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DELTA NATURE RESERVE

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DELTA NATURE RESERVE
EVALUATION STUDY

A. OUTLINE

1. INTRODUCTION

A study of the area known as the Delta Nature Reserve was initiated to identify and evaluate various options for development within the park.

2. PURPOSE

This study is intended to provide information and make recommendations regarding the optimum use of the property.

3. OBJECTIVES

The specific objectives are to:

- a. Collate presently available information concerning the Delta Nature Reserve.
- b. Describe the existing environmental conditions of the site to form a basis for assessment of development plans.
- c. Propose several development concepts, which differ by degree of alteration to the existing site, and evaluate their possible impacts.

4. THE STUDY AREA

Located at the northeastern edge of a large (approximately 9800 acres), raised sphagnum peat bog known as Burns Bog, the municipally owned Delta Nature Reserve occupies a registered area of 154.88 acres. This total, however, excludes the 8.28 acre Burlington Northern Railway right-of-way which cuts through the north-east corner of the Nature Reserve to divide it into two unequal portions. See Figure # 1 for a site plan of the area.

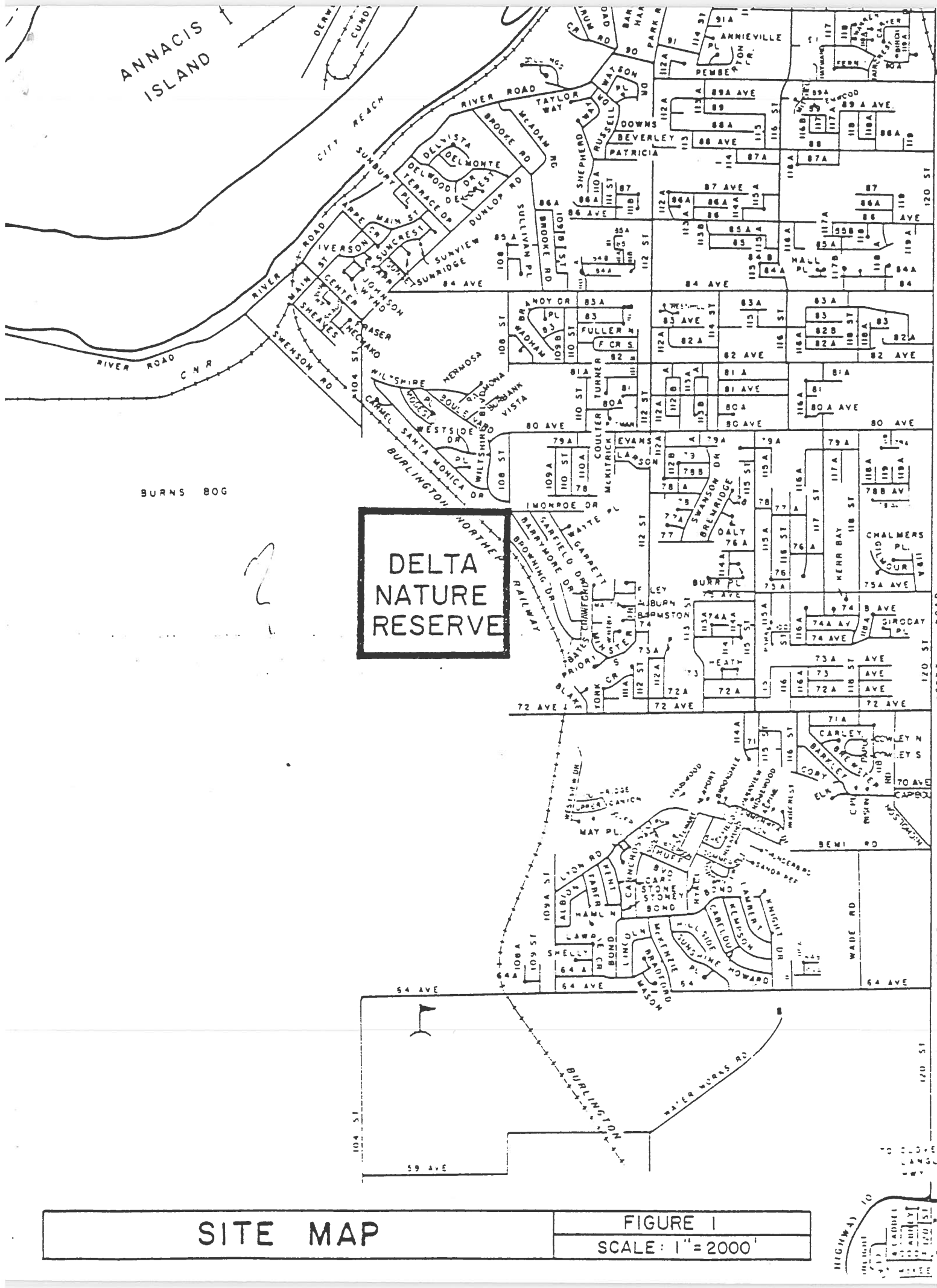
ANNACIS ISLAND

BURNS BOG

DELTA NATURE RESERVE

SITE MAP

FIGURE 1
SCALE: 1" = 2000'



The land east of the railway is approximately 2.5 acres in size and is bounded by the alignments of 108th Street to the east and Monroe Drive to the north. At present the only public vehicular access is restricted to the eastern boundary of this portion of the Nature Reserve, at the corner of 108th Street and Monroe Drive. The Browning Drive alignment skirts along the base of the North Delta escarpment and while it is inadequate for use by vehicular traffic, it currently provides an alternate route for pedestrian access to the Nature Reserve.

To the west of the railway right-of-way is the Greater Vancouver Sewerage & Drainage District trunk sewer which provides service connection for parts of Delta and Surrey to the Annacis Island sewage treatment plant. The North Delta Interceptor Canal lies immediately west of the trunk sewer and collects surface drainage from the North Delta uplands to flow northwards into the Fraser River. There is a hog fuel based maintenance road alongside the drainage canal from 72nd Avenue to River Road, however, there are locked gates at both the northern and eastern boundaries of the Nature Reserve where the road passes through.

B. PRESENT ENVIRONMENT OF THE STUDY AREA

1. BOG FORMATION

A brief review of the historical background of Burns Bog, regarding its creation and development, may be helpful in providing a better perspective view of its present condition and the results any developments may have on its future.

Beginning approximately 800,000 years ago, the Fraser delta was subjected to a series of ice advances and retreats from glaciers originating in the Coast Mountain valleys to the north and east which buried the Burns Bog area to a depth of up to 5800 feet (Biggs, 1976). The last in the series of ice advances of the Fraser Glaciation receded to roughly the present site of the North Delta - Panorama Ridge escarpment approximately 11,000

years ago, marking the beginning of the recent geological history of the area. However, due to the depression of the area below sea level as a result of glaciation, it was not until 4,000 - 5,000 years ago that the present Burns Bog began to develop on the recent alluvium of the Fraser River.

Bog development often occurs as a result of in-filling of a shallow water-filled basin. This action is initiated by floating aquatic plants which extend over the water surface. The deposition of plant material causes a gradual shrinkage of the open water surface and an eventual filling of the basin. In the case of Burns Bog, colonization by sphagnum (peat moss) and other plant species heralded the beginning of bog development.

As the sphagnum plants grow upward each year the stems below gradually die, leaving only the top few inches of each plant actually living. The dead but undecomposed lower cells become part of the underlying peat formation and their excellent water holding capabilities (up to twenty times their own weight) permit sphagnum plants to actually raise the water table above its normal height. Thus the peat itself acts as a reservoir, fed by the precipitation falling on it, to develop above the physical limits of the groundwater. This characteristic of the species leads to the development of a domed or "crowned" bog in which the ground elevation at centre is higher than at the edges because conditions at the centre of the bog are more conducive to growing sphagnum moss for a longer period of time.

The waters in a sphagnum bog are acidic (pH 3.5), due primarily to the high cation exchange ability of sphagnum. The plant lowers the pH of the water by absorbing the cations in solution and releasing hydrogen ions. Because of the acidity and water-logged character of the bog, as well as the relatively low temperature encountered, the rate of bacterial decomposition is slowed down and this results in the accumulation of only partially decayed organic matter to form peat. Most of the nutrients of the bog remain stored in the peat. With the main source of incoming minerals being restricted to precipitation and air-borne

particulate matter, available nutrient levels remain low.

This is reflected by the low primary productivity of bogs in comparison with other ecosystems and the limited variety of plants that are tolerant of these harsh conditions. Sphagnum peat bogs are reported to have a net primary production of 340 grams per square metre per year while arctic tundra, cat-tail reedswamp and bulrush reedswamp have 100, 2900 and 4600 g/m²/yr net production, respectively (Moore and Bellamy, 1974). An example of adaptation to these nutrient-limiting conditions is the presence of carnivorous plants (eg. Sundew) which trap insects to supplement their mineral requirements.

However, as the water level in a bog is lowered either by the accumulation of organic material above the water table or by drainage, a change occurs in the bog ecology. Bacterial decomposition is no longer restricted primarily to anaerobic mechanisms, so nutrients are released from the peat and made available for incorporation into other plant systems. The increased supply of nutrients and drier conditions allow a wider variety of plant species to invade and colonize the area, further supplanting the original bog species. This evolution of the bog normally occurs at the edges first and spreads inwards, and is evidenced by the increase in shrub and tree populations. In the case of Bruns Bog, this type of development would eventually lead to complete forestation with Western Hemlock evolving as the dominant species by virtue of its competitive advantage of being more shade tolerant than other tree species.

Recent study of the area in and around the Delta Nature Reserve shows that it may be somewhat unrelated to the rest of Burns Bog and may have developed in a separate fashion. As a result of research done in the area for a doctoral thesis, Mr. R. Hebda (pers. comm.) feels the Nature Reserve primarily consisted of a shrubby swamp until sphagnum species colonized the area approximately 500 years ago. He has called attention to a ridge, roughly parallel to the North Delta escarpment and possibly created from a sand dune, which appears to have caused a physical

separation during the early developmental stages and resulted in dissimilar development patterns. This possibility does not diminish the value of the present Nature Reserve as an instructive example of bog ecology, but rather, it displays an additional facet of the unique character of this site.

2. CLIMATE

The maritime climate of the study area is characterized by mild, wet winters with infrequent intrusions of cold arctic air from the interior and dry warm summers. Data obtained from weather recording stations in Ladner and New Westminster which describe average monthly, annual mean and extreme temperatures are shown in Table 1. Mean winter and summer temperatures for the study area are about 3.6° C and 16.4° C, respectively.

The average monthly and total annual precipitation figures for the two recording sites are provided in Table 2. Average annual precipitation in the Delta Nature Reserve is expected to range between 1016 mm and 1270 mm (40" - 50"). Generally heavy winter and spring precipitation result in high water table levels and extensive surface ponding.

Predominately east and northeast winds occur during the winter months, while southwest and west winds are prevalent during the summer. Wind strength tends to be higher in winter, although both dead calm and potentially damaging wind conditions are infrequent at any time (CBA, 1975).

3. SURFACE DRAINAGE

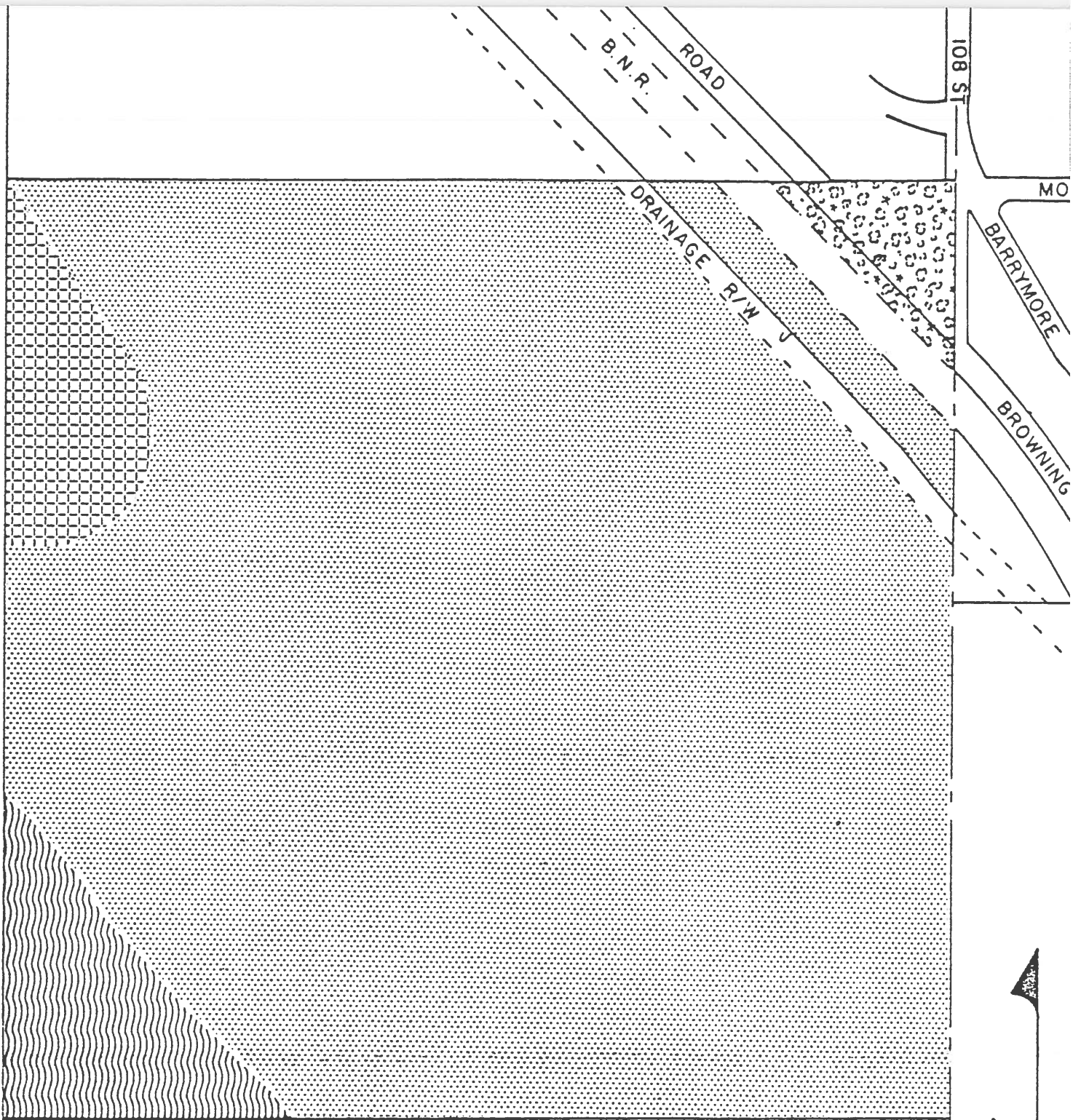
Prior to the construction in 1917 of a drainage canal at the base of the North Delta escarpment, the study area received considerable runoff from several well-defined creeks draining the North Delta uplands. This inflow, with the addition of direct precipitation, was sufficient to maintain a high water

table within the area for most of the year in balance with seepage and evaporation losses. However, construction of the drainage canal to intercept upland runoff, the development of internal ditching systems and the scraping away of peat layers in the central bog area by peat mining operations over the last 35 years have combined to alter the natural convex profile of the bog into its present dish-like condition. The edges of the bog have tended to dry out as the water table dropped. Surface drainage out of the Nature Reserve is reported to be in a westerly direction towards the centre of the bog and then northerly to the River Road collector ditch (CBA, 1975). As a result, soil moisture content is depleted during the summer months by evaporation and evapotranspiration and the effects of this are reflected by the changes in vegetation over the last 100 years from characteristic bog species to invasion by coastal forest species. Clearly, any further alterations to the drainage characteristics of the Nature Reserve and its surroundings will be of key importance in determining the future of its integrity as a bog community.

4. GEOLOGY

The study area is underlain by Pleistocene-aged deposits of massively bedded sands and gravels, probably with clayey seams, at a depth of approximately 100 feet. These deposits have been overlain by approximately 30 feet of bedded silts and clays with persistent sand seams followed by another 30 feet of bedded sandy silts. The upper 40 feet is composed of peaty-silty-clay material and a peat layer.

The various soils found within the boundaries of the Nature Reserve include the following series: Lumbum, Triggs, Lulu-Richmond and Bose-Surrey. The approximate areas covered by these soils is shown in Figure 2. The topography of the Lumbum, Triggs and Lulu-Richmond series are all described as nearly level to gently undulating with 0-2% slope and an elevation of approximately ten



SOIL MAP

FIGURE 2

SCALE: 1" = 400'



MESISOL (Lumbum Series)



FIBRISOL (Triggs Series)



MESISOL - HUMISOL (Lulu - Richmond Soil Complex)



HUMO - FERRIC PODZOL (Bose - Surrey Soil Complex)

feet. However, the Bose-Surrey series is termed strongly to extremely sloping with approximately a 28% slope and an elevation decreasing from about 130 feet in the northeast corner to approximately 20 feet at the railway tracks.

The Lumbum Series occupies almost 90% of the surface area of the Nature Reserve and is classed as a Typic Mesisol soil, which are very poorly drained organic soils composed of dominantly moderately decomposed organic fibers. These soils have developed from deep (more than 52 inches) organic materials, mainly remains of moss and shrubs in the upper part and sedges and reeds at depth. The capability of this soil for agricultural use is rated as a Class 4 or 5, its main limitation being poor drainage. This soil series forms the perimeter of Burns Bog which surrounds the large central area composed primarily of the Triggs soil series.

Approximately 5% of the Nature Reserve, located in the southwest corner of the study area, is represented by the Triggs Series. This series is classed as a Sphagno-Fibrisol soil and has developed from deep (greater than five feet), relatively undecomposed accumulations of sphagnum mosses. Without artificial drainage the water table is at or near the surface for most of the year and the water holding capacity is extremely high. Peat mining operations process Triggs soils for sale as a soil conditioner to improve the structure and water holding characteristics of mineral soils. The percent soil capability rating for agricultural use of this series is Class 7 due to the very poor drainage and low fertility and would require expensive, large-scale reclamation prior to agricultural utilization.

In the northwest corner of the Nature Reserve a soil complex of both Lulu and Richmond Series occupies about 4% of the total study area. Lulu Series is classed as a Terric Mesisol soil which Richmond Series soil is termed Terric Humisol. The former series is primarily composed of moderately decomposed subsurface organic layers while the latter series is dominated by well decomposed subsurface layers. This soil is derived from shallow (about three

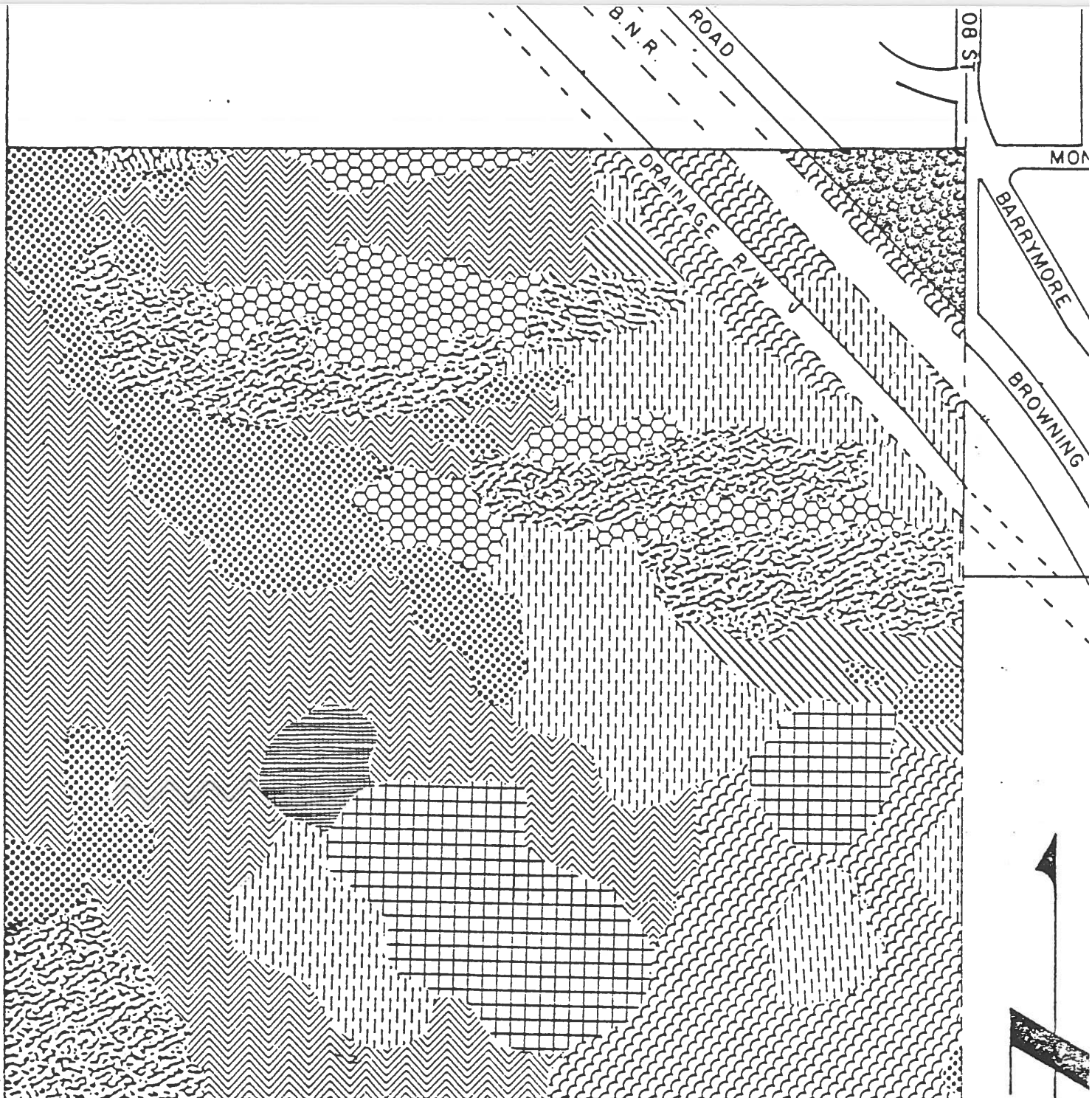
feet deep) organic deposits underlain by a mixture of marine and non-marine deltaic deposits. Once again, the soil is very poorly drained and the water table is at or near the surface during the winter, spring and early summer if artificial drainage is not provided. The soil capability rating is a Class 4 with the poor drainage being the major restriction.

In contrast to the above described lowland organic soils, the Bose-Surrey soil complex to the east of the Burlington Northern rail line is an example of an upland soil type and is classified as a Mini Humo-Ferric Podzol. The parent material of this soil is a mantle, generally less than three feet thick, of wave washed lag gravels overlying glaciomarine or glacial till deposits. Both underlying deposits are hard, compact and nearly impervious. This soil is well to moderately well drained and is given a Class 4 to 5 soil capability rating due to its low water holding ability and stoniness.

5. VEGETATION











Plant species diversity and rates of growth tend to increase from the centre to the perimeter of the bog due to increased dryness and nutrient availability. Since the study area is located at the edge of Burns Bog, it contains not only typical bog plant communities but mixed coniferous - deciduous woodland species as well. In addition, the distinctly different soil types and topographies of the areas on either side of the railway line are native habitats for a diverse variety of plant species and this promotes a further visual contrast of plant communities.

Native bog vegetation includes bog birch and shore pine with a dense understory of hardhack, Labrador tea, bracken, blueberry, salal and several species of sphagnum moss. It is reported (Hebda, pers. comm) that the pine and birch forest growing at the edge of the lowlands is less than 100 years old and is the direct result of man's disturbance of natural drainage patterns. There are also several species, such as cloudberry and cascade blueberry,



VEGETATION MAP

FIGURE-3
SCALE: 1"=400'

-  SECOND GROWTH FIR AND DECIDUOUS (Maple, Dogwood, Birch, Alder)
-  ALDER WITH LIGHT SALMONBERRY UNDERSTOREY
-  LARGE MATURE CEDAR, HEMLOCK, SPRUCE
-  OPEN MEADOW (Labrador Tea, Bracken Fern, with scattered dwarf Pine, Hemlock, Cedar, Spruce)
-  SHORE PINE WITH LABRADOR TEA, SALAL GROUND COVER
-  MIXED DECIDUOUS (Alder, Birch, Willow, Pacific Crabapple)
-  DENSE HARDHACK - OPEN
-  HEAVY SNAG - DEADFALL AREA (Dense Willow, Crabapple, Hardhack Mix)
-  STUNTED PINE, CEDAR, HEMLOCK, SPRUCE MIX
-  LOGGED AREA - SECOND GROWTH ALDER, WILLOW - DEADFALLS

that are very rare for this locale and whose appearance is usually restricted to sub-arctic or sub-alpine regions. The upland vegetation to the east of the railway tracks includes second growth Douglas fir, alder, birch, dogwood and maple. A partial list of the flora of the study area is described in Table 3. Figure 3 illustrates the vegetative cover zones found within the Nature Reserve.

6. WILDLIFE

As a result of the peat extraction operations within Burns Bog, open pools of water have been created and cranberries have grown up around these pools. Waterfowl utilize these flooded peat cuttings mainly as resting and feeding areas, especially during times of unfavourable weather and sea conditions at Boundary Bay and Roberts and Sturgeon Banks. The surrounding agricultural lands also serve as a food source for these birds and there appears to be a movement of waterfowl from these lands into and out of the bog (Biggs, 1976). The bog also provides an important refuge area for raptorial species due to the large trees at the perimeter of the bog, its large size and relatively undeveloped environment. It is believed the surrounding agricultural lands are also used extensively by hawks and owls which nest and roost in the bog.

The mixed coniferous - deciduous woodlands area at the eastern edge of the bog, including part of the Nature Reserve, is considered to be an important nesting and feeding habitat for most passerine bird species found within the bog. Table 4 includes a list of bird species observed in the study area during the summer of 1971.

A partial listing of the many species of animals which frequent the bog is presented in Table 4. While some of the smaller species such as, opossum, raccoon, coast mole and muskrat may also be found in various other naturally vegetated underdeveloped areas of Delta, the presence of black bear and Columbian Blacktailed deer are considered to be isolated resident populations. As estimated population of 12 black bear feed mainly on berries while approximately 50 blacktailed deer find browse in the whole area.

However, due to the high water table in the bog during the winter months, the deer are forced into the adjacent woodland areas where continued development of the North Delta escarpment appears to be exerting a severely limiting effect on this population.

7. LAND AND RESOURCE UTILIZATION

a. PRESENT

The Delta Nature Reserve has been formally declared as such by the Delta Municipal Council and all of lowland reserve area has been included in the Agricultural Land Reserve by the B.C. Land Commission. The Greater Vancouver Regional District, in their report titled "The Livable Region 1976/1986", propose that the area be included in their designation of "Open Space Conservancy". This classification restricts land use exclusively to recreation and conservation purposes. As there appears to be a common consensus among the various levels of government, relating to the type of utilization of the subject area, no changes in the current status are anticipated and it is believed the above declarations will protect the land from any alternative developments. The diverse uses of the surrounding lands will exert direct and indirect pressures on the subject area, and therefore merit consideration.

As previously mentioned, Burns Bog soils are generally unsuited for agricultural use due to the limiting factors of year round high water table, high fibre content and low fertility. As a result, agriculture is restricted to the south and west periphery of the bog where soils more suitable for farming are dominant. Along eastern side of Burns Bog, in the vicinity of the Nature Reserve, the alignment of Browning Drive marks the western extremity of the single family residential zoning. Along the northern edge of the bog an industrial use corridor has been established and is attractive to a wide variety of industries because of waterfront accessibility. However, rapid encroachment into the bog south of River Road has not occurred due to problems and expenses incurred in providing structural stability on the peaty soils.

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The vast central area of Burns Bog has been zoned specifically for peat extraction. A company known as Western Peat Moss Ltd. owns over 6000 acres of this central area, including the lowlands immediately adjacent to the Nature Reserve, and has been actively removing peat since 1933. They estimate the remaining peat volumes could support the operation for another twenty to thirty years. During World War II, the peat was used as a packing material in shipments of armaments and ammunition. Now, however, it is primarily used in horticultural applications as a soil conditioner to improve the structure and water holding capabilities of mineral soils. Once it has been dried, peat is difficult to re-wet with water yet retains a good absorptive capacity for petroleum products. This property of selective absorption makes peat moss an effective oil spill absorbent and provides alternative uses for the product.

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b. FUTURE

Although no significant alterations to the present type of utilization is expected for the Nature Reserve lands, developments of the surroundings may seriously endanger the continued viability of the park.

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2/11

As previously described, there are sufficient peat resources within the bog to sustain the present Western Peat Moss Ltd. operation for a further 20 to 30 years. No formal plans have been proposed that would foreshorten this time frame, however, informal discussions suggest the company has entertained the possibility of sand-filling the central bog area to create a shopping centre complex with residential development. Such a development would, of course, have lethal effects on the present status of the Nature Reserve but full consideration of such an extensive undertaking would be premature in the absence of definite development plans and would be beyond the scope of this report. Mention is made of this proposal to illustrate the possible extent of surrounding future developments and to place the future of the Nature Reserve in a clearer perspective.

no

Several possible road developments through Burns Bog are currently under consideration and their eventual implementation may create significant impacts on the Nature Reserve. The proposals include

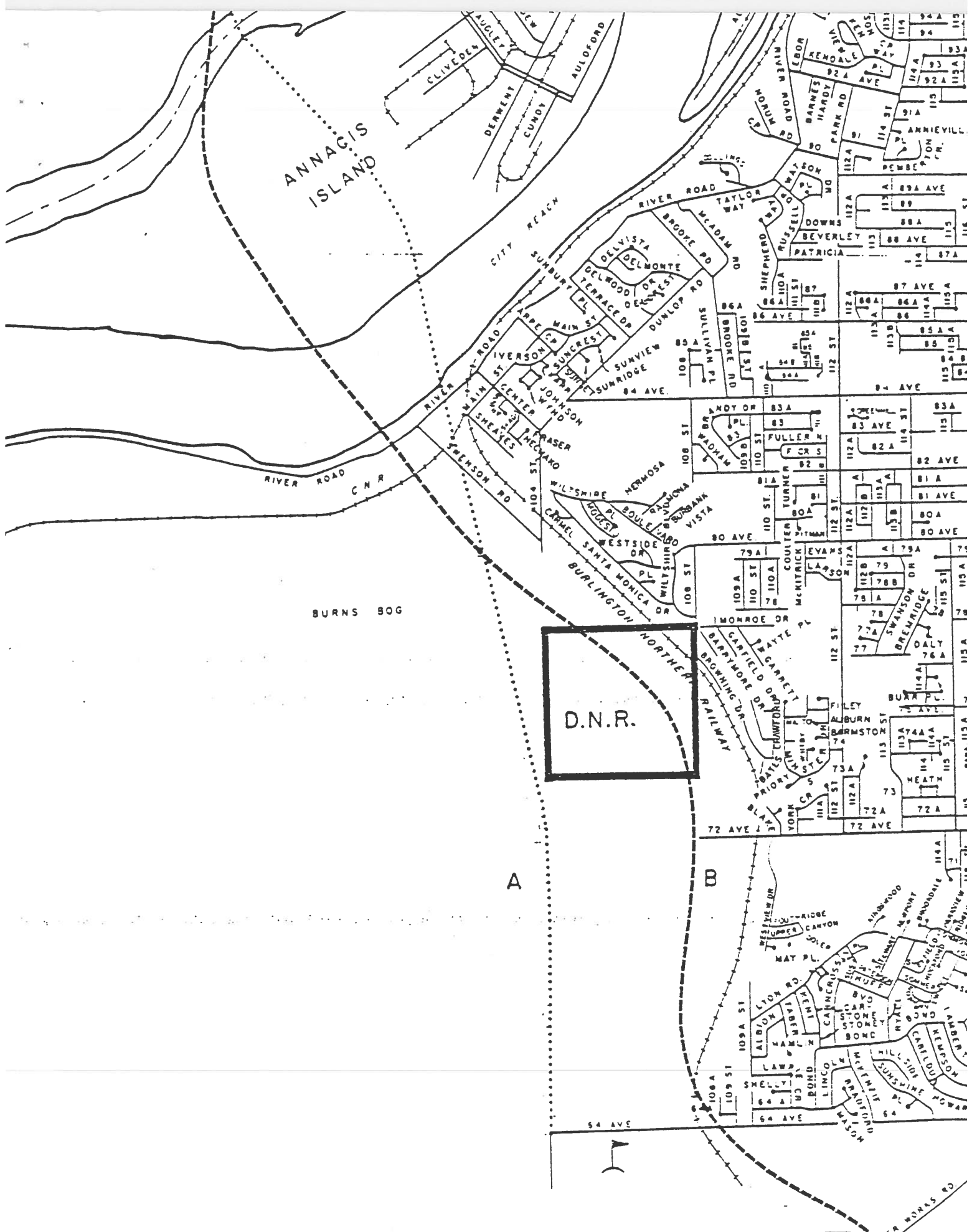
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the Annacis Island crossing, the construction of a new River Road and the development of Browning Drive.

A location and design study was completed in 1974 by CBA Engineering Ltd. for the B.C. Department of Highways regarding a highway crossing of the Fraser River at Annacis Island. A number of possible route options were considered and a preliminary environmental impact evaluation was undertaken for the two most likely alternatives. Figure 4 illustrates the approximate alignments of the two route options under investigation. Route A is located immediately west of the Nature Reserve and is designed to connect a bridge crossing with the existing 104th Street to the south. Alignment B cuts through part of the Nature Reserve and is described as generally following the contours of the base of the escarpment.

The assessment followed a format of comparison of the impacts of one option against the other in terms of anticipated effects on the evaluation criteria. Alignment B emerged as the preferred route, even though it has a higher potential for creating traffic noise problems and will eliminate a section of the transition zone between the lowland and upland areas. It is felt the shorter connector roads will present less of a barrier to wildlife movements and because of its orientation at the periphery of the bog it will exert less effects on the drainage patterns, bog ecosystem and waterfowl wintering areas. This alignment is also considered to have the effect of restricting access and services to the eastern extremity of the lowland and not create extensive development areas. In their appraisal of the effects specifically regarding the Nature Reserve, they conclude that the area between the alignment and the escarpment would likely become more developed as an outdoor recreation area while the larger portion west of the alignment may be more easily restricted to educational use. In addition, this option does not preclude the possibility of a future westward expansion of the Nature Reserve.

The other major road development considered for Burns Bog involves the construction of a new east-west highway roughly parallel to, but south of, the existing River Road. A final alignment for this proposal has not been determined but the route will likely be situated



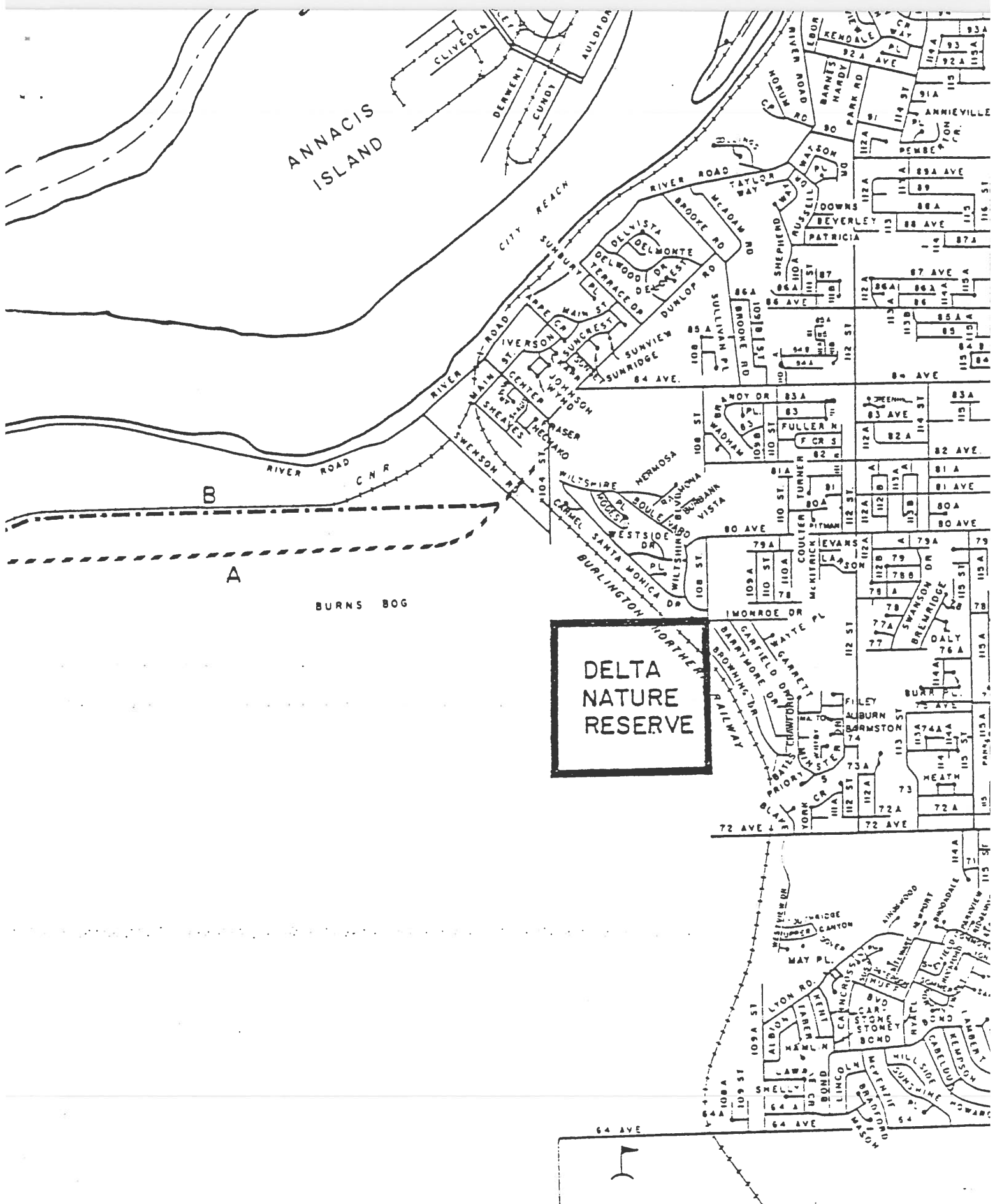
ANNACIS ISLAND CROSSING	FIGURE 4
	SCALE: 1" = 2000'

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M-2

within the corridor formed by the C.N.R. right-of-way to the north and the B.C. Hydro right-of-way to the south according to a 1973 feasibility appraisal. Final selection of the route will be based upon investigations of the engineering feasibility, economics and adjacent property development. The approximate alignments of the two routes being considered are shown in Figure 5. A large storage ditch will be created parallel to and immediately south of the new road to intercept the drainage out of the bog. However, it is understood that control mechanisms will be installed to prevent excessive drainage of the bog and permit maintenance of adequate groundwater levels. Although alignment B would alienate about 200 more acres, either route will directly affect the northern perimeter of Burns Bog by physically cutting it off from the rest of the bog environment. As almost all of the property north of the B.C. Hydro right-of-way is zoned for industrial use, creation of a road in this vicinity would undoubtedly accelerate landfilling and development of these lands. While this activity would diminish the effective size of the bog, a possible indirect benefit may accrue through the retention of high groundwater levels in the Nature Reserve. This would inhibit the rate of succession and result in a stabilizing influence on the bog ecosystem.

The development of the established Browing Drive alignment, near the base of the North Delta embankment, would exert influences on the Nature Reserve not unlike those anticipated in Alternative B of the Annacis Island crossing study. The road would further fragment the Nature Reserve by isolating the triangular transition zone from the bog lowland. Due to the intrusive nature of the development and the traffic and pedestrian safety problems that would be created, the likely result would be the deletion of this small but significant portion from the rest of the park. To put the problem in perspective, however, there is no necessity to develop this road from a municipal planning viewpoint and therefore no development is anticipated in the foreseeable future.

A positive aspect evidenced by this consideration of future road developments is that final decisions in favour of these developments



<h1>PROPOSED RIVER ROAD</h1>	FIGURE 5
	SCALE: 1" = 2000'

as described has not been made. Alternative plans remain viable, reconsiderations of the proposed alignments are still feasible and even cancellation of the projects is entirely possible. In view of the uncertainty of definite development plans, any discussions concerning the Nature Reserve must be approached with a sense of optimism for the continued stability of the surrounding land uses.

8. PREVIOUS DEVELOPMENTS WITHIN THE NATURE RESERVE

The Burns Bog Branch of the B.C. Waterfowl Association was formed in May of 1966. In a letter dated November 12, 1966, they requested an opportunity to discuss a proposal for the present study area with the Delta Parks and Recreation Commission. The major objective of the proposal was to secure the permanent preservation of a portion of Burns Bog in its natural state. If this were accomplished, the group would then work towards making the area more accessible to the public, cut nature paths and riding trails through the area and seek possible means of expanding or improving the area. At that time, however, the Municipal Council could not act on this proposal as the area had already been committed as the future site of a local sewage treatment plant.

Additional support for the establishment of a nature park was provided by many diverse groups, including the Sur-Del Riding Club, the British Columbia Nature Council, the North Delta Ratepayers Association, the Vancouver Natural History Society and the Nature Conservancy of Canada. From the scientific community, Drs. Beamish and Krajina of the U.B.C. Botany Department examined the Nature Reserve area and formally proposed that it be set aside as an ecological reserve. This appeal for reserve status was reiterated by Dr. Norman Radforth, head of the Biology Department at the University of New Brunswick and an expert on muskeg and mire ecosystems. The Delta School Board also supported the preservation ideals in their request for a perpetual lease on the site as an Educational Reserve. The object of such a lease would be to keep the area in its natural state, prevent damage by the public and allow utilization of the biological teaching aspects of the area. Also emphasized by the educators was the necessity of preserving the upland slope to the east of the railway tracks to serve as an

example of a gradient area and to provide an overall view to put the bog in its proper perspective.

On May 25, 1971, as a result of the concerns and interests expressed by the above groups, the Delta Municipal Council approved a recommendation to make the site available for use by the School Board for school purposes. All developments, however, would require Council approval as the Municipality was to retain control of the property.

During the summer of 1971, a Federal Opportunities for Youth (OFY) grant provided \$8,000. in funds for student employment and development within the Nature Reserve area. The purposes of this project included identifying and cataloguing the flora and fauna observed in the area and improving the access within the Nature Reserve while disrupting the natural setting as little as possible. The specific objectives of this project are more fully described in the outline of general instructions submitted June 15, 1971 and contained in Table 5. A vegetative cover map was also produced during this project and is shown as Figure 3 of this report.

The following October, this area was opened as the "Delta Nature Reserve" but was not officially declared a nature reserve by Municipal Council until April 2, 1973. At this later date, Council also indicated the jurisdiction of the property would be under the Delta Parks and Recreation Commission, with the Board of School Trustees and the Bruns Bog Protection Society acting as advisors.

As a result of acts of vandalism and a lack of continued maintenance programs, the amenities provided by the 1971 OFY project had suffered considerable deterioration. In the summer of 1973, another OFY grant was made available for students to restore previous developments such as the observation tower, footpaths and bridges. The project also included the compilation of an explanatory booklet of some of the major species of flora and fauna to be used in conjunction with a photographic slide presentation.

In 1975, construction of the new trunk sewer line caused considerable disturbance to the vegetation in the vicinity of the drainage right-of-way. To facilitate sewer line construction, an access road was built adjacent to the drainage canal and resulted in the removal of a large number of mature cedar. Consequently, the integrity and character of the Theatre area was irreversibly altered. Theatre was composed of a number of tall cedars surrounding a relatively small open area, creating an intimate and isolated atmosphere. Within the open area were deadfalls which were developed into benches to provide seating. The encroachment of the access road removed some of the surrounding trees and changed the visual perception within the area. The former site of the Theatre and some trees still exist, but there are few characteristics to distinguish it from the surroundings.

Upon completion of the sewer line work, fences with locking gates were constructed at north and east boundaries where the access road enters the Nature Reserve. The fences extend from the drainage canal to the edge of the brush in an effort to prevent unauthorized vehicular access into the property.

Since the most recent OFY project, regular maintenance programs have been absent and once again vandalism has taken its toll. At present time, a state of disrepair exists and is evidenced by the vegetation at the edges of pathways being trampled by users avoiding the wet trails and virtually no directional signs or vegetation markers exist. There are also clear indications of motorcycles being ridden in the Nature Reserve and causing further damage to vegetation. Therefore, it is vital to establish a course of action now to direct future development plans and ensure the optimum use of the property is achieved.

C. PROPOSALS CONSIDERED FOR THE STUDY AREA

The objective of this section is to examine and evaluate various concepts for development which vary by degrees of alteration to the existing site. The evaluation will attempt to consider factors within the context of the previously outlined accomplishments and consistent with the preservational attitudes of the many interested groups which provided the initial impetus for the creation of the Nature Reserve.

There are two basic underlying physical and social aims of this report. Most important is the preservation of the distinctive bog environment. Any proposed developments must not adversely affect the delicate balance of this ecosystem. Secondly, the objective of each proposal is to provide an opportunity for people to experience contact with the area and gain an understanding of its ecological significance. The selected development plan should therefore contain features which best satisfy the above criteria.

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The four basic alternatives presented may be described as representative points along a development scale of increasing magnitude. The specific components of each plan have been grouped together on the basis of perceived compatibility and expected impact on the Nature Reserve. Some features of each proposal are not critical to its implementation but are included to be indicative of the degree of development anticipated for the proposal.

1. NO DEVELOPMENT

This alternative is a conscious attempt to preserve the area from the negative impacts of human interaction with the bog environment. It is based on the premise that any development or encouragement of public use will eventually lead to overdevelopment of the resources and overtax the system's capability of adjusting to changes. Irreversible upset of the present ecosystem could be the direct result of human influence and overuse.

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The only action contemplated is the removal of the existing bridge across the drainage canal to inhibit movement into Nature Reserve west of the bridge. The intent is to allow the presently developed trail system to atrophy from a lack of maintenance and public usage. This would permit the trails to become re-vegetated naturally by native species and adjacent areas would no longer be subject to trampling or disturbance. The area would become more attractive to wildlife because of increased cover, food sources, nesting sites and decreased human intrusion. With no development there would be no need to alter any physical aspects of the park or regulating factors such as groundwater levels and drainage patterns. The elimination of easy access would therefore have the effect of enhancing the quality of the habitat.

If there is no further development and no encouragement of public use, the likelihood of intentional or inadvertent damage would be reduced. In the past, any man-made structures suffered extensive vandalism and were eventually completely destroyed. Although these destructive energies have generally been directed towards the structural developments, intentional damage to vegetation has occurred and arson represents a very great threat in this regard. In terms of fire potential, careless smoking habits and other inadvertent acts should be recognized as a liability of opening the area up to the public. Unfortunately, the degree of fire protection available to the area is extremely limited due to poor vehicular access to the site periphery, lack of adequate water supplies, the vast acreage involved and the dense vegetational cover which severely restricts ground movements. More recently, damage caused by uncontrolled motorcycle use is resulting in further degradation of the trails and adjacent vegetation and making walking along the paths more difficult. The noise and exhaust fumes from these vehicles is expected to have adverse effects on wildlife populations in proximity to the trail system. Plant pilferage would likely decline if the access routes were to become overgrown and thus hamper removal attempts.

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As the area presently exists, no police patrols enter the Nature Reserve on a regular basis. If public use is encouraged, however, periodic surveillance by the police would become necessary to guard against the above mentioned vandalism, mischief and general misuse of the area. The degree of policing required would be dependent upon the amount of use the area experiences, the value of the developments and the complaints received. Because of the lack of adequate vehicular access to and within the Nature Reserve and the impracticality of patrolling the trails on foot, it would be extremely difficult to effectively control the activities in the area without an increased cost in manpower or at the expense of patrols in other problem areas. In practice, it is only reasonable to expect police patrols of the site periphery and public roads leading to the park.

From an economic expenditure viewpoint, this proposal is the most attractive. The only expenses anticipated are those pertaining to the removal of the bridge crossing the drainage canal and the erection of signs at the Nature Reserve boundaries prohibiting any vandalism, plant pilferage or vehicular use in the area. Maintenance costs would only involve the preservation of the above signs.

While this alternative provides the best attempt to preserve the existing environment with the least disruption or alteration of the system, several items counterbalance the conservancy and protective aspects. With a lack of access, there would be a lack of public contact with the area and the many and varied reasons for initially preserving the bog may become forgotten. Diminishing public awareness could lead to a loss of interest and concern, resulting in an indifferent attitude as to the future use of the land. Since the area is already publicly-owned, it could become an attractive source of revenue through commercial development if the present land use controls are not kept in effect.

Probably the most easily quantifiable loss in terms of public use would be suffered by the nearby elementary schools. Even in its existing condition, at least 600 pupils from grades 2 through 7

go on field trips through the Nature Reserve at various times of the year. At present, the only organized student utilization appears to be restricted to schools near enough to permit easy bicycling or hiking to the site. More distant Delta schools requiring charter buses tend to use the more extensively developed bog environment on display at the Richmond Nature Park.

It is contended that the bog environment, as contained within the Nature Reserve boundaries, is not a stable ecosystem but is undergoing rapid succession due to outside influences. Without the presence and control of adequate buffer areas, it is considered doubtful as to whether the Nature Reserve can maintain its true bog character. If such is the case, it may be desirable for the public to have the opportunity to view the area while it remains a bog and observe the transitions that occur through the natural process of succession.

While the decreased accessibility may reduce the frequency of misuse, the lack of public use may prevent damages from being detected. The loss of access would also inhibit the control capabilities of police and fire protection personnel.

In conclusion, the basic aim of this alternative is to prevent potential overuse of the area and to suggest redirection of development energies towards more suitable sites for active park use. The desirability of guarding the area from overdevelopment, however, is questioned by the uncertainty of the Nature Reserve's ability to maintain its integrity over time in view of its evolving incompatibility with the surrounding uses.

2. MINIMUM DEVELOPMENT.

The Minimum Development alternative essentially proposes a restoration of the works that took place during the 1971 OFY project, previously described and outlined in Table 5. The purpose of this level of development is to permit public enjoyment of the area for such passive uses as nature walks, bird watching, photography and

non-collecting educational field trips. However, overall public use will be limited by carefully restricting development in certain sensitive areas, to prevent overuse and other adverse impacts. The developments envisioned are primarily designed to improve the educational potential of the area with a minimum of environmental disturbance to the site. In this regard, no clearing of land or changes to the existing drainage patterns are proposed.

Specific developments would include upgrading the existing trail system by installing more boardwalks in the wetter trail areas, erecting a site map at the main trail entrance showing established trails and points of interest, reconstruction of the observation tower, vegetation markers along the trails and the creation of a sheltered meeting place near the entrance trail.

Of the above items, only the building of the meeting place could be considered a new development. However, this structure is intended to replace the previously described Theatre meeting area. The most suitable location for it would be in the vicinity of the old Theatre. This proposed site is relatively flat, dry, surrounded by large trees and near to the main trail entrance. The purpose of the meeting place would be to offer protection from adverse weather conditions and facilitate on-site teaching. It could also function as a rendezvous or organizing area for school groups. The structure could simply be a roof supported by posts covering a long table with benches on either side and be constructed of rough materials consistent with the character of the surroundings. Figure 6 illustrates the type of structure envisioned.

Since any developments are designed to encourage public use, the subsequent need for washroom facilities and garbage containers should be recognized and provided for. Portable toilets are probably the only feasible method of dealing with sanitary wastes and the optimum location for such facilities be near to the meeting place and entrance trail. Unfortunately, the desired locations of the toilets and garbage containers are not easily accessible for servicing by the presently available routes. The only practical

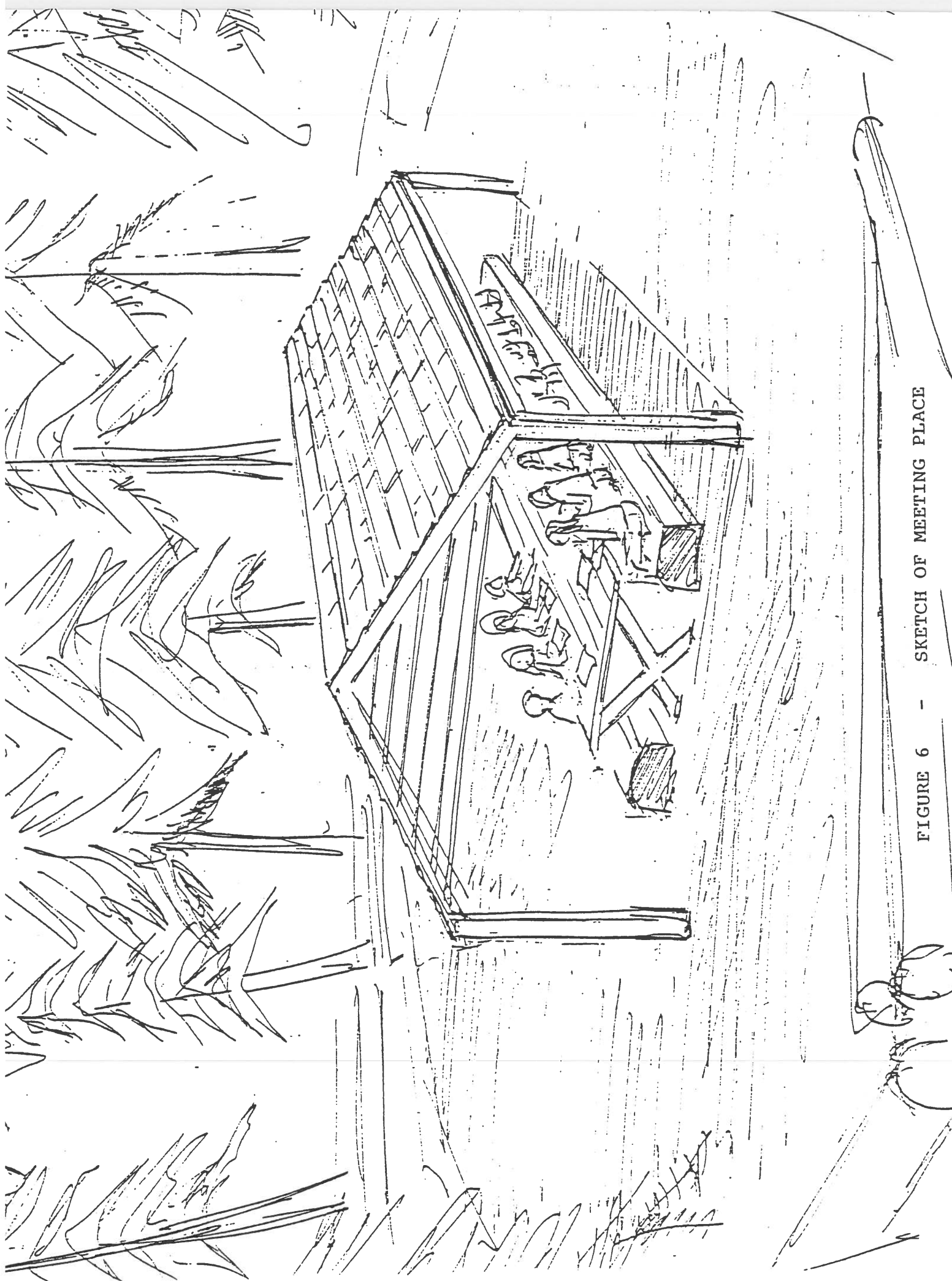
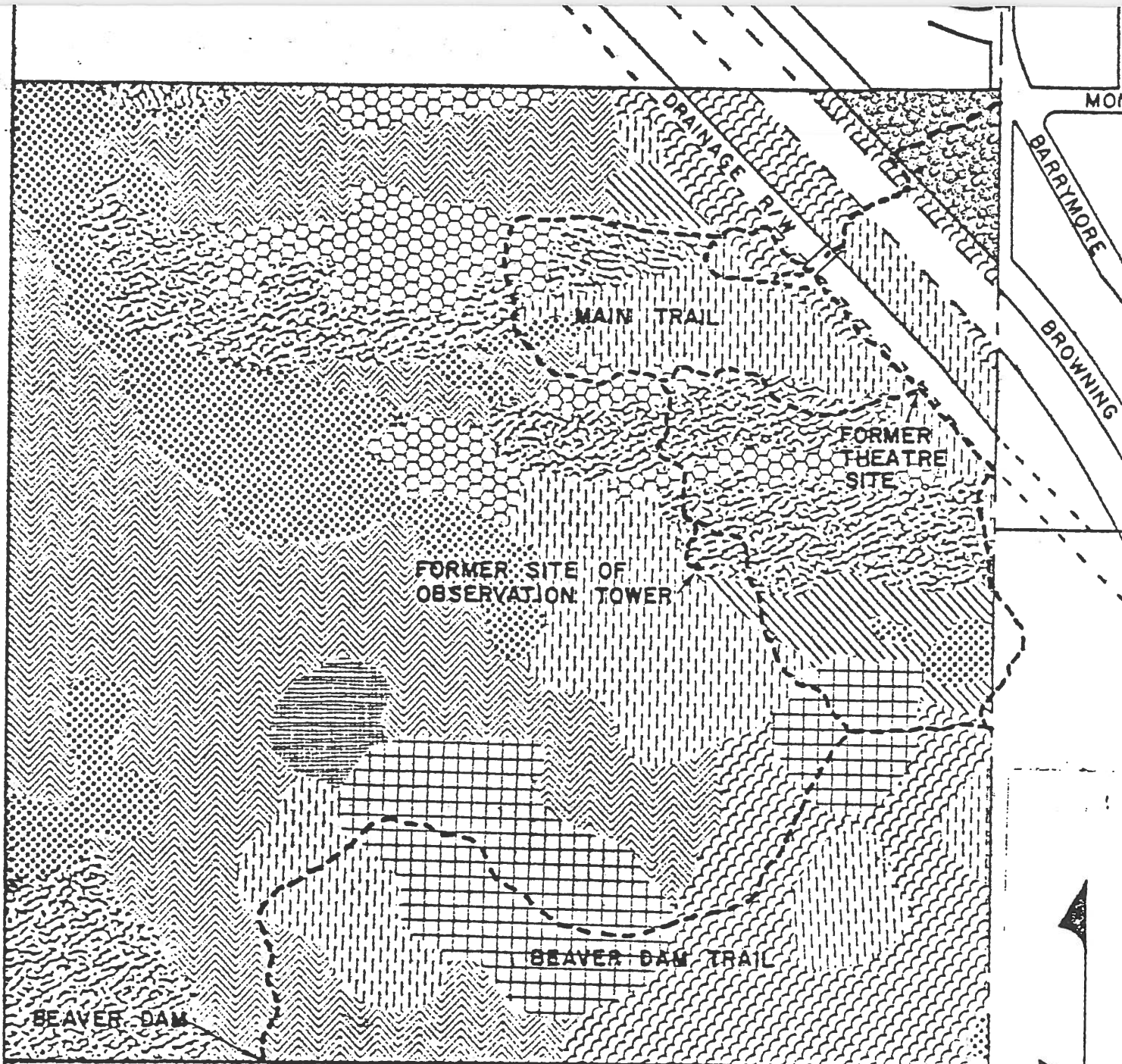


FIGURE 6 - SKETCH OF MEETING PLACE

access is from 72nd Avenue to the south, over the rail crossing and private property of Western Peat Moss Ltd. to the drainage canal right-of-way road. It is possible, through negotiations with the company involved, that access may be granted for service and maintenance vehicles. However, public vehicular access would continue to be restricted to the official park entrance at the corner of 108th Street and Monroe Drive.

Trail developments should take the form of repairs and additions to stairways and boardwalks of the existing system, but not involve the clearing of any new areas for trails. The present trail system is indicated in Figure 7. The intention is to allow safe and comfortable access to and within the Nature Reserve, even in wet weather, with a minimum of disturbance to the adjacent vegetation. Some portions of the bog trails are frequently wet and this has led to a widening of the trails by the public's attempts to avoid the high water table. The addition of more boardwalks should reduce the degree of trampling, maintain reasonably narrow path widths and allow more usage over a greater part of the year. At the present time, utilization by elementary school children is generally confined to the months of April to June and occasionally September if it is a dry Fall. In some places, especially along the trail to the beaver dam, the surrounding vegetation is attempting to re-occupy the path and some trimming is necessary to restore the trail to its previous condition. From the park entrance at 108th Street to the Browning Drive right-of-way, minor repairs to the stairways would greatly assist movements on this steep embankment and would help to keep pedestrian traffic limited to a narrow path alignment.











Of benefit to the infrequent visitor and to the teacher directing group activities would be the establishment of a site map at the entrance to the Main trail and directional signs along the trails to indicate correct routes and provide orientation. Vegetation markers at appropriate points along the paths would be helpful in describing various plant species characteristic of bog communities as well as those invading species which represent successional



EXISTING TRAIL SYSTEM

FIGURE 7

SCALE: 1" = 400'

-  SECOND GROWTH FIR AND DECIDUOUS (Maple, Dogwood, Birch, Alder)
-  ALDER WITH LIGHT SALMONBERRY UNDERSTOREY
-  LARGE MATURE CEDAR, HEMLOCK, SPRUCE
-  OPEN MEADOW (Labrador Tea, Brocken Fern, with scattered dwarf Pine, Hemlock, Cedar, Spruce)
-  SHORE PINE WITH LABRADOR TEA, SALAL GROUND COVER
-  MIXED DECIDUOUS (Alder, Birch, Willow, Pacific Crabapple)
-  DENSE HARDHACK - OPEN
-  HEAVY SNAG - DEADFALL AREA (Dense Willow, Crabapple, Hardhack Mix)
-  STUNTED PINE, CEDAR, HEMLOCK, SPRUCE MIX
-  LOGGED AREA - SECOND GROWTH ALDER, WILLOW - DEADFALLS

changes. If certain species of wildlife are regularly sited in specific areas, the best vantage points could have accompanying signs providing background information. These instructional and educational markers would permit visitors to conduct self-guided tours and would provide discussion topics for teachers and their students.

An ancillary structure that could easily be incorporated into the existing trail system involves the reconstruction of the observation tower. This structure once occupied a site at the interface of an open meadow and a wooded area. Such a feature not only adds variety and interest to a nature walk but also provides a wider perspective with which to view the components and relationships within the bog environment.

With the proposed developments as described above, protection of the area from incompatible public uses such as motorcycle riding becomes vital. Police patrols alone probably will not be completely effective in deterring this form of recreation from the site and the necessity of further measures is anticipated. Control of access routes at the point of entry may be effected by installing additional fencing at the north and east park boundaries adjacent to the drainage canal and constructing a post barrier at the east end of the bridge over the canal. With prominent signs prohibiting vehicular use within the park and the drainage canal acting as a natural barrier, it is felt that the largest and most sensitive portion of the Nature Reserve can be protected from this kind of misuse. The Nature Reserve land to the east of the drainage canal is not as susceptible to damage and so similar access control mechanisms may not be necessary. It is hoped that with the construction and regular maintenance of the developments there will evolve a sense of respect and appreciation for the area, relieving the need for constant policing.

In the foregoing descriptions of possible developments, the focus has been on the positive attributes but there are also certain drawbacks which should be considered. Attracting the public to the site will create or aggravate vehicle parking problems, the

necessity for pedestrians to cross frequently used railroad tracks and the acute need for effective police and fire protection.

Because of the limited use the area currently receives, the present policy of roadside parking on 108th Street has adequately satisfied the parking needs. Increasing the public use, however, in the absence of additional parking facilities may cause traffic and public safety problems and generate adverse reactions from surrounding residents. The alteration of Nature Reserve land adjacent to 108th Street to provide angle or 90 degree parking has not been included in this level of development because similar facilities did not exist previously and their creation would necessitate removal of vegetation and filling of land. Inasmuch as the proposed developments may be of limited appeal to the general public, but of more interest to education or naturalist oriented individuals and groups, the frequency and intensity of use may not increase significantly to warrant extensive changes to the present parking capabilities at this time. It is suggested that these facilities be developed to satisfy a recognizable demand, rather than constructing in response to theoretical projections.

The Burlington Northern railway tracks cutting through the Nature Reserve at the base of the embankment represents a serious public safety concern. This set of tracks carries an average of 10 trains per day, travelling at speeds of about 45 mph. Arrangements are currently being made to have the present pedestrian access route officially recognized as a public crossing and will require on-coming trains to sound a warning whistle. The responsibility of the Municipality includes the provision and maintenance of pedestrian warning signs as well as the installation of a boardwalk across the tracks to facilitate pedestrian movement. Although compliance with these basic requirements satisfies the legal liability, the weight of the moral responsibility makes this access route an unattractive alternative.

With increased use, the need for fire protection and policing become essential to control the previously described problems of vandalism, pilferage etc. Access may be available by the same

route as for service and maintenance vehicles, however, fire protection personnel still face the problem of obtaining on-site water for fire-fighting purposes. Although ponds could be dug to provide water reservoirs for portable pumps, this action could have significant and adverse reactions on the drainage patterns and groundwater levels in localized areas. Suspended organic matter could clog pumps and hose nozzles. The drainage canal appears to represent a viable alternative source of on-site water, however, its depth and volume may not be sufficient at all times of the year to supply adequate protection. The fire department may therefore be forced to rely on the restricted quantities of water they are capable of carrying to the site in their trucks.

Regardless of the motives for development, any increase in human contact with the area will cause displacement of wildlife due to their inability to accept human intrusion on even very restricted levels.

The most deceptive and insidious aspect of this proposal is that it may initiate a process of continuing development that would ultimately lead to the highest, but not necessarily the best, use of the land. In this regard, it may be difficult to resist pressures to incorporate more extensive developments at a later date that may be highly beneficial from a public use viewpoint but may be detrimental to the preservation of the vegetation and wildlife of the bog.

Thus, this proposal offers an opportunity for the public to maintain an awareness and an appreciation for the Nature Reserve at a minimum of environmental disturbance and economic cost. However, it does so at the risk of encouraging public use in spite of insufficient protective measures and allowing the possibility of additional incompatible developments in the future.

3. MODERATE DEVELOPMENT

This level of development includes all of the proposals outlined in the previous alternative and adds several components intended to resolve some of the difficulties or problems inherent in the previous plan.. These additional proposals were not included in the Minimum Development concept because they did not exist previously or their implementation requires some degree of site modification. The possible developments include enlarged parking facilities with an observation deck at the 108th Street entrance, a gravelled access road on the drainage canal right-of-way with limited parking, a picnic site, improvement in the water storage capabilities of the canal and ditches as well as the creation of a new nature trail. This development concept attempts to broaden the appeal of this unique environment to a wider spectrum of potential users. By providing safe, convenient access to the site, interest in the area should extend beyond the serious nature student to include more casual observers, families, senior citizens and physically handicapped persons.

To facilitate and encourage use of the park entrance at 108th Street, several parking spaces and an observation platform should be provided. An artist's conception of this proposal is shown in Figure 8. The creation of on-site parking would reduce traffic congestion, accident potential and alleviate the concerns of neighbouring residents regarding parking on boulevards. An observation deck at this elevation would provide an excellent overview of the Nature Reserve lowland about to be entered. This facility would permit an immediate appreciation of the site's relative size and position with regards to the vast area of Burns Bog and prominent geological formations. It would be an extremely valuable teaching aid in allowing the student visual reinforcement of an instructor's introductory statements on the geological history of the general area, transition zones and vegetational changes with respect to physiography. The creation of both of these amenities would also serve to better define the park entrance and facilitate location problems for unfamiliar visitors.

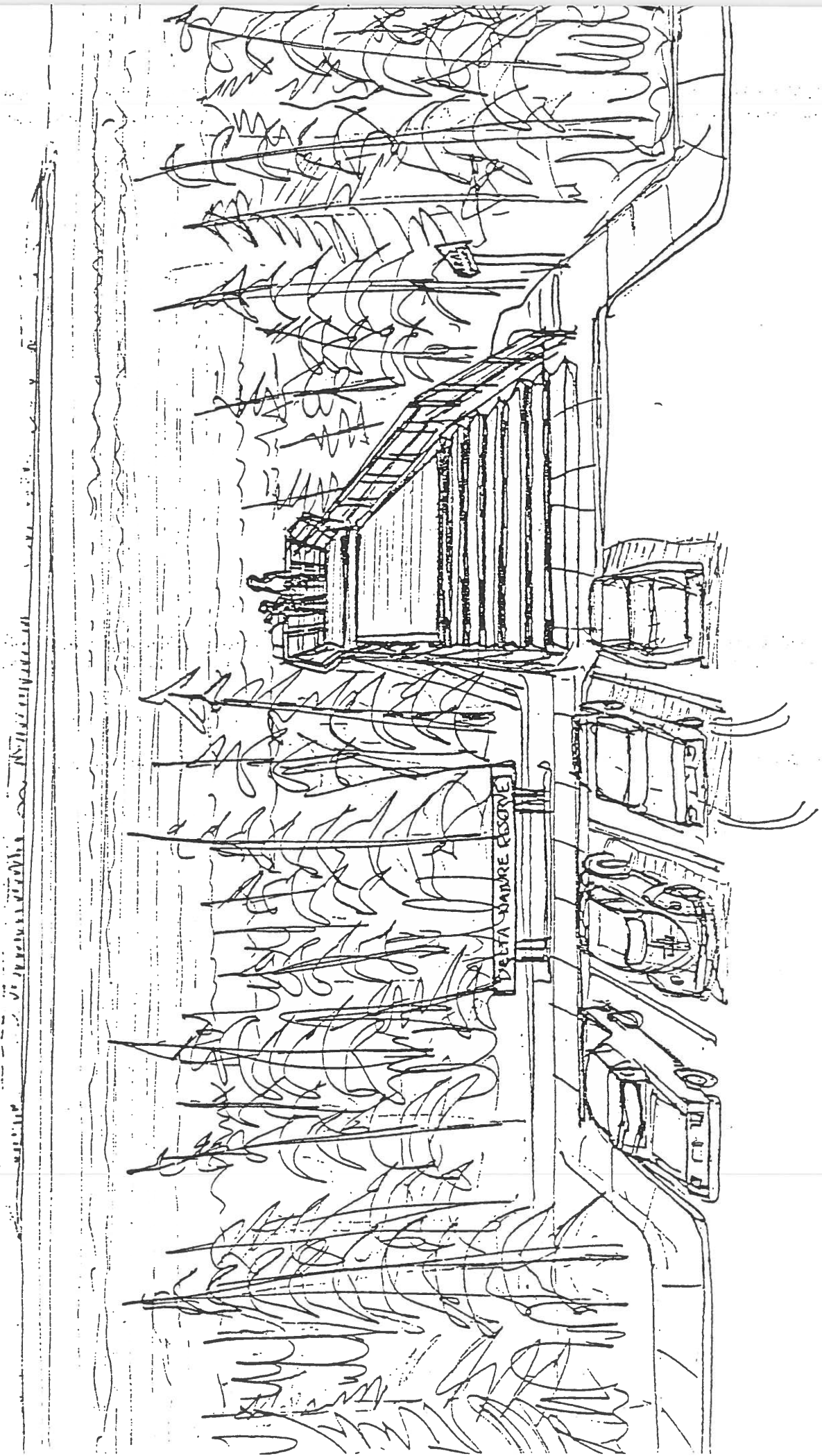


FIGURE 8 - SKETCH OF 108TH STREET ENTRANCE

A gravelled public access route via 72nd Avenue and the drainage canal right-of-way would be able to provide certain features not feasible for development at the present entrance. A picnic area on the inside of the eastern boundary fence could be developed with minimal site alteration as the land is presently flat, generally dry and free of heavy brush. This site is adjacent to the area proposed under Minimum Development for construction of the meeting place. A limited parking area at the end of the access road would be on the other side of the picnic site and vehicles would be prevented from entering the Nature Reserve by the existing fence. The proposal could appear as shown in Figure 9. This development would encourage a greater usage of the park by the family unit and would allow older and physically handicapped persons direct access to the bog environment without having to negotiate the steep embankment or the pedestrian railway crossing. The additional parking created would also relieve the pressure on the limited facilities at 108th Street. Upgrading of the present hog fuel roadway to a gravel base would be necessary to cope with heavier traffic volumes and would improve the quality of the access for fire, police and maintenance vehicles.

The fire hazard potential of the area would be expected to continue to increase with usage, therefore several proposals are suggested to improve the fire protection capabilities. A weir system could be created in the Nature Reserve portion of the drainage canal to increase its water storage capacity and function as a reservoir for fire fighting purposes. The perimeter ditches could also be cleaned out and gates installed to retain high ground water levels as well as providing additional sources of water for the portable pumps. These modifications would create a better physical firebreak and a more effective barrier to undesirable uses such as motorcycle and horseback riding. Although campfires and portable cooking stoves would be strictly prohibited, it is anticipated that the picnic and meeting place areas would be the most likely sources of origin for fires. Sandfilling of these particular sites has therefore been suggested to reduce this danger.

The creation of a new nature trail, roughly parallel to the existing north-south path, connecting the main and beaver dam trails could be

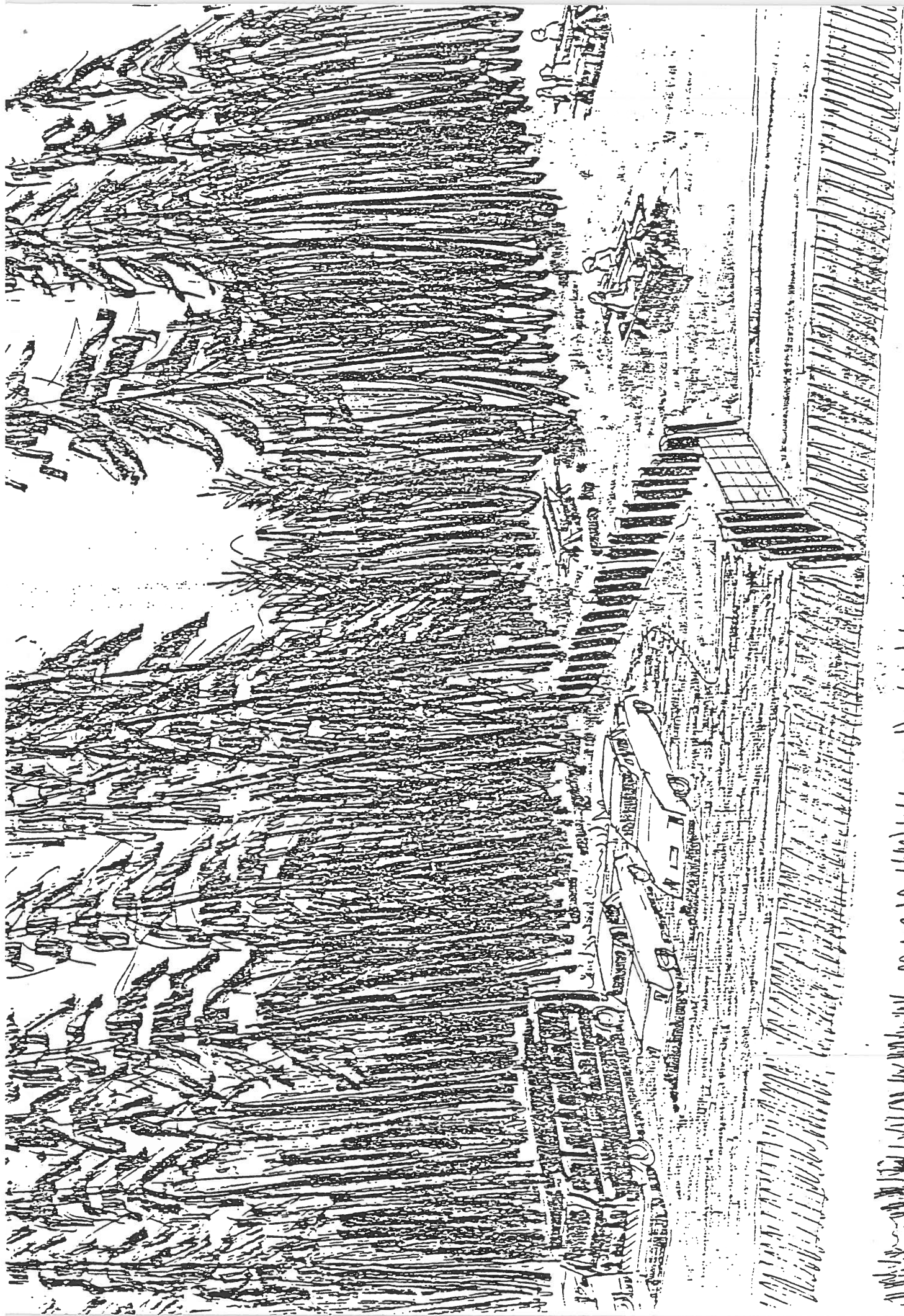
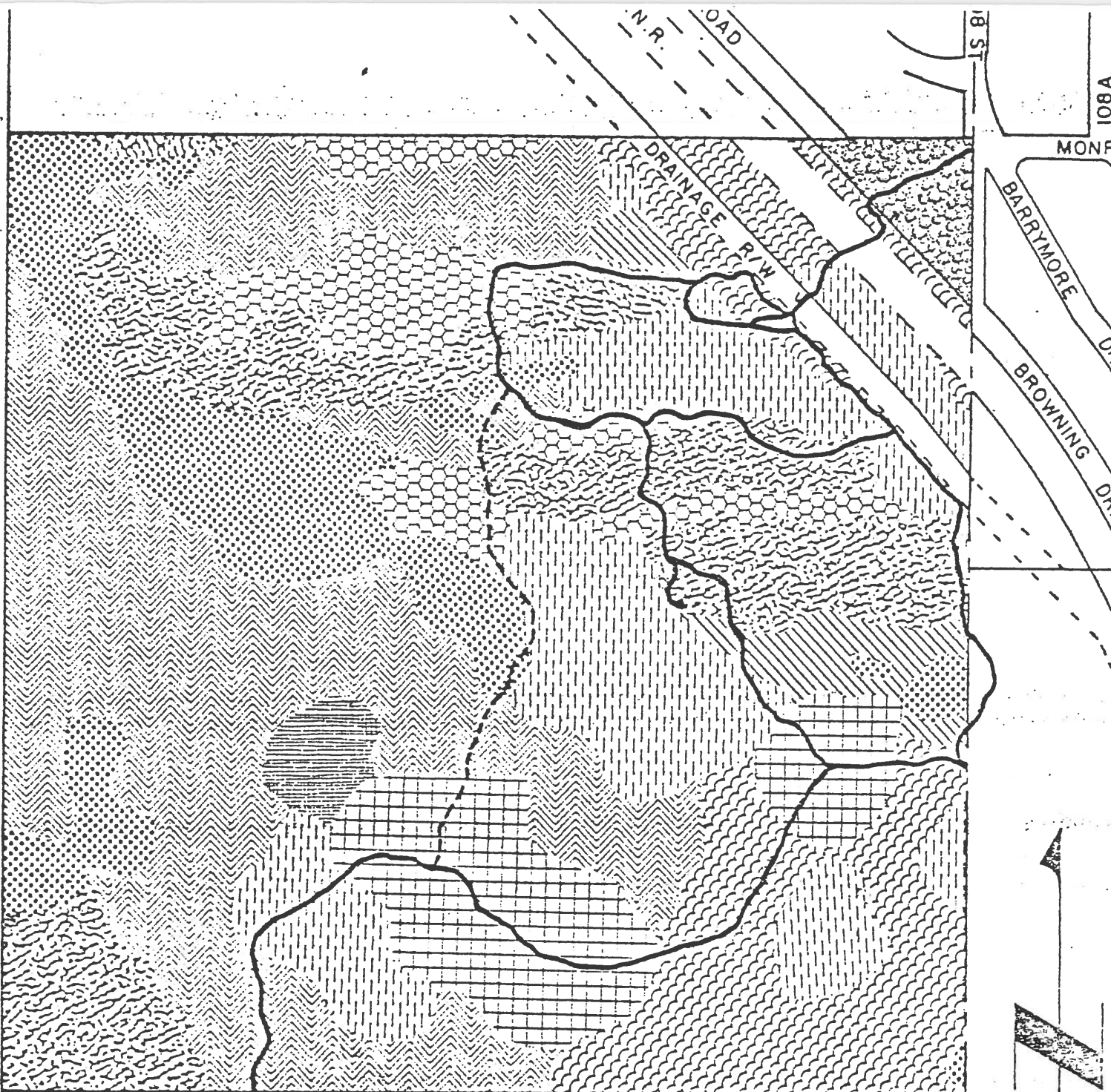


FIGURE 9 - SKETCH OF PICNIC AREA

beneficial from educational and path maintenance viewpoints. It would offer variety in trail selection and provide new area for observation and interpretation. This additional connector route would reduce the usage of the existing north-south trail and permit the diversion of traffic onto one route if the other is being over-used or in need of modification. A possible path configuration, providing exposure to many different vegetational zones, is shown in Figure 10. However, the final alignment selected for any new pathway should follow existing animal trails, as in the original trail developments.











The developments contemplated in this proposal are highly desirable in terms of improving the educational and passive park facilities and maximizing the control capabilities, but do so at the expense of the existing environment. The creation of the parking facilities and the observation platform at the 108th Street entrance will require removal of a strip of vegetation along the top of the bank. Even though the platform suggested is a raised structure, selective topping of some trees in front will be necessary to permit a clear overview of the bog below. This will not only impact the vegetation but also eliminate some wildlife nesting sites and harbourage areas and may degrade the aesthetic value of the hillside. Similarly, the creation of any new trail necessitates the removal of vegetation and wildlife habitat along its alignment, adversely affecting the quality of habitat in adjoining areas by the proximity of human intrusion. Although blocking the drainage canal should not have a negative effect on the bog drainage system, widening of the canal may be required to provide sufficient water storage capabilities, thus encroaching further onto the adjacent Nature Reserve lands. The modifications to the perimeter ditches will also create a physical barrier to the migration of wildlife.

Providing a second public access via 72nd Avenue would present administrative and operational difficulties. Western Peat Moss Ltd. presently have an agreement with Burlington Northern Inc. regarding the private railway crossing at the foot of 72nd Avenue and are not anxious to see public use of this crossing. The company fears the results would be increases in traffic congestion, theft and vandal-



NEW TRAIL LOCATION

FIGURE 10
SCALE: 1" = 400'

-  SECOND GROWTH FIR AND DECIDUOUS (Maple, Dogwood, Birch, Alder)
-  ALDER WITH LIGHT SALMONBERRY UNDERSTOREY
-  LARGE MATURE CEDAR, HEMLOCK, SPRUCE
-  OPEN MEADOW (Labrador Tea, Bracken Fern, with scattered dwarf Pine, Hemlock, Cedar, Spruce)
-  SHORE PINE WITH LABRADOR TEA, SALAL GROUND COVER
-  MIXED DECIDUOUS (Alder, Birch, Willow, Pacific Crabapple)
-  DENSE HARDHACK - OPEN
-  HEAVY SNAG - DEADFALL AREA (Dense Willow, Crabapple, Hardhack Mix)
-  STUNTED PINE, CEDAR, HEMLOCK, SPRUCE MIX
-  LOGGED AREA - SECOND GROWTH ALDER, WILLOW - DEADFALLS

ism. To have a public crossing designated as a public one, Delta would be responsible for all necessary construction and maintenance costs, including the considerable expense of a set of automatic signal lights. This vehicular access route to the bog site would not be welcomed by the Delta Police as it would facilitate acts of vandalism and other inappropriate uses of the road. To ensure proper control of the area at night, a security gate may be required at the south end of the access road. This measure would, however, create further operational problems and expense involving the daily opening and closing of this route by Parks personnel.

There are several economic consequences that should be considered in a development proposal of this magnitude. Once a course of action has been determined, it appears feasible to expect Federal and possibly Provincial funding will be available for the majority of the expenses incurred during the initial construction phase. A summary of in-place construction costs for the major structures is included in Table 6. However, continued funding for maintenance purposes is not normally available and this responsibility will likely rest with the Delta Parks Department. It must be recognized that none of the proposed developments will be maintenance-free and some proposals, such as the control measures on the perimeter ditches and access road, will require more attention than others. It is difficult to anticipate the frequency and extent of the maintenance problems that may be encountered and so any estimate of annual costs would be very misleading. It may be more appropriate to first establish a finite budget which would set an upper limit of economic commitment to this park and confine the developments to that limit.

With improved facilities for parking in the north-east corner and the development of direct access to the bog site, additional pressures would be generated in the direction of active park developments. High development and maintenance costs of the foregoing proposals could be used as justification for promoting more extensive utilization of the area. This tendency toward maximizing the public usage would further intensify maintenance, policing and fire protection concerns and threaten the tranquil character of the park.

This alternative provides much more convenient access, better developed control measures and some expansion of passive park developments to attract a wider range of users. However, this will result in some loss of bog and upland habitat, increases in development and maintenance costs, heightened vulnerability to vandalism and an increase in pressure toward more active park uses.

4. EXTENSIVE DEVELOPMENT

This level of development describes the maximum degree of modification the park may receive yet retain its initial purposes as a Nature Reserve. It includes all of the developments suggested in the two previous proposals plus a nature house with caretaker facilities, ornamental ponds, paving of the access road as well as amenities such as water, sewer and electrical services. However, the necessity for the latter services is somewhat dependent upon the presence of a resident caretaker. This proposal is intended to promote the fullest public use and greatest public benefit of the area while remaining within the passive park limitations.

A nature house, situated in the area adjacent to the drainage canal and near the proposed picnic site and main trail entrance, would admirably serve a wide variety of purposes. Its primary function would be to provide ecological information to augment the physical experience of the surrounding bog environment through specimen displays of native wildlife and vegetation, informational pamphlets, slide presentations, etc. It would serve as a visitor's shelter from inclement weather as well as a meeting place and study area for education groups.

The inclusion of living accommodations into the nature house would permit an onsite resident caretaker to fulfill the dual roles of resource person and custodian. The caretaker would be available to answer visitors' enquiries and assist teachers in conducting tours of the Nature Reserve. By fragmenting school classes, a smaller teacher-pupil ratio would be created and the smaller group size would be better suited to the narrow nature trails. The caretaker could also be responsible for securing access control points at night and re-opening

the facilities in the morning. The presence of onsite staff as an authority figure would reduce the police and fire protection concerns because of vigilance against potential damages and the early detection of actual incidents of vandalism and fire.

The installation of water, sewer, electricity and telephone services would yield benefits to the nature house, caretaker, control agencies and the public. With heat and light facilities and the nature house could be open on a year-round basis and electrically-powered teaching aids, such as audio-visual equipment and light microscopes, could be used. All of the comforts normally associated with present day residential living would be feasible at this site, making the accommodations much more attractive to caretakers. Fire protection capabilities would be considerably strengthened by the construction of a water line into the site, allowing immediate reaction to fire by the custodian and eliminating the total reliance on the availability of store surface water or the limited quantities transported by fire trucks. A communications system, such as a radio telephone, for use by the caretaker would minimize the notification phase of emergency situations and improve the effectiveness of police and fire protection efforts. The availability of potable water in the picnic area for drinking and washing and the provision of complete sanitary facilities are amenities that would make the park better equipped and more attractive to the needs and desires of the general public.

Creating ornamental ponds to encourage waterfowl use of the area and for aesthetic purposes would be possible at this level of development. The caretaker and regular maintenance staff could operate feeding stations and provide supervision against predation or harassment of the birds. By promoting waterfowl use through the creation and protection of these feeding and loafing areas, better opportunities for observation and identification of bird species not normally encountered at this location would be offered. The ponds, as aesthetic components, would provide visual contrast with the wooded surroundings and contribute to the relaxing, passive character of the park.

With improved facilities being expected to cause an increase in public usage of the site, the gravelled access road would require up-grading to an asphalt paved surface. This action would further promote public use by improving the quality of the access, reduce the frequency of road maintenance and repairs and minimize dust problems. It would provide the type of road surface suitable for year-round use by all types of equipment, including heavy maintenance and emergency vehicles. A paved surface would make this a safer, more appealing entry route for bicycling enthusiasts as well.

This level of development would have the further effect of ensuring the continued usage of the site as a park. The degree of financial commitment involved in the implementation of the above proposals would preclude subsequent alternative development of the Nature Reserve for residential, commercial or industrial uses. Park development to the proposed extent would do the most to promote usage and make the existence of the park more apparent to the public, thereby increasing the public awareness of the value of the Nature Reserve. This awareness could extend beyond the boundaries of the park and heighten public sensitivities to proposed developments in the general area, resulting in a more critical evaluation of their impacts on the Nature Reserve. Thus, protection of the site would be aided through careful management of the immediate surroundings.

Although this concept optimizes the usage and public benefits of the site, it also maximizes the financial and ecological costs. Construction and maintenance costs of elaborate structures and services are of such a magnitude that their contemplation may be unrealistic from a practical viewpoint. The Nature House at the Richmond Nature Park offers an example of the type of structure proposed for the Delta site, including caretaker suite and class study facilities. This structure costs approximately \$97,000 with the majority of the expense borne by the Municipality of Richmond. Costs for a similar facility would likely be higher due to the remoteness of the area and the prerequisite need for services normally available at construction sites. Ongoing costs to maintain a development of this scale will require a considerable degree of financial commitment. For the Richmond Nature Park the

Municipality's operating budget is currently in excess of \$30,000 annually. Consideration of these economic factors should exert a significant influence in the assessment of this proposal.

Assuming the initial costs could be surmounted, the ecological costs should then be considered. Active encouragement of public patronage to maximize utilization of the extensive developments will subject the site to further environmental stress. Native wildlife species would be further discouraged from inhabiting the eastern bog perimeter adjacent to the drainage canal, increasing competition for habitats of marginal suitability and thereby reducing the chances for species survival. The expected increase in frequency of public use is anticipated to make even greater demands on the resiliency of the sensitive bog flora. Although the overall extent of damages to the bog ecosystem may be reduced through improved control mechanisms, the frequency of occurrence of vandalism, fire, etc. may increase in proportion to the increase in numbers of visitors.

Further problems may be incurred when altering the bog ecosystem to accommodate alien environments. The creation of ponds to encourage use of the area by waterfowl would require the construction of a marsh environment within the bog ecosystem. This would necessitate several significant changes from the present conditions. In addition to the site alterations caused by the initial excavations, control and manipulation of water levels within the ponds is vital to foster the growth of marsh vegetation. Changes to the water chemistry by such means as liming to neutralize the acidic qualities and artificial fertilization to improve the productivity would also be required. The presence of the ponds and the regulation of water levels could promote groundwater seepage towards these ponds, thereby inducing drier conditions in the surrounding environment, resulting in an accelerated rate of succession. This development component could therefore permanently alienate certain areas of native bog habitat and further jeopardize the future of the surrounding ecosystem.

An additional concern of this extensive development alternative is the increased pressure its implementation would exert in the direction of more active use proposals. Once the access and control difficulties are solved, it may be difficult to resist the feasibility of incorporating more intensive uses, such as overnight camping and typical residential park playgrounds, into the park structure. However, such continued development would not enhance the natural wilderness aspect of the Nature Reserve, which was a prime motivating force for its initial preservation.

Of the four development plans considered, this alternative would provide the most complete and sophisticated array of facilities. The objectives of the suggested amenities are to maximize the educational potential and fully develop the security and convenience aspects of the site. The attendant costs associated with this level of development may, in a practical sense, be its fundamental disadvantage and ultimately decide the viability of this option. However, these extensive developments would intensify the stress on the tolerance levels of the natural flora and fauna to human invasion and provide the justification for continued development and alienation of reserve lands.

CONCLUSION

From an examination of the use and interest the Nature Reserve has generated in the past, and the increasing popularity of a similar park in Richmond, the need for this type of facility is unquestionable. Although limited numbers of students still visit the Nature Reserve on a regular basis, the full educational value cannot be realized because of the present conditions and the deteriorating or non-existent facilities. If this situation persists, the use of the area by school groups will continue to decline and potential visitors will locate alternative sites which meet their needs. The character of the park is not perceived to be of wide-ranging public appeal, but of special interest to educational and naturalistic-oriented activities. As a result, the optimum public use of the park will be achieved through developments which are complementary to these particular viewpoints.

From the foregoing considerations of the various development proposals, the impressions that are formed suggest the direction development should take to provide a viable park environment. If no development is permitted, the isolation of the Nature Reserve from public use will remove an important aspect from its established purpose but may not necessarily ensure it from further environmental changes. In addition, the successional changes that are occurring in this section of the bog are of educational importance and public viewing should be encouraged to allow an appreciation of its significance. Neither the Minimum nor the Moderate proposals are considered to be ideal because of their under and over-development deficiencies. The location of the Nature Reserve and its attractive "natural" qualities make the elaborate plans of the extensive development description appear somewhat extravagant for the area as well as prohibitively expensive to implement. As a result, a hybrid plan involving the components of the Minimum proposal with certain aspects of Moderate development would yield the best approach to the mitigation of the public use-environmental protection conflict of park modification. This level of development should include the following features: all of the items described

in the Minimum proposal with the further creation of a parking area and observation deck at the 108th Street entrance, a weir system on the drainage canal and a gravelled access road along the canal right-of-way for use by service vehicles only. It is felt this type of development would satisfy the essential needs of the park's prime users with a minimum of environmental disruption.

RECOMMENDATION

- ✓ A. Irrespective of the presence or absence of any development of park facilities:
- The Nature Reserve site must be protected from vandalism and incompatible recreational uses.
 - There should be no attempt to accelerate the drainage of the lowland bog area.
 - Long range plans for adjacent and surrounding properties must take into account direct and indirect impacts on the Nature Reserve.
- B. If any degree of park development is undertaken:
- a permanent maintenance program should be established.
 - current negotiations for a public pedestrian crossing of the Burlington Northern Railway tracks should be pursued to completion.
 - all group use facilities should be restricted in their location to the peripheral edge of the bog lowland adjacent to the drainage canal.
 - the emphasis of the project should be towards improving the on-site educational facilities and less concerned with creating general public recreation attractions.
 - the potential appeal of the Nature Reserve to the full range of educational levels is such that the Delta School Board and Douglas College should be given an opportunity to contribute their resources to the development of this site.

- the extent of development should not exceed the magnitude of the proposal described in the Conclusion of this report.

Van Nes, D. et al. 1971

The Delta Nature Reserve. Report for
Federal Opportunities for Youth Pro-
gram. 29 pp.

2

TABLE 1 - AVERAGE MONTHLY, ANNUAL MEAN AND EXTREME TEMPERATURES

MONTH	LADNER STATION (°C)	NEW WESTMINSTER STATION (
JANUARY	2.1	2.4
FEBRUARY	4.1	4.0
MARCH	5.2	6.3
APRIL	8.1	9.8
MAY	11.7	13.3
JUNE	14.4	15.7
JULY	16.3	18.0
AUGUST	16.1	17.7
SEPTEMBER	13.4	15.3
OCTOBER	9.6	10.8
NOVEMBER	5.7	6.0
DECEMBER	3.4	3.9
Annual Mean	9.2	10.3
Maximum	35.0	37.2
Minimum	-16.7	-18.9

Source: - Atmospheric Environment Service.

TABLE 2 - AVERAGE MONTHLY AND TOTAL ANNUAL PRECIPITATION

MONTH	LADNER STATION		NEW WESTMINSTER STATION	
	<u>INCHES</u>	<u>MM</u>	<u>INCHES</u>	<u>MM</u>
JANUARY	4.51	114.6	8.42	213.9
FEBRUARY	3.89	98.8	6.18	157.0
MARCH	3.09	78.5	5.77	146.6
APRIL	2.21	56.1	3.65	92.7
MAY	1.74	44.2	2.84	72.1
JUNE	1.57	39.9	2.73	69.3
JULY	1.03	26.2	1.50	38.1
AUGUST	1.34	34.0	1.79	45.5
SEPTEMBER	2.35	59.7	3.28	83.3
OCTOBER	4.32	109.7	6.57	166.9
NOVEMBER	5.09	129.3	7.51	190.8
DECEMBER	5.14	130.6	9.30	236.2
ANNUAL	36.28	921.5 MM	59.54	1512.3 MM
SNOWFALL	14.5	36.8 CM	27.8	70.6 CM

Source: Atmospheric Environment Service

TABLE 3 - FLORA OF THE BURNS BOG AREA

A. Incomplete list compiled by Dr. K.S. Beamish of the University of British Columbia on June 8th, 1968.

1. DECIDUOUS TREES

COMMON NAME

Betulaceae - (birch family)

Alnus oregona Nutt.

Betula papyrifera Marsh.

Cornaceae - (dogwood family)

Cornus canadensis L.

C. Stolonifera Michx.

Bunchberry

Red osier dogwood

Salicaceae - (willows)

Salix geyeriana Anderss.

S. hookeriana Barr.

Populus tremuloides Michx.

II. EVERGREEN TREES

Cupressaceae

Thuja plicata D. Don.

Western Red Cedar

Pinaceae

Picea sitchensis Carr.

Pinus contorta Dougl.

Tsuga heterophylla Sarg.

Sitka Spruce

Jack Pine

Hemlock

III. SHRUBS AND OTHER SEED PLANTS

Compositae - (dandelion family)

Hypochaeris radicata L.

Cruciferae - (mustard family)

Careamine breweri Wats.

Capsella bursa-pastoris (L.) Medic

Rorippa islandica (Oed.)

Barbarea orthoceras Ledeb.

Cyperaceae - (sedges)

Carex canescens L.

C. apuciflora Lightf.

C. Kelloggii W. Boott

C. obnupta Bailey Var. obnupta

C. paupercula Michx.

C. phyllomanica W. Boott.

C. rostrata Stokes

Eriophorum chamissonis C.A. Mayer

E. angustifolium Roth.

Cotton grass

Droseraceae - (sundews)

Drosera rotundifolia L.

COMMON NAME

Ericaceae - (heather family)

Gaultheria shallon Pursh
Kalmia polifolia Wang
Ledum groenlandicum Oeder
Menziesia ferruginea Smith
Oxycoccus quadripetalus Gilib
Vaccinium deliciosum Piper
V. myrtilloides Michx.
V. ovalifolium Smith
V. uliginosum L.

Salal
 Bog Laurel
 Labrador Tea
 False azalea
 Cascade blueberry
 Velvet-leaf blueberry
 Oval-leaf huckleberry
 Bog blueberry

Gramineae - (grasses)

Agrostis exarata Trin.
Aira praecox L.
Alopecurus pallescens Piper
Holcus lanatus L.
Phalaris arundinaceae L.

Bent Grass
 Early hair grass
 Velvet grass
 Reed canary grass

Juncaceae - (rushes)

Juncus bufonius L.
J. effusus L.

Common toad rush
 Common rush

Liliaceae

Maianthemum dilatatum - (Wood)
 Nels. & McB.

Wild lily of the valle

Primulaceae

Lysimachia thyrsiflora L.
Trientalis arctica Fisch.

Rosaceae

Malus fusca (Raf.) Schneid.
Potentilla rivalis Nutt.
Rosa nutkana Presl.
Rubus chamaemorus L.
Rubus ursinus Cham.
Sorbus aucuparia L.
Spirea douglasii Hook.

Crabapple
 Cinquefoil
 Nootka rose
 Cloudberry
 Trailing blackberry
 Mountain ash
 Hardhack

B. Flora observed in the Delta Nature Reserve in the summer of 1971.

SPECIES NAME

COMMON NAME

Prunus emarginata
Acer macrophyllum
A. circantum
Rhamnus purshiana
Vaccinium Canadense
V. Oxycoccus intermedium
Spirea douglasii
Sorbus sitchensis
Sambucus callicarpa
Mahonia spp.
Lonicera involucreta

Bitter cherry
 Broadleaf maple
 Vine maple
 Cascara
 Canada blueberry
 Cranberry
 Hardhack
 Sitka ash
 Red-berry elder
 Mahonia (Oregon Grape)
 Black twinberry

<u>SPECIES NAME</u>	<u>COMMON NAME</u>
<u>Viburnum pauciflorum</u>	Squashberry
<u>Spiraea discolor</u>	Ocean Spray
<u>Rubus leucodermis</u>	Black cap
<u>Menziesia ferruginea</u>	False Azalea
<u>Oplopanax horridus</u>	Devil's club
<u>Rubus ursinus</u>	Trailing blackberry
<u>Trillium ovatum</u>	Western trillium
<u>Anaphalis margaritacea</u>	Pearly everlasting
<u>Achillea millefolium</u>	Yarrow
<u>Gallium boreale</u>	Northern Bedstraw
<u>Mimulus lewisii</u>	Red Monkey Flower
<u>Ranunculus occidentalis</u>	Western buttercup
<u>Tanacetum vulgare</u>	Tansy
<u>Lysichiton kamtshatcense</u>	Skunk cabbage
<u>Lathyrus nuttallii</u>	Purple pea
<u>Penstemon spp.</u>	Penstemon
<u>Epilobium angustifolium</u>	Fireweed
<u>Cirsium lanceolatum</u>	Common thistle
<u>C. edule</u>	Indian
<u>Urtica lyallii</u>	Stinging nettle
<u>Typha latifolia</u>	Cat-tail
<u>Equisetum arvense</u>	Common horsetail

COMMON FERNS

<u>Pteridium aquilinum pubescens</u>	Bracken
<u>Athyrium filix-femina</u>	Lady
<u>Polystichum munitum</u>	Sword
<u>Adiantum pedatum aleuticum</u>	Maidenhair

OTHER PLANTS IDENTIFIED

Duckweed
Liverwort

* Source: - 1971 Delta Nature Reserve Report

TABLE 4 - AN INCOMPLETE LIST OF FAUNA AS OBSERVED IN THE DELTA NATURE RESERVE IN THE SUMMER OF 1971 *.

BIRDS

Order Falconiformes

Red Tailed Hawk - Buteo jamaicensis

- a soaring hawk, seldom hovers, usually seen perched on high snags.
- three identifiable individuals.
- feed mainly on Peromyscus - indication of unsuccessful attack on rabbit (animal was decapitated; the head and shoulder were found near victim's body).

Order Galliformes

Ruffed Grouse - Bonasa umbellus

- sighted mainly in scrub deciduous

Ring-necked Pheasant - Phasianus colchicus

- sighted predominantly on hillside.
- feed mainly on seeds and berries.

Order Columbiformes

Band Tailed Pigeons - Columba fasciata

- sighted in high hemlock, cedar boughs
- identifiable by large tail with light band

Rock Dove - Columba livia

- no evidence of nest sites; but have been observed on a number of occasions.
- noisy flight characteristic.

Order Strigiformes

Screech Owl - Otus asio

- no. of pellets indicate Peromyscus, as prime food source

Order Apodiformes

Rufous hummingbird - Selasphorus rufus

- diving aerial display during courtship by male - comes within inches of female.
- to counteract wetabolic requirements, enters a state of turgor at night.

Order Piciformes

Pileated Woodpecker - Dryocopus pileatus

- very large distinctive black, red coloration.

Hairy Woodpecker - Dendrocopus villosus

- sighted on a number of snags throughout reserve.

Red-shafted Flicker - Colaptes cafer

- feed on insect larvae.

Order Passeriformes

Western Flycatcher - Empidonax difficilis

- descend from high branches to capture flying insects.

Barn Swallow - Hirundo rustica

- sighted on hillside, along canal
- insect feeders

Steller's Jay - Cyanocitta stelleri

- very common
- distinctive flight - alternating flapping and soaring
- very harsh pitched call
- nest robber, feed on eggs, berries

Black-capped Chickadee - Parus atricapillus

- common
- acrobatic movements in trees
- feed on insects.

Common Bushtit - Psaltriparus minimus

- large flocks; travelling from tree to tree
- very similar in habit to chickadee
- feed on seeds

Brown Creeper - Certhia familiaris

- insect feeder

Long-Billed Marsh Wren - Telmatodytes palustris

- nest sites along canal cottonwoods, willows
- feed mainly on insects.

Robin - Turdus migratorius

- most common bird; found throughout reserve.
- feed on elderberry (esp.) salmonberry, insects

Cedar Waxwing - Bombycilla cedrorum

- feed on fruit, insects, berries.
- very beautiful; almost silent monotone call

Red-eyed Vireo - Vireo olivaceus

- feed on crawling insects from the foliage of shade and forest trees.
- nest site in fork of branch along canal.

Yellowthroat - Geothlypis trichas

- predominant in shore pine meadows
- insectivorous

Wilson's Warbler - Wilsonia pusilla

- sighted near entrance sign.
- insectivore

Western Tanager - Piranga ludoviciana

- fruit eaters (salmonberry)
- not very common

American Goldfinch - Spinus tristis

- abundant on hillside feeding on dandelion seeds.

Rufous-sided Towhee - Pipilo erythrophthalmus

- abundant
- feed on insects, berries

White-crowned Sparrow - Zonotrichia leucophrys

- seeds predominantly

Fox Sparrow - Passerella iliaca

- ground feeder, insects, seeds

MAMMALS

Order Insectivora

Wandering Shrew - Sorex vagrans

- near canal (1)
- voracious eater, may consume more food per day than body weight.
- eats all kinds of insects, earthworms.

Coast Mole - Scapanus orarius

- (2 plus) hillside, canal trail
- hair is velvet in appearance, uniform length
- food is mainly earthworms, insects

Shrew Mole - Neurotrichus gibbsi

- (5) canal trail
- forages on surface, more so than the above
- food primarily earthworms, isopods

Order Lagomorpha

Snowshoe (Varying) Hare - Lepus americanus (10 plus)

- canal, grassy hillside, road
- do not burrow, form depressions in sheltered thickets or within exposed roots of stumps
- observed feeding on grasses, Equisetum

Order Rodentia

Northwestern Chipmunk - Eutamias amoenus felix

- (7) canal, roadside
- feed on berries (salmon, thimble) and seeds
- observed feeding on bitter cherry fruit

Chickaree (Douglas Squirrel) - Tamiascirus douglasi

- (8), shore pine meadow, hillside, Cedar-Hemlock mix
- food consists of seeds, berries, mushrooms (esp.) seeds of Douglas fir, pine, broad-leafed and vine maples, alder catkins, huckleberries.
- nest in tree cavities and are made of fine strands of cedar bark and of moss.

American Beaver - Castor canadensis

- no actual sightings
- probably have burrow along canal bank
- willow, alder predominant food source.

Deer (white-footed) Mouse - Peromyscus maniculatus

- (five plus) canal fringes
- feed on a variety of plant and animal foods
- seeds, berries, grasses, insects

Porcupine - Erethizon dorsatum

- (1) adventure trail
- feeds upon green vegetation and the bark of trees (esp. pine).
- possible den site among fallen logs near adventure trail.

Order Carnivora

Red Fox - Vulpes fulva

- no personal sightings
- food includes deer, mice, birds, insects, berries

Black Bear - Ursus americanus

- (2) open meadow
- great deal of fecal evidence throughout
- feed predominately on skunk cabbage, salmonberry, insects.

Raccoon - Procyon lotor

- (1) near canal in windfall mall
- omniverous, feed on birds, eggs, frogs, snakes, fish
- tracks observed everyday near canal where drainage ditch enters.

Order Ungulates

Columbian Blacktail Deer - Odocoileus hemionus columbianus

- (2) in open meadow, along canal
- browsers, require high protein: cell wall ratio
- feed on young shoots of salal, cedar, red huckleberry and a variety of herbaceous plants.

REPTILESPuget Garter Snake - Thamnophis ordinoides

- (10 plus) sightings
- food consists largely of earthworms, insects and other small organisms.
- yellow dorsal stripe with 2 red lateral stripes

AMPHIBIANSNorthwestern Toad - Bufo boreas boreas

- 5 sightings observed, twice along beaver dam trail
- feed primarily on insects and other small creeping organisms
- nocturnal, may wander considerable distances from water but usually retire to shade spot at dawn.

Western Spotted Frog - Rana pretiosa pretiosa

- feed on insects

DELTA NATURE RESERVE

Site Preparation General Instructions -1. Canal Clean-up and Access Trail.

A. An access trail must be constructed from the extreme NE corner of the Reserve to the canal at the bridge crossing.

- (a) Locate the "best" site for the bridge.
- (b) Complete the access trail to that point using the most direct route.

B. The West side of the canal should be cleared back to the timber to remove most or all of the brambles and woody species which have started growing there. *

C. The East side of the canal should be cleared in patches (50 - 100 feet every 300 feet) and each patch joined with a good trail. *

*(All debris from clearing must be disposed of in such a way as not to be seen from the canal.)

F. The canal itself contains such material that should be removed (cans, bottles, branches, etc.). This material should be trucked away from the area.

* The purpose of the canal clean-up is:

- (i) To improve access to the meadows.
- (ii) To improve access to the canal.
- (iii) To reduce the sight of "garbage" in the area.
- (iv) To impress visitors with the importance of the area.

2. Bridge Construction.

Several points must be considered before this bridge is to be built:

- (a) The water level of the canal is very high in the winter and will float away any low-lying structure.
- (b) All vehicular traffic is to be discouraged in the area - including motor bikes, etc.
- (c) This bridge may have to be relocated in a few years because of the GYNSD project - it should be bolted together.
- (d) It should "look like a bridge" - not just some logs across a canal.

A suggested bridge design is attached to this page. Changes from this design should be discussed with the project co-ordinator.

All use of logs for the bridge must be from dead material only. No new or live trees should be used.

3. Improvement of Existing Trails.

One main trail exists at present and should be improved by:

- (a) Removal of all dead branches.
- (b) Brush out the trail as indicated in red on the map.
- (c) Improve the "wet spot" on the trail by placing 4" x 6" x 4' long logs across the trail. The trees for this are already cut down.
- (d) Place a sign indicating the entrance to the trail.

IMPORTANT - As much as possible the main trail should:

- (a) Be able to accommodate large groups of people in comfort.
- (b) Look as much like a natural "game trail" as possible (no visible axe cuts, etc.)

4. Preparation of new trails.

All new trails shall be constructed only upon the advice and direction of the project coordinator. (Several are to be constructed).

5. Improvement of the Logging Road.

- (a) Brush cut the road to its original width and dispose of all slash in such a way as it is not visible from the road.
- (b) Improve any wet areas as directed above.

6. Placement of Signs and Fences.

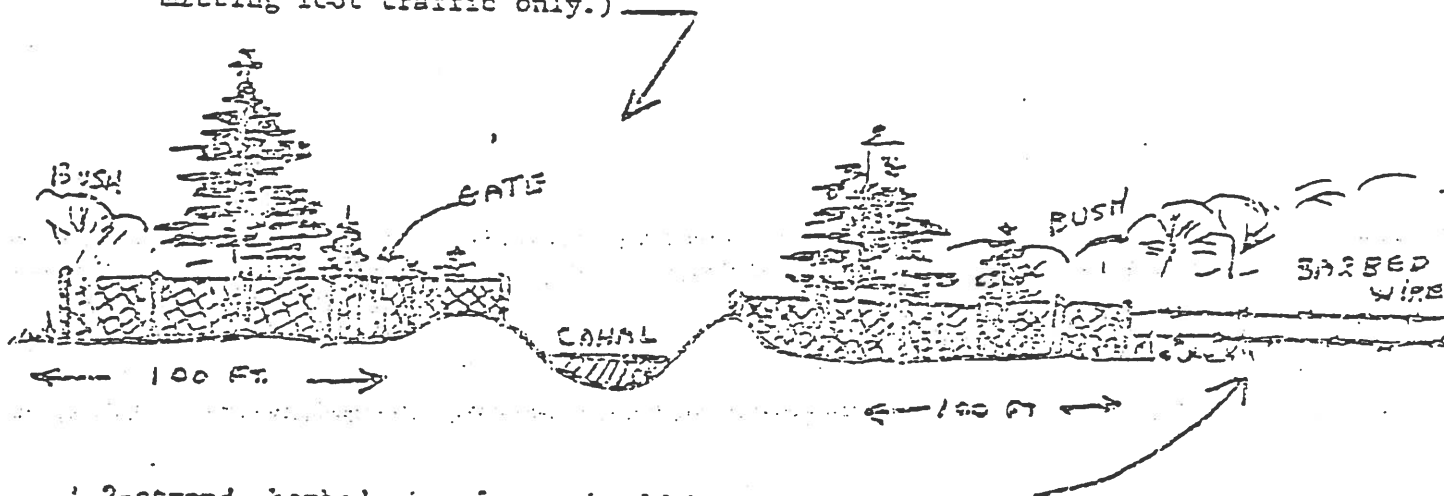
The purpose of fences is only to impress visitors with the importance of the area - not to keep people out.

The purpose of signs is to impress visitors and to inform others of the value and importance of the area.

(a) Fences:

A chain-link fence should be placed across the canal at both ends of the property (see map) and extend about 50 feet into the bush on either side of the canal.

(2 fences 200 feet long each with an entrance on each permitting foot traffic only.)



A 2-strand, barbed-wire fence should be extended from the end of the chain link fence to the NW corner of the property.

(b) Signs should be:

- (i) Well made.
- (ii) Located every 150 feet on fences or appropriate trees along the entire North and East sides.
- (iii) One main sign should be posted at the NE corner (wording to be arranged).

7. Removal of All Human Traces.

Throughout the area people have left scars of misuse such as chopped trees, fires, old picnic sites, etc. These should be located and removed by:

- (a) Cutting out all stumps below ground level and replacing with vegetation, etc. Stumps are to be hidden or removed from the site.
- (b) Remove all debris from the area. (cans, etc.)
- (c) Bury all burnt material.

8. Construction of an Outdoor Lecture Theatre.

At the entrance to the main trail, just off the canal exists a site to be used for large groups. Develop as follows:

- (a) Cut down all vegetation to the ground in the "theatre area".
- (b) Remove the bark from all the logs in the area to make seats.
- (c) Cut foot holds in the logs to make stairs and to increase safety of use.
- (d) Open the "theatre" to the canal in such a way as to make it look like a "theatre" entrance.

9. Construction of Weirs on the Canal.

Permission must be granted by the Municipal Authorities before any work of this kind is done. One weir at the North boundary of the property would be sufficient for the next 2-3 years. It should not exceed 3 feet above the base of the canal.

10. Construction of an Observation Tower.

Studies are now underway to determine the best site and construction of such a tower.

- Purpose:
- (a) To enable individuals to study animal life in the area with proper visibility.
 - (b) To enable students to use photographic equipment to fullest advantage.

FOOTNOTE: The intention of the above items (as drawn up by V. Kodak, E. Klassen, and D. Van Nes) is to prepare the D.N.R. for use by students and other interested study groups or individuals in such a way as to instill a feeling of use and importance for the area.

It is extremely pertinent to say here that this is the initial development of this area and all that is done now will influence the quality of future work - and ultimately the life of the area as a Nature Reserve.

D. Van Nes
June 15, 1971.

TABLE 6 - CONSTRUCTION COSTS FOR MAJOR STRUCTURES

The following list offers a rough estimate of in-place construction costs for work done by Corporation of Delta works crews.

BOARDWALK:

8' sections with 2" X 4" rails and
1" X 6" slats. 57 sections @ \$15.00 \$ 855.00

OBSERVATION TOWER:

8' X 10' elevated platform with
handrailing and ladder. \$ 700.00

SITE MAP, VEGETATION
AND TRAIL MARKERS:

\$ 350.00

MEETING PLACE:

12' X 35' covered area, open sides
with long table and benches. \$ 2500.00

108TH STREET ENTRANCE:

- Observation Deck with 10' X 18'
raised viewing platform. \$ 2500.00

- Gravel surfaced parking area \$ 1000.00

GRAVEL SURFACE ACCESS ROAD
FROM 72ND AVENUE:

18' wide top, 6" deep, with parking
area at terminus. Requires 1200 cu.
yds. @ 15.00. \$18000.00

PICNIC SITE:

50' X 40' cleared area with 6"
sandfill, 4 wooden picnic tables
and sanitary facilities. \$ 700.00

*total 26605
19-16 prices*

Delta Nature Reserve (Vegetation)

Lot 7 of DL 437 148 Acres



AREA KEY

- 1 Second Growth Fir and Deciduous (Maple, Dogwood, Birch, Alder) on hillside
 - 2 Alder - Light salmonberry understory
 - 3 Large Mature Cedar, Hemlock, Spruce - varied understory (Vine Maple, salal Salmonberry)
 - 4 Open Meadow predominantly Labrador Tea, Bracken Fern with scattered dwarf Pine, Hemlock, Cedar, Spruce.
 - 5 Shore Pine, Labrador Tea, Salal ground cover
 - 6 Mixed Deciduous (Alder, Birch, Willow, Pacific Crabapple)
 - 7 Dense Hardhack - open
 - 8 Heavily Snag - Deadfall Area (Dense Willow Crabapple, Hardhack Mix)
- 3-5 Mix (Stunted Pine, Cedar, Hemlock, Spruce Mix)
- Logged Area - Second Growth Alder, Willow - Deadfall



