions of these lands. It is part of the task of this resource data compilation to review such studies ranging from geology and soils to the ecology of the Great Blue Heron.

Much of the existing resource data from the various U.B.C. natural science faculties was difficult to apply and needed extensive editing. The resource inventory was found lacking in information of the surficial geology and hydrology, as well as vegetation and wildlife.

Field surveys were conducted to inventory the surficial geology and hydrology. Dr. Vladimir Krajina was retained by Mr. Murdock, the Endowment Lands administrator, to outline the vegetative associations. The information presented in this overview must be regarded as a first attempt to compile the raw resource data in a systematic manner. It basically records components of the natural systems and highlights those aspects which are limiting to alternatives of future land use.

At the same time, data which is still lacking for a meaningful suitability analysis of the natural resource base will be noted.

STUDY OBJECTIVE

The objective is to compile information of the natural resources of the Endowment Lands in such a manner as to make them useful to the analysis of future land use suitability. This report is an overview report and deliberately sets out to review existing information regardless of its source in order to identify areas where new work will have to be carried out. At the same time, it hopes to provide information which lends itself to arrive at a precursory resource inventory which is useful to future development decisions. Hopefully, decision-makers will realize the importance of adequate early assessment of the likely environmental impacts of development.

RESEARCH TO DATE AND LIMITATIONS

The bibliography appended to this report lists the various documents and sources of data which have been consulted in the preparation of this report.

This section hopes to comment briefly on the degree to which those studies have relevance as to the resource inventory analysis of the Endowment Lands without making an attempt to review each report in detail.

A number of fragmented and isolated studies concerned with soils, forestry, vegetation and the heronry have dealt more or less with the academic aspects within these specific disciplines. It was difficult to isolate some of these studies so as to make them useful for suitability analysis with respect to future land use.

All previous development schemes which have been proposed for the University Endowment Lands have shown the lack of knowledge of the natural resource base and land capability in the planning. These previous studies have mainly been concerned with the architectural, engineering, and urban design ramifications of development without regard to the environmental parameters.

It is therefore the goal of this report to set forth the natural resources of the Endowment Land in an overview manner and to make them available to the resource analyst capable of identifying areas suitable for residential, recreational and educational land use.

BASELINE INVENTORY

Climate

The climate of the University Endowment Lands has a relatively mild and wet winter and warm and dry summer. The climate is influenced by the Pacific Ocean, which moderates temperature extremes and increases precipitation and humidity.

Data from the meteorological station on the University Endowment Lands indicate that Point Grey shows some significant climatological differences compared to the Greater Vancouver Area. The Endowment Lands enjoy less mean annual precipitation, less mean annual snowfall, and greater total hours of sunshine. The order of magnitude is 45 inches of precipitation annually for the Endowment Lands and 68 inches of precipitation annually for Stanley Park. The annual snowfall is less than within the Stanley Park region. However, the total number of snow days would be slightly greater than Stanley Park because of the higher elevation above sea level of the Endowment Lands.

The mean temperature on the Endowment Lands does not vary significantly from temperatures within the rest of Vancouver.

East winds predominate during winter months whereas west and southwest winds prevail during the summer. Air circulation shows the annual force is 4 miles per hour with gusts of wind rarely exceeding 30 miles per hour.

The easterly winds are accompanied by considerable precipitation and air pollutants. These pollutants are derived from the Vancouver Metropolitan Area. However, the winds are of sufficient wind speed and persistency to dilute the air pollutants. During periods of westerly winds, associated with sunny weather, air pollutants are virtually absent.

Important locally in terms of concentration of pollutants in the air are the frequency of inversion periods. Ground based inversions occur in autumn, mainly during the night. The resultant poor ventilation occurs about 15% of the time (Nikelva, 1972). However, proximity to the ocean results in somewhat greater air dilution at the Endowment Lands compared to Vancouver City.

Topography

The Univeristy Endowment Lands consist of the glacial and interglacial material. The gently undulating uplands are surrounded by the North Arm of the Fraser River, the Georgia Strait and English Bay. Steep cliffs around the perimeter of the peninsula form the interface between the northernmost part of the Endowment Lands and the Spanish Banks area. The uplands show maximum summit height of approximately 425 feet which drops to approximately 225 feet along the southern portions with subsequent lower sea cliffs in that area.

Geology

The source material for the geological section has been obtained from the Geological Survey of Canada, mainly Armstrong, 1956. This information was plotted on a scale of 1 inch = 4 miles and is of rather regional character. Therefore, all surficial geological aspects are highly generalized and needed airphoto interpretation with ground checks for the resource inventory.

The Point Grey Peninsula including the Endowment Lands consists entirely of unconsolidated deposits. Bedrock, both granite and more recent sandstone and mudstone, have been recorded 500 feet below surface in a test well at the Biological Science Building. This places all the bedrock below sea level and the unconsolidated deposits of Point Grey above sea level.

During glaciation, the movement of the ice sheet was from north to south which resulted in small undulation or drumlin type ridges in the same direction. Reference to the Topographic Map shows the pronounced north-south alinement of the Endowment Lands uplands. The gouged depressions and ridges subsequently imposed north-south alinement onto the drainage.

The oldest deposits discernable on the perimeter of the Point Grey Peninsula are the Quadra glacial and marine sands and silts. They are the thickest unconsolidated layer which makes up the bulk of the Point Grey Peninsula. These deposits have been laid down under marine and deltaic conditions during the long inter-glacial period between the last two periods of glaciation. Their depositional history is exemplified by their heterogeneous texture. These deposits are in excess of 200 feet thick.

The Quadra sands and silts are topped by the Newton Stoney Clays. These are the main parent materials of the soil horizons on the Endowment Lands. They are glacio-marine till deposits of sandy to silty texture and minor sub-stratified drift which on the Endowment Lands is between 5 and 15 feet thick. The Newton Stoney Clay was deposited during the melting of the ice sheet which resulted in sedimentation of very fine rock flour from below the ice. The material dropped from the ice sheet consisted of boulders and sometimes huge erratics which are found embedded in the finer silt and clay mixture of the Newton Stoney Clay.

The Newton Stoney Clay is compact and hard and well cemented. The large percentage of rock flour within the matrix results in impermeable conditions.

Geology (cont'd)

After the recession of the ice sheet during the rebound of the land, a post-glacial sea deposited a thin layer of beach gravel and sand overtop of the compacted Newton Stoney Clay. These are referred to as the Bose Gravel and Sunnyside Sand.

The Bose Gravel is from one to three feet thick and the Sunnyside Sands are from three to five feet thick. They are mixed into all of the active soil layers on the Endowment Lands and resulted in fair to good permeability of the soil profile.

Soils

The soils on the Endowment Lands have been studied by many undergraduate and some graduate students. Three studies by three different students were used as the basis for this soils inventory. These reports were by:

Brian McBride, 1974

P. Ebb, 1973

Dr. Rowles, 1953

A series of airphotos accompanied the soils report with rough field data and location of test pits on which the soils information was based. During the examination of this data, extensive revisions were necessary. After airphoto interpretation and field checks of all the data was incorporated into what turned out to be a compromise soils map between all parties concerned.

The soils within the study area are derived from the Bose Gravels and Sunnyside Sands. They are relatively young, having been formed over 8000 years since the retreat of the last ice sheet. The influence of the relatively warm, wet climate reflects the soil profile development.

The soils fall into three distinct orders. The Podzolic Order, the Gleysolic Order and the Organic Order. The Podzolic Order is broken down into sub units called series mainly as to their permeability and drainage. The Organic Soils are associated with organic peat, typified in the Camosun Bog area.

Description of the soils can be found in Ebb's report in the appendix. Only aspects of the soils relevant to potential land use will be discussed. The Podzols are generally highly leached, acidic soils, on coarse textured parent material, which gives them relatively good percolation. Exceptions are soils which form internal cementation zones or pedogenic pans which may create percolation barriers.

The Soil Map shows the extent and location of the Summer Series, an imperfectly drained podzol with a cemented horizon, hence with poor percolation. The remainder of the Podzol Soils, the Sunshine Series and the Bose Series, in contrast are medium to coarse textures and well-drained acid forest soils.

Soils (cont'd)

All the Gleysol Soils, the Heron Series, are found in shallow depressions with poor drainage. This results in somewhat higher content of organics. These soils, because of their impeded drainage, indicate seepage and wet spots on the Endowment Lands.

The Organic Soils are those soils under reducing conditions. They consist mainly of unleached organics, such as muck and fibrous peat. On the Endowment Lands there are only two occurrences, one within the Camosun Bog and another due south-east of the golf course. Because of the high moisture absorption and adsorption characteristic of these soils, they are very difficult to drain.

Vegetation

The vegetation component of this report has been compile by Dr. Vladimir Krajina and only aspects which are important to the land use opportunity will be mentioned. The Endowment Lands belong to the Coastal Douglas Fir Biogeoclimatic Zone. The information set down in Dr. Krajina's letter to the president's committee (refer to appendix) on the use of the University Endowment Lands, dated January, 1973, summarizes as follows:

1. The Lodgepole Pine - Labrador Tea - Peat Moss Plant Association in the vicinity of the Camosun Bog, which is an unique association.

2. The Douglas Fir - Grand Fir - Western Red Cedar - Sword Fern Plant Association in selected sites along the Endowment Lands. The rating of the association is based on high productivity, coupled with large, old stands which are impressive.

5. Red Alder - Sitka Spruce - Western Red Cedar - Skunk Cabbage Plant Association is an association frequently found on poorly drained soils. It occurs on areas which display groundwater seepage or impeded drainage, but not to the point of standing surface water.

6. Aspen - Lodgepole Pine - Western Red Cedar - Western Hemlock - Western Hardhack Plant Association has only very small representative samples, 6a and 6b, generally on the margins of the Camosun Bog and other areas of impeded drainage. These plant communities are rated as unique in the Endowment Lands.

7. Broadleaf Maple - Black Cottonwood - Red Alder - Grand Fir - Western Red Cedar - Salmonberry - Indian Plum - Colts Wort - Giant Horsetail Plant Association. This plant association is rated as unique.

The location of the above associations are shown on the Vegetation Map.

Hydrology

The hydrological information is based on the surficial geology and the soils. The groundwater hydrology was based entirely on the air-photo analysis while the surface hydrology was analyzed on the basis of the soils and field measurements of flow volume during the spring of 1974.

The surface and groundwater hydrology is a result of the climate, surficial geology, soils and vegetation. Each component modifies the result of precipitation and dictates the mode of surface and groundwater drainage. The Endowment Lands receive 45 inches of precipitation annually, mainly as rain. The rainfall is intercepted by either the vegetation or man-made structures. The vegetation absorbs moisture during the active growing season for the process of evapotransporation. Areas where the vegetation cover is removed will therefore have more moisture to contribute to surface runoff and groundwater regime. The soil and the surficial material will absorb the remaining moisture and recharge the groundwater. Any surplus groundwater will be discharged as surface runoff.

During periods of high rainfall (winter months) all moisture will generally be confined to the soil stratum of the top three feet. The groundwater will drain over the top of the Newton Stoney Clay in the soil layer as near surface groundwater and frequently this perched groundwater will reach the surface to form pools of standing water.

However, some moisture will percolate through moderately permeable portions of the Newton Stoney Clay to recharge the actual true groundwater level, approximately 100 to 180 feet below the top horizon. The storage capacity of the groundwater reservoir is extremely limited. Groundwater and surface water drainage, even within the vegetated portions of the Endowment Lands, reflect closely the mode of precipitaion. In other words, the dampening factor of a pervious groundwater regime is almost non-existent. The result is a moisture surplus during the winter months which quickly discharges as surface runoff, and a moisture and surface runoff deficit results during the summer drought. In addition, the soil profile consists of relatively poorly sorted, fairly coarse textured soil with poor storage capacity which will give up the moisture rapidly.

In summary, only two components of the natural system dampen the surface water runoff from the uplands of the Endowment Lands. These are the vegetation and the top three feet of soil. The few creeks found on the Endowment Lands flow north-south in shallow depressions. Examination of the drainage this spring showed these creeks discharging into the ocean at rates varying from .5 cubic foot per second to 4 cubic feet per second. During the course of the study the smaller creeks dried up.

Hydrology (cont'd)

All northern creeks have an insufficient water recharge area to maintain a constant year round flow. However, Tin Can Creek flowing south has a water recharge area in excess of 250 acres which maintains a year round flow.

Although during the growing season vegetation removes up to 18 inches of mean annual rainfall from the total moisture budget, the interception, and to a certain extent storage of water by soils below plant growth, will result in a release of moisture which is far slower than exposed soil and unconsolidated materials. A clear-cut area under the same conditions will have 16 to 18 inches of mean annual rainfall more to contribute to surface and groundwater runoff but does so in the form of flash floods immediately following rain. In other words, during the critical summer drought, no moisture will be available for the streams.

The poor runoff regime is exemplified by the drainage at the northern cliffs. The deeply incised gulleys are out of portion to the average flow volume. The reason for this is the high flow and erosion resulting from winter rainstorms while summer results in a dry gulley.

The northern bluffs of the Endowment Lands show an aquifer discharge from the true groundwater table which is located within the Quadra formation. Here the groundwater flows over a fairly extensive clay horizon and surfaces approximately 20 to 30 feet above Marine Drive in the bluff. Correspondingly, this seepage results in sluffing and minor mud flows from erosion upon reaching the cliff face. This problem is somewhat complicated by the presence of near surface groundwater runoff which is present expecially during periods of high rainfall.

The Hydrology Map shows surface runoff and near surface groundwater runoff within the respective drainages which are clearly delineated. As mentioned, the amount of storage within the Endowment Lands is limited and the delay in runoff is relatively poor even under present natural conditions.

Fish and Wildlife

A cursory assessment of the drainages which show a year round flow on the Endowment Lands was conducted by biologist of the Services Divison of the Lands Service. This included the southern drainages, mainly Tin Can Creek and parallel drainage to the west of that creek. The northern drainage generally confined to deeply incised gullies was declared unsuitable for fish.

The wildlife assessment was based on records of the Natural History Society, the Vertebrate Museum at U.B.C. and the Natural History section of the Provincial Museuj. In addition, discussions with zoologists familiar with vertebrates on the Endowment Lands as well as members of the Natural History Society and the assistant curator of Natural History at the Provincial Museum were found valuable.

Fish of the southern drainage on the Endowment Lands, Tin Can Creek, was found to have the highest capability for coho, chum and migratory cutthroat trout. The other systems were considered to have low supportive capacity for resident cutthroat. At the time of observation, in July, no cutthroat was found above Marine Drive in Tin Can Creek. However, observations earlier in the year, in March, had shown cutthroat fry within the Endowment Lands in Tin Can Creek. Reference to the Hydrology Map shows that the drainage to the west of Tin Can Creek is approximately equal in size to that of Tin Can Creek itself. It flows into Shaughnessy Golf Course where it is ditched and ponded to finally join Tin Can Creek in the Musqueam Indian Reserve. Because of the wooden weirs this drainage is inaccessible to anadromous fish.

The remaining southern drainage enters tide water through steep gullies and impassable culverts at Marine Drive. No anadromous fish can gain access in these creeks.

Amphibians, reptiles, mammals and birds were recorded as to their distribution on the Endowment Lands. Specifically, their habitat requirements were used as a basis to establish components within the natural system important to their livelihood. In addition, an estimate of species diversity and density was attempted in order to be able to establish the importance of the various habitats.

The greatest diversity and density of animals on the Endowment Lands was found to be the open canopy and edge zone vegetative association. These zones offer the opportunity to observe the animals and therefore, establish an attractive "habitat" for both man and animal.

Fish and Wildlife (cont'd)

The closed canopy mature Douglas fir stands record high densities of resident and wintering animals during severe winter periods. Indeed, this association may well represent the critical habitat necessary to maintain such high densities of small rodents and perching birds.

The wetland streams and bogs create an important habitat association, which because of their high productivity create excellent habitat for amphibians and certain mammals and birds. In addition, it is the breeding ground for many insects which then can enter the food chain in the biosystem on the Endowment Lands.

The heronry supports the largest population of herons in the Fraser delta. Records by John Krebs and his students indicate that the heronry is the only one known heronry in the Lower Mainland in an alder stand. Other heronries in British Columbia are situated in either Douglas fir or Sitka spruce which places the nests generally 120 to 150 feet above ground while in the Endowment Lands the nests are only 50 to 70 feet above ground. In Stanley Park the heronry is located beside Stanley Park Drive and the Stanley Park Aquarium. The Stanley Park heronry has habituated the nesting birds to disturbance. On the U.B.C. Endowment Lands, however, the birds were spooked easily and reacted to quietly moving observers below the alder trees.

Reference to the paper by Brian Partridge, involved in studies at this heronry, showed a certain change in occupied nests within the heronry. A general decline in population resulted in many empty nests and the nucleus of the remaining birds, 38 pairs in 1974 (personal observation), shifted to the northern perimeter of the heronry as plotted on the map. The author feels this to be due to two intrusions:

a) extensive research carried out on the southern end of the heronry, and

b) the proximity of Marine Drive to the heronry.

All indications are that a certain buffer around the present heronry is needed because of its vulnerable location. This buffer will permit the nesting heron to move to different trees within the perimeter zone.

Archeology

A search of literature and information available at the Department of Archeology, U.B.C. was conducted. A map showing the location and present status of past and present archeological excavations was supplied. Personal communications with Dr. Borden of the Department of Archeology augmented the recorded information with up to date archeological events.

No significant archeological sites are known on the Endowment Lands. The majority of excavated plots are located adjacent to tide water. The closest archeological site to the Endowment Lands boundary would be at the northern bluffs where Marine Drive meets Spanish Banks. Here a 2000 year old village site extends from the high water mark including the bluff to Marine Drive. However, present disturbance due to the highway, park landscaping, as well as extensive recreational use of the small bluffs have disturbed the few remaining, unexcavated plots. This site is regarded as having only limited significance to future excavation.

The actual uplands which to data have not yielded any significant archeological sites may do so when clearing or excavation associated with development schemes are begun. Such events have occurred on uplands surrounding the Endowment Lands, such as on the University Campus as well as in the vicinity of 4th and Blanca. The only significance is to inform the foreman of the clearing and excavation operations that he may encounter Indian artifacts, and in that event to inform the Provincial Museum of Archeology.

COMPILATION OF ALL RESOURCE COMPONENTS

The only comprehensive report considering all the physical and natural components which make up the ecology of the Endowment Lands is that of Don Norris and is in note form, prepared for requirements of a graduate forestry course. In addition, this report covers the legal status and cultural history of the Endowment Lands.

The compilation of the physical resource parameters such as geology, soils and hydrology permitted the establishment of geotechnical limitations on the Endowment Lands towards any future residential and institutional land use.

Specifically, the physical resource components have been compiled as follows:

A. Topography

The gently undulating plateau of the Point Grey Peninsula comes to an abrupt edge along the perimeter forming gulleys and cliffs. In the study area, this edge drops a vertical distance of 300 feet and slopes exceed the angle of repose. The Slope Map in the report outlines these areas which are near to and in excess of the angle of repose and grades them as a limitation to any intensive future land use (shaded area).

In addition, the gentler slopes have been isolated into 5% intervals from 0 to 15% slope angle. The objective of this slope classification system is to ascertain areas favourable or unfavourable to future land use. Topography slopes of 5 to 10% are favourable for most uses. The steeper portions in excess of 10% impose certain limitations to the construction of major arterial roads that require an 8 to 10% grade.

The Slope Map expresses slope aspect, the landform and potential vista of areas within the Endowment Lands. However, such parameters are part of a residential suitability analysis.

B. Geology

All the unconsolidated material formed in the Endowment Lands area are easy to excavate except for some of the compacted Newton Stoney Clays which may need blasting or heavy mechanical devices for excavation. Special problems encountered within the Newton Stoney Clay are the large boulders dropped from the ice load which may have to be excavated and removed.

All the unconsolidated material has good foundation and bearing strength offering a good building substrate. The Surficial Geology Map shows all geological components inherently developable as regards residential, insititutional and recreational development.

Some geological parameters can be regarded as aesthetically desirable within recreational as well as residential settings. Some of the large glacial erratics may offer a pleasing diversity within the Coast Forest setting and can be incorporated into the landscape of residential or recreational developments.

C. Soils

Only soils which exhibit poor drainage, a high content of fine material and organics, and internal cementation exhibit certain limitations to future land use opportunities. Most soil layers do not exceed 5 feet in thickness and average 2½ to 3 feet in profile. It should be kept in mind that this top layer can be removed in order to give good foundation for buildings and other development.

The Organic Soils can exceed 5 feet in thickness and display high moisture content and a high proportion of organics. These soils have developed in areas of impeded drainage and have plastic flow under pressure with poor foundation and shear strength.

The soils of the Heron Series in the Gleysolic Order are again evolved in areas of wet spots. The organic top horizon can be extensive, up to 2 feet thick. This top layer shows poor foundation and bearing strength.

The Summer Series of the Podzolic Order, which exhibits internal cementation about 1½ to 2 feet below the soil top, impedes percolation. This soil has moderate foundation strength because of the changing attributes of the cemented layer when saturated with water and when dry.

The Soil Map shows the above-mentioned soils graded as a limitation for future land use opportunity (shaded area). It should be pointed out again that these are geotechnical limitations of road construction and residential development.

D. Hydrology

The surface and groundwater hydrology on the Endowment Lands shows drastic seasonal variation. During the dry summer months the only limitations imposed on future land use is confined to areas of surface runoff such as Tin Can Creek and areas of the Camosun Bog. However, during the wet period in the winter, the water budget on the Endowment Lands shows a large surplus. Therefore, hydrology expressed as geotechnical limitation is a consideration of the worst time in the water budget - the wet winters.

For all practical purposes, the groundwater drainage is confined to the top three feet within the soil horizon. Where topography is gentle and depressions are formed impeded drainage areas create wetlands and bogs. These zones such as the Camosun Bog, are outlined on the Hydrology Map as areas with limitation to land use (shaded area).

Some areas have imperfectly drained soil horizons due to past construction of highways and buildings. One such area is outlined at University Boulevard and Acadia Road. The same phenomena can be observed along 16th Avenue as well as along South West Marine Drive (shaded areas). In this case the impeded drainage zones are creating limitations to land use opportunity. In some cases these can easily be corrected with the installation of adequate drainage facilities.

It is necessary to make some basic assumptions relative to land use opportunities offered by the hydrological components on the Endowment Lands. These are:

a) To maintain the Camosun Bog it will be necessary to leave intact the Camosun Bog water catchment and recharge area, as outlined on the Hydrology Map (shaded area). In fact, vegetation and surface material growing and remaining within the water catchment area should be left undisturbed. This will make the mode of runoff more desirable because of the greater amount of moisture available during the dry season. Interception of the groundwater and surface water runoff by Imperial Road, to some extent 16th Avenue, has already seriously degraded the Camosun Bog water regime and resulted in summer moisture deficits and winter flooding. It is relatively easy to manipulate the water catchment area by increasing its total acreage and future management techniques will have to be explored.

b) To maintain the Tin Can Creek drainage system, which flows into the North Arm of the Fraser River, it will be necessary to leave intact the majority of the water recharge and catchment area as outlined on the Hydrology Map (hatched area). In order to provide

Hydrology (cont'd)

year round flow the vegetation is essential to create the appropriate mode of runoff which will provide the necessary time lag in the moisture drainage. The Tin Can Creek water catchment area makes up most of the southern region of the Endowment Lands. It may be pointed out that a certain amount of compromise may be possible but only after a more detailed investigation has been conducted.

One further aspect which is considered a limitation to future land use opportunities are the presence of natural seepages. The northern bluff along Marine Drive exhibits year round groundwater seepage which adds to the erosion of the slope from tide water (shaded area). Reference to the Hydrology Map shows that the catchment area for the near surface groundwater is small and that most of the origins of this groundwater is from the deeper, main groundwater reservoir.

The surface runoff within the northern bluff area is disturbed.

The water recharge areas of the three gulleys are partially utilized by residential zones and by Chancellor Boulevard. Some of these structures have drainage ditches which lead into these gulleys; winter flash floods are undampened and create considerable erosion within these gulleys. Therefore, the surface runoff within the gulleys and a portion of their water catchment area has been regarded as a limitation (shaded area).

In summary, it is felt that the physical component of the environment on the Endowment Lands imposes certain geotechnical limitations. These have been plotted on the respective maps and can be overlain to arrive at a total composite for all geotechnical limitations. At the same time, these resources offer certain opportunities and create potential for many different kinds of land uses. As yet, insufficient information is available to test the physical resource components against land use such as residential, recreational and institutional development.

E. Vegetation

A compilation of the natural components of the environment on the Endowment Lands was found to be more difficult because of the variety of processes involved. Dr. Krajina's vegetation map plotted all vegetative associations and assigned relative values to certain communities. These values were derived on the basis of:

a) uniqueness,

b) diversity,

c) density, and

d) productivity.

A desirable plant community, therefore, was regarded as a limitation to any land use which would create disturbance, such as residential and institutional development (shaded and hatched areas). Certain areas, such as the Camosun Bog, would have limitations to active recreational developments and can only be considered as conservation areas.

Dr. Krajina has indicated that the present information of the vegetation is incomplete and will need further input to establish in more detail the desirability of certain vegetative associations with regards to future land use. In order to facilitate at least a precursory understanding of the vegetation on the Endowment Lands the Vegetation Map was graded as to the most important associations.

It is strongly recommended that the vegetation be investigated from the point of view of forestry, productivity, height and density of stands, in order to establish exactly how tolerant the plant communities are towards various levels of residential and recreational development.

F. Fish and Wildlife

I. Wildlife

The Endowment Lands and their environs provide certain opportunity for the establishment of flora and fauna. From the classical perspective of ecology, there are certain interactions of physical and natural components which may result in the transfer and mixing of nutrients which may make them available to the biological system. Within the vicinity of the Endowment Lands these are:

1. the land-water interface and the Fraser estuary,
2. the creek and riparian setting,
3. the marshlands and bogs on the uplands.

The opportunities provided by such rich life processes are limited on the Endowment Lands by summer drought. Therefore, water which is so abundant during winter months, is a critical limiting factor to the perpetuation of the wetlands and creeks on the Endowment Lands. The remainder of the Lower Mainland suffers in addition one further critical limitation, and that is snow cover, which makes it difficult for terrestrial animals to travel and to gain access to needed food sources on the ground. In contrast, the Endowment Lands shows some of the lowest snowfall in B.C. Within the more mature Douglas fir stands the interception of the snow by the vegetation creates in addition, even more favourable conditions in terms of ground exposure. The mild winters coupled with lack of snowfall creates therefore, extremely attractive conditions for certain groups of animals, both resident and wintering.

All the above factors create certain conditions:

a) there is year round vegetable matter for browse and grazing,

b) there is year round insect populations,

c) the soil and understory is exposed (no snow cover) year round, therefore, making tubers, bulbs and seeds accessible to animals.

The animals taking advantage of such conditions can be divided into two groups. These are the resident and the wintering animals.

a) The Resident Animals

1. the above conditions result in a high population density of rodents,

Fish and Wildlife (cont'd)

2. the high number of rodents results in a high number of predators, both mammalian and avian,

3. proximity to tide water offers extremely high opportunity of food at the north and south portions of the Endowment Lands.

b) Wintering and Migrant Animals

1. The above-mentioned conditions result in ideal wintering and stop-over habitat characteristics for birds. Because of the relatively high mobility of avian populations they can take advantage of food sources immediately adjacent to the Endowment Lands, as well. Specifically, the avian populations rely on the following foods:

   a) birds require high density of insects for their livelihood,

   b) certain birds require food sources from the estuarine, marine, and riparian habitat within and surrounding the Endowment Lands.

A special note should be made of birds nesting on the Endowment Lands. They are both resident birds and migratory birds. Of the resident birds, the herons have captured the attention of many an Endowment Lands visitor. The heronry is the largest heronry within the Lower Mainland. Among the avian fauna the herons can be classed as a unique bird population because of their size and nature of nesting area.

In order to highlight the importance of the Endowment Lands for vertebrates, Table 1 lists the habitat requirements for amphibians, reptiles, mammals and birds. This table deals only with species diversity and show that the open canopy woods and edge zone shrub thickets have the highest diversity of reptiles, mammals and birds. Reference to the Fish and Wildlife Map shows all edge zones shaded grey.

The remaining habitat both the wetlands and mature Douglas fir association exhibits considerably lower species diversities. However, it is within these habitats that we find unusual animals. These are the Black swift, Vaux's swift and the Hutton's vireo.

TABLE 1
HABITAT REQUIREMENTS FOR AMPHIBIANS, REPTILES, MAMMALS AND BIRDS
ON THE ENDOWMENT LANDS

WETLANDS AND BOGS	MATURE DOUGLAS FIR FOREST	OPEN CANOPY AND EDGE ZONE SHRUB THICKETS
Amphibians		
Pacifc coast newt Western red-backed salamander Red salamander Northwestern toad Pacific tree-toad Red-legged frog	Western red-backed salamander Red salamander Pacific tree-toad	Pacific tree-toad
Reptiles		
		Northern aligator lizard Puget garter snake Coast garter snake (in vicinity of coastline)
Mammals		
Bendire shrew Townsend vole Muskrat Long-tailed weasel Mink Canadian river otter (prefers coastline)	Cinereus shrew Douglas squirrel Northern flying squirrel White-footed deermouse	Bushy-tailed wood rat Western redback vole Black rat Norway rat (prefers coastline) Red fox Raccoon (frequents coastline) Fisher (prefers the coastline) Long-tailed weasel Spotted skunk

WETLANDS AND BOGS	MATURE DOUGLAS FIR FOREST	OPEN CANOPY AND EDGE ZONE SHRUB THICKETS
Birds		
Canada goose	Goshawk	Great blue heron
Mallard	Sharp-shinned hawk	Sharp-shinned hawk
Osprey	Blue grouse	Red-tailed hawk
Sparrow hawk	Ruffed grouse	Bald eagle (prefers coastline scavenging)
Common nighthawk	Screech owl	Ring-necked pheasant
Black swift	Great horned owl	Killdeer
Vaux's swift	Pileated woodpecker	Common snipe
Belted kingfisher	Hairy woodpecker	Glaucous-winged gull
Red-shafted flicker	Downy woodpecker	Mew gull
Western flycatcher	Western flycatcher	Bonaparte's gull (all gulls found feeding on termites)
Western wood peewee	Western wood peewee	Band-tailed pigeon
Cliff swallow	Olive-sided flycatcher	Mourning dove
Rough-winged swallow	Steller's jay	Rock dove
Barn swallow	Red-breasted nuthatch	Saw-whet owl
Common raven	Brown creeper	Common nighthawk
Red-winged blackbird	Winter wren	Black swift
Brewer's blackbird	Bewick's wren	Vaux's swift
Brown-headed cowbird	Varied thrush	Anna's hummingbird
American goldfinch	Hermit thrush	Rufous hummingbird
	Ruby-crowned kinglet	Red-shafted flicker
	Cedar waxwing	Yellow-bellied sapsucker
	Northern shrike	Eastern kingbird
	Hutton's vireo	Western kingbird
	Solitary vireo	Trail's flycatcher
	Myrtle warbler	Dusky flycatcher
	Audobon's warbler	Violet-green swallow
	Townsend's warbler	Tree swallow
	Western tanager	Rough-winged swallow
	Black-headed grosbeak	Barn swallow
	Evening grosbeak	Cliff swallow
	Purple finch	Purple martin
	Pine siskin	Common raven
	Red crossbill	Northwestern crow (prefers coastline)
	Oregon Junco	

WETLANDS AND BOGS	MATURE DOUGLAS FIR FOREST	OPEN CANOPY AND EDGE ZONE SHRUB THICKETS
Birds (cont'd)		
		Black-capped chickadee
		Chestnut-backed chickadee
		Common bushtit
		House wren
		Winter wren
		Bewick's wren
		Robin
		Swainson's thrush
		Townsend's solitaire
		Golden-crowned kinglet
		Ruby-crowned kinglet
		Cedar waxwing
		Northern shrike
		Starling
		Red-eyed vireo
		Warbling vireo
		Orange-crowned warbler
		Yellow warbler
		Audobon's warbler
		Black-throated gray warbler
		Wilson's warbler
		Brown-headed cowbird
		Western tanager
		Evening grosbeak
		Purple finch
		House finch
		Pine siskin
		American goldfinch
		Rufous-sided towhee
		Oregon junco
		White-crowned sparrow
		Fox sparrow
		Song sparrow
		Gold-crowned sparrow

Fish and Wildlife (cont'd)

Reference to Table 2, The Food Requirements for Amphibians, Reptiles, Mammals and Birds on the Endowment Lands, shows that the greatest species diversity is exhibited by those animals which depend on insects for their livelihood. In this context, insects in return depend on wetlands, specifically bogs and stream banks, for their larval stages. It was therefore decided to weight the wetlands, surface drainages and bogs as areas limited to development.

It is not unusual that in terms of habitat the edge zones which by definition are the boundaries between distinctly different zones, show the highest species diversity. However, in terms of species density this may not necessarily be the case. The highest productivity levels are confined to coastline and the estuary of the Fraser. As mentioned, within the uplands the wetlands and bogs show some of the higher primary productivity in the Endowment Lands. The dense and diverse vegetation, the numerous insects and amphibians and small mammals found within the wetlands reflect the large amount of available food.

The wetlands are interspersed with sufficient frequency on the Endowment Lands to form the nursery for many animals which contribute to adjacent habitats such as the mature Douglas fir coast forest section. The net result of this is that a high density of winter insect populations are uniformly distributed within the Endowment Lands. This in turn results in a high density of the Black swift and the Vaux's swift.

The presence of sufficient forest litter and old decaying tree stumps provides for a micro-habitat for many insects as well. This is taken advantage of by the Winter wrens which show some of the highest wintering population densities in the southern B.C. area.

In terms of trophic levels, the herbivores are at the bottom of the totem pole in the food chain. The Endowment Lands show high densities in populations of the White-footed deermouse and the Townsend vole. These animals are preyed upon by a large number of raptors, raccoons, mink and fox.

The coastline and the estuary, provides the most productive zone adjacent to the Endowment Lands. Birds such as the Great blue heron, Bald eagle, as well as Osprey and gulls can take advantage of the estuary while terrestrial animals need direct access. Therefore, small mammals populations are extremely abundant along the perimeter of the coastline which at present is the West Point Grey Foreshore Park. However, such high productivity is handed up to the uplands of the Endowment Lands via the food chain. High

TABLE 2
FOOD REQUIREMENTS FOR AMPHIBIANS, REPTILES, MAMMALS AND BIRDS ON THE ENDOWMENT LANDS

INSECTS	VEGETABLE MATTER	SMALL MAMMALS AND FISH
Amphibians		
Pacific coast newt	Pacific coast newt	
Western red-backed salamander		
Red salamander		
Northwestern toad		
Pacific tree-toas		
Red-legged frog		
Reptiles		
Northern aligator		Puget garter snake
Puget garter snake		Coast garter snake
Coast garter snake		
Mammals		
Bendire shrew	Douglas squirrel	Red fox
Cinereus shrew	Northern flying squirrel	Raccoon
	White-footed deermouse	Fisher
	Bushy-tailed wood rat	Long-tailed weasel
	Western redback vole	Mink
	Townsend vole	Spotted skunk
	Muskrat	Canadian river otter
	Black rat	
	Norway rat	

INSECTS	VEGETABLE MATTER	SMALL MAMMALS AND FISH
Birds		
Glaucous-winged gull	Canada goose	Great blue heron
Mew gull	Mallard	Goshawk
Bonaparte's gull	Blue grouse	Sharp-shinned hawk
Common nighthawk	Ruffed grouse	Red-tailed hawk
Black swift	Ring-necked pheasant	Bald eagle
Vaux's swift	Killdeer	Osprey
Red-shafted flicker	Common snipe	Sparrow hawk
Pileated woodpecker	Band-tailed pigeon	Glaucous-winged gull
Yellow-bellied sapsucker	Mourning dove	Mew gull
Hairy woodpecker	Rock dove	Bonaparte's gull
Downy woodpecker	Anna's hummingbird	Screech owl
Eastern kingbird	Rufous hummingbird	Great horned owl
Western kingbird	Steller's jay	Saw-whet owl
Trail's flycatcher	Common raven	Belted kingfisher
Dusky flycatcher	Northwestern crow	Common raven
Western flycatcher	Black-capped chickadee	Northwestern crow
Western wood peewee	Chestnut-backed chickadee	Northern shrike
Olive-sided flycatcher	Common bushtit	
Violet-green swallow	Red-breasted nuthatch	
Tree swallow	Robin	
Rough-winged swallow	Cedar waxwing	
Barn swallow	Starling	
Cliff swallow	Brown-headed cowbird	
Purple martin	Western tanager	
Steller's jay	Black-headed grosbeak	
Black-capped chickadee	Evening grosbeak	
Chestnut-backed chickadee	Purple finch	
Common bushtit	House finch	
Red-breasted nuthatch	Pine siskin	
Brown creeper	American goldfinch	
House wren	Red crossbill	
Winter wren	Rufous-sided towhee	
Bewick's wren	Oregon junco	
Robin	White-crowned sparrow	
Varied thrush	Golden-crowned sparrow	
Hermit thrush	Fox sparrow	
Swainson's thrush	Song sparrow	
Townsend's solitaire		
Golden-crowned kinglet		

	INSECTS	VEGETABLE MATTER	SMALL MAMMALS AND FISH
Birds (cont'd)			
Ruby-crowned kinglet			
Cedar waxwing			
Northern shrike			
Starling			
Hutton's vireo			
Solitary vireo			
Red-eyed vireo			
Warbling vireo			
Orange-crowned warbler			
Yellow warbler			
Myrtle warbler			
Audobon's warbler			
Black-throated gray warbler			
Tonwsend's warbler			
Red-winged blackbird			
Brewer's blackbird			
Brown-headed cowbird			
Western tanager			
Evening grosbeak			
Purple finch			
House finch			
American goldfinch			
Oregon junco			
White-crowned sparrow			
Golden-crowned sparrow			
Fox sparrow			
Song sparrow			
Wilson's warbler			

Fish and Wildlife (cont'd)

densities of rodents, perching birds and their predators "spill" into the uplands of the Endowment Lands. Unfortunately, the presence of perimeter roads such as Marine Drive have interupted the process and have created effective barriers especially to the distribution and food accessibility of the smaller rodents. Even with the existence of these barriers, areas at the southern and northern perimeter of the Endowment Lands were regarded as important wildlife habitats and therefore, shaded in grey.

A special note should be made of the habitats found within the mature Douglas fir association. Although not regarded as a highly productive area, it nevertheless offers critical wintering habitat. This habitat is used by insects, birds and small mammals during severe cold and snow periods. Therefore, those sections which show closed canopy Douglas fir stands within the Endowment Lands have been shaded in grey and are regarded as limitations to future land use opportunities.

II Fish

Tin Can Creek has the best capability for anadromous fish such as coho and chum salmon and migratory cutthroat trout. At the same time, this system can support a good number of resident cutthroat trout. The drainage system immediately to the west of Tin Can Creek which flows into Tin Can Creek, via the golf course, has low supportive capacity for anadromous fish and the same applies to resident cutthroat trout. The remainder of the southern and northern drainages show very low to no capability for fish populations.

Tin Can Creek is at present utilized by cutthroat trout which have been observed above and below Marine Drive. The present value of this drainage for fish is significant as well as the potential fish habitat is great. Comprehensive protection of the semi-natural conditions of the drainage system is recommended.

Even though the other streams of the southern drainage have low present fish values, and low potential, they have certain attraction to integrate them into the other wildlife and vegetation spectrum. It is in these areas that we find the heronry, extensive closed canopy Douglas fir forest, as well as areas which are reverting to a bog, wetland situation. All these components of the physical and natural system lead to conservation, passive recreation and controlled active recreational use which should be significant with regards to future residential and recreational developments on the Endowment Lands.

For the purpose of preserving the most desirable drainage system, the Tin Can Creek drainage as well as the drainage to the west have been shown as limited to development and therefore, shaded grey.

G. Archeology

All the archeology sites are found off the present Endowment Lands. Therefore, no significant archeological sites are expected. The normal provisions of the Archeological Sites Act would apply to any development activity on the Endowment Lands.

CONCLUSIONS

The physical components of the inventory of the Endowment Lands have been compiled in such a manner as to arrive at the land use limitations as regards to future land use opportunities, by simply overlaying the transparent original maps. All shaded areas have limitations to future land use opportunity.

The maps used for the overlay system are:

Slope Map,

Surficial Geology Map,

Soils Map,

Hydrology Map, and

Fish and Wildlife Map.

On the basis of the above information, a single limiting component on the final composite map, is weighted at 20%. Where two components coincide it is weighted at the twice the limitation, or 40%. In some cases all physical and natural components overlayed to produce 100% limitation. These areas are isolated in a solid black shade. In addition, 100% limitations were attached to those values regarded as unique and these are the Camosun Bog, with its recharge area, as well as the heronry, with a buffer zone.

SUGGESTED STUDY OUTLINE

During the course of the present compilation of the known resource base on the Endowment Lands, it was found that the data sources are very academic and fragmentary in nature. It is therefore suggested that an environmental team be assembled in order to inventory and analyze those components of the natural resource base which showed insufficient data. Specialists within the team must be able to present their information sithin 6 weeks from an agreed starting date, in order to provide the appointed urban design teams with sufficient data on the environmental component to prevent misuse.

The components of the study are as follows:

A Baseline Inventory

1. Topography — completed

2. Climate — completed

3. Geology — completed

4. Soils - further field checks to establish the exact extent of those soils which show inherent limitations to land use, estimated time 4 man days.

5. Hydrology — completed

6. Vegetation and Forestry - approximately 10 man days will be required to inventory forest and vegetative associations, to establish the height and density of stands, the wind firmness of stands, and rooting depth.

7. Fish and Wildlife

Waterfowl and other birds - information on the heronry complete, however further information should be collected to establish present use of the Endowment Lands by waterfowl and their habitat requirements. The same applies to perching birds dependent on the Coastal Forest on the Endowment Lands for their wintering. This aspect requires the service of a competent waterfowl and wildlife biologist for approximately 4 man days.

Fish - an inspection of all water courses draining the Endowment Lands should be conducted to evaluate their suitability as fish habitat which will require the services of an experienced aquatic biologist for 2 man days.

Small mammals, reptiles and amphibians - graduate students and faculty of the University of British Columbia should be interviewed

Suggested Study Outline (cont'd)

in order to establish the presence and significance of small mammals, reptiles and amphibians on the Endowment Lands. This will require the services of a biologist for approximately 4 man days.

8. Archeology — completed

B Analysis

1. Topography — completed

2. Climate — completed

3. Geology — completed

4. Soils - the revised soils inventory should be of sufficient depth to analyze and establish suitability classes in relation to future land use, 2 man days.

5. Hydrology - should be analyzed in relation to the other physical components to establish suitability classes and potential management and mitigation measures, 4 man days.

6. Vegetation - associations will have to be weighed and classified as to their suitability towards various land use alternatives. Classes will have to be established in each catagory or residential, commercial, recreational, and educational development alternatives. As mentioned previously, vegetation falls into two components, those inherently limiting to land use opportunity due to uniqueness and intolerance and those desirable to land use opportunity such as recreation and residential use. This aspect of the natural system will need fairly extensive coverage and require approximately 10 man days.

7. Forestry - this aspect will be closely associated with the vegetation analysis and will establish the tree component of the natural vegetation and their suitability classes. It will include what is traditionally regarded as the landscape reconnaissance and will discuss site modifications, 10 man days.

8. Fish and Wildlife - would be classified as to the suitability of fish and wildlife towards various land use alternatives. As in vegetation there are two distinct components, that limiting land use opportunity because of uniqueness and those desirable to recreational land use opportunity: fish, 2 man days; wildlife, 2 man days.

Suggested Study Outline (cont'd)

9. Archeology completed

C. The final integration and analysis of all the natural resource components of the Endowment Lands will require the services of a natural resource manager and will map on an overlay system the different suitability classes for various anticipated land use opportunities. Generally, these land use opportunities include classes weighed relative to low density and high density residential development, active and passive recreation and conservation. Each land use should be established in areas within the Endowment Lands on the basis of these inherent suitabilities. Where some compromise will habe to be established due to strong pressures not part of the technical resource component, management and mitigation techniques should be outlined. This final component will require a minimum of 10 man days.

D. Report preparation will require an additional 4 man days.

E. The total work requirement therefore, including specialists, such as a physical resource scientist, a forester, a botanist, an aquatic biologist, a terrestrial biologist and a resource integrator will be 68 man days.

The preparation of the overlay mapping system including drafting, photography and the preparation of the final report will be fairly costly and would include illustrative maps for display purposes as well as photographs illustrating samples of the natural resource base. This aspect of the study will probably cost for film and material - $2000.00

BIBLIOGRAPHY

The following is a list of reports on which some of the components of the resource inventory are based. These reports which were found to be an important part of this resource compilation are appended.

1. Krajina, Vladimir J. letter to the President's Committee on "Use of the University Endowment Lands", January, 1973.

2. Norris, Don. notes prepared for the Forestry 404 class on "The University Endowment Lands", 1971.

3. Ebb, P. essay for Soils 419 entitled "Soil survey on the University of British Columbia Endowment Lands", 1971.

4. Partridge, Brian. "Possible effects of development of the University Endowment Lands on the Great Blue Heron (Ardea herodias) colony located there", 1973.

5. Norris, Don. "Report on educational and research uses of the University of British Columbia Endowment Lands", a preliminary survey report for Forestry 525, April, 1971.

6. McBride, Brian. "Land suitability use for the University Endowment Lands", a thesis submitted for the degree of the Bachelor of Science, April, 1974.

7. Krebs, John. "Colonial nesting and social feeding as strategies for exploiting food resources in the Great Blue Heron (Ardea herodias)", Department of Zoology, U.B.C., 1973.

8. Krebs, John. "Significance of head tilting in the Great Blue Heron", Nature, 1973.

9. Rowles, C.A. "Soils report on the University Endowment Lands", submission to the Endowment Land Committee, February, 1953.

10. Armstrong, J.E. "Surficial Geology of the Vancouver Area", paper 60 - 29, Geological Survey of Canada, 1956.

11. Mathew, W.H. "Surficial deposits of the Lower Fraser River Valley", unpublished preliminary report, 1953.

LIST OF APPENDICES

AMPHIBIANS OF THE ENDOWMENT LANDS

AMPHIBIAN NAME	DESCRIPTION
PACIFIC COAST NEWT Taricha granulosa	Congregates in ponds and small lakes to spawn.
WESTERN RED-BACKED SALAMANDER Plethodon vehiculum	Strickly terrestrial, never found in water but dependent upon moisture for existence, consequently restricted to damp places such as rotting logs in shaded woods.
RED SALAMANDER Ensatina eschscholtzi	Found in habitat of above, since it is also terrestrial.
NORTHWESTERN TOAD Bufo boreas	Congregates in the early spring in swamps for spawning. May wander considerable distances from water but usually retire to some damp hole or shaded spot at dawn, being nocturnal
PACIFIC TREE-TOAD Hyla regilla	Congregates in numbers each spring in almost every pond and swamp. After leaving the water tree-toads spend most of their life in shrubs and trees.
RED-LEGGED FROG Rana aurora	Inhabitant of woods, banks and streams, and edges of ponds.

REPTILES OF THE ENDOWMENT LANDS

REPTILE NAME	DESCRIPTION
NORTHERN ALIGATOR LIZARD Gerrhonotus coeruleus	Found usually in dry rocky areas (exposed bluffs).
PUGET GARTER SNAKE Thamnophis ordinoides	Normally found in dense thickets, along roadsides, and the margins of fields.
COAST GARTER SNAKE Thamnophis elegans	This snake is a beach-loving reptile seldom found far from water (can swim).

MAMMALS OF THE ENDOWMENT LANDS

MAMMAL NAME	DESCRIPTION
BENDIRE SHREW Sorex bendiri	Found in wet ground in heavily wooded areas, banks of sluggish streams, beach debris
CINEREUS SHREW Sorex cinereus	Wooded and forested country are wideapread habitat for this shrew
DOUGLAS SQUIRREL or CHICKAREE Tamiasciurus douglasi	Found in the edges of dense forests, most commonly in open conifer or mixed forests.
NORTHERN FLYING SQUIRREL Glaucomys sabrinus	Found in trees more than 50 feet in height in forested area.
WHITE-FOOTED MOUSE or DEERMOUSE Peromyscus maniculatus	Extremely variable, may occur in almost any area habitable by terrestrial mammals.
BUSHY-TAILED WOOD RAT or PACK RAT Neotoma cinerea	Found in broken rock, frequently occurs in cliffs, gullies however, open forest floor may serve as nest-sites.
WESTERN REDBACK VOLE Clethrionomys occidentalis	Known only from the extreme south coast south of Burrard Inlet - one specimen found in Point Grey. Found in the forest floor in mixed second-growth forest stands.
TOWNSEND VOLE Microtus townsendi	Found in moist fields and sedge meadows.
MUSKRAT Ondatra zibethica	Prefers the marshy borders of ponds, where it feeds on sedges, pond weeds, and other plants growing in and near water. Sometimes in fields, thickets.
BLACK RAT Rattus rattus	Lives in second-growth forests or on forest edges.
NORWAY RAT Rattus norvegicus	Found in brush margin to the sea-beach.
RED FOX Vulpes fulva	Frequents edge zones - open meadows interspersed with groves of bush and trees. Also around stream banks-

MAMMAL NAME	DESCRIPTION
RACCOON Procyon lotor	Found in both deciduous and coniferous forests and shrubbery, utilizes hollow trees and sometimes burrows under the roots. Feeds entirely on the beach.
FISHER Martes pennanti	Numerous in mixed forests of coniferous and deciduous trees.
LONG-TAILED WEASEL Mustela frenata	Versatile animal found from sea-level to mountain-top in almost every terrestrial habitat. Frequents stream-banks, forest edge.
MINK Mustela vison	Semi-aquatic in habitat. Dwells in woodlands and marshes surrounding sea-shores and banks of streams.
SPOTTED SKUNK Spilogale gracilis	Found in lowland thickets and heavy cover.
CANADIAN RIVER OTTER Lutra canadensis	Associated with shore-lines. Resides on land, usually in dens under the roots of large trees,close to water.

BIRDS OF THE ENDOWMENT LANDS

BIRD NAME	DESCRIPTION
GREAT BLUE HERON Ardea herodias	Common resident. Forage on tidal flats of the Fraser delta. Nesting: survey of heronry was shown to have 123 nests with 18 eggs and 279 young (June 1970) Heronry is located in a patch of alders surrounded by a mature mixed forest. Nest heights range from 56 to 92 feet above ground (average height 72 feet).
CANADA GOOSE Branta canadensis	Frequent resident. Noted on marshes. Nesting: nests in marshes; occassionally in old tree nests of large birds of prey, tree platform or cliff.
MALLARD Anas platyrhynchus	Found in marshes,and ponds. Nesting: usually among reeds or grass.
GOSHAWK Accipiter gentilis	Found in forests and woodlands.
SHARP-SHINNED HAWK Accipiter striatus	Found in forests and thickets.
RED-TAILED HAWK Buteo jamaicensis	Open areas, woodlands are habitat Nesting: nests a platform of sticks in forest tree, isolated low tree, cliff.
BALD EAGLE Haliaeetus leucocephalus	Frequent resident to coast, Nesting: nest a bulky platform of sticks in tall tree, cliff.
OSPREY Pandion haliaetus	Frequent resident of coast.
SPARROW HAWK Falco sparverius	Found on wooded streams. Nesting: in cavity in isolated tree, cliff or building.
BLUE GROUSE Dendragapus obscurus	Habitat: coniferous forests.
RUFFED GROUSE Bonasa umbellus	Found in mixed or deciduous forests Nesting: a sheltered depression on forest floor

BIRD NAME	DESCRIPTION
RING-NECKED PHEASANT Phasianus colchicus	Found in marshy areas.
KILLDEER Charadrius vociferus	Found in fields, marshes and creek banks.
COMMON SNIPE Capella gallinago	Habitat: fresh marshes, ditches, streamsides, bogs, wet meadows.
GLAUCOUS-WINGED GULL Larus glaucescens	Found on coast, ocean, bays, beaches, dumps, waterfronts. Feed on termites over Endowment Lands.
MEW GULL Larus canus	Found in similar places to other gulls. Also feeding on termites.
BONAPARTE'S GULL Larus philadelphia	Found in similar places to other gulls. Also feeding on termites.
BAND-TAILED PIGEON Columba fasciata	Habitat: river woodlands, tall brush. Nesting: a flimsy platform in thicket, low tree.
MOURNING DOVE Zenaidura macroura	Habitat: open woods, coastal scrub, grassland. Nesting: a flimsy twig platform in tree, shrub, grassland, or ground.
ROCK DOVE or DOMESTIC PIGEON Columba livia	Found on cliffs, open areas, built areas.
SCREECH OWL Otus asio	Found in woodlands, shade trees, wooded canyons. Nesting: in tree cavity, woodpecker holes.
GREAT HORNED OWL Bubo virginianus	Found in forests, woodlands, thickets, streamsides, open country, cliffs. Nesting: in old nests of heron or hawk; in tree, pothole, cliff or river bluff; even on ground.
SAW-WHET OWL Aegolius acadicus	Forests, cliffs and groves are common areas where found.

BIRD NAME	DESCRIPTION
COMMON NIGHTHAWK Chordeiles minor	Found in open pine woods, treeless plains to mountains.
BLACK SWIFT Cypseloides niger	Open sky; favours coastal cliffs and mountain country.
VAUX'S SWIFT Chaetura vauxi	Open sky, forest burns, openings.
ANNA'S HUMMINGBIRD Calypte anna	Found in broken woodlands. Noted to feed in winter on jasmine flowers.
RUFOUS HUMMINGBIRD Selasphorus rufus	Found in forest edge zones on flower plants. Seem to like streamsides and lowlands in spring and mainly mountainous meadows, forest openings in fall.
BELTED KINGFISHER Megaceryle alcyon	Habitat: ponds, streams of coast. Nesting: in burrows in streambanks and sandbanks.
RED-SHAFTED FLICKER Colaptes cafer	Likes groves, river woods, open forests and semiopen country.
PILEATED WOODPECKER Dryocopus pileatur	Found in coniferous and mixed forests. Nesting: in holes in trees.
YELLOW-BELLIED SAPSUCKER Sphyrapicus varius	Likes woodlands, aspen groves. Reported in summer.
HAIRY WOODPECKER Dendrocopos villosus	Habitat: woodlands, river groves. Reported present throughout the year. Nesting in tree holes.
DOWNY WOODPECKER Dendrocopos pubescens	Habitat: cottonwoods, arid brush, drier groves. Nesting: in holes in trees.
EASTERN KINGBIRD Tyrannus tyrannus	Enjoys wood edges, parklands, river groves, shelter belts and roadways.
WESTERN KINGBIRD Tyrannus verticalis	Likes open country with scattered trees and roadsides.
TRAIL'S FLYCATCHER Empidonax traillii	Likes willow and alder thickets in low valleys, swamps or meadows, brushy bogs as well.

BIRD NAME	DESCRIPTION
DUSKY FLYCATCHER Empidonax oberholseri	Found in brush with scattering trees, and open coniferous forest.
WESTERN FLYCATCHER Empidonax difficilis	Found in summer in moist woods, mixed or conifer forest, groves, must have water and shade.
WESTERN WOOD PEEWEE Contopus sordidulus	Frequent in summer in woodlands, pine-oak forest, open conifers, and stream groves.
OLIVE-SIDED FLYCATCHER Nuttallornis borealis	Frequent in summer in conifer forest andon tips of dead trees or branches.
VIOLET-GREEN SWALLOW Tachycineta thalassina	Common in summer. Seen in open forests, cliffs, woodlands, buildings.
TREE SWALLOW Iridoproxne bicolor	Likes open country near water, marshes, meadows, streams, wires, when nesting requires dead trees, snags, preferably near water. Nesting: a feather-lined cup in hole in tree, building, nest box.
ROUGH-WINGED SWALLOW Stelgidopteryx ruficollis	Likes to be near streams and marshes.
BARN SWALLOW Hirundo rustica	Habitat: open or semiwooded country, fields, marshes; usually near habitation.
CLIFF SWALLOW Petrochelidon pyrrhonota	Likes open to semiwooded country, cliffs, streams. Nesting: 209 nest on Dentistry Building and 27 on Dairy Barn. Nests an open cup of mud, straw.
PURPLE MARTIN Progne subis	Like open forests, wide-ranging in migration.
STELLER'S JAY Cyanocitta stelleri	Live in conifer and pine-oak forests. Nesting: a twiggy, rootlet-lined bowl in conifer.
COMMON RAVEN Corvus corax	Common resident. Widespread through conifer forests. Like cliffs, boreal forests. Nesting: on cliffs, trees
NORTHWESTERN CROW Corvus caurinus	Near tidewater and shores often found. Nesting: a well-made bowl of sticks in trees.

BIRD NAME	DESCRIPTION
BLACK-CAPPED CHICKADEE Parus atricapillus	Found in mixed and decidous forests. Nesting: a fur-lined hole in rotting stub or tree.
CHESTNUT-BACKED CHIKADEE Parus rufescens	Habitat: moist conifer forests; adjacent to oaks, shade trees. Nesting: In hole in tree, stub.
COMMON BUSHTIT Psaltriparus minimus	Common to oak scrub, broad-leaved and mixed woods, junipers. Nesting: a long woven pouch in bush or tree.
RED-BREASTED NUTHATCH Sitta canadensis	Lives in conifer forests; also other trees in winter. Nesting: in hole in dead conifers, stubs; entrance smeared in pitch.
BROWN CREEPER Certhia familiaris	Lives in mature forests, groves. Nesting: behind strip of loose bark.
HOUSE WREN Troglodytes aedon	Habitat: thickets, open woods, brush and inhabited areas. Nesting: in hole in tree, stub or bird box.
WINTER WREN Troglodytes troglodytes	Found in coniferous forests, woodlands, underbrush and sea cliffs. Nesting: of moss and twigs in exposed roots, crevices and crannies.
BEWICK'S WREN Thryomanes bewickii	Found in thickets, underbrush juniper Nesting: in hole, crevice, cranny, bird box.
ROBIN Turdus migratorius	Habitat: towns, lawns, open forests, streamsides; in winter, berry-bearing trees. Nesting: a mud-walled, grass-lined bowl, usually in tree.
VARIED THRUSH Ixoreus naevius	Habitat: thick, wet forest, conifers; in winter, woods, ravines, thickets. Nesting: a cup of twigs, moss, in small trees.
HERMIT THRUSH Hylocichla guttata	Habitat: conifer or mixed woods, forest floor; in winter, woods, thickets, and parks.

BIRD NAME	DESCRIPTION
SWAINSON'S THRUSH Hylocichla ustulata	Habitat: willow thickets, river woods, aspens, forest undergrowth, conifers. Nesting: a cup of twigs, dead leaves, rootlets in bush, small trees.
TOWNSEND'S SOLITAIRE Myadestes townsendi	Found in mountain forests; in winter, brushy slopes
GOLDEN-CROWNED KINGLET Regulus satrapa	Found in conifer forests; in winter in other woodlands, thickets.
RUBY-CROWNED KINGLET Regulus calendula	Found in conifer forests; in winter, in other woodlands, thickets.
CEDAR WAXWING Bombycilla cedrorum	Found in open woodlands, fruiting trees, in winter, irregular. Nesting: a cup of twigs, grass, moss on horizontal branch.
NORTHERN SHRIKE Lanius excubitor	Found on semiopen country with lookout posts.
STARLING Sturnus vulgaris	Habitat: farms, open country, open groves, fields. Nesting: in holes in trees, buildings.
HUTTON'S VIREO Vireo huttoni	Rare resident found in woods and adjacent brush; prefer oaks.
SOLITARY VIREO Vireo solitarius	Habitat: mixed forests, pine-oak woods.
RED-EYED VIREO Vireo olivaceus	Habitat: deciduous and mixed woods, aspen groves, poplars, shade trees.
WARBLING VIREO Vireo gilvus	Habitat: woodlands, shade trees, groves.
ORANGE-CROWNED WARBLER Vermivora celata	Found in brushy woodland clearings, hillsides, aspens, undergrowth,
YELLOW WARBLER Dendroica petechia	Found in willows, poplars, streamside trees and shrubs, shade trees.

BIRD NAME	DESCRIPTION
MYRTLE WARBLER Dendroica coronata	Habitat: coniferous and mixed forests.
AUDUBON'S WARBLER Dendroica auduboni	Found in conifer forests; in winter, varied, open woods, treetops, brush, thickets, beaches.
BLACK-THROATED GRAY WARBLER Dendroica nigrescens	Found on dry oak slopes, junipers and open mixed forests. In migration, varied trees, brush.
TOWNSEND'S WARBLER Dendroica townsendi	Found in tall conifers, cool fir forests; in winter, also oaks.
WILSON'S WARBLER Wilsonia pusilla	Habitat: thickets along woodland streams, moist tangles, low shrubs, willows, alders
RED-WINGED BLACKBIRD Agelaius phoeniceus	Found in marshes, swamps, edges of water.
BREWER'S BLACKBIRD Euphagus cyanocephalus	Found in riversides, groves, thickets, towns.
BROWN-HEADED COWBIRD Molothrus ater	Habitat: wood edges, river groves. Nesting: lays speckled eggs in nests of other species.
WESTERN TANAGER Piranga ludoviciana	Likes open conifer or mixed forests; widespread in migration
BLACK-HEADED GROSBEAK Pheucticus melanocephalus	Found in pine-oak woods, mixed forests, streamside groves and parks.
EVENING GROSBEAK Hesperiphona vespertina	Found in conifer forests; in winter, maples, fruiting shrubs.
PURPLE FINCH Carpodacus purpureus	Found in mixed and conifer woodlands.
HOUSE FINCH Carpodacus mexicanus	Found in open woods, coastal scrub.

BIRD NAME	DESCRIPTION
PINE SISKIN Spinus pinus	Found in conifer forests, mixed woods, alders, treetops, nearby weedy areas.
AMERICAN GOLDFINCH Spinus tristis	Found near river groves, in willows, poplars, on roadsides.
RED CROSSBILL Loxia curvirostra	Found in conifer forests and groves.
RUFOUS-SIDED TOWHEE Pipilo erythrophthalmus	Habitat: brush, undergrowth, forest edges, shrubs. Nesting: a loose cup on ground or in low bush.
OREGON JUNCO Junco oreganus	Habitat: conifer and mixed forests; in winter, also roadsides, brush parks.
WHITE-CROWNED SPARROW Zonotrichia leucophrys	Habitat: scattered cover; low brush, thickets; in winter, roadsides and open scrub.
GOLDEN-CROWNED SPARROW Zonotrichia atricapilla	Found in spruce; in winter, partly favours denser shrub.
FOX SPARROW Passerella iliaca	Habitat: stunted boreal woodlands, forest undergrowth.
SONG SPARROW Melospiza melodia	Likes thickets, brush, marshes, roadsides, sea beaches.

THE UNIVERSITY OF BRITISH COLUMBIA

VANCOUVER 8, CANADA

DEPARTMENT OF BOTANY

January 24, 1973

To the

President's Committee

on "Use of the University
Endowment Lands"

Since 1949, when I became a member of the Department of Biology and Botany, U.B.C., I have used the areas of Endowment Lands for many field trips which I organized for my students of either plant ecology or dendrology (totally about 500 students) and also for about 35 graduate students. Without these areas I could not teach my students so efficiently as I possibly did according to the personal letters of my graduate students, which I received in 1971. The Endowment Lands, which already lost some of precious "wilderness" areas by some more recent development, and the lands between Marine Drive and the coast or the banks of the Fraser River are the closest natural areas near the University of British Columbia which can be demonstrated to the university students without any greater loss of time otherwise required for the access of similar areas. To teach especially Plant Ecology (both vegetation and its environment) without availability of such areas would be very difficult if not even impossible.

I had the opportunity to help a little in the study which was carried out by one of my previous students, Mr. D.J. Norris (Educational and Research Uses of the University of British Columbia Endowment Lands, 1971) and, therefore, I do not wish to repeat what Norris included in his very interesting report, which should be fully used by the President's Committee on "Use of the University Endowment Lands".

The area of the Endowment Lands belongs to the coastal Douglas-fir biogeoclimatic zone (climate is *Cbs* according to Köppen, annual precipitation about 50"). Most of this area was submerged under the sea during the last glaciation. Therefore, the soils, originally as marine depcsits, are overlain by glacial till only in the highest parts of this area and many ecosystems

. . . /.

are still bearing this evidence. Such plant communities are most interesting for teaching of the ecological interpretation, even if they are more complex than they should be for those who are learning the first steps in ecology.

Among the plant communities which should remain available at the close proximity of the campus are especially the following ones:

(1) Lodgepole pine (*Pinus contorta*) - labrador tea (*Ledum groenlandicum*) - peat moss (*Sphagnum* spp.) plant association in the vicinity of the 20th Avenue and Camosun Street. In this plant community there are such plants as *Rubus chamaemorus* (an arctic relict, completely missing in the United States south of Canadian border), *Vaccinium ovalifolium, V. canadense* (both occurring now mainly in the coastal subalpine zone), *V. uliginosum* (bog bilberry, growing rarely only in characteristic peat bogs in the coastal areas), *Oxycoccus microcarpus* (cranberry), *Kalmia polifolia* (false laurel), *Spiraea douglasii* (western hardhack) and most commonly *Ledum groenlandicum*, after which this plant community was named. Several peat mosses (*Sphagnum nemoreum, S. papillosum, S. fallax, S. tenellum, S. rubellum*) occurred in this locality, however, most of them became extinct and replaced mainly by *Pleurozium schreberi* when the drainage of this area was introduced. Nevertheless, the peat bog cumulose deposits, developed in this basin, may supply the palynological information of the forest history of this area since glaciation (a preliminary study was carried out under the supervision of Professor Glenn E. Rouse). If this locality will be destroyed, the potential documentation of the local forest history will be never properly revealed. Therefore, the conservation of especially this part of the Endowment Lands, representing peat bog plant community, is considered as the most pressing. Soil is Sphagno-Fibrisol (2-8 m deep). The habitat should be fenced and permitted for studies and observations only to a limited group of students.

(2) Douglas-fir (*Pseudotsuga menziesii*) - grand fir (*Abies grandis*) - western redcedar (*Thuja plicata*) - swordfern (*Polystichum munitum*) plant association (in several localities, especially in the Foreshore Park between the Marine Drive and the North Arm of Fraser River). Douglas-fir grows here in height of 160-180 feet tall trees in 100 years. Some very old trees (over 500 years) are surviving here even if they were strongly affected either by fire or by wind. From the plants, living here, the following should be

. . . /.

mentioned: *Alnus rubra, Acer macrophyllum, A. circinatum, Cornus nuttallii, Rhamnus purshiana, Sambucus pubens, Rubus spectabilis, R. parviflorus, Ribes lacustre, Polystichum munitum, Tiarella trifoliata, Athyrium filix-femina, Adenocaulon bicolor, Galium triflorum, Montia sibirica, Trillium ovatum, Geum macrophyllum, Streptopus amplexifolius, Dryopteris austriaca, Polypodium glycyrrhiza, Carex leptopoda, C. hendersonii, Osmorhiza chilensis, Tellima grandiflora, Dicentra formosa, Stellaria crispa, Blechnum spicant, Disporum oreganum, Bromus vulgaris, Cina latifolia* and *Festuca subulata.* From bryophytes at least the following should be mentioned: *Plagiomnium insigne, P. venustum* (on the bark of broadleaf maple), *Leucolepis menziesii, Rhizomnium glabrescens, Brachythecium asperrimum, Epipterygium tozeri* (otherwise very rare), *Isothecium stoloniferum, Claopodium crispifolium, Neckera menziesii, N. douglasii, Antitrichia curtipendula, Eurhynchium praelongum, Homalothecium fulgescens, H. nuttallii, Tetraphis pellucida, Lepidozium reptans, Calypogeia fissa, C. suecica, C. trichomanis, Scapania bolanderi, S. umbrosa, Lophocolea bidentata, L. cuspidata, L. heterophylla, Plagiochila asplenioides, Cephalozia leucantha, C. lammersiana, C. media, Cephaloziella divaricata, Radula complanata, Porella cordaeana, P. navicularis, P. platyphylla, Frullania nisquallensis, Pellia neesiana, Conocephalum conicum* and *Marchantia polymorpha.* Soil is mainly Gleyed Dystric Brunisol. In some areas the lateral seepage water, keeping this environment highly productive, was diverted by drainage along the Marine Drive.

Some basic ecological studies were made here in these highly productive forest sites of the Endowment Lands (see R. Garm, 1958: Some spects of the nitrogen cycle in soil of the Douglas-fir forest).

(3) Red alder (*Alnus rubra*) - Douglas-fir (*Pseudotsuga menziesii*) - western redcedar (*Thuja plicata*) - western hemlock (*Tsuga heterophylla*) - Oregon grape (*Mahonia nervosa*) - thimble-berry (*Rubus parviflorus*) - moss (*Eurhynchium oreganum*) plant association, developed on the plateau which was submerged under the sea during the last glaciation. Soil is still close to Regosols of marine deposits developing towards Dystric Brunisols. If it is rather Regosol, the occurrence of *Rubus spectabilis* and even *Sambucus pubens* is frequent. These plants become less frequent in Dystric Brunisols. *Polystichum munitum* is only sparse. *Mahonia nervosa* is frequent and sometimes dominant. Red alder (*Alnus rubra*) and bitter cherry (*Prunus emarginata*) are frequent and in some areas, where Douglas-fir did not start to grow early enough, these angiospermous trees became dominant, *Alnus rubra* (with some

. . . /.

Cornus nuttallii) being promoted especially in consequence of nutritionally rich marine deposits. Western hemlock (*Tsuga heterophylla*) got established here on decaying wood. There are some plants which grow better in the swordfern plant associations (see plant community no. 2), but most of them grow in much lower vigour and species significance here. Besides *Mahonia nervosa*, which is missing in the typical swordfern plant communities and on the contrary very common here, *Trientalis latifolia* is frequently growing here.

Theoretically, this soil would mature into a Thin Podzol and, then, the plant association would be successionally replaced by the salal *(Gaultheria shallon)* plant community. Interestingly enough, salal is missing here either completely or occurring only on decaying wood. These successional consequences with several variants could be easily demonstrated in the Endowment Lands.

(4) Red alder (*Alnus rubra*) - bitter cherry (*Prunus emarginata*) - Douglas-fir (*Pseudotsuga menziesii*) - western hemlock (*Tsuga heterophylla*) - salal (*Gaultheria shallon*) plant association is occurring mainly on glacial till (especially near Camosun Park). Red alder, which is usually missing in these sites elsewhere, occurs here as an evidence of a certain marine influence in the past. Western hemlock grows here only as a scrub which would not develop larger trees in habitats with annual precipitation as low as it is (about 50"). Besides *Eurhynchium oreganum*, which is a common moss here, *Hylocomium splendens* is frequent, whereas *Rhytidiadelphus loreus, Dicranum fuscescens, D. howellii, Plagiothecium undulatum* grow mainly on decaying wood. *Hypnum circinale, Cetraria glauca, Pertusaria ambigens, Sphaerophorus globosus, Physcia caesia, Alectoria sarmentosa, Hypogymnia enteromorpha* and *H. tubulosa* grow on the bark of coniferous species. These corticolous lichens are becoming rare with the growing air pollution in the last years and may disappear completely. In the herb layer *Linnaea borealis, Goodyera oblongifolia, Listera cordata, Pyrola secunda* and *Monotropa hypopitys* grow, whereas in the shrub layer, besides common salal (*Gaultheria shallon*), occur *Mahonia nervosa, Ribes sanguineum, Rosa gymnocarpa, Vaccinium parvifolium, Rubus parviflorus* and very rarely even *Vaccinium alaskaense* as a possible relict from the post-glacial time.

(5) Red alder (*Alnus rubra*) - Sitka spruce (*Picea sitchensis*) - western redcedar (*Thuja plicata*) - skunk-cabbage (*Lysichiton americanum*) plant association is represented only by fragments, even if it used to be

. . . /.

fairly frequent in the Endowment Lands. It occurs on Gleysols with thick black muck, developed in seepage habitats where moving water comes to the surface and permanently saturates even the humus layer. It is a common habitat for Sitka spruce which grows here usually with Oregon crab apple (*Pyrus fusca*). In the shrub layer *Rubus spectabilis, Acer circinatum* and *Rhamnus purshiana* are frequent. In the herb layer *Lysichiton americanum* is the most significant and common herb (substatially damaged by the artificial drainage) associated with *Maianthemum dilatatum, Veratrum viride, Oenanthe sarmentosa, Montia sibirica, Mimulus moschatus, Cardamine breweri* and *Veronica americana*. In the moss layer these bryophytes are frequent: *Eurhynchium praelongum, Rhizomnium perssonii, Plagiomnium insigne, Leucolepis menziesii, Brachythecium asperrimum, B. lamprochryseum, Caliergonella cuspidata, Climacium dendroides, Rhytidiadelphus squarrosus* (this one mostly in the disturbed areas), *Marchantia polymorpha, Conocephalum conicum, Blasia pusilla, Pellia columbiana, Riccardia sinuata, Chiloscyphus pallescens* and *Anthoceros punctatus*. To restore some of these habitats the excessive artificial drainage should be stopped. Otherwise Sitka spruce and western redcedar will die out in these habitats.

(6) Aspen (*Populus tremuloides* var. *vancouveriana*) - lodgepole pine (*Pinus contorta*) - western redcedar (*Thuja plicata*) - western hemlock (*Tsuga heterophylla*) - western hardhack (*Spiraea douglasii*) plant association has especially two representative small areas at the Endowment Lands: one, very small, at the margin of the bog area near Camosun Street and 20th Avenue, the second, slightly larger, north of eastern section of Imperial Road. Ecologically this ecosystem represents a plant community between the bog (labrador tea) plant association and the skunk-cabbage plant association (with some characteristics even of the salal plant association). *Maianthemum latifolium, Cornus canadensis* and especially *Spiraea douglasii* are major plant characteristics of this ecosystem. The fact, that aspen (*Populus tremuloides* var. *vancouveriana*) occurs here, makes it most interesting. This variety, distinct from var. *tremuloides* by larger and more coarsely dentate leaves, is very rare now. It was probably more common over the area which developed into the City of Vancouver. Therefore, already from the point of view of a special genotype this form of aspen should be conserved in its natural habitat.

. . . /.

(7) Broadleaf maple (*Acer macrophyllum*) - black cottonwood (*Populus trichocarpa*) - red alder (*Alnus rubra*) - grand fir (*Abies grandis*) - western redcedar (*Thuja plicata*) - salmon-berry (*Rubus spectabilis*) - Indian plum (*Osmaronia cerasiformis*) - colts-wort (*Petasites palmatus*) - giant horsetail (*Equisetum telmateia*) plant association has still some fragmentary developments along Marine Drive at the Spanish Banks. *Osmaronia cerasiformis*, dioecious shrub of the Rose family, has the only locality here at the Endowment Lands and it is rather rare in the Fraser River Delta (but it is more frequent in the southeast parks of the Vancouver Island). *Scirpus microcarpus*, several sedges, *Luzula parviflora*, *Juncus ensifolius*, *J. effusus*, *J. nodosus*, *Glyceria striata*, *Cinna latifolia*, *Dicentra formosa*, *Geum macrophyllum*, *Montia sibirica*, *Equisetum telmateia*, *E. arvense*, *Petasites palmatus*, *Tolmiea menziesii*, *Tellima grandiflora* and many other plants, characteristic for such constantly wet habitats, are present here. The soil is derived from marine deposits and is mainly Gleysol being constantly saturated by laterally supplied seepage water which is circumneutral or even slightly alkaline.

These seven plant communities (some of them in different stages of their development) are the major ecosystems which should be available for instruction of students in plant ecology, forest ecology and soil science. Their fauna is definitely of some great interest to the zoologists. The autecological implications of these ecosystems could not be discussed in such a brief report.

There were at least two nest sites of bald eagle (*Haliaeetus leucocephalus*) at the Endowment Lands (see no. 8 on the attached map). It may well be that they are not used any more. They do not belong to any particular plant community.

Great Blue Herons (*Ardea herodias*) nest on the Endowment Lands (see no. 9 on the attached map). It has been estimated that about 50% (about 125 nesting pairs) of these beautiful birds nest on the Endowment Lands close to the Fraser River. "If these birds were driven off they would perish since other nesting sites and food sources in the surrounding area could not stand the increased load" (Norris, 1971). This number was substantially lowered in the last two years (J.Krebs, pers.comm.).

Respectfully submitted

by

Vladimir J. Krajina

Vladimir J. Krajina
Professor, Dept. of Botany

UNIVERSITY ENDOWMENT LANDS
POINT GREY B.C.

BEING A PART OF
LOT 140 GROUP 1 N.W.D.

Scale 1 Inch = 1500 Feet

LEGEND FOR MAJOR NUMBERS

(1) LODGEPOLE PINE - LABRADOR TEA - PEAT MOSS PLANT ASSOCIATION

(2) DOUGLAS-FIR - GRAND FIR - WESTERN REDCEDAR - SWORDFERN PLANT ASSOCIATION

(3) RED ALDER - DOUGLAS-FIR - WESTERN REDCEDAR - WESTERN HEMLOCK - OREGON GRAPE - THIMBLE-BERRY - MOSS PLANT ASSOCIATION

(4) RED ALDER - BITTER CHERRY - DOUGLAS-FIR - WESTERN HEMLOCK - SALAL PLANT ASSOCIATION

(5) RED ALDER - SITKA SPRUCE - WESTERN REDCEDAR - SKUNK-CABBAGE PLANT ASSOCIATION

(6) ASPEN - LODGEPOLE PINE - WESTERN REDCEDAR - WESTERN HEMLOCK - WESTERN HARDHACK PLANT ASSOCIATION

References

(7) BROADLEAF MAPLE - BLACK COTTONWOOD - RED ALDER - GRAND FIR - WESTERN REDCEDAR - SALMON-BERRY - INDIAN PLUM - COLTS-FOOT - GIANT HORSETAIL PLANT ASSOCIATION

(8) NESTING PLACE OF BALD EAGLE

(9) HERONRY (NESTING PLACE OF GREAT BLUE HERON)

ENGLISH BAY

STRAIT OF GEORGIA

MUSQUEAM INDIAN RESERVE No. 2

L.140

L540

L139

L2027

L320

L4804

L4805

L4806

L4807

L3044

L3045

L7184

6494

WESTWOOD GOLF COURSE

ACADIA CAMP

MARINE DRIVE

BOULEVARD

KING EDWARD AVENUE

SURVEYS AND MAPPING BRANCH
LEGAL DIVISION

Soils 419 Essay

SOIL SURVEY
OF
THE UNIVERSITY OF B.C. ENDOWMENT LANDS

by

P. EPP

Soils Dept. U.B.C.

May, 1973

Table of Contents

ACKNOWLEDGEMENT

Acknowledgement is made to Dr. L. Lavkulich for his assistance and guidance in the undertaking of this survey. Aerial photographs used as field sheets were obtained through the Soils Dept. at U.B.C. from the Air Division, Dept of Lands, Forests, & Water Resources, Victoria, B.C.

INTRODUCTION

The soil survey of the U.B.C. Endowment Lands was undertaken in fullfilment of the requirements of Soils 419, under the direction of Dr. L. Lavkulich. This area was chosen for the survey because it is the site of many research projects at U.B.C. and so it was felt that a knowledge of the soils and soil-vegetation relationships would be useful.

Field work was begun in the fall of 1972 and completed in the spring of 1973. Field sheets consisted of 9" x 9" aerial photographs, scale approximately five inches to one mile (20 chains to the inch). Soils descriptions and soil-vegetation relationships are included in this report.

Soil Forming Deposits

The soils found on the U.B.C. Endowment Lands are formed from Sunnyside sands, consisting of littoral and beach deposits, and the Bose gravels, composed mainly of lag gravels. These deposits are part of the Capilano Group, and overlie Newton glacio-marine deposits which are part of the Vashon Group.

The Sunnyside and Bose deposits are composed of medium to coarse sand and gravel and are generally less than five feet thick The Newton deposits are composed of stony silty clay, clay, silt and sand. These glacio-marine deposits are glacial drift. Stones and part of the fine material was carried by floating ice, with the remainder transported by meltwater and seawater. (Luttmerding and Sprout,.I966.)

Soil Mapping and Classification

The soils of the U.B.C. Endowment Lands were mapped in detail at a scale of about I,000 feet to the inch. Aerial photographs were used as field sheets and the classification data was plotted upon them. The soil series used in this survey correspond to those in the Soil Survey of Langely Municipality and Barnston Island by Luttmerding and Sprout, I966.

Test pits and other excavations were used to examine profiles identify them and to obtain profile descriptions. The profiles were examined to determine soil texture, structure, consistence, permeability, drainage, colour, horizon sequence, and other observable features. Vegetation was also noted.

The basic mapping unit is the soil series. A soil series consists of a group of related soils derived from similar parent material and having similar profile and drainage characteristics

except for variation in surface texture. Where the surface texture is also uniform, the mapping unit is the soil type. Soil types are distinguished by the series name followed by the surface texture. (Luttmerding and Sprout, 1966).

Soil-vegetation relationships were established with the aid of the vegetation study done by H. Slavinsky.

Description of Soils

Podzol Soils

Podzol soils are rapid to imperfectly drained mineral soils which have developed under mixed and coniferous forest vegetation. Under virgin conditions they are characterized by organic surface horizons (L-H), a light-coloured eluviated horizon (Ae) of variable thickness and illuvial horizons (Bhf and/or Bf) of high chroma in which organic matter and sesquioxides are the main accumulation products. Generally clay translocation and accumulation is not significant and the solum is moderately to strongly acid. The Ae horizon may be totally absent in some series.

Major development processes involve the accumulation of organic surface layers, the formation and translocation of organo-sesquioxide complexes and their deposition and accumulation in the B horizon, and the decomposition of the clay materials in the Ae horizon. (Luttmerding and Sprout, 1966).

Gleyed Orstein Podzol Soils (1965 classification)

This subgroup consists of imperfectly drained mineral soils which, under virgin conditions, have organic surface horizons (L-H), a light coloured eluviated horizon (Ae) and cemented or

indurated Bfhc or Bfc horizons of rather high chroma.the cemented or indurated B horizons may be discontinuous or interupted. They generally but not always, lie immediately below the Ae horizon. Gleying and mottling occurs in the B and C horizons.

The Summer series was classified as a Gleyed Orstein Podzol.

Summer Series

The Summer series occupies a very minor area just north of Chancellor Blvd. where it was mapped in association with the Sunshine series.

The topography is gently undulating with slopes to five percent. The parent material consists of deposits of Sunnyside sand which overly Newton glacio-marine deposits. The depth of the overlay is more than three feet but probably not more than five feet.

Surface and internal drainage is restricted by iron cementation in the Bfhc and Bfcgj horizons and by the impervious underlying deposits. The result is a perched water table after heavy rainfalls. The surface texture is sandy loam. This is underlain by sand which in turn, is underlain by massive materials varying from silty clay loam to heavy clay.

An undisturbed profile of the Summer series, located north of Chancellor Blvd., about three-quarters of a mile west of Blanca St. was described as follows:

Horizon	Depth Inches	Description
L-H	I-0	Raw to well decomposed mixture of deciuous and coniferous forest litter.
Ahe	0-4	Gray to dark-gray (IOYR 4.5/2, dry) or very dark gray (IOYR 3/I, moist) sandy loam. Weak

Horizon	Depth Inches	Description
		Fine subangular blocky structure. Very friable when moist.
Ae	4-9	Gray (IOYR 5/I, dry) or gray to brown (IOYR 5/I-7.5YR 5/2, moist) sandy loam. Weak, fine subangular blocky structure. Very friable when moist .
Bfc	9-I5	Brown to dark-brown (7.5YR 4/4, dry) or very dusky red (2.5YR 2/2, moist) sandy loam. Strongly iron cemented to indurated. Breaks into sharp fragments which are extremely hard when dry and very to extremely firm when moist. Very slowly permeable to water.
Bfcgj	I5-I9	Yellowish-brown (IOYR 5/4, dry) or br wn to dark-brown (7.5YR 4/2-IOYR 4/3, moist) sandy loam. Strong, fine to medium subangular blocky structure. Few, fine to medium, faint mottles. Very to extremely firm when moist.
CB	I9-23	Olive-gray (5Y 4/2, moist) fine sand. Weak, fine to medium, subangular blocky structure breaking to single-grained. Common, medium prominent, reddish -brown (5YR 4.5/4, moist mottles. Loose to friable when moist.
Cg	23- 40-	Grayish-brown to olive (2.5Y 5/2-5Y 5/2, moist) fine sand. Weak, medium, psuedo-subangular blocky structure breaking to single grain ed. Common to many, medium, prominent, reddish-brown to yellowish-red (5YR 4/5, moist) mottles. Very friable when moist.

Mini-Humo-Ferric Podzols

Under Virgin conditions these soils are characterized by a L-H horizon of forest litter underlain by one or more reddish-brown Bf horizons whose colour fades with depth. The solum is acidic and rather low in base status. A thin light coloured elluvia horizon (Ae) up to one inch thick may also be present.

The Sutton and Bose series are described as Mini Humo-Ferric Podzol soils.

Sunshine Series

The Sunshine series ocuppies minor acreages throughout the Endowment Lands in association with Heron and Bose series as well as some areas north of University Blvd. which were delineated as Sunshine sandy loam. Most areas are gently undulating with slopes to five percent but some strongly sloping areas with slopes to fifteen percent also occurr.

Sunnyside sand, originally littoral or marine beach deposits composed of medium to coarse sand and subsequently uplifted to its present position, forms the parent material. The sand which contains a few stones and cobbles is generally three to five feet thick, and is underlain by Newton glacio-marine sediments. These impervious underlying deposits restrict drainage where the overlying sand is thin. Therefore the well to moderately well drained Sunshine soils are restricted to areas where the sand is generally three or more feet thick.

The surface texture is sandy loam which grades to sand at variable depths. Traces of Ae horzon development are sometimes present in areas which have been undisturbed for long periods.

An undisturbed profile of th e Sunshine series located between Chancellor Blvd. and N.W. Marine Drive was described as follows:

Horizon	Depth Inches	Description
L-F	I-0	Forest litter, partially decomposed.
BfI	0-8	Dark yellowish brown (IOYR 3/4, moist) sandy loam. Weak, medium, subangular blocky structure. Soft when dry, very friable when moist.

Horizon	Depth Inches	Description
Bf2	8-19	Dark yellowish brown (IOYR 4/4, moist) sandy loam. Weak, medium, subangular blocky structure. Soft when dry, very friable when moist.
Bf3	I9- 25	Yellowish brown IOYR 5/4-5/6, moist) sandy loam. Weak, medium subangular blocky structure. Slightly hard when dry, friable to firm when moist.
BC	25-30	Yellowish-brown to dark yellowish brown (IOYR 4.5/4, moist) medium sand. Massive, breaking to sin gle-grained. Slightly cemented to loose when moist. Occasional mottles.
Cg	30-40-	Light olive brown to olive (2.5Y 5/4-5Y 4.5/3 moist) coarse sands. Dark yellowish brown (IOYR 4/4-3/3, moist) mottles. Massive to sin gle grained. Firm to loose when moist.

Bose Series

The Bose series ocuppies a major portion of the U.B.C. Endowment Lands ocurring as Bose gravelly sandy loam as well as in association with Sunshine and Heron soils. The topography is generally gently to moderately sloping and undulating with slopes from two to nine percent, but strongly sloping areas also occurr.

The parent material of the Bose series is a mantle of wave-sorted lap gravels of about three to five feet thick which overlie Newton glacio-marine deposits. The surface texture varies from gravelly sandy loam to sandy loam; stoniness varies from light to h eavy. The solum is slightly acid and, in scattered locations, there is developement of a thin Aej horizon.

The Bose series is wellto rapidly drained, with the underlying Newton deposits restricting drainage in the lower part of the solum where mottling indicates perching of a temporary water table. An undisturbed soil profile was examined on the south side

of the campus near where Imperial Drive and th e powerlie cut branch apart, and was given the following description:

Horizon	Depth Inches	Description
L-H	I-0	Mostly humified forest litter.
BfI	0-I0	Brown (IOYR 4/4, dry) or dark reddish brown (5YR 3/3, moist) gravelly sandy loam. Very weak, fine to medium granular structure. Moderate amount of cobbles. Very friable when moist.
Bf2	I0-20	Brown (7.5YR 4.5/4, dry) or dark reddish brown (5YR 3/3, moist) gravelly sandy loam. Very weak, fine to medium, granular structure. Moderate cobbles and stones. Very friable when moist.
C	20-34	Pale-brown (IOYR 6/3, dry) or brown (IOYR 4.5/3, moist) sandy loam to gravelly sandy loam. Moderately compacted, breaking to to single grained. Ocassional cobbles and stones. Very friable when moist.
IICgj	34-40-	Light-gray (2.5Y 7/2, dry) or olive-gray (5Y 5/2, moist) sandy loam to loam. Massive structure. Few, medium distinct mottles. Many cobbles an d some stones. Friable when moist.

Humic Gleysol Soils

This group of soils has developed under poor drainage conditions an d are characterized by a dark coloured surface horizon greater than three inches thick which is underlain by one or more g leyed and mottled horizons.Weakly developed eluvial or illuvial horizons may be present. There may be up to twelve inches of muck or peat present on the surface.

Rego Humic Gleysol Soils

This subgroup os distinguished by a dark coloured Ah horizon more than three inches thick, underlain by one or more gleyed or

mottled Cg horizons. There are no eluvial or illuvial horizons and up to twelve inches of peat or muck may occur on th e surface.

Heron series was classified as a Rego Humic Gleysol.

Heron Series

The Heron soils ocuppy scaterred depressional areas throughout the map area and are often mapped in association with Sunshin e and Bose series. The topography is mostly level to gently sloping.

The parent material consists of shallow deposits of Sunnyside sands which overlie Newton glacio-marine sediments. The depth of the overlay is generally less than three feet.

Surface textures are generally sandy loam, grading to sands at about ten inches. The underlying glacio-marine materials are clay loam to clay textured and almost impermeable to water. Water perches above these impervious deposits due to excessive rainfall and seepage, and causes the Heron soils to be poorly drained.

An undisturbed profile was examined just south of Chancellor Blvd. near the western edge of the mapped area and was described as follows:

Horizon	Depth Inches	Description
L-F	2-0	Fresh and partly decomposed forest litter
Ah	0-IO	Very dark brown (IOYR 2/2, moist) sandy loam. Very weak, medium subangular blocky structure. Very friabke when moist.
IICg	IO- 28	Grayish-brown (IOYR 5/2, moist) sand. Single grained except for massive, very weakly cement-pockets. Many prominent, red (5Y 4/6-4/8, moist) Friable when moist.
IIICg	28-40-	Grayish-brown (2.5Y 5/2, moist) clay loam. Massive. Common, distinct mottles. Firm when moist. Slightly sticky and plastic when wet.

For an approximate chemical analyses of the above series, refer to Soil Survey of Langely Municipality and Barnston Island by Luttmerding an d Sprout, I966.

Soil-Vegetation Relationships

It is difficult to establish any positive correlations between the soils and the vegetation found on those soils. Several generalizations can be made though.

Ingeneral, the dominant vegetation on the Heron soils is Alder, with the subordinate vegetation being dominated by Rubus spectabilis. Cottonwood and scattered hemlock and cedar also occur in the overstory while numerous other shrubs, sedges, ferns, and mosses.

Sunshine soils are covered wit h young alder or mature fir stands depending on the history of the area. Under the denser fir stands a thin Ae horizon may be present in the soil. Cear, hemlock, willow, alder, birch, and cottonwood may also be present. Understory vegetation generally consists of bracken, huckleberry, thimbleberry, and other shrubs.

Native overstory vegetation of the bose soils is fir, cedar, and hemlock, but may include alder and cottonwood if the are has been cleared. The understory vegetation consists of thimbleberry, trailing blackberry, sword, and bracken fern, and other shrubs.

Heron soils can generally be distinguished on the aerial photographs by the lighter colour of the vegetation on these soils but no distinction is possible between th e Sunshine and Bose soils on the basis of the vegetation as seen in the aerial photographs.

References

I. Luttmerding , H. A., and P.N. Sprout. Soil Survey of Langely Municipality and Barnston Island. B.C.D.A., Kelowna, B.C., 1966.

2. Slavinsky, H. Unpublished vegetation study of the U.B.C. Endowment Lands.

POSSIBLE EFFECTS OF DEVELOPMENT OF THE UNIVERSITY ENDOWMENT LANDS ON THE GREAT BLUE HERON (*Ardea herodias fennini*) COLONY LOCATED THERE

Contents:

PRESENT STATUS OF THE COLONY:

The colony, which has been studied since 1970, seems to be decreasing rapidly in size, yet it remains one of the largest heronries in the Lower Mainland. In 1970, there were 120 nesting pairs (Paine, 1972; Krebs, in press). In 1971, there were 78 nesting pairs and the colony had split in two, with 55 nests in the main (old) colony and 23 in a new satellite colony about 400 metres away. In 1972, the old main colony had been abandoned completely and the satellite colony contained 32 active nests (pers. obs.). (This is still as large as the Port Coquitlam heronry was in 1970.) The reasons for the sharp decline are unknown, but Krebs (in press) points out that the decline coincides with two unusually severe winters in the Vancouver area and increased human disturbance of the colony. Similar declines have been associated with severe winters in England (Milstein et. al., 1970).

These suggestions seem to be borne out since after the mild 1972-73 winter the colony increased in size to about 38 active nests (pers. obs.). Higher numbers of juvenile herons are apparent on the Iona Island Mud Flats (fig 2) indicating that there may be a higher than normal recruitment this year providing the winter is not too severe. Full effects of the mild 1972-73 winter will be noted next spring, when the young of that year are of breeding age.

EFFECTS OF DISTURBANCE ON THE COLONY:

There are two critical periods in the heron breeding cycle during which disturbance leads to significant reduction of breeding success. These are the pairing period and the brooding period.

Pairing Period:

In late February or early March, adult male herons return to the traditional colony, followed in later weeks by adult females. Territories are set up, and the males choose nest sites, usually

LO TION OF THE UNIVERSITY OF BRITISH COLUMBIA HERONRY:

The UBC heronry is located in the University Endowment Lands forest, approximately three quarters of a mile North of the Simon Fraser Monument on Marine Drive (fig. 1). The heronry consists of two sub-colonies (denoted the main and satellite colonies). Both are located in groves of Red Alder (Alnus rubra) surrounded by a mixed coniferous forest of Douglas Fir (Pseudoptsuga menzeii), Western Hemlock (Tsuga heterophylla), Western Red Cedar (Thuja plicata), Sitka Spruce (Picea sitchensis) and two species of fir (Abies amabilis and A. grandis). The alders grow in the wettest areas of the Endowment Lands forest. Though herons are known to nest in several species of trees, those in the Endowment Lands nest exclusively in the alders, the nests being between 60 and 100 feet off the ground, usually one or two to a tree.

The deciding factor in the herons' choice of alder for nest sites seems to be that the alder are approximately 20 feet shorter than the surrounding coniferous forest, providing protection from the wind.(Krebs, in press). Wind protection is probably of great importance to breeding success, since the herons are large birds, and their nests, which may weigh up to 30 pounds, are easily dislodged from the tree tops. This is especially true in Point Grey, where the tall surrounding forest protects the colony from the direct force of fierce storms from the South and Southwest (Dr. J. M. Taylor, pers. comm.).

The herons nest colonially during the breeding season (February- August). After that time, they spread out, and while many continue to feed communally on the Iona Island Mudflats (fig.2) most become solitary in roosting habit. Where individual herons roost during the winter is not known, but many continue to be seen throughout the Endowment Lands and the UBC foreshore, as well as along the Fraser Delta and North toward Squamish. Hence, heron utilisation of the Endowment Lands includes more than the colony proper.

in nests remaining from previous years. The males then display and call in attempts to attract females. During this period, the birds are very skittish, and if disturbed will leave the area for up to several hours.

In 1972, publication by a local ecology-minded group of a map showing the location of the main heronry led to increased numbers of bird watchers and hikers in the area during this period. The herons' abandonment of the main colony for the satellite area further back into the woods, described above, may be in part a result of this disturbance.

Brooding Period:

The second period during which disturbance causes reduced breeding success is the brooding period. Several researchers have shown that increased human disturbance is correlated with increased Corvid (crow, raven) predation on heron eggs, since the parents leave the nest unattended (Milstein et. al., 1970; Paine, 1972; Krebs, in press). The nest need only be left unattended for a few minutes for the Corvids to swoop in and steal the eggs.

A slightly higher level of disturbance can result in abandonment of nests by brooding pairs, leaving the eggs to die (Paine, 1972; Krebs, in press).

The nestling period (mid-June to late July) comprises the six weeks after the young hatch, before they fledge. The colony is more resistant to disturbance during this period.

POSSIBLE EFFECTS OF DEVELOPMENT OF THE ENDOWMENT LANDS:

Heavy machinery operating near the heronry during the breeding season is likely, in my opinion, to affect the herons' brooding success. Significant reduction of new recruitment to the colony could result in its disappearance. Alternatively, the herons could move elsewhere , but the unique nature of the Fraser Delta Mud Flats for feeding would go unexploited.

Few areas have the capacity to support the number of herons that the Mud Flats can. Herons have been observed to consume as much as twenty times the amount of food per hour of that

captured by herons feeding inland, when feeding on the Mud Flats. The herons must live within a critical distance of this food source, however, to make utilization economical.

Due to its unique location at the edge of the Mud Flats, the UBC heronry has the capacity to produce more young than do the other two heronries in the Lower Mainland (at Port Coquitlam and Stanley Park) which are limited by availability of food sources. In 1971, banding studies showed the clutch size at the UBC heronry to be significantly larger than at Port Coquitlam (Krebs, pers. comm.). In addition, the unique exploitation by the herons of the dual habitats of 100 foot forest and salt-water mud flats makes the UBC herons valuable for scientific study. (Dr. J. M. Taylor, pers. comm.).

Increased human disturbance, even from such groups as bird watchers and naturalists, who are inclined to try to minimize their noise, could have a drastic effect on the colony. At present, the colony is protected from human disturbance by the large area of forest surrounding it. Development of the Endowment Lands would result in the removal of much of this protection.

It has been suggested that the colony be protected by a "buffer zone". The size of a buffer zone necessary to protect the colony is impossible to calculate since the determining factor seems to be the amount of human disturbance, not the distance from houses, roads, and so on. The birds themselves chose a location 400 metres from the old colony, when the heronry moved, but this may be dictated by location of suitable alder groves. It might be possible to maintain the colony on just a few acres, if humans were completely excluded for the critical periods of the breeding cycle. The herons would still be visible to the public in their feeding areas.

There is a problem, however, that the heron colonies are not static, and as trees are killed by the nesting herons over several years, the colony may shift to new locations nearby. (eg. Milstein et. al., 1970). So there is no guarantee that the herons

would remain in a reserve set aside for them. (If there were n(uitable areas nearby, the colony might disappear.)

Another problem, undoubtedly understudy by government engineers, is the possibility of windfall of the trees remaining in the Endowment Lands after development. Large areas of timber have been known to fall from wind after roads or developments were put through previously untouched forest. An example of this is seen at Manning Park, where whole mountainsides have been denuded by this process.

SUMMARY AND CONCLUSIONS:

At present there are about 70 adult herons utilizing the UBC heronry during the breeding season, each pair producing a clutch of 3-5 young. The UBC heronry is unique in the Lower Mainland in that local food sources allow it to support a larger population than other colonies. Increased human disturbance is definitely correlated with reduced breeding success, and there is no quarantee that the heronry would survive if the Endowment Lands were developed. In my opinion, the chances might be increased if a buffer zone several hundred metres across were established and the area was closed to the public during the critical breeding periods lasting from late-February to late-April.

Vancouver is certainly one of the few, and perhaps the only large city in North America where it is still possible for the residents to see large and majestic birds, such as the herons, living and feeding in the wild. (The Endowmwnt Lands also harbour at least one pair of Bald Eagles, which can frequently be seen from Marine Drive.) In my opinion, it is one of the greatest attractions of Vancouver. To lose the herons (and the eagles) would be a sorry concession to the pressures of urbanization.

More and more, people are realizing that quality of life is not measured only in heights and numbers of buildings. British Columbia has the opportunity to become a leader in the new concept of "Wild Zoos" -- preserving habitats so that future generations will be able to enjoy the majestic wild animals we take for granted. Few people outside of B.C. will notice if the herons are eliminated, but if an attempt is made to save them, the Province could

receive good press all over North America.

Respectfully Submitted,

Brian Partridge

Brian Partridge
28 October 1973

References:

Krebs, J. R. "Colonial nesting in the Great Blue Heron" Behaviour, in press

Krebs, J. R., and Partridge, B. 1973 "Significance of Head-Tilting in the Great Blue Heron" Nature vol.242, no.5399 pp533-535.

Milstein, P. le S., Prestt, I. and Bell, A. A. 1970 The Breeding Cycle of the Grey Heron" Ardea 58:171-257.

Paine, J. M. 1972 "A Study of Colonial Nesting in the Great Blue Heron, Ardea herodias, fennini" unpub. B.Sc. Thesis UBC April, 1972.

Fig. 1

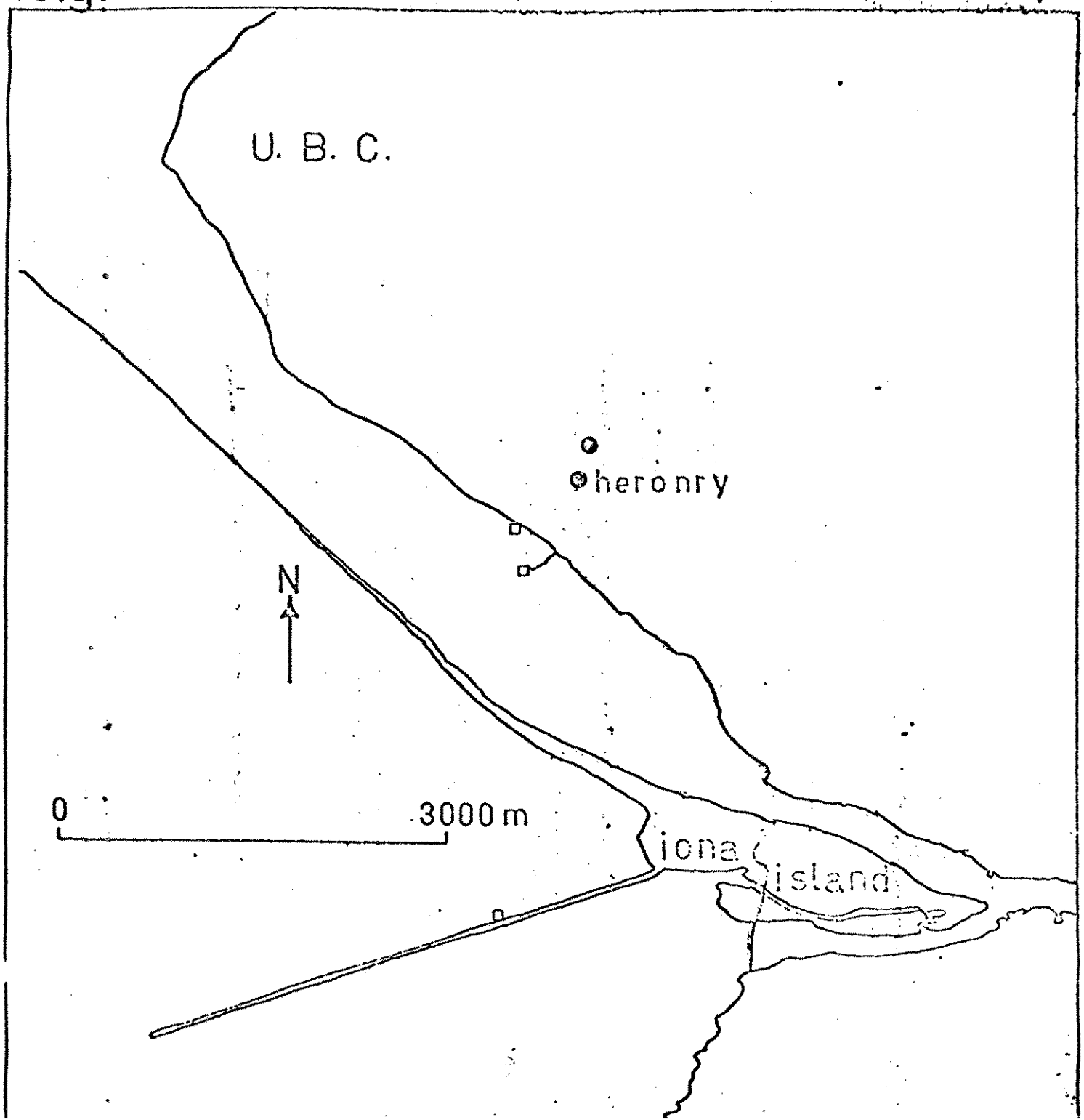
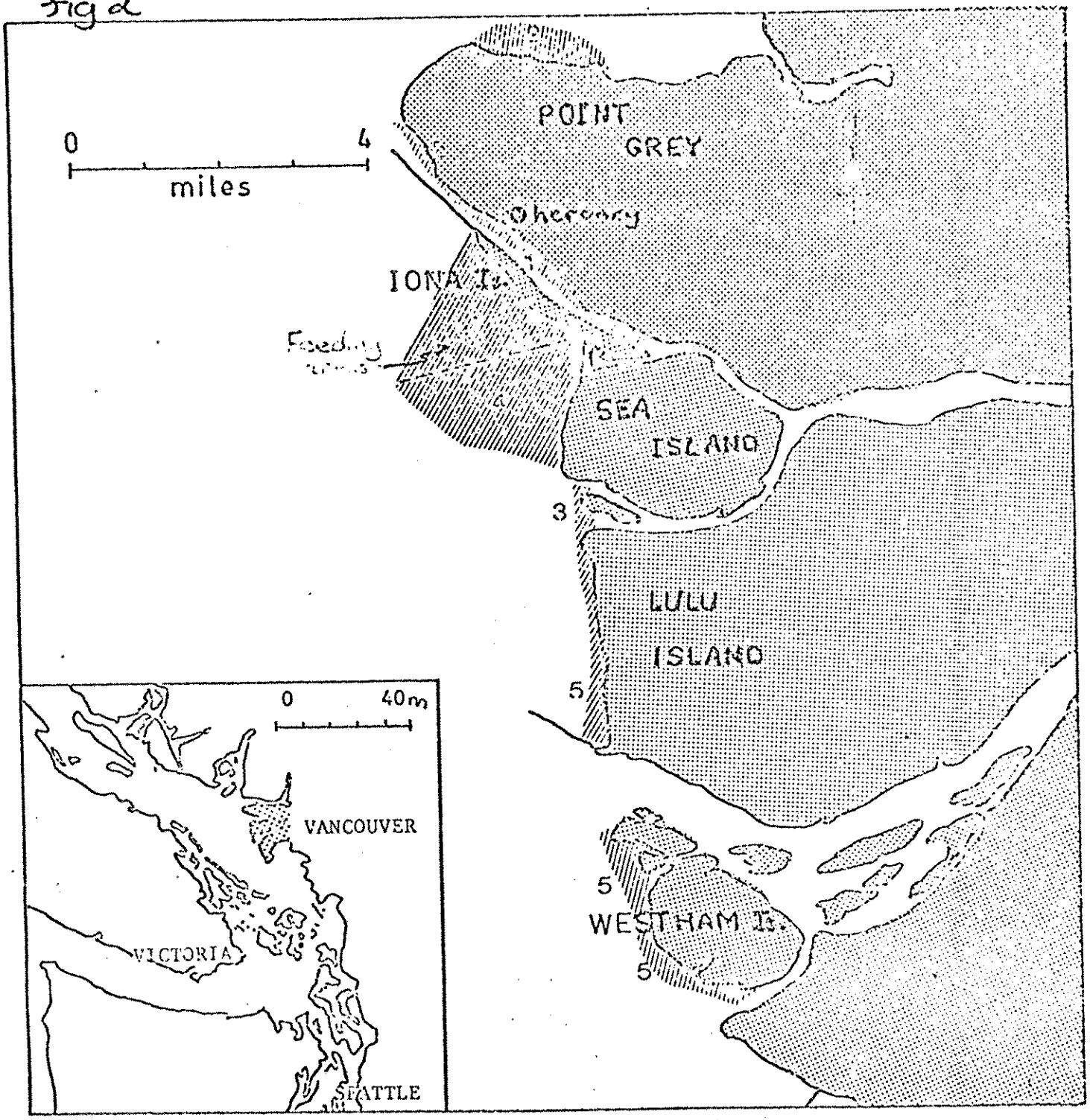


Fig 2


0
4
miles
POINT
GREY
Ohercorcy
IONA Is.
Feeding
SEA
ISLAND
3
LULU
ISLAND
5
5
WESTHAM I.
5
0
40m
VANCOUVER
VICTORIA
SEATTLE

Lavkulich

EDUCATIONAL AND RESEARCH USES OF THE UNIVERSITY OF BRITISH COLUMBIA ENDOWMENT LANDS: A PRELIMINARY SURVEY

by

D. J. NORRIS

A report prepared as part of the requirements for Forestry 525 (Problems in Forest Land Management - Dr. D. S. Lacate)

APRIL 1971

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to express my appreciation to all the respondents who took the time to fill out the questionnaire and to discuss this project with me. I would also like to express my thanks to Dr. Lavkulich for checking over the manuscript and to Dr. Lacate, my special appreciation for all his help, advice and guidance while making this survey.

D. J. Norris.

EDUCATIONAL AND RESEARCH USES OF THE UNIVERSITY OF BRITISH COLUMBIA ENDOWMENT LANDS: A PRELIMINARY SURVEY

INTRODUCTION

The University of British Columbia has as its immediate neighbour, approximately 1,800 acres of forest land. The close proximity of this land to the University makes it valuable for educational and research uses, as of yet an undetermined amount.

This report summarizes the results of a preliminary survey intended to determine: a) the magnitude of use of the Endowment Lands for educational and research purposes, b) the location and/or intensity of use, c) types of use, d) the reasons for use and e) the location of unique areas which may require protection. In addition, an attempt was made to discover whether or not the use of the lands was increasing, decreasing or remaining the same.

Although the Endowment Lands are used by other institutions (British Columbia Institute of Technology, local public schools) for educational purposes, this report considers in detail only the uses made of the Endowment Lands by the University of British Columbia community. Only gross estimates of usage are available for other institutions. No estimates were made for recreational uses, which are known to include jogging, hiking, mushroom collecting, sightseeing, horse riding and scout camping. Within the university community, uses of the land for open field recreation (football, tennis) and for Physical Education exercise programs were not included. Similarly the objectives of the report do not include documentation of the location of permanent sample plots on the lands, although some influences from these plots may be included in the section concerning research projects.

For the purposes of this report, the U. B. C. Endowment Lands were considered to be all lands (including the foreshore) west of the city of Vancouver, that are covered by forest. In addition, the use of open fields on campus for educational or research purposes was included, with the exception of playing fields and other organized Physical Education programs.

METHOD

A questionnaire and map were devised and circulated to a number of members of the University community (A sample of the questionnaire may be found in Appendix 1). The questionnaire was so designed that each member of staff interviewed (respondent) would give leads to other possible users of the Endowment Lands.

Thus the questionnaire was handled much like a chain letter. This approach was used to cover as many departments and staff members as possible without using time interviewing people who did not use the Endowment Lands. Thus the survey cannot be considered as a statistical sample of the university population, and as a result all percentages used in this report are percentages of people interviewed. Although the totals reported cannot be used to estimate total usage, they serve as satisfactory baseline figures and give a perspective of the magnitude of use. The figures given are, in alllikelihood, minimum values.

Each respondent was given the questionnaire to complete and then interviewed personally to discuss the questions and answers. This approach had the advantages of: a) preventing misinterpretations of either quesions or answers, b) gaining information that was not asked for on the questionnaire, but was both interesting and pertinent to the purposes of this report, c) obtaining 100% cooperation from the people interviewed, d) obtaining information that otherwise would have been withheld to prevent disturbances to areas that are unique and easily destroyed.

RESULTS

1. Magnitude and Types of Uses Made of the Endowment Lands.

Table 1 indicates the numbers of professors who have used the Endowment Lands for any purpose (the first numeral) over the past four years. The second numeral indicates the number of professors interviewed that were present at U. B. C. that year. The absolute increase in the number of staff members using the Endowment Lands has increased by 14 over the past four years. Percentage increase next year (with numbers of professors as the basis for calculation) is likely to be 8.6 %.

The uses of the Endowment Lands were classified into five categories, organized student field trips, collection of laboratory materials, staff research, graduate student research, and undergraduate student projects. To cover any uses not mentioned a sixth category "other" was used. Table 2 presents the pattern of uses by percentages (totals column) and by two numbers in the faculty (department) column. The first number indicates the number of professors who mentioned the use, and the second number indicates the number of professors interviewed who were present during a given year.

The percentage values in the totals column for "Numbers of Professors" indicates the percentage of professors, interviewed, who used the endowment lands for student field trips. The percentage rate of change, using the percent values as the basis for calculations, is +5.3 %, -5.1 %, -5.3 %, and +14.3 % (change from 1970 -'71 to 1971 - '72). These figures reflect percentage change with respect to the increase in the number of professors interviewed. What these values indicate, in effect, is the fact that it takes one to two years to organize a course and recognize the values of the Endowment Lands for educational use via field trips.

A. Organized Student Field Trips

The greatest use made of the Endowment Lands, in terms of numbers of people involved, was organized field trips. Table 3 indicates the magnitude of the numbers of student field trips, in units of student trips, made over the past four years. A student trip is defined as one trip made by one student, with no time dimension involved. Thus, if one student makes two trips, his activity is counted as two student trips.

ALL ACTIVITIES

Faculty	Agriculture	Archeology	Botany	Education	Forestry	Geology	Geography
Year							
'67-68	3 - 4	1 - 1	6 - 6	3 - 3	4 - 4	1 - 1	
'68-69	3 - 4	1 - 1	7 - 7	3 - 3	5 - 5	1 - 1	
'69-70	3 - 4	1 - 1	6 - 6	3 - 3	6 - 7	1 - 1	2 - 3
'70-71	3 - 4	1 - 1	7 - 7	3 - 3	8 - 9	1 - 1	2 - 3
'71-72			+1) 7 - 7 -1)		+1 9 - 10		+1 3 - 3

TABLE 1 Number of Professors Using the Endowment Lands

Faculty	Agriculture	Archeology	Botany	Education	Forestry	Geology	Geograph
Uses / Years							
Field Trips 67-68	3 - 4	1 - 1	5 - 6	3 - 3	3 - 4	1 - 1	-
68-69	3 - 4	1 - 1	6 - 7	3 - 3	4 - 5	1 - 1	-
69-70	3 - 4	1 - 1	5 - 6	2 - 2	5 - 7	1 - 1	2 - 3
70-71	3 - 4	1 - 1	6 - 8	3 - 3	6 - 9	1 - 1	2 - 3
71-72				+2	8 - 9		
Collection of Lab. materials	3 - 4	1 - 1	8 - 8	3 - 3	4 - 9	1 - 1	1 - 3
Staff Research	2 - 4	1 - 1	4 - 8	1 - 3	1 - 9	1 - 1	1 - 3
Grad. Student Research	2 - 4	1 - 1	5 - 8		2 - 9		
Undergrad. Student Projects	1 - 4	1 - 1	6 - 8	3 - 3	5 - 9	1 - 1	3 - 3
Other	1 - 4	1 - 1					

TABLE 2 Uses Made of the Endowment Lands

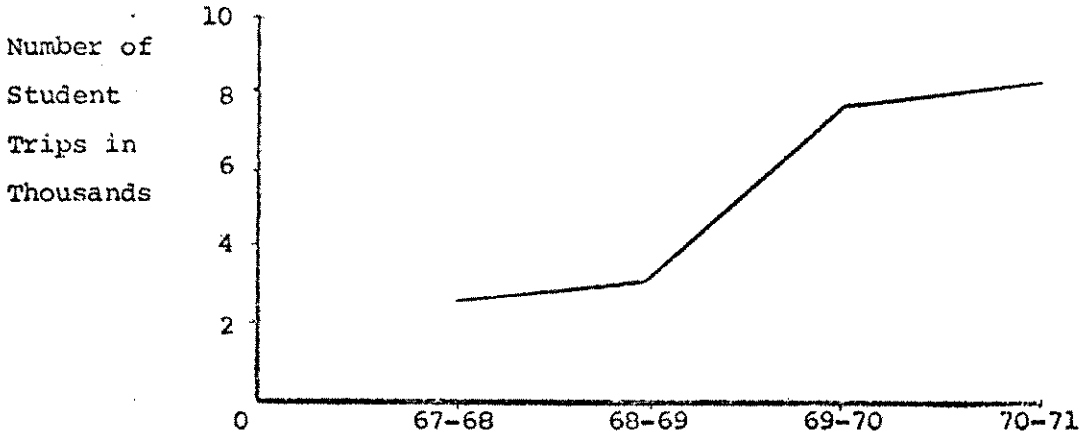
Faculty	Year	Agriculture	Archeology	Botany	Education	Forestry	Geology
No. of Field Trips	1967-68	13.0	8.0	28.5	16.5	7.0	1.0
	1968-69	13.0	2.0	30.5	16.5	17.5	1.0
	1969-70	16.5	2.0	28.5	11.0	12.5	1.0
	1970-71	16.5	2.0	30.5	13.0	19.0	1.0
No. of Student Trips	1967-68	470.0	127.5	462.5	660.0	280.0	300.0
	1968-69	442.5	30.0	417.5	660.0	600.0	400.0
	1969-70	605.0	30.0	507.5	440.0	410.0	400.0
	1970-71	522.5	30.0	417.5	520.0	513.5	500.0

TABLE 3 Numbers of Field Trips and Student Made Over the Past Four Years

Percentage increases over the past four years shows that increases in student-trips is a function of an increased number of students, and field trips and a function of the increased number of professors using the Endowment Lands for student field trips.

The number of student-trips and the number of field trips have increased quite significantly over the past four years. However, in 1969-70 the rate of increase in the number of professors and in the number of field trips dropped, whereas the increase in student trips was phenomenal. Most of this large increase was due to the large number of students in Georgraphy 101. This course is a prerequisite for many other courses and as a consequence many students take the course. By removing the effect of this course, increases of 17.0 %, 8.6 % and 15.0 % per year are obtained. Thus the rate of increase of student-trips was showed in 1969 - 70, but this change was masked by the students in Geography 101.

In 1969-70 several courses were eliminated and this factor may have caused the rate of increases to be lower than for the other years.



Number of Student Trips Over Past Four Years

One question in the questionnaire asked, "If the Endowment Lands became unavailable for your use(s), would you continue your activities in other areas?" Most often the reply was partly, since some uses could be done elsewhere, on the same scale or on a reduced scale, while other uses could not be relocated.

Table 4 shows that more than two thirds of the professors felt that they could go elsewhere for student field trips, at a reduced scale because other similar localities were either more expensive to get to (in terms of time and money) or of inferior quality (in terms of variety of features). Seven percent of the respondents felt that they would have to forego the field trips altogether for the same reasons mentioned above.

Number of Professors Whose Field Trips:	Agriculture		Archeology		Botany		Education		Forestry		Geology		Geography		Zoology		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Could go elsewhere	1	33			3	50			1	20					2	33	7	25.0
Would be reduced	2	67	1	100	3	50	2	67	4	80	1	100	3	100	3	50	19	67.9
Could not go elsewhere							1	33							1	16.7	2	7.1

TABLE 4 Possible Constraints on Field Trips, by Numbers of Professors, If Endowment Lands were Lost.

	Agriculture	Archeology	Botany	Education	Forestry	Geology	Geography	Zoology	Total	(Number -
Number of Students	0	15	40	120	51	818	0	144	1,188.0	
Number of students whose Projects would be cancelled		15	15	40	30	800	0	84	984.0	82%

TABLE 5 Undergraduate Student Projects

B. Collection of Laboratory Materials

Seventy percent of the respondents mentioned the collection of laboratory materials as a use. Five respondents felt that the Endowment Lands provided an excellent variety of live material ranging from minute animals to large trees.

With the wide variety of organisms, the use of the Endowment Lands for the collection of laboratory materials was as popular with staff members as the use for student field trips. If the lands were ruined, the laboratory material would have to be collected from other areas (not Stanley Park) and stored until used. Otherwise the laboratory program would have to be changed.

C. Undergraduate Student Projects

Student projects ranked as the third major use of the Endowment Lands; 62.5 % of the professors mentioned this use. Table 5 shows the magnitude of this use by numbers of students. Student projects are not, in this report, considered to be extensions of laboratory assignments.

If the Endowment Lands became unavailable for this use, an estimated 82 % of the projects would be either cancelled or redirected towards literature reviews.

D. Staff Research

Forty-seven and one half percent of the professors mentioned that they carry on research projects in the University Endowment Lands. Interestingly almost 10 % of the respondents indicated that the reason they do not use the Endowment Lands for research is because practical experience has shown that at any time any project can be disrupted, without warning, by construction equipment, spraying programs, or, in exposed areas, by vandals. One researcher had set up an experiment, in an area promised to him, only to have a bulldozer clear the area. His equipment was saved only because the operator of this bulldozer had enough foresight to pick the equipment up and put it in a safe place. If these respondents could get reassurance that their projects would not be disturbed, they would likely use the Endowment Lands more effectively.

Five out of nineteen projects (26.3 %) now being done could not be relocated because: a) it would be impossible to do the study elsewhere (10.5 %) b) similar areas are inferior (5.25 %) c) the increased cost in time and money would be too great (10.5 %).

E. Graduate Student Research

Graduate student research was mentioned by 40 % of the people interviewed. In excess of 16 graduate students have projects on the Endowment Lands.

F. Other Uses

Other uses described by 7.5 % of the respondents included calibration of pollen collecting and counting equipment (in the Camosun peat bog), training in the technique or art of excavating archeological sites (there are several on the Endowment Lands of which the best site was destroyed by stump blasting and gully filling), banding of migratory birds (especially the Great Blue Herons) and a soil-vegetation survey.

11. Areas of Use

The map on the following page indicates the areas which are most intensively used for student field trips, research projects and the collection of laboratory materials. The area of greatest use is in the immediate proximity to the campus and is likely to be built over within the next few years.

The areas that is used by 68 % of the respondents (the northern foreshore) may well be ruined in the opinion of all who use the area, by a six lane "scenic" drive around the base of the peninsula which constitutes the University Endowment Lands.

On the Endowment Lands there are three unique areas, the Camosun peat bog, the Heron nesting site and the Aspen (populus tremuloides) grove.

The peat bog, which is an arctic relic, contains at least one rare plant (Rubus chamaemorus) and two shrubs (Vaccinium ovalifolium, Vaccinium alaskaense) that are uncommon in this area. There is also one unnamed and undescribed moss. The peat bog is also valuable as it contains the pollen history of plants that have existed in this area since glaciation.

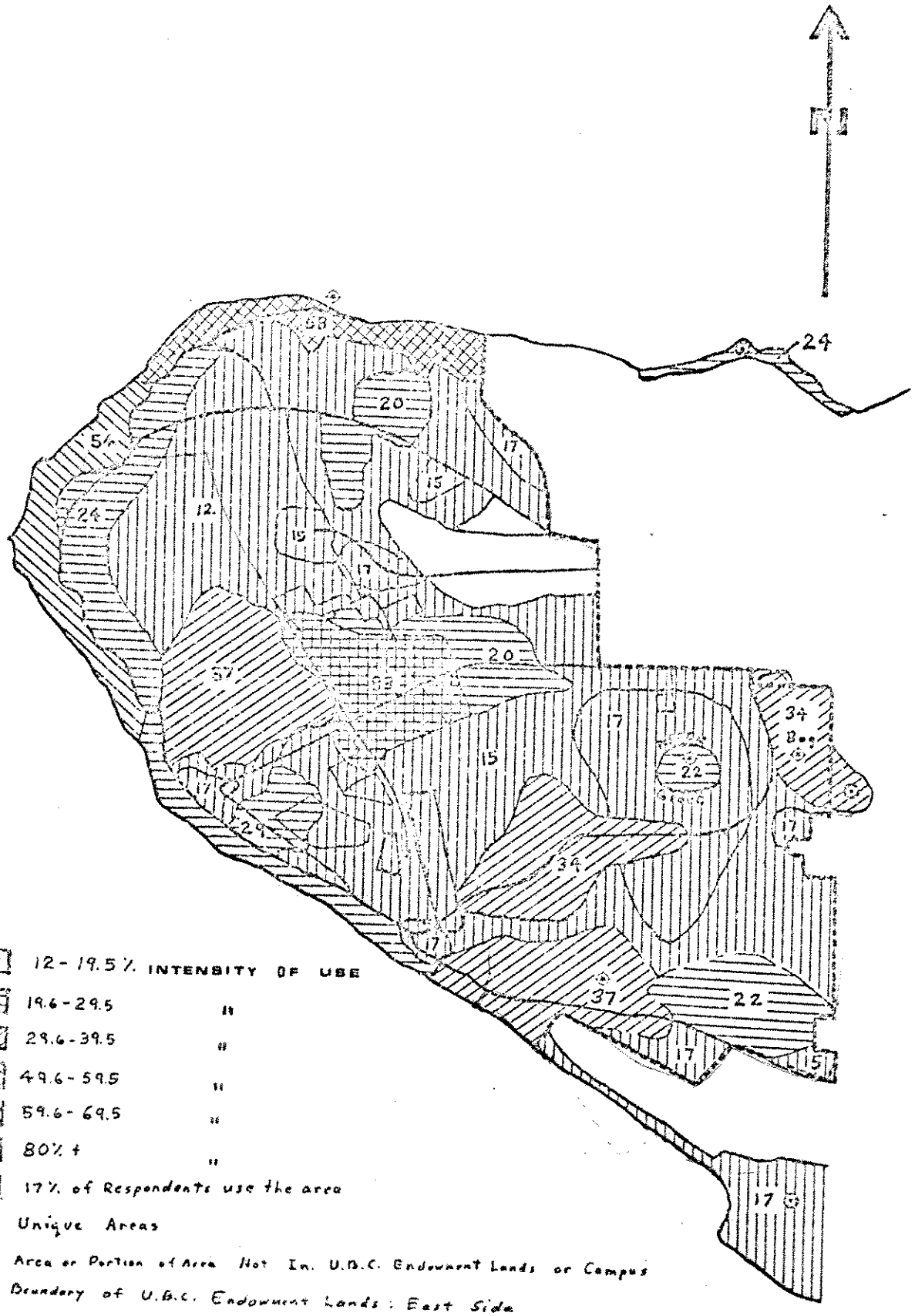
The bog has withstood to a certain degree, a drainage project and earth filling (earth from excavations on campus). However, it will be destroyed if much more abuse occurs. Two respondents felt that an artificial bog could likely be created in the future, as an annex to the botanical gardens, if the Camosun peat bog was destroyed.

Up to 50 % of the Great Blue Herons in the Lower Mainland (Fraser Valley) nest on the Endowment Lands. In 1969 - 70 125 nesting pairs produced 179 young and 18 sterile eggs. This refuge could be badly disturbed if construction operations were carried on too close to the site. If these birds were driven off, they would perish since other nesting sites and food sources in the surrounding area could not stand the increased load. The ease of access to the Endowment Land nests is much more convenient than in the other nesting sites, since the nests are much closer to the ground. The nests in other areas are in excess of 60 feet from the ground.

The only unique area apparently not in immediate danger of disruption is one of the very few Aspen groves that occurs in the Coastal Douglas-fir biogeoclimatic zone.

The northern foreshore was also considered by 9.75 % of the respondents to be a unique area because it contains unusual cliff stratification, and wave erosion. Also many micro-geologic processes can be readily observed.

AREAS OF USE ON U.B.C. ENDOWMENT LANDS



LEGEND

- 12 - 19.5 % INTENSITY OF USE
- 19.6 - 29.5 "
- 29.6 - 39.5 "
- 49.6 - 59.5 "
- 59.6 - 69.5 "
- 80% + "
- 17 — 17 % of Respondents use the area
- Unique Areas
- Area or Portion of Area Not In U.B.C. Endowment Lands or Campus
- Boundary of U.B.C. Endowment Lands : East Side

Faculty Reasons	Agriculture	Archeology	Botany	Education	Forestry	Geology	Geography	Zoology	Total No.	Total %
Nearness to Campus	3 - 4	1 - 1	8 - 8	3 - 3	8 - 9	1 - 1	3 - 3	11 - 11	38 - 40	95
Unique Features	2 - 4	1 - 1	5 - 8	2 - 3	1 - 9	1 - 1	3 - 3	3 - 11	16 - 40	40
Cost (time - Money)	2 - 4		5 - 8	2 - 3	4 - 9		1 - 3	5 - 11	19 - 40	47.5
Ease of Access	2 - 4	1 - 1	6 - 8	3 - 3	5 - 9	1 - 1	2 - 3	10 - 11	30 - 40	75
Variety of Organisms	2 - 4		5 - 8	1 - 3	1 - 9		1 - 3	6 - 11	16 - 40	40
Wilderness Qualities	1 - 4		3 - 8	1 - 3				7 - 11	12 - 40	30
Other					2 - 9				2 - 40	5

TABLE 6 Reasons for Using Endowment Lands

The area on Imperial Drive, used by 34 % of the respondents, has now been closed off, for security reasons. This area is near the TRIUMF research facilities. Access to this area may or may not be gained in the near future, even during working hours on weekdays.

111. Reasons for Using the Endowment Lands

Table 6 summarizes the reasons why the respondents use the Endowment Lands.

It is interesting to note that 30 % of the respondents still consider the Endowment Lands as a wilderness area (or at least still has some wilderness qualities) even though the area has been badly disturbed in the past.

Forty percent of the respondents consider the Endowment Lands as an excellent source of a wide variety of plant and animal life for study and demonstration of biological principles. The mixed hardwood conifer forest provides ideal conditions for the growth and reproduction of many kinds of detritus organisms.

Almost one half of the respondents (47.5 %) felt that by using the Endowment Lands they could save money and time. Time was especially critical for at least five professors.

Ease of access to the Endowment Lands was one of the most important reasons for using the lands. Access was differentiated from nearness to campus by the fact that some areas would inaccessible within the time limits of a two hour laboratory period unless a road or trail could be used. Physical nearness to campus implies simply that the Endowment Lands are handy. Handiness (or nearness to campus) was reported by 95 % of the respondents as at least one reason why they used the area.

DISCUSSION AND SUMMARY

The purpose of this report was to provide a preliminary report on the amount, type and intensity of use of the University of British Columbia Endowment Lands. Since the number of questionnaires was only forty, the numbers reported are undoubtedly an underestimation.

Although the approach used does not represent a statistically valid sample, it did provide an idea of the magnitude of the various uses considered.

During 1970-71, 138 field trips and 8,305 student-trips (out of a student body of over 20,000) were made to the Endowment Lands. Thus the values show that the magnitude of student-trips is in the thousands rather than in the hundreds. Similarly, the numbers of individual student projects (1,188) and research projects (35+) were considerably more than most people would have estimated.

Trends in this report show that the numbers of professors using the Endowment Lands, the numbers of field trips and the numbers of student-trips are all increasing at a rate in excess of 8 % per year.

The areas of greatest intensity of use for student field trips, projects and research programs are all in danger of being lost through potential campus expansion, road construction and earth fill operations. The unique peat bog is presently being filled in with soil from on-campus construction operations, drained, and sprayed to control mosquitoes.

Construction and spray programs are incompletely coordinated with research projects, one prime example of which is mentioned in the text. Such examples of uncoordinated operation and planning has caused almost 10 % of the respondents to cease or not start research programs on the Endowment Lands.

Another unique feature, the northern portion of the foreshore is threatened by a road construction program which would adversely effect the area in many ways. This scheme is opposed by all professors who use the area and by several citizens' associations.

The Great Blue Heron nesting site is almost unknown outside of the zoology department, which may be an advantage since anonymity may help to protect the area from vandals. However the heron nesting site should be placed into a preserve status.

The results of the preliminary examination of the educational and research uses of the Endowment Lands by various segments of the U. B. C. community indicate that a more thorough campus-wide survey would be justified. A more comprehensive survey would provide a better base for future land use decisions that may involve major alterations of the uncommon and valuable land resources now available to U. B. C. and the educational institutions.

If there was one feeling that was common to most of the respondents, it was the feeling that the Endowment Lands should be minimally developed, especially the foreshore and the area south and east of Imperial Drive. Perhaps this feeling is correct since if one looks at an aerial photo-mosaic of the Fraser Valley (west from Mission) there are only two forested areas left of any size; Stanley Park and the U. B. C. Endowment Lands. The rest of the area is either under cultivation or under buildings. Since the present uses of the Endowment Lands (especially collecting laboratory materials) are not compatible with the present uses of Stanley Park, perhaps minimal development would be the best answer to maintain the education and scientific uses of the Endowment Lands.

SURVEY OF THE EDUCATIONAL AND SCIENTIFIC USES
OF THE UNIVERSITY ENDOWMENT LANDS

NAME

DEPARTMENT COURSE NUMBER(S)

Have you used the endowment lands, including foreshore, for any purpose this year

Yes ☐ No ☐

If "Yes"

No. of Students in	1 - 10	11 - 20	20 - 30	30- 40	40 +
1967-68					
1968-69					
1969-70					
1970-71					

No. of trips to Endowment Lands	< 3	3 - 6	7 - 10	10 +
1967-68				
1968-69				
1969-70				
1970-71				

If "No", do you plan to in the future? Yes ☐ No ☐

If yes to either of the above, uses would be for :

Please ✓ if yes.

		Yes
(a)	Student field trips	
(b)	Collection of laboratory materials	
(c)	Research Projects - Staff	
	Graduate students	
(d)	Undergrad. student projects	
(e)	Other (please specify)	

Why do you use the endowment lands rather than other areas;

Please ✓ if Yes

NB: If yes to (b) please describe in a few words.

		Yes
(a)	Nearness to campus (or school)	
(b)	Unique features	
(c)	Cost	
(d)	Ease of access	
(e)	Variety of organisms	
(f)	Wilderness qualities	
(g)	Other (specify)	

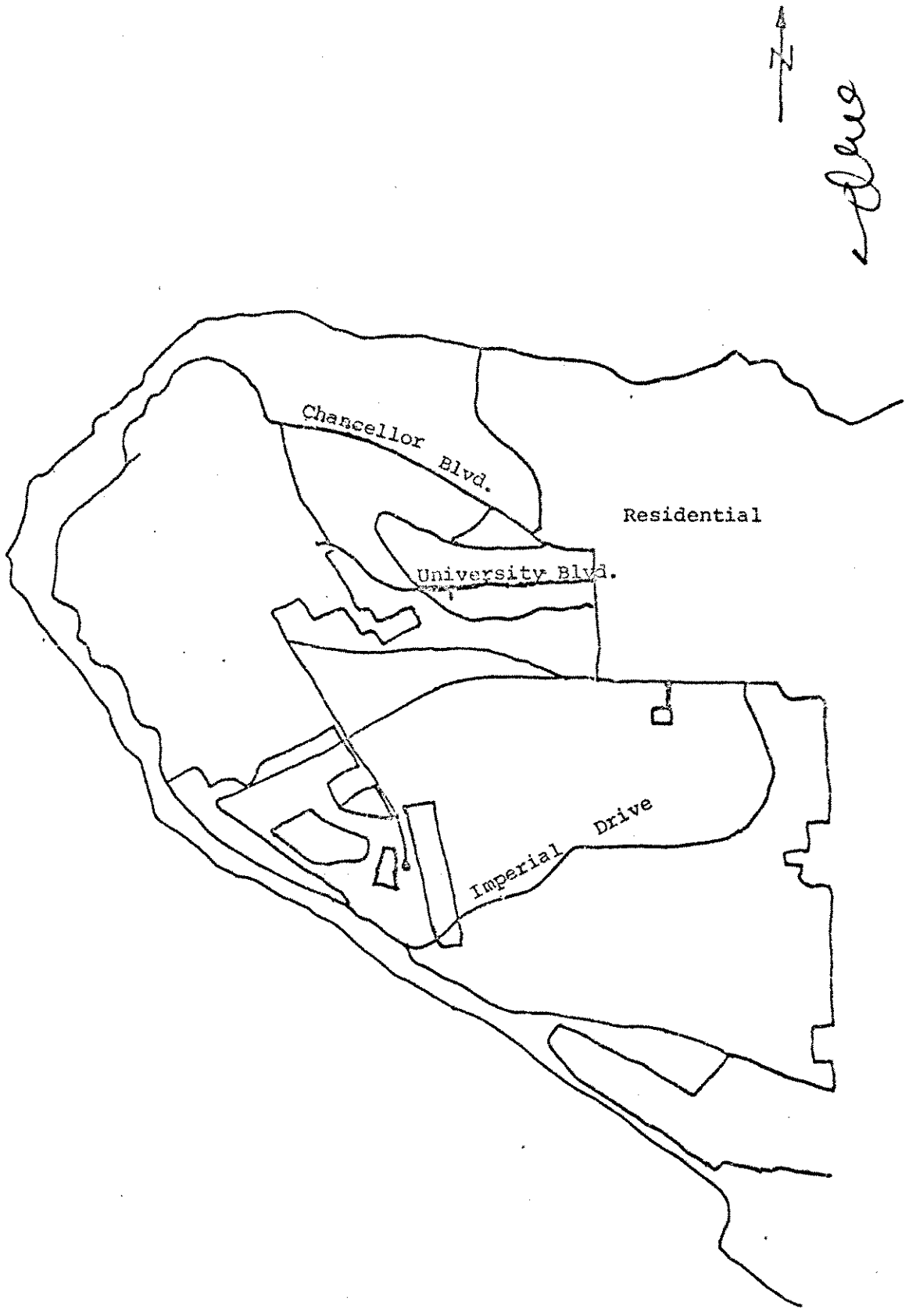
If the endowment lands became unavailable for your use(s) would you continue your activities in other areas? Yes ☐ No ☐

If yes to preceding question, where would you go?

On the attached map, would you please indicate area(s) of use.

Do you know of any other professors or grad. students that use the endowment lands?
(Name & Department)

U. B. C. Endowment Lands



THE UNIVERSITY ENDOWMENT LANDS

Notes prepared by the Forestry
404 (Advances in Silviculture)
class, 1971.

Consolidated
by

D. Norris

Instructor -
J. V. Thirgood.

1. SITUATION, EXTENT AND LEGAL STATUS

1.1 Name, Situation and Owner

1.11 Name. The University Endowment Lands

1.12 Situation. The area is situated on the Lower Mainland of British Columbia, on the extreme westerly tip (Point Grey) of the Burrard Peninsula. The University Endowment Lands are 6 or 7 miles from downtown Vancouver and 7 to 8 miles from the industrial belt along the west arm of the Fraser River. They are abutted by residential areas to North east.

1.13 Ownership. The lands were endowed to the University of British Columbia in 1925 but are administered under the auspices of the University Real Estate Development Corporation by the Provincial Government Department of Lands and Forests. The following tenure situations exist:

a) Most of the presently-developed residential sections in Units 1, 2 and 7, which cover an area of about 273 acres, is Crown Land but two of the lots are held on lease.

b) A triangular-shaped piece of land, 37 acres in extent, along the eastern border between the proposed locations of Blanca Street and President's Boulevard, has been Crown granted to the Society of Jesus.

c) The largest block of leased land is the 186.5 acre park and foreshore area on the seaward side of Marine Drive which is under a 99-year lease to the Vancouver Parks Board (here is situated the Dolphins Tea House).

d) Other 99-year leases include, the 17.5 acre site of the Queen Elizabeth School south of 16th Avenue, leased to the Vancouver School Board.

e) A. Suba, R. C. A. Heuser, and Royal Trust hold 99-year leases in the present University shopping center on University Boulevard.

f) Short-term leases include about 120 acres leased to the Westward Ho Golf Club; the British Columbia Hydro loop on Blanca Street; the area occupied by the Home Oil Service station in the University Endowment Land; Canadian Pacific Railway cable site; and a 4-acre block of land held by D. J. Gillettle at the head of ravine no. 2.

g) ThePoint Grey Riding Club and the North-west Telephone Company have leased land in the University Endowment Land. Both have short term repossession clauses in their lease contracts.

h) Two leases which will continue as long as the lands remain in Provincial Crown ownership have been granted to the Federal Government for the erection of historical monuments to mark the point where Simon Fraser is said to have reached the sea and to commemorate the meeting between Captain Vancouver and the Spaniards at Spanish Banks.

1.2 Boundaries The area is bounded on the north and west by the Georgia Strait shoreline to high-water (Spanish Banks of English Bay), and on the south by the north arm of the Fraser River. On the south-east and east are the following boundaries, named from south to north, which mark the edge of Vancouver residential areas:

South-East (i) from the shore along the boundary of Shaughnessy Golf Country Club,
(ii) South-West Marine Drive,

East (i) Camosun Street, 16th. Avenue, Blanca Street, 8th Avenue, Drummond Avenue,
(ii) a line from 4th Avenue along the edge of a residential area to the shore.

1.3 Area

Total	3464	acres
U.B.C. Campus	994	"
Leased or sold	731	"
Forest	1739	"

The 731 acres, leased or sold, are used for single-family dwellings, duplexes, apartments, fraternity houses, a small shopping centre (of five acres) and an 18-hole golf course (170 acres) along University Boulevard. Of the 1,739 acres of forest, ravines cover 75 acres and about 10 acres consist of small scattered reserves.

1.4 Land Use

The main uses of the Endowment Lands are subdivided as follows:

1) University Campus,

2) Housing, with allied services. This land use is predominately located between Westbrook Crescent and Acadia Road, between Dalhousie Road and North-West Marine Drive, and also extending along Chancellor Boulevard to Blanca Street. Some land is occupied by University Hill United Church and St. Andrew's Church. There are three schools administered by the Vancouver School Board, University Hill Elementary School (Chancellor Boulevard), University Hill Secondary School (Acadia Road) and Southlands Elementary School (Camosun Street). In the vicinity of University Boulevard and Western Parkway there are two gas stations, shopping centres, Imperial Bank of Commerce, R. C. M. P. and Magistrate's Court. Other services include a water-storage reservoir near 16th. Avenue and Sasamat Street, which is for the use of both the residential area and the Campus, and a right-of-way for power lines administered by B. C. Hydro. These high voltage lines come from a sub-station located near King Edward Avenue and Camosun Street, follow the Imperial Road west to a point about one mile from Marine Drive, and from there cut through the forest in a westerly direction, to the Campus.

3) A few small parks for recreation.

4) An 18-hole golf-course (along University Boulevard) This golf course is leased from the Endowment Lands by the Westward Ho Golf Club.

5) The forest. The forest comprises about 50% of the total area. This land is unmanaged but some use is made of the land for recreation and education. Garbage-dumping is common along accessible roads and wider trails.

6) Beaches The beaches are on lease to the City of Vancouver for recreational purposes.

1.5 History and Development of the Site

I.51 General History of the University Endowment Lands In 1908 an Act was passed establishing and incorporating the University of British Columbia. Subsequent to the Act some 750,000 acres of agricultural land throughout the province were laid aside for University endowment purposes. During the next decade the scheme was found to be unsatisfactory because the public demand for the land was insufficient to warrant continuation of the program.

A committee, established in 1922 to select a site for the University (which was previously situated near the General Hospital), chose Point Grey as the new site for the University. The committee's requirements for an ideal location were that it (1) should be at least one square mile in area, (2) should possess fertile and wooded land, (3) should be in a pleasant climate, (4) should be no more than 20 miles from a large town, (5) should have easy accessto the main transportation routes, (6) should border a large body of water (for educational and recreation reasons), and (7) should be accessible to the present and future population of the province. The original planners realized the importance of the site with respect to forestry education.

Canada, at that time, was primarily an agricultural nation and the committee felt that the site should reflect a dependency on rural life. The following statements demonstrate the feeling:

> "..... it is necessary, therefore, that the universities which are to train Canadians should be so situated that their students may have the opportunity of becoming acquainted with and of appreciating, the much more desirable life of a properly ordered rural community. "

> " Canadians stultify themselves if they permit the knowledge for which they pay to be given to students whose bodies are weak and whose health is injured through living in unsanitary boarding houses. "

The original intention for the use of the Endowment Lands was for high class housing, the sale of property being considered the best means of acquiring adequate revenue for the University. In 1923, 2700 acres were set aside by the provincial government with the object of selling or leasing the land. It was considered that the profits from these operations would provide for the operation of the campus in perpetuity.

However, over a period of thirty years, from 1925 to 1956, this planned objective of cash endowment for the University was not realized. To the contrary, there was a reduction of land available for Endowment purposes, together with a cash shrinkage of more than one million dollars from the original treasury fund of over two million dollars.

The following are the more important historic developments:

1) The first 100 acres of the Endowment Lands (Unit 1) were developed and sold for housing in 1925. Three years later a further section of about 85 acres was sold (Unit II) which adjoins Unit I and comprises a part of the northern slope, overlooking Howe Sound. The sale included clearing and levelling, and the development of sewage lines, water lines, roads, curbs and sidewalks.

2) Up to 1930 there were 44 homes either completed or under construction. During the depression years of 1930 to 1936, only 21 lots were sold and 50 homes erected.

3) The Provincial Government in 1931 sold 37 acres of prime land to the Society of Jesus for $37,000 for the construction of St. George's School for boys. There were no constraints applied as to the use of this land and of the 37 acres 14 acres were used for the Boys' School, 6 acres were sold in the early 1960's to the B. C. Electric Company for a substation, and the remaining 17 acres were sold to Regal Realty, private developers. Regal Realty paid $500,000 for the 17 acres and the developers are being financed by a $1.2 million Bank of British Columbia Loan. The Bank of B. C. has helped financially by offering more favourable terms than those available from conventional mortgage companies. Some consolation to the Provincial Government is the fact that the Jesuits have paid property tax on the land since they purchased it 38 years ago!

4) Commencing January 1, 1936, a new administration building and sales office were built at Chancellor Boulevard and Acadia Road.

5) Unit VIII adjoining the City of Vancouver, was sold in 1940. This Unit contained 54 lots ranging from 60 to 70 feet frontage and 90 to 110 feet in depth. The development was popular and 46 houses were constructed in the three years to May, 1943. Lack of material and labour during the war (WW II) delayed home construction on the remaining few lots.

6) From 1936 to 1941 only 73 lots were sold and 25 homes constructed in Units I and II.

7) The post-war year of 1946 was marked by:

   a) Enrolment of almost 9,000 students at U. B. C.
   b) The renewed interest in the Endowment Land for prospective home seekers.
   c) In February, 1946, the Minister of Lands and Forests reviewed the financial standing of the Endowment Lands, following which the lot prices were increased to $8,000. Specifications in the house plans were directed to conform to the quality of existing homes in the area. Under these conditions, 24 lots valued at $73,260 were sold.

d) At the end of 1946, only 84 lots remained unsold in the sub-divided areas.
e) Additional bus services were provided for the residential area addition to the regular bus schedule along University Boulevard. The new service to the residential section was half-hourly.
f) A school board was established.
g) The Fire Department personnel were increased. The University area Fire Department was, and is, administered through University Endowment Lands with the University paying 80%of the maintenance costs. Two firehalls exist.
h) A water-supply main was built from Vancouver City to the Campus, and plans were made for a new truck sewer along Marine Drives, which is in service today.

8) Acadia Camp, released to the University of B. C. by the Army, was made available in 1947 for student housing.

9) In 1951-2 about 300 acres were cleared for subdivision and development. (Units III and IV).

10) In 1955 an additional 433 acres of the University Endowment Lands were Crown-granted to the University for campus enlargement, thereby reducing the net undeveloped area to 1827 acres.

11) In 1956 the first of many plans to develop the Endowment Lands was proposed. This plan resulted from two-years of study by Dr. David B. Turner of the Department of Lands. It was completed in 1956 and tabled in the legislature in 1959. The plan called for government to spend $20 million developing the land with 3,500 homes, 34 apartment blocks, 109 acres of "clean" industry, churches, schools and recreation areas. All this development would be based on 99-year leases, resulting in an annual income to the University of about $2.3 to $3 million after the first 15 years. This plan was not implemented.

12) A second plan was proposed in 1963, by Webb and Knapp (Canada) Ltd., a property development firm. This called for a development expenditure of $300 million to be provided by private funds. The plan proposed the establishment of ten self-contained neighbourhoods of tree-lined crescents, office and research centres, and a town centre with cultural and commercial facilities, providing the University with an income of about $3 million a year after 15 years. The three million dollars would have contributed only a small part of the total $75 million University operating budget, and the idea was rejected.

13) The third plan involved leasing or selling land to industry. The hope was to encourage industry to move clean, quiet departments, such as research and development, on to the Endowment Lands (as they have done at California's Standford University). Only part of this plan was put into effect when the $3 million B. C. Research Council Buildings were established on Campus.

14) The Bennett Government in March 1965 set up the Universities Real Estate Development Corporation to combine with the new Bank of British Columbia to handle the lands and create revenue for the University of B. C., Simon Fraser University and the University of Victoria. The Provincial Government proposed to transfer to the Corporation all the Endowment Lands, the $2.3 million in the University Endowment Lands Administration Fund, a $2 million downtown block earmarked for the bank building and elimination of a $2.1 million debt owed by the Endowment Lands to the Government. This plan is still under discussion.

On the 700 presently developed acres (1967) there are 436 homes, 12 duplexes, 8 apartment blocks, 12 fraternity houses, an 18-hole golf course and a small shopping centre. Land speculation and appreciation on the Endowment Lands is exemplified by the case of a lot which was sold for $6,800. in 1952, remained untouched for 11 years and was sold again for $27,000 in 1963; five years later it was sold for $33,500 and is still undeveloped. It has been stated, however, that any future development will now be on an 40 to 50-year lease.

The University Endowment Lands are the choicest and potentially the most lucrative acres in Greater Vancouver but no clearly defined Government policy exists. There is:

1) no one at the top charged with decision-making,
2) no current plan on which a decision could be based,
3) no immediate prospect of decision-makers being appointed,
4) no agreement within the provincial cabinet on how much urgency is attached to adecision.

The Universities Real Estate Development Corporation was approved in 1964 by the Legislature, but was never instituted and directors have never been named. The area is administered by provincial civil servants, and any major decision comes from Victoria.

Some Provincial sources point out that the government is subsidizing the area by:

1. The Highways Department cares for three major roads in the area - Marine Drive, Chancellor and University Boulevard - with cost to local taxpayers.
2. Provincial Government pays for fire and police protection - including $7,500 of the $10,000 a year paid the City of Vancouver for standby fire proection.
3. Administering the land.

As against this, Endowment Land residents claim that:

1. The area does not receive the normal annual per capital grants from the Provincial government,
2. roads not well maintained and are choked with students not residents,
3. promises to build other roads - Sixteenth - have not been fulfilled.
4. fire and police services are primarily for U.B.C. with the developed area coming a poor second,
5. residents pay for two schools- elementary and high school - with usual education department grants but many students come from non-paying families on campus,
6. running the community costs less because it has no debt charges as do other communities.

In the provincial government books for 1966, the operating expenses for the area were $638,165 compared to the return from taxes which were $320,000, the balance coming from the University of B. C., government grants, leases and such items as metered water, paid for by the local residents.

As of 1969, 1600 acres are still wilderness and 670 acres have been purchased

1.52 History of Forest Operations

1. The earliest recorded use of the present Endowment Lands was as a source of timber for early explorers, probably in the early 1800's. Prior to this, Indian bands of the area would have used the large western red cedar, up to 16 feet in diameter, for their longhouses and canoes.

2. 1886. The forest, containing high quality Douglas-fir and western red cedar, with some western hemlock, was logged by contractors for the Hastings Sawmill Company on the site of the museum fronting on Dunbar Street near 4th Avenue. The best timber was extracted in a highly selective operation: only spars and surface clears were removed. The contractors set up three camps and used ox teams to haul the logs out over skid trails. These trails were made of small logs, about 10 inches in diameter and 10 feet long, laid crossways about 2 feet apart. The centre of the skid trail was partially cut out or tapered inwards to keep moving logs in place as well as being oiled to ease log movement. Almost every small ravine running from the plateau to the sea still has evidence of skid trails used for extracting the timber. The gulley running down to Wreck Beach was the site of a log chute. C. Dagget did most of the logging south of the point which now is the first viewpoint on S. W. Marine Drive south of Wreck Beach.

3. 1896-1905. Richard S. Forbes and Company operating 3 or 4 house camps, logged much of the remaining high-quality timber which was sold on the open market. Shingle bolts and cedar log bolts about 16 feet long were removed from the site of the present Anglican College in 1898.

4. 1906-1912. This period saw the establishment of small camps in patches of timber remaining after the prime logging was complete. In 1908 a small camp was located on the site of Totem Park.

5. 1912-1923. After the University Farm and University Department of Forestry were established the whole area was logged periodically for firewood and

shingle bolts. Dixon was the contractor who cleared the present campus in 1912. The last public timber license was granted in 1923 to S. C. Budd.

6. Late 1920's to 1950. All the area south of University Boulevard was logged in the late 1920's with no slash burning. A railway link ran along Acadia Road and Chancellor Boulevard to the city to transport the logs.

During the Depression years from 1929 to 1932 plantations of Douglas-fir were established as a make-work project. These were mostly located near or on the present Campus, and one extended northwards from 16th Ave. to University Hill High School. In 1936-7 Government work crews undertook considerable cordwood cutting, snag-felling and trail building. These work crews cut narrow bands, now appearing as pure alder, running from north-west to south-west across the forest.

Between 1928 and 1942 a foreman, named Edmonds, was employed by the Department of Forestry to look after a nursery, to keep trails open, to cut and sell wood, and to fell snags for fuel for the boilers in the greenhouse. The last snags were felled in 1945. It took up to 25 years to clear the campus of snags, and much of the felling was done by Indians who were paid on the basis of stump-area sawn.

In 1940 the forest area bounded by 16th Ave., Marine Drive, 29th Ave. and Arterial Road, was inventoried by Davis M. Carey. Stocking was sub-divided into seven categories as follows:

	Type	Vol.	Area (acres)
A.	D,C,H	2,500	344
B.	A,C	2,300	105
C.	H,F,C,A	2,200	91
D.	C,H,A	1,620	18
E.	D,C,H	700	20
F.	C,A	1,062	18
G.	Dec.	-	34
			640

D. = Douglas-fir, F. = grand fir, C. = Cedar, A.= Alder, H. - Hemlock
Dec. = other deciduous

1951 onwards. The last major cuts were in 1951 and 1955. In 1951 a large area of forest extending from Spanish Banks to University Boulevard, now covered with pure alder, was cut for an undisclosed project which was terminated in 1952 with the election of the Social Credit Government. 1955 saw the clearing of an area east of Foreshore Park for the building

by Henry Hygard of the Federal Government Forest Products Laboratory on N. W. Marine Drive, part of a 300-acre development scheme for research purposes. Stumpage from this operation was $1,500. Since 1955 there have been several further fellings on this south-west portion.

Logging of the area has been gradual: no large portion was logged at one time and no large slash fires are documented. Evidence of skid-trails still exist throughout the area and there are local disturbances resulting from poor logging practices. Stands of low-value species composition (e.g. alder and maple) have resulted. Numerous dead cedar wind-falls and large stumps attest to the size of the old growth prior to logging. In the final evaluation of the lands, careful note should be made of the areas not sufficiently restocked.

1.53 Development of the Campus Forest In 1935 the area above Marine Drive came under a preliminary working plan prepared by G. S. Allen. The objectives of management were:

i) to develop a demonstration forest and a forest laboratory for students of natural sciences, and provide a permanent shelter for wildlife,
ii) to provide a windbreak for adjacent University grounds,
iii) to produce saleable forest products on a sustained yield basis and create permanent employment for at least one man.

This area lies west of the University buildings between Marine Drive and the University Campus. The total area was then 104 acres, divided into 45 blocks. The areas covered in the report were Blocks 1 to 25 (57 acres). Within this area 78.9% was forested, 1.4% cultivated and 19.7% classed as scrub. The two major species were cedar (30, 106 cu. ft.) and Douglas-fir (27, 454 cu. ft.) which were to be managed under 60-year rotations and a 10-year cutting cycle. Secondary species were lodgepole pine, hemlock, spruce, balsam, alder, maple and cascara.

Allen noted that the forest, originally virgin fir-cedar, had a very uneven appearance because of selective logging. It consisted of over-mature trees considered too poor to cut, mature trees too small and reproduction established since logging. No serious fires had occurred although fire-scars on some large firs and cedars indicated past ground fires. Rabbits and possibly grouse had done considerable damage to planted firs, cutting leaders and branches to within 6 inches of the ground. The only important pathogens were mistletoe on hemlock, and white pine blister rust on white pines.

By 1935 cedar and hardwoods had largely replaced fir. Allen recognized three forest types:

i) Pure Hardwood - 90% of the stand hardwood with the principal species alder and maple, with cherry, willow, cascara and crabapple as secondary species.
ii) Mixed conifer and hardwood - the principal type, consisting of a fairly even mixture of hardwoods with an understorey of conifer of conifer reproduction. The main species were cedar, hemlock, balsam, alder

and maple, with secondary species fir, spruce, cherry, willow and cascara.

iii. Pure conifer - mostly pure cedar, cedar and hemlock, or a mixture of cedar, hemlock and grand fir.

The future annual growth estimated in 1935 in a mixed coniferous stand was 400 fbm per acre. Pure alder on a 30-year rotation was thought to average 400 fbm. per acre per year.

Four treatments were recommended for the first ten year cutting cycle:

i) remove all overmature and decadent timber,
ii) remove all dead-topped cedar, all mistletoe-infested hemlock, and all trees of poor form,
iii) liberate conifers by removing suppressing hardwoods, but leaving thrifty hardwoods,
iv) plant openings and bare spots to suitable species, using 2-3 transplants in all cases.

This plan was intended to initiate management during the first cutting cycle of 10 years.

During the first ten-year period of the management plan, it was proposed that fir, cedar, lodgepole pine, cascara and dogwood be planted.

Allen prescribed the adoption of a selection system in the all-aged mixed stands, while in the even-aged deciduous stands, clear cutting in small groups was recommended. The rotations were to be 60 years for all conifers (to produce an average diameter of at least 12 inches), and 30 years for hardwoods (for the same average diameter).

Cutting during the first 10-year period was to be confined to overmature and poorly-shaped trees. The plan called for thinning in overstocked pure coniferous stands (up to 20 years of age) to allow a spacing of about 8 ft. x 8 ft. Cleaning and liberation cuttings were to remove wolf trees and thick underbrush to free young conifers.

There is no evidence that this plan was implemented.

In 1949 a Committee, set up to study the forest, recommended a permanent belt of trees east of Marine Drive, preservation of existing forest, addition of lands sufficient to bring the total Campus forest area to 200 acres and the incorporation of these into a master plan of Campus development. In 1949 some University departments had requested land for research and demonstration purposes. Department of Forestry requirements were for 220 acres of forest. The department also heartily endorsed the establishment of a Botanic Garden and agreed to the inclusion of part of the Campus Forest in the Garden provided that the Farm woodlot be reserved permanently for experiments and demonstration, that the forested strip north of Agronomy Road and along Marine Drive be retained as windbreak and Arboretum, and that an additional 100 acres of forest land be acquired from the University Endowment Lands for a Campus forest. The total forest area requested by several departments (Zoology, Botanic Garden, Botany and Forestry) was reduced to 150 acres through co-operation in using the land.

A 1949 timber cruise assessed the forest stock as:

Type	Area (acres)	Total Volume (M cu. ft.)
2nd growth conifer	175.7	504.2
" hardwoods	95.6	84.9
" conifers & hardwoods	90.9	76.5
old growth conifers	32.5	120.0
scattered old growth conifers with younger understory	18.9	20.0
non-commercial cover	16.5	-
Total	430.1	805.6

These data include only forested land on the Campus.

Costs of establishing the Campus Forest to the level suggested in 1949 (225 acres) would have included:

i) land clearing and establishment ($250/acre), with very little revenue from the sale of timber, and
ii) the establishment of mensuration plots for studying growth and yield on a continuing annual basis ($2,000).

By planning the combined forest use among all departments through further overlapping of requirements, the minimum area needed was again reduced, this time from 145 to 78 acres, as shown below:

Area requirements were reduced from:

	Acres
1. Plantations for student exercise, exotic trials, seed production, tree breeding, experiments, and growth plots	50
2. Natural forest for demonstration plots	25
3. Natural forest for study of growth and yield	50
4. Arboretum	20
Total	145 ac.

to

1. At least 20 ac. of #1 could be in co-operation with other departments	-20
2. Half of #2 could be in co-operation with zoology	-12
3. At least half of #3 could be reserved within the Botanic Garden proper	-25
4. Arboretum within the Botanic Garden	-20
Total reduced area required	78 ac.

It was not until 1957 that committees and groups were again set up to determine the size of a proposed Campus Forest. Up to 1957, forested portions of the Campus had been used for demonstration purposes in courses such as Dendrology, Forest Ecology, and Silviculture, and for field excursions in Surveying, Mensuration, Photogrammetry and Management and periodically, small logging operations had demonstration value for Forestry students. The 54 acres of Douglas-fir plantations established in 1934, having been reduced by the expansion of the University to only 20 acres, were of increasing value for demonstration and plots. Stands south of the Agricultural Barns were used for demonstrations of thinning and pruning techniques. Suggestions for the future development of a Campus Forest were made by J. H. G. Smith in 1957:

i) The minimum requirements by the Botanic Gardens should be set considering the values of land and the cost of development.
ii) Areas should be laid aside as required for:

   a. Zoology-forestry nature area,
   b. blocks for mensuration and silviculture studies, and
   c. plantations and seed orchards for demonstration and research.

iii) Non-coniferous types developed, with funds derived from the sale of timber to go to the Campus Forest and the Botanic Garden, and
iv) The remaining land should be administered on advice from the Faculty of Forestry.

Despite all, the forest land has remained essentially unmanaged and its potential disregarded.

1.6 Legal status

Apart from the land set aside for campus development, the Endowment Lands have been retained as Crown Land, administered by the Provincial Government under the name of the University Real Estate Development Corporation. An office of the B. C. Department of Lands and Forests on Chancellor Boulevard exists for daily administration of the Endowment Lands.

The authority for control is contained in the University Endowment Land Administration Act of 1925. Just after this date the University moved from the site of the present General Hospital to Point Grey. The legal description of the area is District Lot 140 Group 1, New Westminster Land District.

In Section 2 of this Act, the Minister of Lands and Forests is given sweeping administrative rights on the Endowment Lands including surveying, subdividing, improvement and taxation. He can administer loans for development, but the loan fund cannot exceed 2 million dollars.

The Endowment Lands Administration Account in Section 3 of the Act is derived from local taxes levied within the Endowment area. This account, at the discretion of the Minister of Finance, is used to meet expenditure incurred by the University. Sections 4 and 5 deal with investment of surpluses over these expenditures in the Consolidated Revenue Fund over which the minister has direct control.

Section 6 states that the Minister of Lands and Forests must reveal the amount of money required for administration, maintenance and construction, including such services as water and sewer systems, before taxing under the Taxation Act and Public Schools Act.

In dealing with local improvements, Section 8 makes provisions for the Minister of Lands and Forests to authorize them with the consent of at least two thirds of the property owners. This section also requires that the description of the land be available to the Minister. The Lieutenant Governor in Council may have powers to (i) carry out and enforce all covenants and conditions contained in contracts and (ii) require that building permits be necessary and that inspection be mandatory. Section II states that no person shall pick, cut, damage, or remove the whole or any part of any flower, plant, shrub or trees without permission. This section is seldom enforced.

Section 12 states that no building, other than a private dwelling house, garage or greenhouse shall be erected or maintained except in designated areas, also that no building, wall, fence, pole, aerial or other structure shall be erected on the parcel until plans and specifications have been submitted and approved. This section is very important because it is an attempt to control land use practices on the Endowment Lands. In the past parts of the lands have been sold outright to real estate developers, but none since 1950. However, there have been no land sale in recent years, the University Endowment Lands Administration Act does not prevent the sale, in fee simple, of endowment land property.

A Land Use Code, due to be revised in early 1971, was produced to standardize development on the Endowment Lands. Any radical or unspecified development on the area, however, has to be approved by an Order-in-Council from the Cabinet of the Legislature of B. C. Development on land under the auspices of the University of B. C. is subject to approval by the Board of Governors of the University, but the Cabinet has no obligation to ratify these developments.

2. Permanent site factors

2.1 Topography and drainage

2.11 Topography

The relief of the Endowment Lands is gently undulating. The area resembles a plateau that is gently rounded about an east-west axis which divides the area into northern and southern halves. The land falls to both the north and the south of the axis. In places it dips abruptly with vertical cliffs to the sea. On the land side to the east the axis continues in a south-easterly direction: the land east of the site is rolling and gently falls in an easterly and south-easterly direction.

The steepest slopes are along northwest and southwest Marine Drive where the land dips into the sea.

Elevation ranges from sea level to 420 feet on the Campus but most of the Endowment Lands are between 350 and 400 feet. There are a few small but prominent ridges, perhaps the remnants of early logging railroad grades.

2.12 Drainage

Three deep ravines along the north edge of the site extend in a south-easterly direction from the shoreline, penetrating inland for 2,500 feet. There are no major rivers - only a few small streams and creeks. The drainage patterns in most cases run in a north-south direction with the dividing line approximately at 16th Avenue.

The area is generally well-drained except for the north-east corner at the Camosun peat bog and in a few other locations where slight relief changes have resulted in perched water tables in hollows. The Camosun bog comprises 60 acres with about 36 acres located within the Lands. The bog has a drainage basin of about 100 acres, is saucer-shaped, surrounded by high land on all sides, and extends to a depth of about 26 feet in the centre of the area. The relative flatness and poor drainage of the area around the Camosun bog contributes to its unique nature.

2.2 Climate

The climate of relatively mild wet winters and warm summers is greatly influenced by the flat terrain, the Pacific Ocean, the semi-permanent high and low pressure regions located over the North Pacific Ocean and the warm Japanese Current. The climate is termed Mediterranean sub-humid in the 1970 U. B. C. Forestry Handbook and classed in the Koppen classification as Csb. (Pacific mesothermal with mild winters). Csb annual average temperature is below 64.4 degrees F. (hence class C) with the warmest month more than 50 degrees F. The driest month receives less than 1.2 inches (s). The area is subject to oceanic influences.

2.21 Winds

East and southeast winds predominate during the winter months, whereas west and southwest winds prevail during the summer. Wind strength does not vary appreciably from month to month. The average annual force is 4 m.p.h., but strong storms come from the Pacific Ocean, usually losing force before reaching the Endowment Lands, the strongest gust reported locally being 72 m.p.h. Winds rarely exceed 30 m.p.h. A hurricane was, however, experienced in the fall of 1962 which caused considerable damage to forest stands.

2.22 Temperature

The average monthly temperatures range from 39 degrees F. in December to 63 degrees F. in July, with 10 - 85 degrees as common extremes. Surrounding mountains protect the lower Mainland against cold Arctic air, from the continental interior flows and against direct effects of Pacific storms.

The length of the growing period (above 42 degrees F.) is 265 days. Sharp frosts lasting for several days may occur between November and April.

2.23 Sunshine

Sunshine hours range from a monthly average of 36 in December to 282 in July, with the greatest amount occurring between May and September.

2.24 Precipitation

The average precipitation is about 45 inches with a total from May through September of only about 11 inches evenly distributed. There are 155 days per year with measurable rainfall.

Snowfall ranges from 2 inches to 3 feet, with an average of about 15 inches. The relative humidity averages 50% with extremes of 100%to 40% on wettest and driest days. During the Fall fog is fairly common during night and early morning.

2.25 Meteorological Records

Temperature and precipitation have been recorded at Point Grey only since September 1957. A station is maintained on campus by theDepartment of Geography. Climatic data is also recorded at the Department of Transport Weather Station on the Endowment Lands.

2.26 Climatic Data

The following are compiled climatic data for the Endowment Lands area:

i) Temperature

Maximum temperature	91 degrees F.
Minimum temperature	-1 degree F.
Average for January	32 to 40 degrees F.
Average for July	60 to 65 degrees F.
Mean annual	49 degrees F.
Average frost-free period	260 days

ii) Sunshine

Hours of sunshine	1,800 hours
Monthly average for December	36 hours
Monthly average for July	282 hours

iii) Precipitation

Mean annual rainfall	45 inches
Mean rainfall for May to September	11 inches
Average potential evapotranspiration[1]	25.1 inches
Average moisture deficit[1]	5.2 inches
Average moisture surplus[1]	25.1 inches

[1] Thornthwaite values

2.3 Geology

The Endowment Lands and Point Grey resulted from an uplifting of the land sometime during the Pleistocene glaciation period, and it was this glaciation which deposited the soil parent materials. The ice drift moved from the north to south over the Endowment Lands. Evidence of extensive glacial activities is seen today in existing erratics and hugh granitic boulders that originated in the coast mountain range. The Main Mall on the Campus is located on a drumlin formed by the gouging and filling of the ice as it made its way across the campus area.

Recent drill holes put down beside the Biological Sciences Building and Fisheries Research Building on the Campus showed that bedrock lies at depths between 300 and 500 feet under the glacial deposits and raised beaches. Thick beds of interglacial deposits of sand, gravel, silt and clay (Quadra) are exposed along the Campus sea cliffs, but these are relatively unimportant as soil parent materials, except locally. Recent post-glacial deposits such as fans and beaches form parent materials for young soils at the bases of the cliffs.

Ice sheets of the glacial periods have contributed to the formation of the Newton Stoney Clay and the Surrey Till. These are the main parent materials of the deeper soil horizons on the Endowment Lands. They are glacio-marine and glacial deposits of sandy to silty till and substratified drift about 1 to 60 feet thick, but generally less than 20, deposited during the last Continental glacial ice advance. The Surrey Till is unsorted material deposited directly from the ice. During the melting of the ice sheet the ice thinned and pulled away from the sea floor to float and drop the material which formed Newton Stoney Clay.

Both Newton Stoney Clay and Surrey Till are gray in colour, often mottled, compact and hard, particularly in the upper part where it shows cementation. They contain large amounts of silt and clay and consequently are of low permeability.

These two materials account for the deeper soils on the Endowment Lands. Where they are not near the surface they are overlain by thin deposits of Bose gravel and Sunnyside sand. Underlying these is an impervious material and where the sands and gravels are thin the water table is very near the surface during the rains. The minerals of the Bose and Sunnyside materials have been repeatedly crushed and the soluble material dissolved and carried away. This and the coarse nature of the particles causes soils to have limited supply of some chemical elements in forms available to plants. The reddish brown Bose Gravel deposits and raised beaches range from 2 to 10 feet in thickness. Sunnyside sand consists of raised littoral beach deposits of medium to coarse sand, of about 2 to 10 feet. After the last ice-sheets receded, the land rose 500 to 1000 feet above the present sea level. Surrey Till and older deposits have been pre-loaded by at least 7,800 feet of ice whereas the post Surrey deposits have been pre-loaded only by the weight of sediments above them. The till was deposited under a great weight of ice whereas the till-like stoney clay was dropped from floating ice. All the unconsolidated deposits formed in the area are easy to excavate, except the tills and the glacio-marine sediments. In the tills, high

cohesion in places necessitates blasting before excavation and in both marine till and glacio/sediments large stones may have to be broken before removal.

2.4 Soils

2.41 Age

All soils in this area are young geologically, having been formed in the 8,000 years since the retreat of the last ice-sheet and subsequent rise of the land above sea level. Some other minor factors contributing to the relative youthfulness of the soils have been the soil movement on the slopes, burning of slash and the churning effect of logging operations.

2.42 Effect of parent material on soil formation

The influence of parent material on soil formation is quite marked. Soils derived from the Stony Clay and Surrey Till consist of sandy till and minor substratified drift up to 60 feet thick and generally less than 20 feet. These are overlain in most places by glacio-marine stony clay silt and minor inter-bedded marine clayey silt, silt clay and sand up to 25 feet thick, but generally less than 10.

The clays and silts of the Vancouver area are composed chiefly of rock flour produced by mechanical abrasion of glaciers and to a lesser extent by chemical decomposition of the rock. The sands are mainly quartz, but contain many felspars and rock fragments. Besides the clays and silts from weathering of glacial deposits, shore deposits of sands and gravel are the other main geological parent materials.

2.43 Effect of drainage on soil formation

Since mineral particles in parent materials are large (gravel and sand), most mineral particles in the soil are coarse and therefore drain well, but are also leached, forming distinct soil horizons, and are permeable to air and roots. The high proportion of coarse to fine material gives the soil poor water storage capacity, unless the soil is rich in organic matter.

During the mild wet winters there is a marked moisture surplus. Most of this water infiltrates into the unfrozen coarse textured soils and down to the horizons formed from Newton Clay. Water moving down to these horizons is slowed and either accumulates or moves laterally. Bright red colours caused by oxidation and precipitation of iron and other materials are evident. Passage of surplus water charged with CO_2 through the soil dissolves soluble materials and basic elements, leaving the soil horizons acidic in reaction and low in soluble minerals.

Relief affects the soil water and erosion activities. When mineral soil is exposed by cultivation, fire or logging, infiltration of water into the soil is slowed and run-off will occur. Water will move the finer particles down the slope, and eventually the run-off will cause gullying. Some of the infiltrated water moves down to join the ground water, and may accumulate above the Newton and Surrey horizons saturating the soil and forming gleyed and organic soils. The Sunnyside gravel is so thin in places that in the

rainy season the water may be perched on an impervious layer near the surface.

In 1935 a large washout occurred near the campus. Following exceptionally heavy rain, a small stream, the banks of which had been cleared of vegetation, cut through the till into the underlying soil. Large quantities of sand were eroded and carried away along with much of the underlying till.

An important feature of the Endowment Land soil is the Camosun peat bog in the east corner. During winter the bog is flooded but this dries during summer so that it can be crossed on foot. The peat is about 25 feet thick and when dry is granular, with some horticultural value. The total amount of peat is estimated to be 1 million cubic yards. Studies have revealed that an aquifer exists at a depth of 80 to 100 feet. Drainage is not feasible owing to the tenacity with which the free water is held by the peat.

2.44 Biotic factors affecting soil formation

The forest has affected soil through contribution to the LF and H Horizons. In forested areas much of the organic matter is present at the soil surface and there is only limited mixing of the organic litter by worms and insects.

Recent highway construction on Marine Drive has affected run-off in the area by lowering the base level. This has resulted in extreme erosion and bank-cutting. In summer the soil tends to dry up quickly.

2.45 Soil Survey and Classification

The four soil types are described fully below. All the soils on the Endowment Lands are upland soil types. The Summer series belongs to the Podzolic soils group, the Heron humic Gleysol soils and the Sunshine and Bose soils belong to the wooded soils.

1) Summer Series

The Summer soils, occurring in scattered patches, and with a relatively small total area, are in the imperfectly drained depressions in association with the Sunshine and Heron series. The topography varies from level to gently sloping and undulating, but is lower than surrounding soils. There is a hummocky micro-relief.

The parent material is composed of shallow deposits of Sunnyside Sand over laying Newton and Surrey materials. The average depth of the sandy overlay is 18 to 48 inches, but it may attain greater depths. Occasional gravel and cobble is scattered in the profile.

Surface and internal drainage are restricted by iron cementation in the Bhfc and Bf horizons, and by the impervious layer overlying the Newton and Surrey materials. It is this layer that results in a perched water table in the wet season.

The Summer soils are classed in the subgroup of gleyed Orthic Podzols. The

profile varies from extremely acid at the surface to near neutral in the lower part. There is good development of an iron cemented horizon, which effectively restricts root penetration. The forest cover is composed of a heavy stand of second-growth cedar, alder, birch and cottonwood, and the ground layer is mainly swordfern and moss. Growth is usually restricted because of the shallow rooting, the high fluctuating water table, low pH and low fertility. Water-holding capacity is low in the upper profile. The soil could be improved by breaking up cemented horizons.

Vegetation cover: Second-growth Thuja, Picea sitchensis, Salix with an understorey of Acer circinatum, ferns, wild lilies and musci. In the clearings are Rubus ursinus, Sambucus pubens, Sorbus sitchensis.

2) Heron Series

These common soils occupy poorly drained depressions and seepage slopes and often occur in close association with the Summer and Sunshine series. The topography is mostly level to gentle sloping, but depressional in relation to adjoining soil types.

The parent material consists of shallow deposits of Sunnyside sands, which overlay the same impervious materials as the other soils above.

The Heron series form part of the Orthic Dark Gray Gleysolic subgroup of Dark Gray Gleysolic soils. A nearly impervious underlay is the cause of a perched water table in the wet season, characterized by a dark coloured surface horizon greater than 3 inches thick which is underlain by one or more gleyed and mottled horizons.

The reaction is from strongly to medium acid. There is substantial improvement in soil productivity following drainage, but the soils generally have poor water holding capacity.

Vegetation cover: Alnus rubra, Salix, Acer circinatum, and scattered Thuja, with an understorey of Rubus spectabilis, Luzula, Polystichum, Athyrium and musci.

3) Sunshine Series

The parent material is Sunnyside sand, which originally was littoral or marine beach deposit composed of medium to coarse sand and subsequently uplifted above the sea to its present position. It overlies impervious layers. The material has been cleanly washed and is generally free of gravels and cobbles so that there are no distinct eluvial or illuvial horizons.

The Sunshine series is a group of Orthic Acid Brown Wooded soils. They are moderately well to well drained, depending on the depth to the underlying impervious geological material. The reaction varies from medium acid at the surface to slightly acid in the parent material. Traces of an Ae horizon may be present in undisturbed areas. These soils are easy to cultivate and respond very well to fertilization. The main limitations are the light textures, low moisture-holding capacities and low plant nutrient supplies. The solum generally has good rooting depth and good structure.

Vegetation cover: Pseudotsuga menziesii, Thuja, Tsuga heterophylla, Populus trichocarpa, Betula papyrifera, Alnus rubra, Salix, with an understorey of Pteridium aquilinum, Rubus parviflorus, Rubus ursinus.

4) Bose series

The parent material consists of a mantle up to 10 feet thick, but generally less than 3 feet, of wave-sorted lag gravels that overlies Newton Glacio-marine sediments and Surrey Till.

The Bose soils are well-to-rapidly-drained, with the topography sloping gently to moderately. The underlying deposits restrict internal drainage in the lower part of the solum where mottling indicates temporary perching of a water table. The surface texture varies from gravelly loamy sand to sandy loam with rapid drainage. Stoniness ranges from light to heavy. The Bose series is in the Orthic Acid Brown Wooded subgroup of Acid Brown Wooded soils. The solum is slightly acid and a thin Ae horizon has developed in scattered locations. These soils generally have low fertility, poor moisture-holding capacity and are stoney.

Vegetation cover: Immature Pseudotsuga menziesii, Alnus rubra, Acer, Betula papyrifera, Thuja, with an understorey of Rubus parviflorus, Rubus ursinus, Polystichum munitum and Pteridium aquilinum.

5) Organic soils

The organic soils are those which contain at least 30 % organic material. They have a minimum depth of 12 inches and usually overlie large amounts of consolidated organic matter. Drainage is usually poor and the water table is at or near the surface for much of theyear. The wet conditions limit decomposition of organic matter and results in the accumulation of peat from the remains of sedge, reeds, wood and moss. Peat is usually extremely acid as the water is low in carbonates. The acidity results from the slow decomposition of organic matter. With increasing acidity, decomposition slows down even more. Sphagnum moss continues to grow and accumulate under these conditions.

2.46 Detailed soil description

1) Summer series

Horizon	Depth	Description
L-H	1-0	Raw to well composed mix. of deciduous and conif. for. litter, pH 4.4.
A	0-9	gray to dark grey color, loamy sand, weak, blocky, structure, very friable when moist, excess roots. pH 4.5.
B	9-22	brown to dark brown, loamy sand, very impermeable to water, occasional roots in upper part, pH 5.4.
C	22-38	olive-gray to grayish brown, weak block structure, cemented patches very firm when wet, friable when moist, pH 5.7.

2) Heron Series

Horizon	Depth	Description
L	0-2	Fresh deciduous forest litter
F	0-1	partly decomposed organic litter containing many fine roots, pH 4.7
A	0-8	very dark to grayish brown, fine sandy loam, moderate content of cemented materials, friable when moist, roots common, pH 5.0
I	8-25	grayish brown, clay loam to clay, mottling prominent, slightly sticky when moist, occasional roots, pH 5.5

3) Sunshine Series

Horizon	Depth	Description
L-F	1-0	coniferous forest litter, decomposition evident pH 4.8
B	0-38	dark to yellowish brown, moist, medium sandy or loamy sand, generally weak structure, slightly cemented when wet, roots abundant to common, pH 5.7
C	38-70	light olive brown to olive, highly variable sand to loam, some lottling, firm to loose when wet, pH 6.1.

4) Bose Series

Horizon	Depth	Description
L-H	1-0	Mostly humified forest litterwith a thin layer of leaf fall on surface.
B	0-24	brown to dark reddish brown, moist, gravelly sandy loam, very weak structure, friable when moist and abundant roots, pH 5.9
C	24-34	pale brown or brown, moist, gravelly sand, moderate compaction, very friable when moist, occasional roots, pH 6.3
I	34-40	light gray to brownish gray, dry, clay loam, friable when moist, a pseudoblocky structure, pH 5.9.

5) Organic soils

Horizon	Depth	Description
1	0-5	Living, sphagnum moss; abundant fibrous roots. pH 4.0
2	5-9	Brown, slightly decomposed Sphagnum moss. Abundant fibrous roots. pH 3.7
3	9-14	Dark, reddish-brown, partly decomposed sphagnum moss, slightly fibrous, abundant roots, pH 3.4

4	14-30	Very dark red partly decomposed sphagnum moss, slightly fibrous, Abundant tree roots. pH 3.6
5	30-	Dusky, red brown, slightly decomposed sphagnum moss. Abundant tree roots. pH 4.4.

Soil Type Horizon	Depth	pH	Cation Exchange Capacity me/100 gms	Base Saturation	Exchangeable Cations me/100 gms Ca	Mg	K	Na	Total
Summer Fine Sandy Loam - Gleyed Orthic Podzol									
L-H	3-0"	3.6	130.39	--	13.82	8.00	-	-	-
Ahe	0-6	4.2	14.40	14.52	1.27	.50	.10	.22	2.09
Bhfc	6-12	5.4	18.30	9.56	.75	.89	.04	.07	1.75
Bf	12-19	5.9	5.94	26.60	1.00	.52	.04	.05	1.58
Cg-1	19-28	6.4	3.58	--	.86	--	.01	.18	--
Cg-2	28"+	6.7	5.30	--	--	--	.03	.28	--
Sunshine Sandy Loam - Orthic Acid Brown Wooded									
Bfh-1	0-10"	5.7	15.42	12.40	1.37	.31	.11	.12	1.91
Bfh-2	10-20	5.7	11.68	9.16	.71	.17	.08	.11	1.07
Bf	20-30	5.8	7.28	16.08	.75	.30	.04	.08	1.17
II BC	30-38	5.7	8.92	7.62	.36	.20	.03	.09	.68
IICg	38+	6.0	--	--	--	--	--	--	--
Heron Fine Sandy Loam - Orthic Dark Gray Gleysolic									
Ah	0-6"	5.0	17.75	20.51	3.13	1.10	.26	.15	3.64
AC	6-8	5.8	8.08	31.44	1.84	.43	.08	.19	2.54
Cg	8-16	5.8	5.33	26.26	1.08	.16	.03	.13	1.40
C-II Cg	16-25	5.5	10.70	60.80	4.48	1.78	.07	.18	6.51
II Cg	25+	5.4	18.02	75.60	7.66	5.51	.18	.27	13.62
Bose Gravel Loamy Sand - Mini Humo-Ferric Podzolic									
LH	1-0"	3.4	9.2	4.8	1.69	.21	.28	.36	
Ae	0-1	3.8	3.0	9.2	.40	.04	.06	.44	
Bf_1	1-14	5.2	2.3	4.8	.92	.10	.06	.18	
Bf_2	14-24	5.2	0.9	3.1	.34	.05	.06	.12	
Bf_3	24-34	5.6	0.4	2.8	.17	.05	.04	.10	
Cg-IIc	34-38	5.2	0.9	5.6	.43	.11	.08	.23	
IIC	38+	5.6	4.5	--	2.08	1.25	.28	.35	

3. VARIABLE SITE FACTORS

3.1 Man

Construction of some roads has changed soil-water relationships, the ditching beside S. W. Marine Drive has upset drainage patterns and has caused deterioration of many trees: some are dead and there is some erosion. The upper side of the road has excess moisture due to the damning effect of the road and the lower side suffers drought. Past logging and the accompanying trail constuction, and power lines have also affected the area.

Many trails and roads have been made throughout the Lands and most are in fairly frequent use. A riding club in the vicinity of Musqueam Reserve uses these trails and have spread sawdust and built wooden bridges over small creeks as improvement measures. Other individuals, children and adults, use the area for hiking, camping, picnicking, motorcycling and other outdoor activities. The Boy Scouts have improved many trails, particularly north of Imperial Drive. Many people come to pick the abundant huckleberries.

One detrimental use of the forest is its use as an unofficial garbage dump. Roadway littering has clogged drainage ditches, making regular cleaning operations imperative. To prevent dumping gates have been installed (in 1971) on Imperial Drive which runs through the forested area. These are closed to the public from 4:30 P. M. to 7:30 A. M.

The theft problem has been generally restricted to trees and shrubs, particularly Christmas trees. Besides theft of whole trees and shrubs, there has been removal of soil and timber. Children have caused butt scars on some good trees while making "forts". This scarring has resulted in some decay and staining and sometimes trees are completely girdled. There have also been religious slogans painted on the pathside trees throughout the forest area.

Such thefts and damage are treated under Section 11 of the University Endowment Lands Act which states that "no person shall cut, damage, remove, the whole or part of any flower, plant, shrub or tree without said permission".

Firewood cutting is common, mainly along Imperial Drive and Spanish Banks. The Endowment Lands Administrator has encouraged cutting of dead wood, especially following the 1962 typhoon "Frieda", but he requests that people wishing to remove firewood should inform him first.

There has been willful damage to research plots and machinery, but the cost of control is high because of the nearness of residential areas and the large expanse of forest.

There appears to be widening conflict of interest between horse riders, hikers, and motor cyclists for the use of trails. Each feels that they have more rights in the area than the others. Furthermore there has been evidence of people living in the forest: a log cabin was built and subsequently pulled down near the junction of the power line and Imperial Road.

Some squatters were removed this summer by University officials. But, withat, man should be controlled rather than eliminated from the forest. The public assumes the Lands to be a large, public vacant lot, and a park image of conservation would aid greatly in reducing vandalism and misuse of the resource.

An organized nature trail has been arranged by the U. B. C. Forestry Undergraduate Society, in cooperation with the Canadian Forestry Association, for the Richmond School Board. The school children generally have a cleanup each time they travel the trail.

3.2 Wild animals

3.21 Mammals

Early records indicate that game included deer and bear which were plentiful and supplied food for the early settlers. Increased human encroachment has reduced the presence so that no large ungulates or bears are now found. The following list of species are those that have been known to inhabit the Endowment Lands in the last few years.

Red Squirrel (Tamiasciurus)
Chipmunks (Eutamias)
White footed deer mouse (Peromyscus maniculatus)
Raccoons (Procyon lotor)
Rats (Rattus)
Red fox (Vulpes fulva)
Rabbits ( )
Mole (Talpidae)
Shrew (Soricidae)

3.22 Birds

Besides a resident bird population, the Endowment Lands are on a major migratory route. The following are individuals or groups that have some direct environmental influence on the forest.

i) Red-necked pheasants (Phasianus colchicus)eat grains, grasses, legumes and weeds.
ii) Grouse ( ) Grouse damage to young seedlings could become important if there is extensive regeneration.
iii) Songbirds, which nest mainly in trees and shrubs, eat coniferous seeds and aid in the control of insects and include the following species: Robin (Turdus migratorius), Woodpecker ( ), Starling, (Sturnus vulgaris) and chickadee (Parus sp.)
iv) Herons (Great Blue) Almost 50% of the total population of the lower mainland nest on the Endowment Lands. They are a unique natural resource.
v) Other types of birds seen on the Lands include: Kingfisher, Crane, Crow, Osprey and Seagulls.

3.3 Domestic Animals

The Endowment Lands are extensively used by horse riders from the "flats" area on the Fraser River, where several large rental firms supply horses for riding. The trails themselves originated with early logging but have in many cases been improved for horse riding. Dogs and cats are also present.

3.4 Insects

The following are some insects found or recorded on the University Endowment Lands:

Insect	Damage
Balsam woolly (Adelges piceae)	Gouty swellings on the tips and nodes of twigs on grand firs; wood formation affected, resulting in reduced growth and possible death.
Sitka spruce weevil (Pissodes sitchensis)	Larvae feeding on terminals results in wilting and suppression of new leaders and deformation of the stem, often forking.
Western red cedar borer (Trachykele blondeli)	Larvae cut elliptical tunnels which are packed with powder boring and pellets. It is most prevalent but scattered on the beach side of Marine Drive.
Coastal dampwood termite (Zootermipsis augusticollis)	Has open tunnel systems in the wood with frass like small pellets.
Timber worm (Ergatus spiculatus)	This is found in fallen Douglas-fir adjacent to the beach below Place Vanier. They may cause salvage problems in the event of Douglas-fir windfalls.
Carpenter ants (Camponotus herculeanus)	Wood scavengers
Alder leaf beetle (Altica bimarginata) Alder sawfly (Tenthridinoidea) Fall webworm (Hyphantria sp) Green Spruce aphid (Meomyzaphis abietina)	All defoliators which reduce the shade effect of hardwood trees, thereby encouraging the establishment of more shade intolerant species.
Fir coneworm (Dioryetria abietella)	Causes loss of seed with consequent effect on natural regeneration. The fir coneworm adult causes irregular cone mining with frass extrusions.

3.5 Fungi

The following diseases and rots are known to be present on the Endowment Lands:

Disease	Host	Damage
Poria root rot (Poria weirii)	DF	Weakens stems so that the trees are more liable to windfall.
Fomes annosus	WH	Causes rot damage in standing timber but also aids in breaking down rotten wood
Western gall rust (Peridermium harknessii)	LP	Common on pines (Pinus contorta), sometimes causing death
Red heart rot (Haematostereum sanguinolentum)	WH	Enters the stem through wounds, causing the wood to become stained.
Cedar pocket rot (Polyporous sericeomollis)	WRC	Causes butt and trunk rot on dead and fallen trees
Sap rot (Polyporus versicolor)		
Cubical trunk rot (Polyporous sulphureus)	A	This was found in the larger alder windfalls around Spanish Banks
Armillarea mellea		Is part of the natural process of wood decay and poses no threat to healthy trees
Red ring rot (Fomes pini)	DF, WRC WH	Destroys heartwood and sapwood, killing and staining trees

3.6 Destructive Plants

The Dwarf mistletoe (Arceuthobium campylopodum) is a serious parasite on western hemlock. This is fairly extensive throughout the area, generally not advancing into most stems but remaining on the outer branches. It can cause severe reduction in growth. Although presently confined to older hemlock it could spread to young age groups and lead to secondary fungal infection.

3.7 Trees, shrubs, herbs, fern and mosses

The following is a list of the most frequent species occurring on the Endowment Lands forest.

Trees:

Douglas-fir	Pseudotsuga menziesii
Shore Pine	Pinus contorta var contorta
Sitka spruce	Picea sitchensis
Western Hemlock	Tsuga heterophylla

~~Western~~ Mountain hemlock	~~Tsuga heterophylla~~ *Tsuga mertensiana*
Grand fir	*Abies grandis*
Western red cedar	*Thuja plicata*
Cottonwood	*Populus trichocarpa*
Birch	*Betula papyrifera*
Red alder	*Alnus rubra*
Bitter cherry	*Prunus emarginata*
Broadleaf maple	*Acer macrophyllum*
Vine maple	*Salix lasiandra*
Cascara	*Rhamnus purchiana*
Shrubs	
Devil's club	*Ophopanax horridus*
Red elder berry	*Sambucus racemosa*
Oregon grape	*Mahonia nervosa*
Labrador tea	*Ledum groenlandicum*
Salal	*Gaultheria shallon*
Thimbleberry	*Rubus parvifloris*
Salmonberry	*Rubus spectabilis*
Red huckleberry	*Vaccinium parvifolium*
Broom (non-native)	*Cytisus scoparius*
Trailing blackberry	*Rubus ursinus*
Bunchberry	*Cornus canadensis*
Western trillium	*Trillium ovatum*
Three leafed mitrewort	*Tiarella trifoliata*
Black raspberry	*Rubus leucodermis*
Swamp gooseberry	*Ribes lacustre*
Fireweed	*Epilobium angustifolium*

Ferns and Fern-allies

Horsetail	Equisetum arvense
Lady fern	Athyrium félix-femina
Deer fern	Blechnum spicant
Sword fern	Polystichum munitum
Pteridium Bracken	Pteridium aquilinium

Others

Mistletoe	Accerthobium campylopodium
Club moss	Lycopodium clavatum
Brome grass	Bromus vulgaris
Merrill's bluegrass	Poa ampla
Skunk cabbage	Lysichitum americanum
Sedge	Carex spp.
Wild lily of the valley	Mainanthemum dilatatum

Mosses

Plageothecium undulatum

Sphagnum spp.

Hylocomium splendens

Mnium insigne

4. Ecology

4.1 Character of Vegetation Types

The University Endowment Lands can be classified as being in the Coastal Douglas-fir zone sub-zone b (the wetter subzone) (Krajina, 1965, 1969).

Conifer dominant-types range in age from 60 - 90 years. Age is dependent on when the area was previously logged and the length of time between logging and regeneration of conifer seedlings. Some of the older conifers were in the seedling or sapling stage when surrounding timber was removed. These trees, which were open grown until second growth was high enough to close the stand canopy, have much dead branching on the lower bole.

Deciduous dominant types (consisting mainly of red alder) range in age from 20 to 50 years. Most were naturally established in areas cleared within the last 40 years.

In some parts deciduous species, such as red alder and wild cherry, are at or near the end of their pathological rotations (generally about 40 to 50 years) and are approaching decadence.

Broad leaf maple, vine maple and dogwood are well established over large portions of the Endowment Lands, especially in open, coniferous-dominant stands, while cascara and black cottonwood are established along roadways.

The following excepts from Krajina's "Biogeo climatic Zones of B. C." well describe the University Endowment Lands.

"The Coastal Douglas-Fir Zone occurs on the leeward side of Vancouver Island (south-east part of the Island, 0-1500 ft.), on the islands in the Strait of Georgia and in the lowest altitudes (0-300 (-500) ft.) on the mainland of the Georgia Strait and in the Fraser River Delta." The Endowment Lands are from 0-300 feet in elevation and so fit well into the limits. "In the wetter part of the zone (precipitation = 30-60 inches) (The Endowment Lands' precipitation is 45-50 inches) the concretionary reddish brown podzolic soils are often degraded, less reddish, more podzolized, and thus represented even by weak podzols, the A_2 layer of which is very thin. The climatic climax phytocoenosis is Pseudotsuga menziesii -Gautheria shallon association.

The most productive trees of the zone are: Pseudotsuga menziesii var. menziesii, growing up to 265 feet in height and ten feet in diameter attaining more than 1,000 years of age, Thuja plicata, Abies grandis and Tsuga heterophylla (this tree relatively much less than in the coastal western hemlock zone). Sitka spruce (Picea sitchensis) is almost lacking and amabilis fir (Abies amabilis) completely so. On the driest habitats Arbutus menziesii is very common." Krajina describes the subzone as "the wetter (Madrono-Douglas-fir) subzone (CDF_b) ..... characterized by annual total precipitation between 102 - 152 cm (40-60") and by the following trees: Pseudotsuga menziesii var. menziesii, Thuja plicata, Abies grandis, Picea sitchensis, Pinus monticola, Pinus contorta and Arbutus mensiesii, Prunus emarginata, Populus balsamifera
Alnus rubra, Acer macrophyllum and Acer circinatum are frequent. Tsuga heterophylla forms climax species in subhygric habitats (with temporary seepage). The absence of Quercus garryana in this subzone is significant."

Six vegetation types are now recognized on the Endowment Lands and are listed below with their predominant plant species:

TYPE 1. Rubus ursinus - fern association

Trees: Abies grandis
Thuja plicata
Pseudotsuga menziesii
Tsuga heterophylla

Understorey: Mnium insigne
Athyrium felix-femina
Sambucus pubens
Rubus parvifolium
R. ursinus
R. spectabilis
Polystichum munitum
Urtica lyallii
Tellima grandiflora
Pteridium aquilinum
Bromus pacificus
Luzula parviflorus

TYPE 11. Salal association

Trees; Tsuga heterophylla
Pseudotsuga menziesii
Alnus rubra
Prunus emarginata
Salix lasiandra
Picea sitchensis

Understorey: Gaultheria shallon
Lysicitum americanum
Athyrium felix-feminan
Vaccinium parvifolium
Pteridium aquilinum
Maianthemum canadense
Tiarella trifoliata
Polypodium spp.
Epilobium angustifolium
Leperus spp.
Anaphalis margaritaceae
Hapana commonus
Horcus mallis
Dactilis lomerata
Trifolium lapense
Plantago lasolata
Poa ampla
Rosa gymnocarpa
Cornus canadensis
Trientalis latifolia
Mahonia nervosa

TYPE 111. Moss-fern association

Trees: Psudotsuga menziesii
Alnus rubra
Tsuga heterophylla
Prunus emarginata

Understorey: Dierenella rufestens
Juncus ensifolius
J. effusus
J. altinus
Trientalis latifolia
Pteridium aquilinum
Rubus spectabilis
Blechnum spicant
Muium glabbereus
Plageothecium undulatum
Lux aquifolius
Gaultheria shallon
Ilex aquifolius

TYPE lV: Skunk cabbage association

Trees: Acer macrophyllum
Alnus rubra
Abies grandis

Understorey: Ranunculus repens
Pesaites speciosus
Convolvulus sepium
Tellima grandiflora
Lystichium americanum
Conolius sepiuum
Pesasites speciosus
Montia sibirica
Epilobium watsonii
Balbaria vulgaris
Esmaronia sp.
Muium insigne
Eurydium stocksii
Carex spp.
Ribes lacustre
Athyrium felix femina
Aqusetum arvense
Equisetum arvense
E. teleatea
E. maxima
Stellaria media

TYPE V: Ross-Salal association

Trees: Acer macrophyllum
Malus devistifolia
Taxus brevifolia
Pseudotsuga menziesii
Psuga heterophylla
Acer circinatum

Understorey: Impatiens sp.
Celechonia hederaceae
Mahonia nervosa
Glechonia hederaceae
Ranunculus repens
Tolmea menziesii
Mnium glabbereus
Luzula parviflora
Urtica lyallii
Epilobium augustifolium
Cadamine spp.
Diopterus austriaca
Atricum undulatum

TYPE V1: Sphagnum association

Trees: Sorbus aucuparia
Malus diversifolia
Salix lasiandra
Populus tremuloides
Pinus contorta
Tsuga heterophylla
Betula papyrifera
Rhamnus purshiana

Understorey: Bromus sitchensis
Calamagrostus sp.
Ledium groenlandium
Vaccinium myrtilloides
Sphagnum recourom
Oxycoccus macrocarpus
Rubus chamaemorus
Rubus parviflorus
Convolvus sepium
Bromus sitchesia
Spirea douglasii
Cegrostus spp.
Juncus effusus
Gaultheria shallon
Luzula sp.
Pteridum aquilinium
Eurychium oreganum
Plageothecium undulatum
Hylocomium splendens

4.2 Relationship of these vegeation types to site conditions

Type 1 Rubus ursinus - Fern Association

This type is characterized by the edaphic climax species of ferns and Rubus ursinus (Bearberry). Drainage has been affected by construction work near the Residence of Place Vanier and near Totem Park which resulted in dieback problems with Thuja plicata (Western red cedar) and Abies

grandis (grand fir) due to the sudden lowering of the water table.

Red cedar and grand fir otherwise grow well. The site is mesic, acidic and relatively rich as evidenced by the nitrate indicator plants, Sambucus pubens, Tellima grandiflora, Tiarella trifoliata, and Rubus spectabilis. The site is too rich for hemlock which typically grows only on rotting wood in such conditions.

Type 11

Gaultheria shallon is fairly abundant in this type, probably as a result of a build up of thick layers of acidic organic matter from decayed wood. At first glance the type would appear to be a salal association, but the presence of sitka spruce (Picea sitchensis), Salix lasiandra, Prunus emarginata, Tiarella trifoliata, and Lysichitum americanum indicate that the site is too moist and too rich to be a salal site. The absence of Rubus spectabilis is due in large part to the acidic organic layer. Disturbed drainage patterns have resulted in lower water levels and the loss of most of the Lysichitum americanum which was abundant 20 years ago. Today skunk cabbage is found only in scattered wet patches. Thus the association is a degraded Lysichitum association, now evolving towards a sword fern (Polystichum munitum) or a Maidenhair fern association (Athyrium felix-femina).

The patchy occurrence of red alder (Alnus rubra), a nitrogen fixer, indicates a fairly high level of nitrogen in the soil, while Picea sitchensis and Mienthemum canadense indicate considerable amounts of Mg^{++}.

Type 111 Moss - fern association

This distinct edaphic climax ecotype is characterized by a clayey impermeable soil resulting in very wet surface layers. Typical species are Juncus ensifolius and Dierenella rufestens which occur on clay soils with little humus. This is a good Douglas-fir site of around Site Index 140, indicated by the presence of Rubus spectabilis and Tridentalis latifolia which are species preferring mineral soils in intermediate sites. Alder, which had an early start over the Douglas-fir after fire or logging, has taken over the site and has generally suppressed the fir.

Type 1V Skunk cabbage association

Water again plays a major role in this type. Water remains on the site because of the clay layer underlying the surface. Drainage has altered the moisture conditions and the original covering of skunk cabbage is much reduced. Ranunculus repens and Equisetum spp. which require a year-round water supply are common. The richness of the site is indicated by a moss Eurydium stocksii. Red alder is very common.

Type V Moss-Salal assocation

This is a transition between a salal type lower on the slopes and moss type higher up. The occurrence of the usually rare Ribes lacustre on the banks

of the small streams is significant: this is the only type in which the species occurs. Other fairly rare species are the Indian plum (Esmaronia spp.) which is apparently found only in this area in the whole Fraser Valley, Taxus brevifolia and Acer pseudoplantanus. This site is fertile for Douglas-fir, which at 50 years old indicates a Site Index of 150.

Type V1 Sphagnum association

The ecology of this site can be traced to when a lake covered the area. Evidence for this is the presence of numerous bog-type communities with Kalmia spp., Ledium spp., Vaccinium spp. and three Sphagnum spp. The soil is covered with a deep layer of humus. The occurrence of Spirea douglasii indicates acidic conditionswith pH between 5.0 and 5.5. This is the only area which is stocked with Pinus contorta. There may have been introgressive hybridization of mountain and western hemlock (T.heterophylla x T. mertensiana). Conditions for tree growth are very poor because of the excess moisture and low Ph.

4.3 Character of some individual tree species

1. Grand fir - Abies grandis

Grand fir prefers the drier sub-zones of the Coastal Douglas-fir and Western Hemlock zone, which has rainfall ranging from 50 to 90 inches. per year. The xeric sites which the species commonly occupies are usually nutrient rich, especially in calcium which it retains in its needles. The University Endowment Lands are not well suited to the species: much of it is dying from lack of seepage water and attack by balsam woolly aphid.

2. Sitka spruce - Picea sitchensis

Sitka spruce needs a humid mesothermal marine climate. It is demanding both of light and of soil nutrients: besides calcium and magnesium it needs soils rich in nitrates, though it is able to use ammonium compounds. Because slash-burning may release large supplies of these nutrients, sitka spruce regenerates well on burned sites, providing the soil stays moist. The species can grow on glacial till if there is a compacted layer to impede rapid water percolation. Such sites are indicated by the presence of Polystichum munitum and Belchnum spicant. As the soil becomes leached, sitka spruce is replaced by other species.

3. Western red cedar - Thuja plicata

Western red cedar is found mostly on moist soils or in fog belts but also on protected well drained sites. It usually occurs in uneven-aged stands because its ability to layer and to tolerate shade once established makes it a climax species. The species prefers deep alluvial silts and clay loams with high calcium, magnesium and nitrates, but it tolerates poorly-drained soils better than Douglas-fir and Western hemlock. It is, however, easily damaged by frost. Cedar's preference for slightly acidic soils makes it common on the University Endowment Lands, though it never reaches its optimum growth or development.

4. Shore pine - Pinus contorta

Shore pine is shade-intolerant, frost resistant and is easily established. Its cones remain closed for many years so that large amounts of seed accumulate: in the event of fire the strong heat opens the cones. Sites pioneered by this species often become invaded by shade tolerant species later.

5. Douglas-fir - Pseudotsuga mensiesii

Pure Douglas-fir on the Pacific Coast is commonly considered as a 'sub-climax' type: it appears in even-aged stands after forest removal by logging, fire or insects. Older stands become associated with shade tolerant cedar and hemlock. In very zeric and mesic conditions, Douglas-fir is shade requiring, but becomes more shade tolerant in subzeric and submeric hygrotypes. It grows best on soils rich in calcium, magnesium and nitrates. Nitrification occurs mainly on soils of moderate acidity (pH greater than 5.5) and moderate amounts of calcium: moder humus types rather than mor, (in which nitrification is restricted) are preferred.

6. Western hemlock - Tsuga heterophylla

In the coastal Douglas-fir zone, western hemlock develops as an edaphic climax species. It has low frost resistance, requiring a minimum of 120 frost-free days, a January mean temerpature of -4 to +5 degrees C. and not more than 3 months with average temperatures below freezing and will not tolerate frozen ground. The absolute minimum temperature tolerated is -25 degrees C. The species needs at least 65" rainfall a year. Its tolerance of low nutrient levels, enables it to thrive on mor humus, utilizing the ammonium or amino acid forms of nitrogen. On rich soils growth is even retarded. In such conditions hemlock prefers nitrogren-rich decaying stumps or logs as a medium for regeneration rather than the soil. Hemlock has a shallow root system, even in deep soils, and thrives in acidic soils with strong podzolization.

7. Red alder - Alnus rubra

Red alder is common throughout the University Endowment Lands where it excludes more valuable coniferous trees. It prefers moist soils and regenerates readily on disturbed mineral soils, usually after a severe fire or logging. In symbiosis with the bacteria Actinomycetes alni it is estimated that red alder has the capacity to fix 400 pounds of soil nitrogen per fully-stocked acre per year. This ability may make it a more valuable species than realized for its role in increasing conifer growth capacity. However, it regenerates so easily that once established it is very difficult to eliminate. The average site index on the University Endowment Land ranges from 70 to 110 feet at 50 years.

4.4 Potential response of vegetation and site to treatment

Indications are that the forest cover of the Endowment Lands in the pre-logging era was exclusively coniferous. No silvicultural treatments with

the exception of slashburning and establishment of a few plantations have been carried out in the past. In 1934 about 54 acres of hemlock and Douglas-fir plantations were established on the campus in Nitobe Gardens, Totem Park and Thunderbird Stadium areas. Fragments of these plantations still exist: they are 35 years old, healthy, but in need of thinning.

Soil disturbance from skid type logging, and the presence of surface water, has led to much of the Rubus and Alnus establishment, especially where areas were logged clear even of seed trees. The occurrence of Douglas-fir probably results from smaller clearcut areas which were supplied with plentiful seed.

Responses to treatment must be considered in relation to red alder, a species which has been described variously as a pioneer with a major role in soil development, a nurse for emerging conifers, a commercial tree and a weed of no value: it presently covers about 55 % of the Endowment Lands forest.

Red alder is capable of suppressing Douglas-fir almost to its exclusion when the two species are established togehter. The ability of alder to dominate early stages of secondary succession appears to depend on its ease of establishment rather than adaption to specific sites. Density of alder regeneration is related to the degree of scarification and relative duration of summer drought. Disturbances that favour dense stands have been almost invariably logging roads, landings, and other forms of localized deep scarification. The failure of red alder to colonize non-scarified soil has important implications for the establishment of Douglas-fir. Seldom is scarification complete on fresh logging operations, and the size of unscarified spots determines the area in which Douglas-fir can succeed with the influence of alder restricted to side shade.

If conditions are not right for alder, establishment of Douglas-fir may occur in a sufficient number of small openings to develop a complete stand without serious suppression. Under these circumstances, occurrence of alder may increase soil nitrogen to the advantage of the conifers. On the wettest sites, alder may develop even on unscarified soil, eventually dominating coniferous trees.

4.5 Possible success from introduced species

Bearing in mind the bioclimatic characteristics of the Endowment Lands, introduced species have to tolerate the following factors:

i. precipitation of between 26 and 40 inches, with occasional minimums down to 23 inches,
ii. humid mesothermal climate with mild winters, and
iii. soils only weakly podzolized and a predomiance of glacial till.

4.51 Introductions from outside North America.

The exotic species growing on the Endowment Lands and campus, particularly near the Ponderosa cafeteria, give a rough indication of relative performance.

a) Larix occidentalis is growing very badly, perhaps because of the distribution of precipitation and deficiency of soil calcium.

b) Red oak (Quercus rubra) which usually requires a much drier site and a lot of calcium, are heavily branched and not very productive.

c) Monkey puzzle (Auracaria auracaria) planted mainly as an ornamental, shows poor growth.

d) Sorbus aucuparia, introduced from Europe, not only grows vigorously, but is regenerating freely all overthe Endowment Lands.

4.52 Introductions from within North America

a) Port Oxford cedar (Chamaecyparis lawsoniana) appears to be tolerant of the local climate and does not require specific soil types: its performance on poorly drained soils such as the Neron Series is known to be satisfactory. Unfortunately its growth and yield tends to be lower than many native species. Typical diameter growth is 11 inches at 100 years, and in pure stands height growth has been about 1.5 feet per year.

b) Red spruce (Picea rubens) is not ideally suited to the local climate, having a shorter natural growing season, but it appears to grow well on poorly drained soils, such as the Summer Series which has a suitable pH and is podzolic soil. The species is shade tolerant and shows relatively good growth and yield in pure plantations.

c) Loblolly pine (Pinus taeda) tends to be less demanding of climate than many other pines. In the southern U. S. coastal plains the vigor of this species is closely related to soil moisture so it would probably do well on the poorly-drained Endowment Land soils. Growth and yield, though hardly matching its performance in the southern States, may be superior to some native species.

d) Pin oak (Quercus palustris) prefers wet sites and has climatic demands ideally suited to the Endowment Lands. It grows well on heavy poorly-drained soils.

5. Artificial structures

The University Endowment Lands, being situated so near Vancouver and the University of British Columbia Campus have many buildings, roads and other facilities. Mayor buildings are mentioned in sections 1.13 (Ownership), 1.4 (Land Use) and 1.51 (General History of the University Endowment Lands).

5.1. Major Roads and Trails

1) S. W. Marine Drive

About 11,500 feet of four-lane paved road stretches from the junction of 41st Avenue and Camosun Street to the junction with Imperial Drive. S. W.

Marine Drive occupies a 200-foot right-of-way.

ll) N. W. Marine Drive

Approximately 30,500 feet of Marine Drive lie on the Endowment Lands. It is a two lane paved road stretching from the junction of S. W. Marine Drive with Imperial Drive to the junction with Blanca Street. N. W. Marine Drive occupies a 75-foot right-of-way.

lll) Chancellor Boulevard

Roughly 12,800 feet of this four lane, paved road lie within the bounds of the Endowment Lands stretching from the junction of 8th Avenue and Blanca street to the junction with N. W. Marine Drive. Chancellor Boulevard occupies a 150-foot right-of-way.

lV University Boulevard

Approximately 11,400 feet of four lane paved, divided road stretches from the junction of 10th Avenue and Blanca Street to the termination at East Mall on the campus, occupying a 150-feet right-of-way.

V 16th Avenue

The section of 16th Avenue on the Endowment Lands is roughly 13,100 feet in length and is a two lane gravel roadway stretching from the junction of 16th Avenue and Blance Street to S. W. Marine Drive. Sixteenth Avenue occupies a 200-foot right-of-way.

Vl Imperial Drive

About 13,00 feet of two lane gravel road lie within the bounds of the Endowment Lands stretching from the junction of 16th Avenue and Discovery Street to S. W. Marine Drive. Imperial Drive occupies a 75-foot right-of-way.

Vll Westbrook Road

This road, lying entirely within the boundaries of the Endowment Lands, is a two-lane gravel roadway that runs from 16th Avenue to the research area located in the vicinity of the Thunderbird Stadium.

Vlll King Edward Avenue

On the Endowment Lands, King Edward Avenue consists of roughly 5,900 feet of two-lane paved road from the junction of King Edward Avenue and Crown Street to Imperial Drive and on to the junction with 29th Avenue and Camosun Street. It occupies a 100-foot right-of-way.

There exists a 20 foot wide trail extending from Chancellor Boulevard to N. W. Marine Drive. It is approximately 350 feet in length.

5.2 Rights-of-way and Utility Lines

There exists an old 100 foot right-of-way from the junction of 41st Avenue with Camosun Street and S. W. Marine Drive to University Boulevard. Its total length is 15,400 feet. A power line, 14,200 feet in length and occupying a right-of-way of 100 feet runs from the junction of King Edward Avenue and Crown Street to 16th Avenue and Main Mall. A second power line occupying a 75 foot right-of-way extends some 4,800 feet from the junction of 16th Avenue and Blanca Street to the junction of Westbrook and Agronomy Roads.

6. Silvicultural Assessment

Logging has eliminated all of the old-growth Douglas-fir, Western hemlock and western red cedar. The area south of University Boulevard and in the Northeast corner of the Endowment Lands was selectively logged with no slash-burning and has developed into a mixture of second-growth conifer and hardwood species, of which alder predominates. The almost pure stands of Douglas-fir near 16th Avenue have probably resulted from plantations established between 1932 and 1944 and which have been largely cleared for development.

Even-aged alder and choke cherry (Prunus emarginata) stands, through which Chancellor Boulevard passes in the vicinity of University Hill Elementary School, were likely the result of heavy slash-burning after logging.

Besides past treatment, site factors (soil and drainage) also have some effect on species composition. The Douglas-fir-cedar-hemlock type near the west 16th Avenue extension south appears to be growing vigorously on a comparatively high quality site. This area has adequate drainage as is characteristic of Bose soil types. Cedar and hemlock become frequent on the Heron soils.

The Douglas-fir type north of the golf-course is on a relatively well-drained, high quality site (Bose and Sunshine soils). This area may have been regenerated artificially or planted.

The hemlock-cedar type occupying most of the low-lying area south of Imperial Drive probably results from the poor soil drainage which is characteristic of the Heron Series and the selective logging which allowed establishment of the shade-tolerant cedar and hemlock, which was initially present in the understorey.

In the well-drained sites south of 16th Avenue the soils were probably too dry in the summer to sustain stands of hemlock and cedar as an understorey and when the area was logged, alder became the predominant species. There may also have been a reduced source of conifer seed because of a more severe cutting in adjacent areas.

The organic soils on the northeast portion of the Endowment Lands, presently occupied by hemlock and stunted shore pine, is gradually drying as a result of drainage activities in the area.

Some points from a 1958 management appraisal were:

a. 60 to 80-year rotations are feasible for Douglas-fir

b. Douglas fir could be thinned for poles, pilings and pulp; cedar utilized for poles and hemlock for pulp. Alder and maple may gain acceptance in the future but at present they are not merchantable. Cottonwood is sold as pulp or veneer logs. There is also a good market for Christmas trees but the best prospects are for conifer poles and pilings.

c. The factor limiting efficient management is the small size of the area.

d. Research and recreation should be emphasized in management prescriptions.

e. Commercial and residential interests should not be allowed to exploit the area.

6.2 Quantitative assessment

6.21 Mapping methods and mensuration

Mapping and forest typing was based on photo mosaics (photographed March 18, 1970). The area was subdivided into three large blocks for management purposes and into 15 forest types based on vegetation and other site factors. Details of how stand parameters were appraised are given below.

a. Volume/acre was estimated using a prism cruise and B. C. Forest Service V-BAR tables.

b. Stand types were delineated using the photo mosaics in conjunction with a ground survey which provided details on aspect, drainage, minor vegetation, forest conditions and artificial structures. The following sympols are used to denote stand composition based on representative % volume.

$$F_7\ C_3$$

i.e. Douglas-fir 70 %; cedar (western red) 30 %

The species code is as follows:

Symbol	Species	Botanical Name
F	Douglas-fir	Pseudotsuga menziesii
H	Western hemlock	Tsuga heterophylla
C	Western red cedar	Thuja plicata
S	Sitka spruce	Picea sitchensis
A	Red alder	Ahus rubra
Mb	Broadleaf maple	Acer Macrophyllum
Ch	Bitter cherry (choke)	Prunus emarginata
MH	Mountain hemlock	Tsuga mertensiana
LP	Lodgepole pine	Pinus contorta var contorta

c. Average d.b.h. was assessed using diameter tape.

d. Average height was measured with Suunto clinometers and paced distances. The average was based on height of several tress of the major species (under B. C. Forest Service definition the major species is that species which constitutes over 20 % of the stand volume) from dominants and codominants.

e. Average age was based on 18-inch increment borings on a single tree of each species at several points in a given type.

f. Site index was obtained by measuring the heights of trees assessed for age in conjunction with site index curves (Eis, S. 1962. Statistical analysis of several methods for estimation of forest habitats and tree growth near Vancouver, B. C., Univ. of B. C. Fac. of For. For. Bull. No. 4).

g. Aspect and slope were described using topographic maps and a Suunto clinometer for slope measurements in the field.

6.22 Summary of assessment

Table I and II summarize the species distribution in each type, topographic features, inventory data, volumes per acre and mean annual increments. Individual types are described below in terms of a simplified version of Krajina's classification of soils and vegetation , which corresponded closely with ground observation.

Simplified Krajina classification (different symbols are used):

A - Eurychium oreganum, Mahonia nervosa, Galtheria shallon and Pseudotsuga menziesii, with acid reddish-brown soils.

B - Erychium oreganum, Hylocomium spendens, Pseudotsuga menziesii and Tsuga heterophylla, with slightly gleyed podzol soils.

C - Eurychium oreganum, Rhytiodephus triquetus, Mnium insigne, Polystichum munitum, Tiarella trifoliata, Pseudotsuga mensiesii, Abies grandis and Thuja plicata, with gleyed concretionary reddish-brown wood soils.

D - Eurychium oreganum, Mahonia, Pseudotsuga mensiesii and Tsuga heterophylla, with well-drained podzols.

E - Gaultheria shallon, Vaccinium alaskanensis, Pseudotsuga menziesii, Tsuga heterophylla, Pleurozium schrebnei, Rhytiopsides robusta and Mahonia, with shallow podzolic soils.

Forest Type I:

Classification: A

Comments: The soils are loose podzols in which water is able to permeate easily to the compacted layer, at which it either moves laterally

or very slowly downwards. During November to May the soil becomes saturated, resulting in poor aeration and occational flooding.

Forest Type 2:

Classification: B

Comments: Gleization occurs in depressions where surface water accumulates.

Forest Type 3:

Classification: C

Comments: Drainage is poor on the gentle slopes so the soils remain moist throughout the year.

Forest Type 4:

Classification: D

Forest Type 5:

Classification: B

Forest Type 6:

Classification: D

Comments: Ground vegetation slightly altered by human actions.

Forest Type 7:

Classification: E

Forest Type 8:

Classification: -

Comments: The site has extremely poor drainage, with peat accumulation and patches of podzolic soils on which hemlock dominates. The bog is association with Sphagnum moss and Pinus contorta.

Forest Type 9:

Classification: B

Comments: Soil type varies. The north-eastern portion is relatively flat with numerous depressions and with more strongly gleyed podzols than the lower portion in the south-west which is steeper and better drained.

Forest Type 10:

Classification: A

Forest Type 11:

Classification: B

Comments: Drainage is poor because of the flatness of the land.

Forest Type 12:

Classification: Northern half - C
Southern half - B

Comments: The alder has invaded this site after logging.

Forest Type 13:

Classification: C

Comments: The type covers only the ravine east of the northern end of Acadia Road.

Forest Type 14:

Clasification: C

Forest Type 15:

Classificati on: B

JVT:dm

TABLE I

TREE SPECIES COMPOSITION AND HEALTH, AREA AND TOPOGRAPHIC FEATURES

Type number	Species* Composition	Age (yrs.)	Area (acres)	Health	Aspect	Slope	Drainage
1	$H_4F_4C_2$	55	260	good	S	10	normal
2	$H_5F_3C_1A_1$	75	180	good (poor hem.)	S	2	normal
3	$A_5F_2H_2C_1$	50	120	average	S	4	normal
4	$H_5F_3C_1A_1$	60	160	average	S	4	normal
5	$H_4C_3A_2F_1$	70	10	good	N	10	normal
6	A_{10}	40	15	-	S	10	normal
7	$F_5H_2C_1A_1Ch_1$	40	30	-	S	10	normal
8	Pl_6H_4	35	35	fair	W	2	poor
9	A_{10}	35	280	good	SE	10	poor in places
10	$A_5Mb_2F_2H_1$	45	105	good	SE	6	normal
11	$C_4H_4A_1Mb_1$	60	10	poor	N	15	normal
12	A_{10}	20	200	good	N	6	poor in places
13	$A_4Mb_3C_2H_1$	65	20	average	N	-	good
14	A_{10}	35	60	good	N	20	good
15	$Ag(FH)_1$	20	50	good	N	8	normal
16	H_8C_2	60	20	-	-	-	

* see text for symbols and interpretation.

TABLE II

INVENTORY DATA, VOLUME AND INCREMENT

Type number	Av. d.b.h. (in.)	Av. height (ft.)	Av. site index (ft. at 100 yrs.)	vol./acre (cu.ft.)	vol./type (cu.ft.)	M.A.I/ac. (cu. ft.)
1	18	90	F-130 H-85	5,500	1,450,000	100
2	24	130	F-140 H-90	9,000	1,620,000	120
3	17	80	F-135	4,500	540,000	90
4	15	80	H-90	4,500	720,000	75
5	26	100	H-125	6,000	60,000	86
6	12	50	-	4,000	60,000	100
7	10	50	F-120	3,000	90,000	75
8	9	35	70	4,000	140,000	114
9	8-10	45	-	2,000	560,000	57
10	15	50	-	2,500	262,000	56
11	-	-	-	4,000	40,000	67
12	6	30	-	1,500	300,000	75
13	-	-	C-120	3,000	60,000	46
14	16	80	C-120	4,500	270,000	129
15	-	-	-	2,000	100,000	100
16	-	-	-	5,000	100,000	83

with a gravel-sandstone substrate. Only limitation is low flow period depth and cover for larger cutthroats which remain in the stream for 1-3 years until a size of 4-10" is realized. Cutthroat of the year were moderately dense in this reach but yearlings were few and restricted to the few well covered pockets and bank undercuts greater than 1' deep. Channel width in this section ranged from about 3-15' and averaged about 6-8'. Discharge was about 1 cfs and likely ranges from about 0.1 or intermittent to perhaps 50 cfs.

This reach is contained in a small draw that has been preserved in a semi-natural state. Vegetation consists of spaced mature conifers and a rather sparse understory community likely because of trampling or control.

A number of small springs enter this reach and for a distance of about 200' below Marine Drive, a reddish precipitate (an oxide of iron and iron bacteria) was evident on the substrate. Cutthroats avoided this section and benthic invertebrates were not present.

The lower 2500' feet of Tin Can Creek become progressively less suitable for trout and salmon as gradient lessens and fines dominate the substrate. A brook lamprey was found in this reach and cutthroat fry were scattered and sparse in the upper end. Only a small upper portion of this reach was viewed.

A significant aspect of the accessible reaches of Tin Can Creek was the absence of coho. Undoubtedly, coho once utilized the system and it is still very good coho habitat.

(b) Above Marine Drive (9000')

Sections totalling about 1000' were examined and it appears that this portion including the section of the northeast tributary below Imperial Road can be described as a single reach typified by low gradient, small pools and riffles, gravel-stone substrate, excellent cover (both in-stream and overhead), and an average channel width of about 5'. Excellent capability for migratory cutthroat but becoming gradually more marginal for coho as size decreases upstream. No fish were observed.

2. Golf Course Creek (9140')

This system is unaccessible to anadromous fish and has low overall capability due to size and gradient-substrate limitations. Most of the eastern fork below Marine Drive is in a culvert under Shaughnessy Golf Course and the western tributary is very poorly organized flowing over thick detritus and forest debris in a poorly defined channel for all of its observed length.

This branch probably becomes intermittent or dry by early July in most years. The eastern tributary above Marine Drive could support a few cutthroats. None were seen here or anywhere in the system. About 50% of the total drainage was observed.

Drainage tends to be poor in portions of this system.

It was not established whether this system is connected as indicated on Urhahn's hydrology map.

3. Booming Grounds Creek (5490')

Inaccessible except for 200' at the beach where a few chum salmon could be accommodated. There is a possibility that coho or cutthroat could ascend the riffle to Marine Drive culvert but a 4' drop is present here and the beach - culvert interval is too steep for spawning and only has very minor rearing capability for rainbow - steelhead. Above Marine Drive, gradient lessens and some minor cutthroat capability is present above the Marine Drive ditch. No fish were observed.

Discussion and Recommendations

Examination of the three stream systems was, of necessity, cursory but we were satisfied that the evaluation in terms of present fish capability is valid.

In terms of present fish utilization, comprehensive protection is only justified for Tin Can Creek. This is an excellent stream and offers a good rangeof socio-biological management options including introduction of coho and chum salmon (it is assumed that chums are absent), standard channel and substrate improvements to raise productive capacity for these fishes, upstream storage to augment low flows, trout - salmon ecology in typical small coastal streams, educational programmes, and all sorts of experimental and basic research possibilities.

The other streams, in almost any other context relative to urban development, would probably be written off to the inevitable consequences of development. In this case, however, it is suggested that appropriate sections be retained in natural or semi-natural states and consideration be given to such things as small impoundments for kids' fishing with the introduction of cutthroats, wood duck production, beavers and so on. In our view, this would be the best use of these water courses in this context. Given certain constraints mainly relative to degree of leave zone and drainage of

road surfaces, these systems can be maintained and improved and still accommodate considerable development. It should be the objective of the province to retain this kind of option for any water course under provincial jurisdiction in this context that has any potential for fish, wildlife, or aesthetics.

e.c.o.

environmental crisis operation

Feb. 1 1972

A FACT SHEET ON THE UNIVERSITY ENDOWMENT LANDS

This paper is based largely on a meeting held on January 13, 1972 sponsored by ECO in which Mr. R.P. Murdoch, manager of the University Endowment Lands Administration Office addressed an open group at U.B.C. It attempts to summarize all that we know about the University Endowment Lands (hereafter called the U.E.L.) and present some of the major problems concerning the lands.

HISTORY

The U.E.L. were first set aside by the government in 1923. The official pronouncement of the lands is the University Endowment Lands Act (Provincial) of 1925. The original concept that the lands be used as a source of monetary endowment for the University is now outdated. Estimates in 1956 were that the lands, if fully developed, would bring in revenues in the order of $2 million per year. Since the U.B.C. budget is in the order of $100 million per year this is not substantial.

CONTROL OF THE LANDS

The lands cover about 3500 acres of the Point Grey peninsula.

a) 1000 acres are designated as campus lands and have been set aside "for University purposes". They are therefore under the control of the U.B.C. Board of Governors.

b) The remaining 2500 acres are Crown land under the control of the provincial cabinet. They are managed for the crown by the U.E.L. Administration Office (5495 Chancellor Blvd., Vancouver 8). Mr. R.P. Murdoch is the manager and is directly responsible to the deputy minister of Lands, Forests and Water Resources (i.e. Williston's office).

PRESENT NATURE OF THE LANDS (i.e. the 2500 acres not classified as campus land)

a) Presently, about 1600 acres are undeveloped.

b) The area presently covered by residential dwellings is held in 'fee simple'. Titles can change hands; residents pay taxes etc. The ratepayers who live on these lands are represented by one vote on the Greater Vancouver Regional District Council. Their representative is Mr. A.C. Kelly. (It should be noted that this area does not include the recently built subdivision on King Edward Ave. This area was under control of the Jesuit fathers and was sold for real estate. It never belonged to the U.E.L.)

c) The area presently covered by commercial establishments (i.e. the 'Village' area) and the fraternity area are held in 'lease hold'. Mr. Murdoch stated that should any future residential areas be developed, they would also be lease hold.

d) The foreshore area from Spanish Banks west around the tip of Point Grey is leased to the Vancouver Parks Board.

e) The four major roads: University Blvd., Chancellor Blvd., 16th Ave., and Marine Dr. are serviced by the Department of Highways.

c/o institute of animal resource ecology, university of british columbia, vancouver 8, british columbia

FORMAL PLANS FOR THE LANDS

Presently, there is no written master plan by the government for the future development of the 2500 acres of non-campus land. Mr. Murdoch hinted in the meeting that he would like to see such a plan.

Apparently, there is a detailed master plan for the campus lands. We have not yet had a chance to seek it out. It is probably filed somewhere in the Dept. of Physical Plant, U.B.C.

The provincial cabinet did at one time commission a study of the possibilities for development of the U.E.L. The committee which carried out this study was headed by Dr. D.B. Turner and handed in its report in 1956. The report recommended setting up the U.E.L. administration as a three man Crown commission, the chairman of which would be an official of the Crown trained in land use and real estate development and the other two members private persons with similar training (note that the university community is not represented here, nor is any other group other than real estate interests). This commission was to have taxing authority and was charged to develop the lands "with a minimum of administrative staff", i.e. they would contract with private real estate firms. This report led to the 1965 statute entitled "Universities Real Estate Development Act" (Bill 90). This act apparently pertains to all the universities in B.C. and deals with more land than just the Point Grey peninsula. This act has <u>never been proclaimed</u>, although theoretically it could be at any time.

WHAT FUTURE PLANS MAY BE SCHEDULED FOR THE LANDS?

a) Mr. Murdoch suggested that the cabinet could at any time decide on a course of action for the lands. If, for example, a realtor approached them with a plan for the development of the lands the likely course of action would be to:
   1. Ask for the opinion of the U.B.C. Board of Governors.
   2. Ask for the opinion of the U.E.L. ratepayers.
   3. Make a decision.

   When asked whether the University students would be consulted in such a situation, Mr. Murdoch said that they would not, but that they might have some influence upon the response of the Board of Governors. He said that he hoped that any decision taken would take account of public opinion, and said that he felt that the primary concern of the cabinet was that the decision be beneficial to the University.

b) Mr. Murdoch said that his office, in co-operation with the Vancouver School Board was researching the possibility of setting aside 5 areas in the U.E.L. (Totalling about 200 acres) for use as "wilderness classrooms" (marked as "W" on the accompanying map) because of their unique nature. These include two ravines, Camosun bog, the 'Plains of Abraham', and an area of foreshore along the Fraser River. When questioned that development of other areas in the U.E.L. could degrade these unique areas by changing the drainage patterns of the peninsula, he agreed that this would have to be taken into account in development plans.

c) The Vancouver Parks Board has plans for dev elopment of the foreshore area west of Spanish Banks. Mr. Murdoch would not comment directly since he is not on the Parks Board. However, there was some discussion on this area and this will be outlined later in the section entitled "Some Problems on the Endowment Lands".

d) Other than the above, no definite plans were mentioned. When questioned, Mr. Murdoch did say that he felt that parts of the lands would eventually be developed, and that he thought that the most likely structures to be built would be multi-family dwellings, i.e. apartment buildings. However, no real estate dealings are presently being undertaken.

SOME PROBLEMS ON THE ENDOWMENT LANDS

a) Camosun Bog: Camosun Bog("c" on the accompanying map) was partially filled in with the dirt taken from the Sedgwick Library excavation. From the discussion, it appeared that this was simply a mistake on the part of the U.E.L. Administration Office which was trying to save the University some money in hauling the fill and did not realize that Camosun Bog was an ecologically unique and important area. Mr. Murdoch said that no more filling would be allowed, but the present damage could not be undone. As this report is being written, a further insult is being dealt to Camosun bog. The Vancouver School Board is building a running track at the south-east corner of 16th Ave. and Imperial Drive. In doing so, it is bulldozing out trees which form part of the succession into the bog and is filling an area immediately adjacent to the bog. It cannot be guessed now what effect this project will have on the nature of the bog.

b) Fourth Avenue Extension: This is presently going through. 4th Ave. will be extended west from Blanca to connect up with Chancellor Blvd. and provide a more direct access to campus than the present jog down Blanca to Chancellor. The triangle left between Blanca, Chancellor and the 4th Ave. extension will likely be sodded as parkland (although not zoned as such).
It was suggested in the discussion that this extension might not be necessary in view of Mr. Murdoch's statement that 16th Ave. is being developed and will eventually be four lanes in order to direct traffic away from University and Chancellor Blvds. and provide a more direct access to the University parking areas.

c) English Bay foreshore: This is an area ("f" on the accompanying map) of some contention. As mentioned before, this area is leased to the Vancouver Parks Board. They are presently filling in an area adjacent to the present Spanish Banks Park, presumably to enlarge the grassy areas of the park. At one time they tried to build a road along University Beach and were stopped by students and citizens. This matter is still up in the air. The present problem to us appears to be this:
   1. Some method is needed to curb erosion of the cliffs above University Beach.
   2. There is a disagreement as to whether University Beach should be a low-density usage, developed park such as Spanish Banks. The Parks Board would appear to favour the latter approach. Many students and local citizens disagree.

   It seems that the Parks Board is trying to come up with plans which would develop the area and make it high-density use. Two such plans are:
   1. Do it in the name of erosion control. This was the supposed reason for the original road, and is being used as a reason for building a grassy area along the beach. Experts at U.B.C. have suggested several methods for controlling erosion without development (one claims that all that is needed is to remove the jetty at the mouth of the Fraser (north side) and allow the river silt to come around onto the beach.
      There was a report prepared for the Parks Board in September, 1970 by Swan-Wooster Engineering Co. which addressed itself to the erosion problem. This report is summarized in the Appendix.
   2. Do it in the name of emergency vehicle access. Mr. Murdoch suggested the

possibility of a "road" being built for access to the beach by emergency vehicles. This would be some system of underground pavement with grass on top. He said that last year three persons with broken bones had to be removed from the beach and that this had to be done by hovercraft. It was brought up in the discussion that this did not appear to be a sufficient reason for building a road. The only objection to the hovercraft apparently, is that it is slower than the other method.

WHY ARE NO AREAS OF THE U.E.L. CLASSIFIED AS PARKLAND?

Mr. Murdoch stated that the reason for this is that once an area is classified formally as parkland, it is very difficult to ever get it reclassified or used for other purposes. The underlying suggestion here seems to be that the cabinet does not want to give up the option of at some time deciding to develop any area of the lands.

CONCLUSIONS (i.e. ECO's conclusions.)

It would seem that the reason that nothing is planned for the lands and that the act of 1965 has never been proclaimed is that there are two mutually exclusive points of view as to what should be done with the lands. One is to develop them as much as possible as real estate. The other is to preserve them in their present semi-wilderness state. Apparently, the government cannot decide which of these views is held by the more influential segment of society and so it is stalling.

In this matter Mr. Murdoch appears to be caught in the middle. He takes a good deal of abuse, and yet it seems that there is little that he can actually do. His present position, it seems to us, is to maintain the status quo and supervise the day to day problems of running the lands. He seems to be in favour of a master plan for the lands which would develop some (perhaps a great deal) of them and leave some areas untouched. However, as it now stands, the final decisions will be made by Bennett, Williston, and the cabinet.

The Camosun bog affair was a first rate blunder. A great deal of research, both government and university has centered on that area. Had the plan to fill the area been made public, we are sure that the hue and cry would have stopped it. Naturalists regard the area as a very important habitat for birds and other wildlife (the B.C. Natural History Society is sure to have more to say on this). This is an excellent example of why at least some areas of the U.E.L. should be classified as parkland.

The controversy concerning the English Bay foreshore seems jam-packed with red herrings. If what the Parks Board wants is to make that area into a park, then they should make that position clear. Then the views of users of the area can be obtained. We feel that the most important group to be consulted are the members of the University community - students, staff, and faculty since they spend their time there and use the area most. One of the problems here is that this area has been put under the control of the Parks Board which is interested in serving the city generally and not the University community.

If the concept of wilderness classrooms is indeed being seriously considered, then these areas at least should also be immediately classified as parkland.

ACKNOWLEDGEMENTS

We are most greatful to Mr. Murdoch and the U.E.L. Administration Office for furnishing us with information. They also supplied the map which is attached (we have made some additions to it).

The Vancouver Board of Parks and Recreation were kind enough to give us a copy of their erosion control study.
Thanks also to Dr. John Harko and Mr. R. Wayne Campbell for their help.

Paul Pearlstone
Executive Director, ECO

APPENDIX

Summaries (with comments) of some recent reports concerning the U.E.L.

1. Vancouver Board of Parks and Recreation. 1970. Point Grey Erosion Control Study. Prepared by Swan Wooster Engineering Co.

This study is not as helpful as its title would suggest. We had hoped that it would have looked at a number of plans for erosion control and assessed them from an engineering perspective. However, in the first section the company gives its terms of reference from the Parks Board, namely to "carry out surveys of the foreshore and prepare designs and estimates of a protective beach fill along the foreshore at the base of the cliff". Also, "the Board of Parks and Recreation require that the 12 foot wide walkway be continuous from the Spanish Banks end to ensure vehicular access for emergency and service vehicles to any proposed new public beach."

Therefore, the consulting company is restricted to considering some type of a physical barrier along the beach along which vehicles can travel, and which hooks up to the road at Spanish Banks. This doesn't give them a great deal of scope; the report is only 11 pages long and (surprise, surprise) recommends the building of a 30 foot wide gravel 'beach' (i.e. road) underlaid by a base of sand which ranges from 30 to 85 feet wide. The estimated cost of the project is $235,000.

The gravel would be imported from outside areas (they tried to find enough gravel on the beach so that they could just dig it up and push it around, but were forced to conclude that this wasn't feasible) and the sand would be pumped by hydraulic pumps from offshore sand banks. This method does not to us provide "minimum disturbance of the natural environment for seashore creatures" as set out in the terms of reference.

The gravel roadway would be 3 feet thick along the 3700 feet of shoreline where erosion is a problem (this is an area which runs from 1300 feet east of the concrete observation tower at the foot of the Fort Camp trail to 700 feet west of the other observation tower). The 2500 feet of shoreline adjacent to Spanish Banks would require only a 1 foot thick gravel roadway since this area "is showing only minor indications of erosion". In other words, the first half mile of road is not needed, but is required by the Parks Board so that easy access be provided to allow the area to be converted into a high density usage beach.

The concept which Swan Wooster puts forward is that this gravel road will curb the removal of slide materials by the waves and thus allow the cliff to attain a stable angle of repose (at approximately 38°). Erosion would then cease and the cliff would eventually grow over in vegetation. We cannot argue this - presumably they know their engineering. What we do question is that all this engineering is necessary to curb erosion. The Parks Board appears to have ulterior motives.

2. Norris, D.J. 1971. Educational and Research Uses of the University of British Columbia Endowment Lands: A Preliminary Survey.

This report, prepared as a requirement for a graduate course in Forestry, attempts to assess the importance of the lands to the University community. It is most interesting as it is the only study which we have seen to take this approach. Norris used a questionnaire which he took around to professors at the University. Each professor was also asked to furnish names of others who might make use of the lands; thus, the questionnaire circulated somewhat like a chain letter. In this manner Norris obtained a qualitative estimate of how the lands are used and how they are viewed.

The study is not statistical and doen not attempt to survey the whole university. Norris freely admits this. Certainly many more faculty use the lands than are mentioned in his report. The report does, however, list some of the major uses and tries to deliniate their importances. No attempt was made to assess recreational uses of the lands or educational uses by any other institution than U.B.C. (although both these are known to exist).

A total of 41 professors were interviewed in 1971. Their fields of study included Agriculture, Archeology, Botany, Education, Forestry, Geology, Geography, and Zoology. The vast majority (93%) used the lands - this is partly due to the method Norris used to find people to interview. The nature of the uses and the areas used are valuable information.

Uses.

a) The greatest use in terms of numbers of people was for organized field trips. All fields of study consulted used the U.E.L. for this purpose. About 2/3 of the professors felt that they would be able to go elsewhere if the lands were not available, but at a reduced level because of the increased costs (in terms of time and money) and inferior quality of other areas.
b) 70% of the respondents used the lands for the collection of laboratory materials. The U.E.L. are especially good as a supply of live materials.
c) 62.5% of the professors made use of the land for student projects. The vast majority of the projects (82%) would have to be cancelled or redirected to literature studies if the lands were not available.
d) Almost half of the respondents (47.5%) used the lands in connection with their research. This figure would be much higher if researchers could be assured that an area would not be disturbed (one poor fellow had his area bulldozed in the middle of his study).
e) Graduate student research on the lands was reported by 40% of the professors.
f) Other uses - 7.5%.

Areas of Use.

The most heavily used of the natural areas in the U.E.L. is the northern foreshore along English Bay. Sixty-eight percent of the respondents used this area. It is ironic that this is the very area which is slated to be vastly changed by the Parks Board's program. This is yet another example of the unsuitability of having the Parks Board manage an area of great concern to the University.

Four areas of the land are classified in the report as "unique areas" to be protected. These are: Camosun bog ("c" on accompanying map), the northern foreshore ("f" on the map), an aspen grove ("a" on the map) which is one of very few occurring in the coastal Douglas-fir biogeoclimatic zone), and the nesting area for a large number of Great Blue Herons ("h") - more will be said about the heronry in a later section. It is sad to observe that these four unique areas, one (the bog) has been partially destroyed and may be further damaged in other development plans, and another (the foreshore) is slated to be greatly changed in the near future. None of these areas is presently protected.

According to the Norris report, the number of professors using the lands, the number of student trips on the lands, and the number of field trips there are all increasing at a rate in excess of 8% per year.

Finally, a quote from the report, "If there was one feeling that was common to most of the respondents, it was the feeling that the Endowment Lands should be minimally developed, especially the foreshore and the area south and east of Imperial Drive".

3. Belshaw, Adrian W. 1971. A Proposal for the Future of the University Endowment Lands. Prepared for the Student's Council of U.B.C.

As far as we know, this is the only written document which expresses the opinion of the U.B.C. students on the U.E.L. It is therefore an important addition to this appendix, since the students are the major resident population in the immediate proximity of the lands.

The Belshaw report starts out by giving some of the background information that has already been covered in this report. It points out that the concept of using the lands for monetary endowment of the University is outmoded, and expresses concern over the plans set out in the Turner report and over the possibility that the lands might be annexed by the city and used as a source of revenue.

The proposals put forth in this report fall under two categories:

a) The creation of a "student community". Belshaw recommends that the present Fort Camp area, Acadia Camp area (as far east as the golf course), and the area presently sited for an industrial park should be made into a student community to give some focus to life on the campus. This area would contain student-built housing, restaurants, cafes, pubs, etc. Since all of these areas are presently developed or slated for development in the near future, natural sites would not have to be sacrificed for this project.

b) The rest of the lands should be kept as undeveloped areas. The arguments for this are: the city needs undeveloped lands especially in view of the way it is expanding; the lands contain unique plant communities which are valuable for teaching and research; the lands are valuable as a breeding area for many birds. The development of the lands as parkland should be carried out so as to minimize disruption of the present natural fauna and flora. Areas recommemded to be fenced off for research purposes were the heronry and Camosun bog.

4. Point Grey Action Group, Canadian Scientific Pollution and Environmental Control Society. 1971. A Proposal for Preserving the University Endowment Lands as Park.

The SPEC proposal outlines some of the reasons for setting aside the U.E.L. as parkland, and suggests some specific uses for areas within the lands.

The proposal is backed up by two letters; one from Dr. V.J. Krajina, a plant ecologist at U.B.C. and one of the most knowledgeable individuals in British Columbia on matters concerning plant communities and soil types; the other letter is from Mr. R. Wayne Campbell, curator of the Bertebrate Museum, Department of Zoology, U.B.C., who is an excellent field naturalist and an expert on the birds of the area.

Dr. Krajina mentions eight plant communities found on the lands which he feels should remain available in close proximity to the University for teaching and research purposes. These include: lodgepole pine - labrador tea - peat moss plant association (found at Camosun bog), Douglas-fir - western redcedar - swordfern plant association, Douglas-fir - western hemlock - moss association, red alder - Douglas-fir - Mahonia nervosa plant association, Douglas-fir - western hemlock - salmonberry - Osmaronia cerasiformis plant association, red alder - black cottonwood - giant horsetail - Petasites palmatus association, and red alder - western redcedar - skunk cabbage plant association. Locations of the associations are given in the letter. Dr. Krajina also points out that many of these plant associations have developed a particular soil structure which is important in itself. He specifically mentions that the first plant community mentioned (the bog area) should be fenced off and conserved.

Mr. Campbell's letter points out the great importance of the mixed woodland areas of the U.E.L. for birds, both in terms of nesting and feeding sites. (D.J. Norris mentions in his report that the U.E.L. comprise onelof only two forested areas of any size left in the Fraser Valley west from Mission -- the other is Stanley Park). Campbell points out that the area is used by birds all year round and is a habitat for a great variety of bird species. Particularly important is the Great Blue Heron nesting area - the largest in the lower mainland. (Mr. Campbell informs us that recently a second heronry has been discovered in the U.E.L.).

He concludes, "Over 100 species of birds frequent the Endowment Lands, many of which are difficult to find in other areas of Southwestern British Columbia. That a relatively undisturbed portion of the area remains as habitat for birds is an integral part of retaining these natural populations close to a large city like Vancouver."

A confirmation of the importance of the U.E.L. for birds comes from the 1971 Christmas bird count organized by the Vancouver Natural History Society. Of 25 areas in the greater Vancouver district which were surveyed, the U.E.L. contained the third highest number of species seen (the highest number of land bird species).

The SPEC proposal goes on to point out the importance of green belt areas near cities and the ideal nature of the U.E.L. as an undeveloped park (ideal because of the varied geography of the area - ravines, beaches, bogs, ridges, etc. Recreational activities proposed for the area were: strolling, picnicking, hiking, nature study, riding trails, golfing, and group camping. In particular, they propose to set up facilities for school children in the area to camp and study in natural surroundings; they also advocate the re-establishment of a salmon run in "Tin Can Creek", and encourage the development of loop nature trails with markers.

The proposed park would be under the control of the Vancouver - Fraser Park District.

Figure 1. Map of the Universtiy Endowment Lands. Area enclosed by the heavy black line is the U.E.L. Area to the west of this is the Campus Lands.

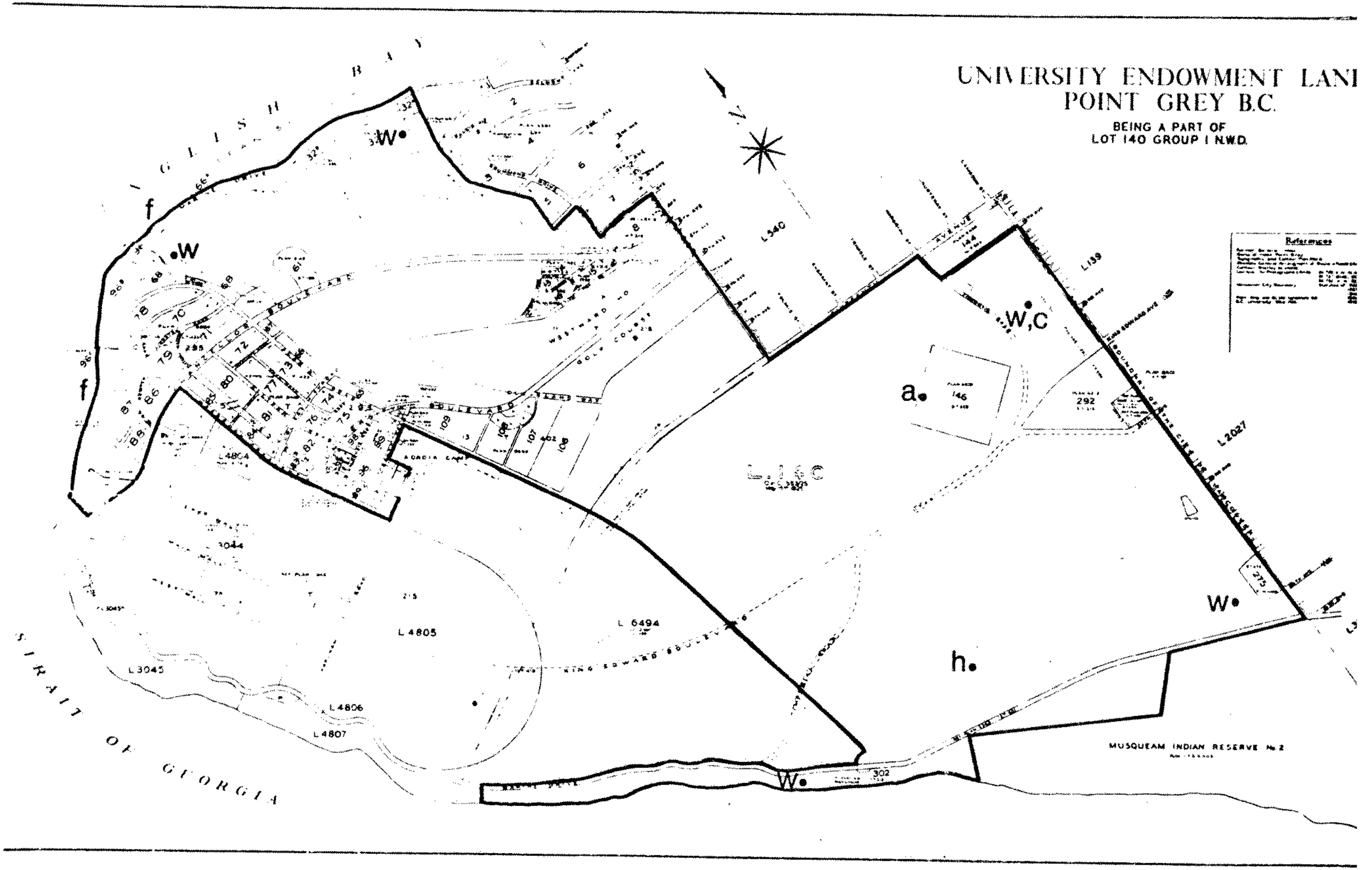
w. = proposed wilderness classroom sites

c. = Camosun Bog

h. = heronry

f. = English Bay foreshore area

a. = Aspen grove.


UNIVERSITY ENDOWMENT LANDS
POINT GREY B.C.
BEING A PART OF
LOT 140 GROUP I N.W.D.
References
ENGLISH BAY
STRAIT OF GEORGIA
MUSQUEAM INDIAN RESERVE No 2
L 340
L 139
L 2027
L 4804
L 4805
L 4806
L 4807
L 3045
L 6494
KING EDWARD BOULEVARD
GOLF COURSE
W
W,C
a
h
f
146
292
275
302
144
109
107
108

2 T. 440