# Soil Survey and Land Evaluation of the Liard and Mackenzie River Area

## Northwest Territories

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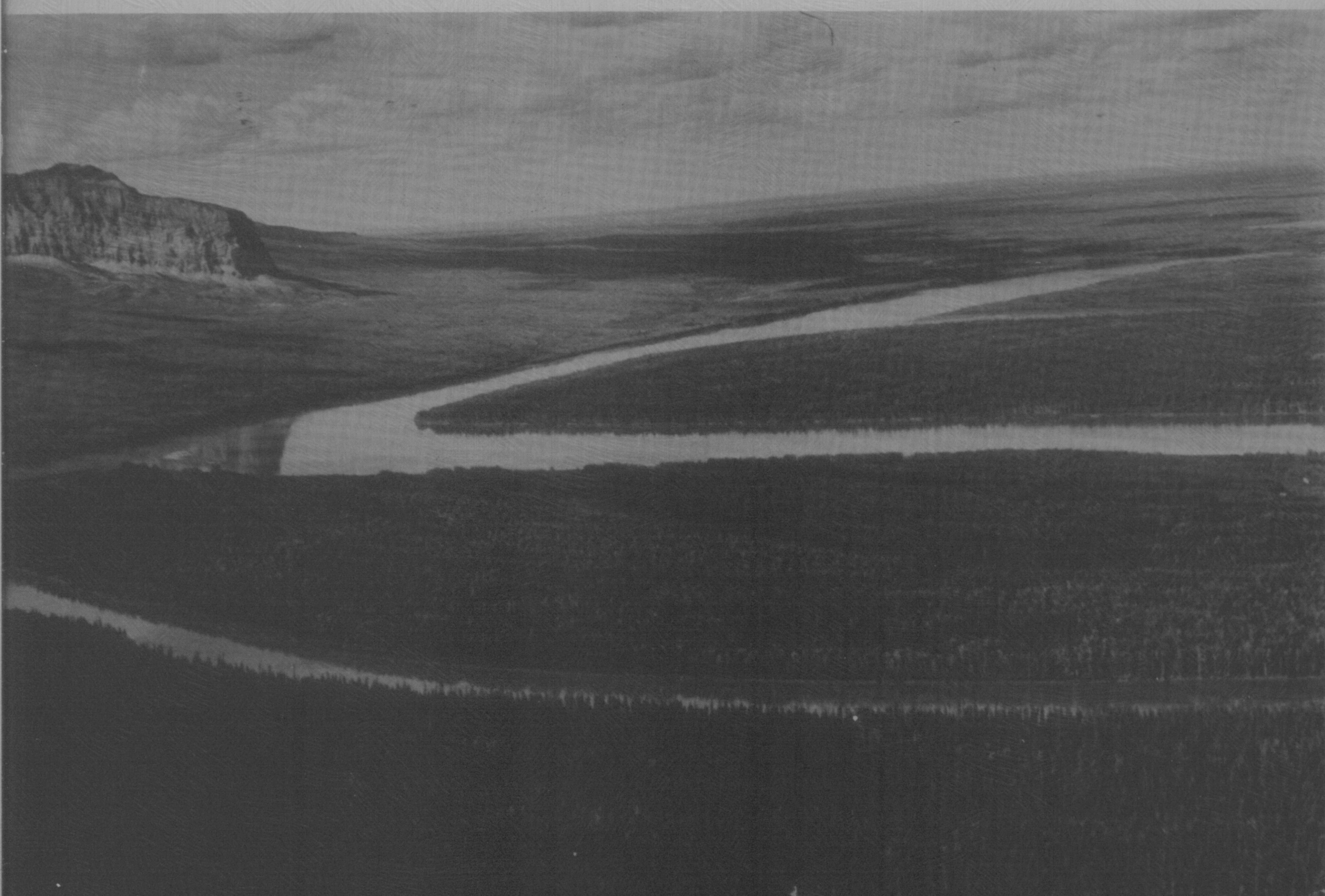

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# SOIL SURVEY AND LAND EVALUATION of the LIARD AND MACKENZIE RIVER AREA NORTHWEST TERRITORIES

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# INTRODUCTION

A survey of the lands along the Liard and Mackenzie rivers was initiated in the spring of 1975 with the objective of characterizing and mapping the soils of the area, interpreting the agricultural capability of the soils and providing recommendations for agricultural land use. Consideration was given to other land uses mainly in terms of summarizing existing information, relating that to the soils and pointing out possible areas of land use conflict. The survey was of a reconnaissance nature with over three million acres mapped on the basis of limited field access. The complete study was carried out within a one-year time period.

A series of maps accompanies this report. The four soil maps at a scale of 1:125,000 show the location, shape and extent of the individual soil areas and main topographic features. Overlay maps of several types were also prepared. The agricultural capability maps provide a rating of soil quality for agricultural use. The forest cover maps group the vegetation of the area by forest cover types and give associated stand heights and densities. The soil materials and drainage maps group soils of similar textures and drainage and are useful for engineering interpretations. The priority rating for farm development maps delineate potential agricultural lands with the different degree and types of limitations or conflicts for agricultural use.

Early sections of the report give a general introduction to the area historically. This is followed by discussions on environmental aspects of the region and their relationships to soils. The report outlines the system that was employed in soil mapping and describes in considerable detail the soil associations mapped.

The Interpretations section of the report outlines soil capability for agriculture, the relation of soils to forestry, grazing and forage potential, fertility status, engineering interpretations, recreational land use, and a priority rating for farm development.

The final section of the report summarizes recommendations for agricultural development.

Five appendices follow the report.

This survey has attempted to be as comprehensive as possible within the terms of reference and time available. This survey, along with previous forest inventories, should provide the basis for broad scale planning decisions related to agriculture, but decisions between competing uses and the social effects of development will require input from other sectors and the people involved. No more inventory is considered necessary at this stage until decisions are made about specific uses; then the possible impact of and the capability of sustaining intensive and or extensive uses can be assessed with on site evaluation and study.

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## LOCATION AND EXTENT

The surveyed area is in the southwestern corner of the Northwest Territories. It includes land adjacent to the Liard River from the British Columbia border to the Mackenzie River and along the Mackenzie River to Camsell Bend (Fig.1 ). The survey covered approximately 3.3 million acres.

The map area is dominated by the Liard and Mackenzie Rivers. The Liard River is a large tributary of the Mackenzie River System. The river rises in the Yukon Territory to the east of Whitehorse and courses southeasterly into northern B.C., where it is joined by the Nelson River. From there, its course is north by northeast to where it joins the Mackenzie River at Fort Simpson,N.W.T. The Mackenzie River flows through the area from southeast to northwest, and eventually to the Arctic Ocean.

## SETTLEMENT AND LAND USE

### History and Development

The Athapascan-speaking Indians (Déné), who first occupied this area after the last ice age, were nomadic hunting people, who relied mainly on moose, wood buffalo, and caribou as sources of food and clothing. The Déné of the area were of two main tribes, Etchareotinne* or Slavey people who lived along the Mackenzie Valley, and Kaska** people who occupied part of the Liard Valley and the mountains to the west. Today, the native language of the Déné in the survey area is Slavey.

* Etchareotinne - "people dwelling in the shelter"
** Kaska - "the big water people"

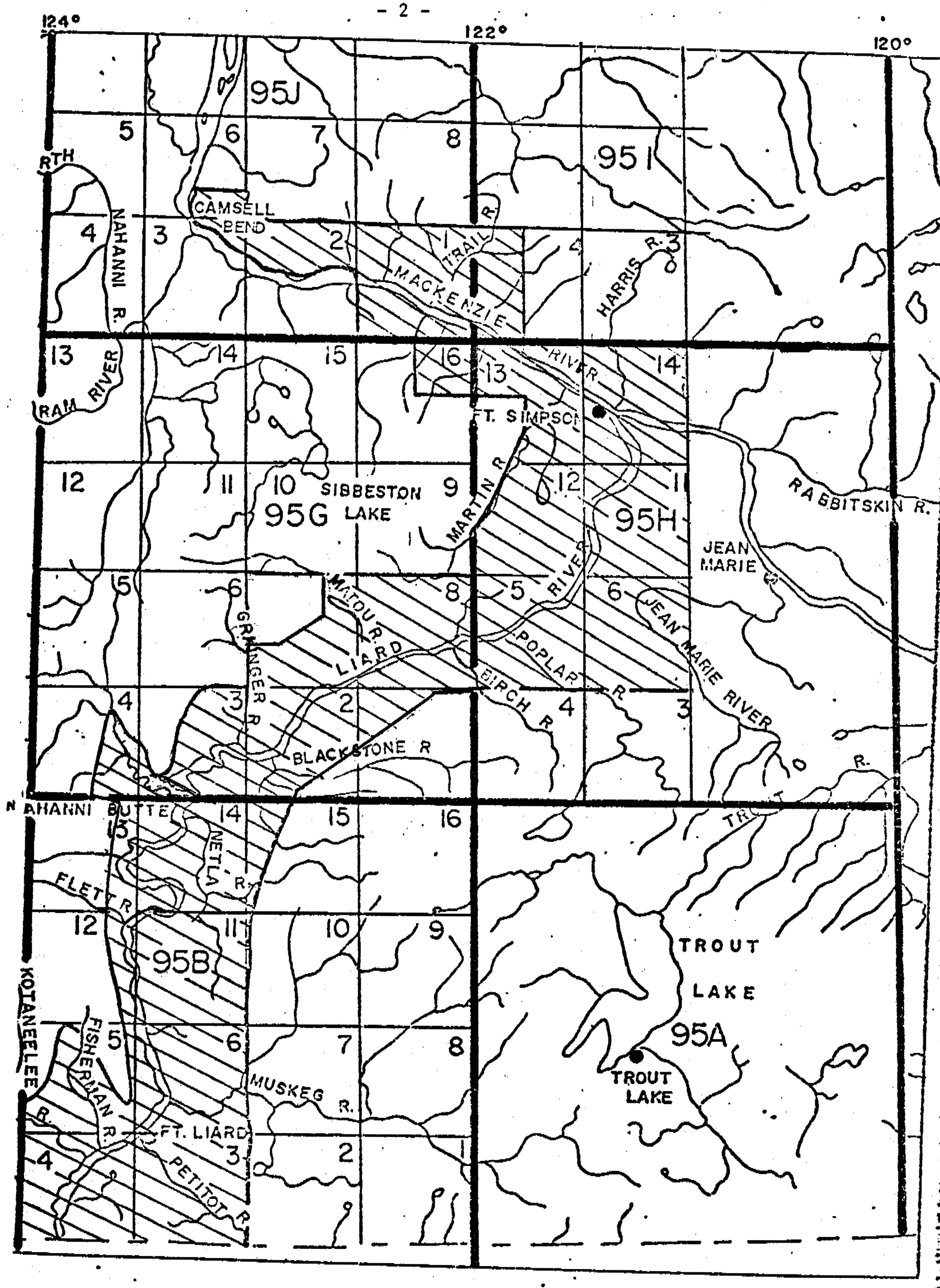


Fig. 1 Map showing location of survey area.

The first Europeans came to this area via the Mackenzie River, in the 18th century, and established a fur-trading economy. Cree and Metis "voyageurs" were the first adventurers. Francois Beaulieu is one of the best-known of these men. In 1789 he went down the Mackenzie River with the explorer-trader Alexander Mackenzie. Reflecting the French-Metis influence, the Liard River itself was originally called Rivieré aux Liards. Liard, which means cottonwood in French, was undoubtedly named after the balsam poplar forests common on the floodplains.

In 1804 a settlement was built at the junction of the Liard and the Mackenzie Rivers by the Northwest Company called Fort of the Forks. With the amalgamation of the Northwest Company and the Hudson Bay Company in 1821, it was renamed Fort Simpson, after Governor Sir George Simpson.

The early days of trade were full of fear, confusion, and often violence. Gradually, however, the Indian people tended to settle down into definite small territories, each with its trading post where furs were exchanged. A post was first established at the present site of Fort Liard in 1807, while the more remote Nahanni people of the Nahanni Valley were not brought into the fur trade until later. Nahanni, which means "the people over there far away" was the name applied by the people of the Lower Liard to the Nahanni Indians to the west. A company post was never set up at Nahanni, but there was an independent post operated by Jack La Flair, in the early 1900's.

Missionaries followed the furtraders and even operated a steamboat, the "Saint Alphonse," down the Mackenzie in 1895. Even in these days around the posts and missions, some families began to keep gardens and cattle were transported from Fort Providence to this area.

The transfer of Rupert's Land from the Hudson's Bay Company to the new Dominion of Canada in 1870 saw the first beginnings of government activity in the area. In 1911 there was an Indian Agency set up at Fort Simpson that included a saw mill and a demonstration farm and gardens. In 1921, Treaty 11, covering this area and most of the Northwest Territories, was signed between the Federal Government and the various Déné tribes in the area. The treaty was designed to give the government authority to pursue interests in the north, such as exploration and encouraging settlement, while assuring the Déné the right to continue their traditional lifestyle. These treaties, however, did not relinquish all land rights, and these are currently being negotiated.

The area has also had a more colorful side to its history. During the late 1880's and early 1900's, many adventurers and gold seekers ventured up the Liard to the fabled valley of the Nahanni River. Traces of their activities in old cabins are still to be found along the River. Names like Jack La Flair, Father Gouet, Faille, and Patterson, are indelibly connected with the area. Patterson (1966), during a canoe trip up river, described the Liard River in this way: "It swept around the bend, a brown heaving mass of destruction let loose upon the land, rising with the hot weather to an early flood, rolling a little with its own strength and speed, tearing down its banks and carrying with it great uprooted trees and all the debris of the mountain."

The area has also had its share of scientific adventurers. R.G. McConnell surveyed the Liard River in 1887 for the Geological Survey of Canada. Since then numerous scientific explorers have studied the geology, soils, and vegetation of the River Valley, including Hume (1923), Hage (1945), Leahey (1944). More recently, Jeffrey (1959, 1964) characterized the forest types of the Lower Liard River and Day (1966) conducted a broad reconnaissance soil survey of the Liard Valley. In addition, there have been numerous inventories of the forest resources by the Department of Forestry. The Geological Survey of Canada has mapped the bedrock and surficial geology of the area. In the last few years, there has been a rash of investigations connected with the Mackenzie Valley Pipeline Study that have covered part of this area. All of the above that have directly or indirectly contributed information valuable to this study are documented in the reference list.

In recent years government services in the field of education, social services, construction, and game preservation have expanded in the area and there has been a surge of mineral and oil exploration. In agriculture, there was a government experimental farm established in Fort Simpson in 1947, but later disbanded, although successful in growing garden and most cereal crops. Today, the only agriculture is small scale but successful garden plots in the communities. The main land use is still hunting, fishing, and trapping.

Present Settlement

Fort Simpson is the largest town in the area, with a population of 1250 (1974). The other two settlements in the survey area are Nahanni Butte (pop. 76) and Fort Liard (pop. 313).

Fort Simpson, the largest town in the area, is located on an island at the confluence of the Liard and Mackenzie Rivers. Fort Simpson is the administration centre of the Upper Mackenzie. Its hospital serves the whole region. Government departments, such as Northern Affairs, Parks Canada, Northwest Lands and Forests, Northern Canada Power Commission, Department of Public Works, and Canadian Wildlife Service have regional offices in Fort Simpson. Most wage employment in the area is provided by service activities and government. Commercial services include hotels, stores, garages, contractors, a bank, and numerous aircraft and helicopter charter companies. There are also several churches and a large day school and residence high school. Water and sewer services exist but need to be extended. Fort Simpson, like all the other towns in the area, has diesel-powered electrical generation.

The permanent population is predominantly Déné, but, due to in-migration associated with petroleum and highway construction activity, the proportion of white population is increasing. Many of the semi-permanent white population includes government staff, clergy, and the staffs of the hospital and certain commercial establishments.

Fort Liard has a predominantly Déné population, which first established here around a trading post established in 1807. Fort Liard's economy has traditionally rested on hunting, trapping, and fishing. Many of the population are semi-nomadic, with seasonal movements to Lake Bovie and other areas in northern B.C., associated with trapping and fishing activities. There are few services available in Fort Liard. There is a community hall, as well as a church, a nursing station, an R.C.M.P. detachment, and a Northwest Lands and Forests office. Education is provided at the public school level. The only commercial outlet is a Hudsons Bay Store.

Nahanni Butte is located at the junction of the Nahanni and Liard Rivers. The Déné population live from the land mainly by hunting, fishing, and trapping. There is a community store which provides most staples, but for most services, apart from the school, it must rely on Fort Simpson or Fort Nelson, B.C. The village is the base for some small-scale tourist activity associated with the Nahanni National Park, which has its headquarters across the river from the main settlement.

Transportation

Road - The all-weather Mackenzie highway connects Fort Simpson to the southern Northwest Territories and Alberta. Most supplies are now hauled to Fort Simpson from Edmonton, approximately 1,100 miles, by transport or by rail to Hay River and trucked the remaining 270 miles. The highway crosses the Liard River and is closed for a period of approximately two months during the year, during freeze-up and break-up. There is at present no road access to Nahanni Butte or Fort Liard. A highway has been planned to connect the Mackenzie highway near Fort Simpson to Fort Nelson, B.C., passing through Fort Liard. This highway has been constructed as far as the Poplar River, the right-of-way is cleared to the Blackstone River, and beyond this it has been surveyed only. Construction on this highway has been postponed at present, but it is expected to be completed by 1980. The construction of the Mackenzie highway north to Wrigley is ongoing and the road is now passable for about 20 miles north of Fort Simpson.

Air - There is passenger air service to Fort Simpson from Edmonton and Yellowknife several times a week. As well as the newly-constructed paved landing strips at the main airport, there is also a small landing strip in the town. There are many aircraft charter companies operating from Fort Simpson. Fort Liard and Nahanni Butte both have dirt landing strips suitable for light planes. At all three settlements, the rivers are used extensively for float plane service as well.

Water - Barges connect the communities of Fort Liard and Nahanni Butte to Fort Nelson by which main supplies are brought to these settlements in summer. Barges cannot navigate the Liard down to Fort Simpson during low water, due to rapids in this section of the river. Barges regularly ply the Mackenzie River from Hay River to the Arctic Coast.

Land Use

Agriculture - There is almost no agriculture in the Liard area, other than small-scale garden plots in the communities. A Dominion Experimental Farm was established in Fort Simpson in 1947 to explore the agricultural potential and to accumulate reliable data on crop responses. The farm, which was located on the fertile alluvial soils of Fort Simpson Island, was quite successful in growing all garden

Fig.2 A garden on alluvial soils at Fort Liard,August 1975 crops and most cereals. Unfortunately, the farm was phased out in the late 1960's and the farmland has become townsite.

Mining - Considerable seismic exploration has occurred in this region and the area is marked by numerous cutlines. Gas has been found and tapped at Pointed Mountian, west of Fort Liard. The supply, which is being piped to Fort Nelson, is expected to last 20 years.

Forestry - There is a small-scale forest industry in the area, supplying local needs. Only one mill is in operation (Anderson Mill) in the Fort Simpson Area. There is significant forestry potential in the southern part of the area. This is discussed further under Interpretations for Forestry. Fire protection is carried out over the area by the Northwest Lands and Forest Service.

Hunting, Trapping, and Fishing - Trapping is still a major source of livelihood for Déné people in the area. About 50 families in the Liard area make their living primarily by trapping, although a much larger number are engaged in trapping part-time. The total value of furs sold varies significantly each year, due to price fluctuations and supply of pelts. The main animals trapped are lynx, martin, and beaver. Hunting and fishing provide a large proportion of food needs.

Tourism - A large section of the South Nahanni River Valley has been established as a National Park. Present access to this scenic wilderness park is by air or boat, but the completion of the Liard highway would change this, if an access road to the park is built.

## PHYSIOGRAPHY

The survey area lies within the Interior Plains physiographic province (Bostock, 1946). Recent physiographic surveys (Bostock, 1969; Minning, et al, 1972) have divided the Interior Plains province into three regions: The Great Slave Plain, the Alberta Plateau, and the Fort Nelson Lowland (Fig. 3). There are no distinct boundaries between these regions, the whole area being generally flat and low-lying, with a few rolling hills up to 2000 feet in elevation. The survey area is bounded on the west by the Liard and Nahanni Ranges of the Canadian Cordillera, which rise up to elevations of 4000 to 5000 feet, and provide a striking contrast to the low-lying river basin.

For the purpose of this survey, the area of the Liard and Mackenzie River valleys was subdivided into Physiographic Districts on the basis of origin of the surficial deposits and landform (Fig. 4). These are the Alluvial Floodplains, Lacustrine Benchland, Deltaic Sands, and Morainal Uplands, which represent the depositional history of the area. Although the Franklin Mountains border the area, they have not had a direct influence other than as barriers to the westward glacial advance. Some mountain slopes and local run-off which border the survey area have been included in the map area, but have not been established as a major Physiographic District. These Districts will be described in more detail in a later section of this report.

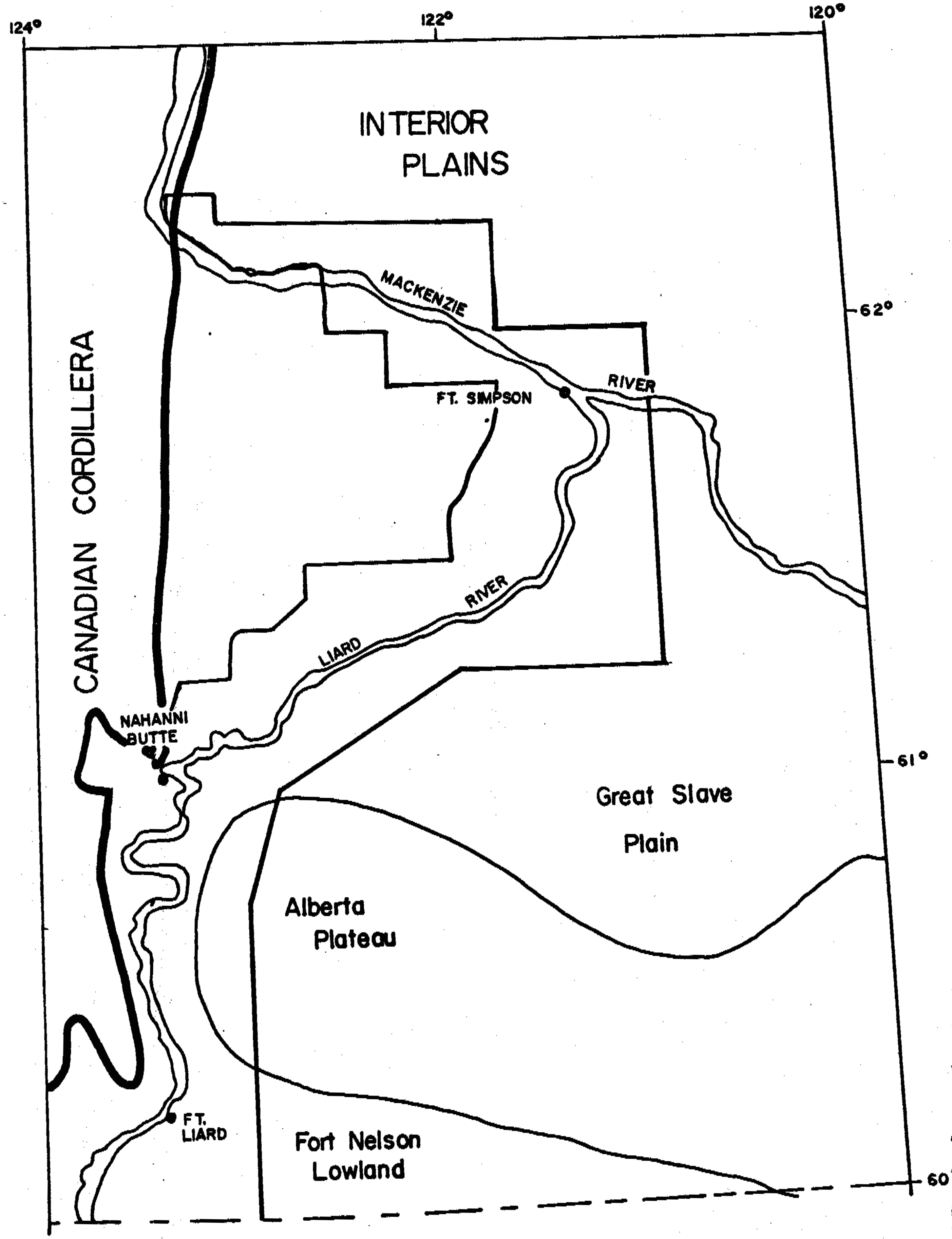


Fig. 3. Physiographic Regions

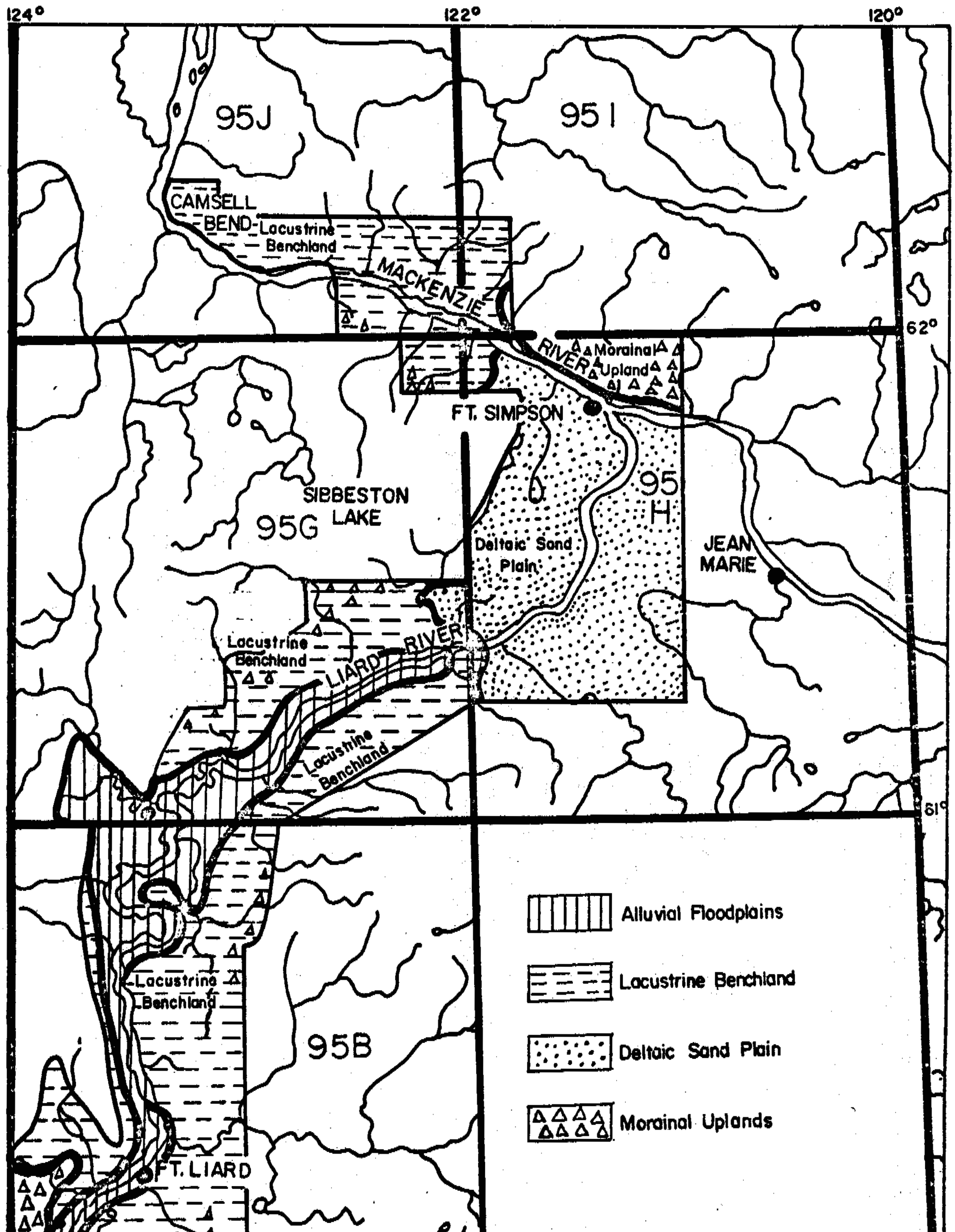


Fig. 4 Physiographic Districts

Drainage

The Liard River catchment basin drains over 11,000 square miles in the Northwest Territories alone. From the southern upstream end of the area, the principal tributaries are: Kotaneelee, Fisherman, Petitot, Muskeg, Flett, Netla, South Nahanni, Grainger, Blackstone, Matou, Birch, and Poplar Rivers. Jean Marie Creek arises near the Liard River in 95H, but flows eastward into the Mackenzie River. The Liard River is by far the largest tributary of the MacKenzie River System, but from Fort Simpson to Camsell Bend several smaller tributaries join the Mackenzie River within the survey area. These are: Martin River (which borders the survey area west of Fort Simpson), Harris River, and Trail River, plus numerous smaller unnamed streams.

Despite the numerous rivers draining the area, there are many lakes and sloughs in the area. Most of the land is well-drained in sloping areas and near the riverbank, but in flat areas the mineral soils are poorly drained and organic soils are common. Soil drainage conditions are described in detail in the soil descriptions.

River Form and Flood Hazard

The Liard River flows from an elevation of 720 feet at the B.C. border to 400 feet above sea level at its junction with the Mackenzie River. It undergoes a few marked changes in its form during its course. From the B.C. border to Flett Creek, the Liard is a braided stream with a relatively straight course. In this section the eastern river banks are fairly steep, from 300 to as much as 900 feet above the present channel. There are numerous islands and a few narrow floodplains--for example, at Fort Liard, in this section. From Flett Creek to the Blackstone River, the river is broad and meandering between banks 15 to 50 feet high. Recent and abandoned floodplains in this section are several miles wide.

From the Blackstone River to Fort Simpson, the Liard River is an irregularly sinuous but stable river, entrenched into resistant materials. A narrow band of mostly abandoned floodplains remain on both sides of the river to the mouth of the Birch River. Beyond this point the banks are high (150-300 feet) with eroded, steep slopes. There are no floodplains or channel bars in this swiftly flowing section of the river, but a few ripples and rapids do occur downstream from the Poplar River, where the river has cut into bedrock.

There is little record of flood history of the Liard River. The Fort Liard Journal of the Hudson's Bay Company for May 19, 1896, records flooding of the Fort to a depth of four feet (Jeffreys, 1964), representing a rise of about 30 feet in water level. A dendrochronological study carried out in 1973 on the Lower Liard (Nahanni Butte to Fort Simpson) found ice scarring of trees to as much as 54 feet above the present river level (Parker and Josca, 1973). They established that major floods due to ice jamming had occurred in 1909, 1934, and 1963. However, this ice jamming and flooding is recorded in the portion of the river with relatively enclosed banks and it is unlikely that the wide floodplain areas could be flooded as deeply. Unfortunately, there is no record of flooding in this section, other than that indicated by soil and vegetation development on low-lying alluvial deposits. This will be discussed more under the description of the Recent Floodplains. Flooding of Fort Simpson Island, which is a Recent Floodplain "Cumulic" soil, occurred in 1963, when water levels of the Mackenzie River rose 30 feet, due to ice jamming. All but 180 acres of the 700 acre island were flooded.

The Liard is a powerful river. The mean annual discharge at Fort Simpson is in the order of 425,000 cubic feet per second. In June and July, it is common for the river level to rise or fall a few feet in a day. During spring run-off or heavy summer rains in the mountains, as occurred in 1975, the Liard is laden with silt and suspended debris torn from its banks, especially in the floodplains. The quantity of floating debris can make the river impassible. Patterson (1966) aptly called the river a "brown, heaving mass of destruction."

By contrast, the Mackenzie River is more stable and slower moving. High banks occur on the left bank of the river for twenty miles downstream from Fort Simpson, but generally banks are low and gently sloping. A few islands and floodplains occur towards Camsell Bend.

Bedrock Geology

Several geological surveys have been made by the Geological Survey of Canada (Bostock, 1944; Bostock, 1969; Craig, 1965). Higgins (1968) summarized the geology as follows (Fig. 5 ). The Interior Plains region is underlain by sedimentary rocks ranging in age from Precambrian through Upper Cretaceous. The survey area is

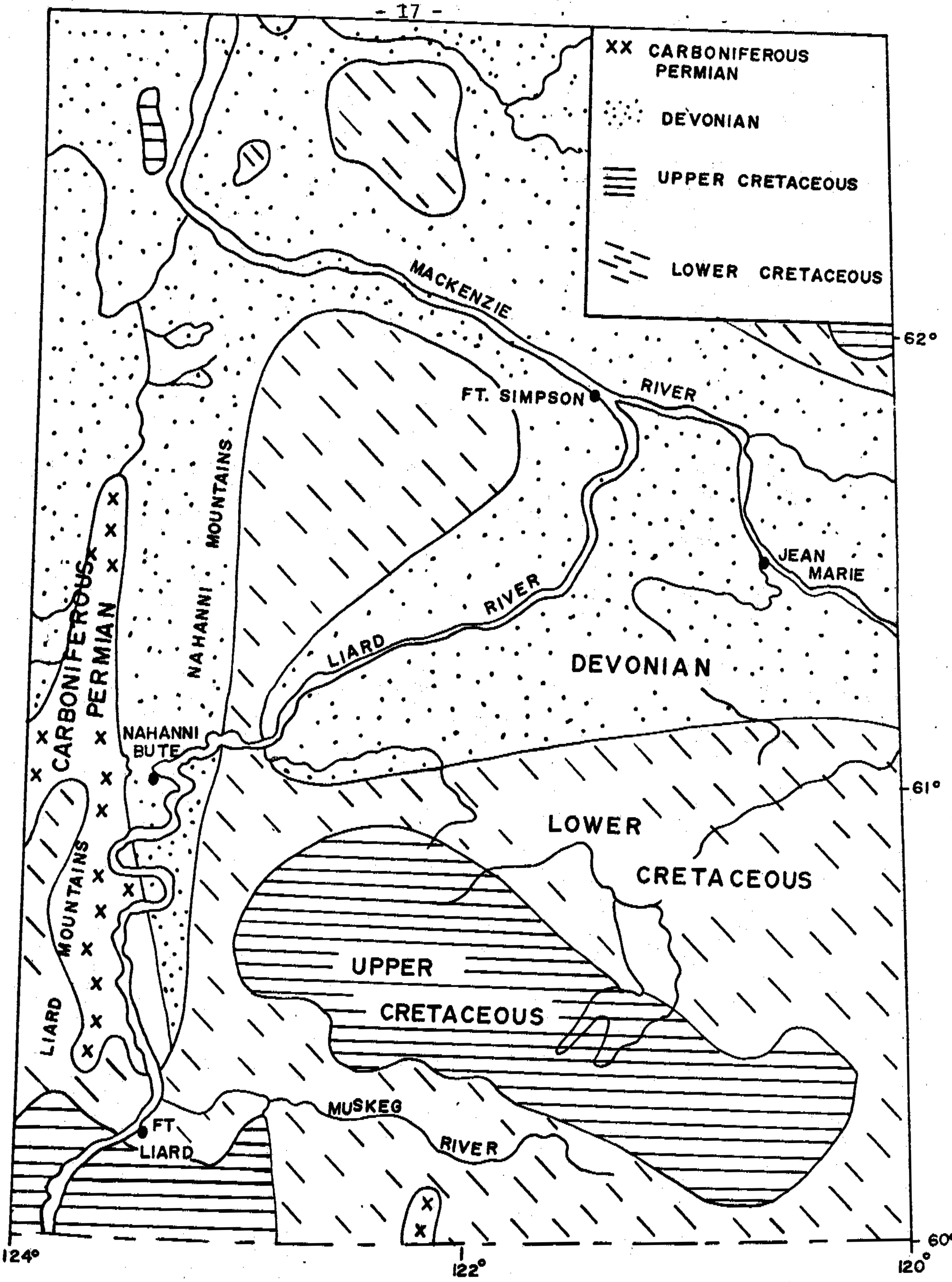


Fig.5 Bedrock Geology

underlain by nearly flat-lying strata of a large basin structure which presents for the most part its Cretaceous and Devonian strata at the surface. South of Fort Liard, Upper Cretaceous sandstone, shale, and siltstone of the Fort Nelson, Wapiti, and Kotaneelee formations, underlay the area. In the main part of the Liard Valley, Lower Cretaceous limestone, sandstone, siltstone, and shale, of the Fort Saint John Group underly the surficial deposits. Exposures of bedrock are rare, except along the banks of the major tributaries, particularly the Petitot, Kotaneelee, and Muskeg Rivers, and along the Lower Liard. Some of the streams, like the Blackstone and the the Birch Rivers, flow on top of bedrock in their upper portions. On the plains southeast of the Liard River, between the Blackstone River and the Birch River, a prominent till-covered bedrock ridge attains an elevation of 1250 feet above sea level. There is a little butte known locally as Sphinx Rock, which outcrops on the floodplain near Nahanni Butte townsite.

North from Jean Marie Creek (61°25'), shale of the Upper Devonian Fort Simpson Formation is predominant. This shale is soft, fissile, and highly erodable, in contrast to the more resistant limestone and sandstone further south. This shale formation has been a major contributer to the matrix of overlying till in the area.

Pleistocene Geology

The events in the geological history presented here have been inferred from geological maps, air photos, field observations, and the reports of Bostock (1969); Higgins (1968); Day (1966); Jeffrey (1964); Rutter et al (1973); Cook (1974)

1) During the last major glaciation the Laurentide ice sheet advanced from northeast to southwest, covering the entire Interior Plains and penetrating the eastern ranges of the Franklin Mountains. Morainal deposits mantle the bedrock throughout the lowland area and in many areas the deposits show distinct drumlinoid patterns with a clear northeast to southwest linear orientation. The till ranges in thickness from a few feet to over a hundred feet, with an average over 20 feet (Rutter et al, 1973).

2) During the period of deglaciation the margin of the Laurentide ice retreated eastward. During the early stages, when the ice sheet was still close to the Liard and Nahanni Ranges, the junction of the Liard and Mackenzie rivers was blocked by ice. It is believed that a glacial lake was formed in the Liard Valley at this time, giving rise to the lacustrine deposits of the Lacustrine Benchland, up to as high as 1600 feet, although there is no physiographic evidence such as abandoned beaches. The lake was probably dammed at several levels at different stages of ice retreat. Thus, from the Blackstone River east, lacustrine deposits are not as high in elevation and till is present much closer to the river.

3) As ice retreat continued, isostatic depression to the east brought about the formation of an ice-marginal lake in the upper part of the Mackenzie Valley. Eventually, when the ice margin was along the edge of the Precambrian Shield, this lake joined with similar lakes in the Great Bear Lake area and the Lower Peace River - Lake Athabaska area to form Glacial Lake McConnell. The ancestral Liard River emptied into this body of water, and this may have been the period when extensive areas of sandy glacio-fluvial deposits were laid down in delta formation southwest of Fort Simpson.

4) Following glaciation, the river probably flowed near its present location on top of extensive silt and sand deposits, initially in a braided stream channel pattern. Subsequent isostatic readjustment lower the base level and permitted the formation of the present valley of the Liard River. The Liard began to consolidate into only a few channels, meandering over the wide valley bottom deposits near Nahanni Butte. A series of stratified fine to coarse sand and silt terraces have been formed as downcutting and alluviation have proceeded.

5) As Glacial Lake McConnell receded, the sandy fluvial and deltaic deposits at the mouth of the Liard were left exposed to wind action and resulted in a large area of wind-modified sands near Fort Simpson.

6) Accumulation of deep peat deposits in undrained channels on old flood plains and in poorly drained depressional areas. A slow, cyclical degradation and aggradation of permafrost has occurred in areas covered by thick organic layers.

7) Tributary streams have cut across and eroded these deposits to some extent and added inflow to the lakes and rivers.

# VEGETATION

## General Description

The study area lies mainly in section B23a, the Upper Mackenzie zone of the Boreal Forest Region (Rowe, 1972). The area is predominately covered by forests of various types. The most heavily forested areas occur in the valley floodplain environment of the Liard, Mackenzie and South Nahanni Rivers, and most smaller streams where the moisture regime and soil conditions are most suitable for sustained growth. White spruce, balsam poplar, and some white birch form the main cover types on Recent Floodplains. Abandoned Floodplains and Lacustrine Benchland areas support mainly trembling aspen, white spruce, and white birch. Black spruce and tamarack are found on the poorly drained mineral soils and peatlands throughout the landscape. The Deltaic Sands and Morainal Uplands have a high proportion of jack pine, in addition to the above species. Non-forested areas are mainly sedge fens, or shrub.

## Vegetation types

Vegetation, although described as much as possible, ~~was~~ not mapped, nor is it included as an integral part of the mapping units. Vegetation does influence the decision on the boundaries of Soil Associations. However, for any given soil type, vegetation can only be inferred in a general way and even then not over the whole area. Such a large area was covered (extending across 2° latitude) that transitions in climate, vegetation, and soil development (depth, occurrence of permafrost) were noticeable but not accountable as separate types within the broad soil groupings mapped. In addition, fire being active in the area makes vegetation a more ephemeral property of the land, although certainly useful as an indicator of site characteristics.

The vegetation types described here are based on field observation and vegetation typology applied by Jeffrey (1959, 1964) and the Forest Management Institute (1974). They are based on differentiation of major tree species and on broad site differences. Understorey species within each type can vary considerably. They are designed to give more systematic description of the main vegetation of the area and for use in describing the vegetation of Soil Associations. The classification is not definitive and only the main species are listed here. A full list of species is given in the Appendix.

A. Vegetation Types of the Recent Floodplain

The dominant environmental influences on vegetation of the Recent Floodplains are flooding and alluvial deposition, rather than fire as in forest types on the rest of the survey area.

1. Riparian Shrub.

The dominant vegetation is a dense layer of high shrubs, mostly alder and willow. Riparian Shrub vegetation is actually a continuum of successional stages on new alluvial deposits.

Willow is the first shrub to colonize new alluvium. As soil build-up progresses away from the river, river alder becomes a main species along with willow. The next stage is a vigorous arborescent shrub dominated by balsam poplar and alder, with scouring rush in the understorey.

This type colonizes the most recent alluvial deposits along the Liard and Mackenzie Rivers and major tributaries. It is subject to regular flooding, deposition of alluvium, and ice-scouring. This type is high quality wildlife habitat. It is identifiable by its banded appearance on air photos, representing variable width strips of the above main types.

Characteristic Species:

Main storey - 10-30 feet dense

| | |
|---|---|
| Salix lasiandra | - willow |
| S. bebbiana | - willow (beaked) |
| S. interior | - willow (sand bar) |
| Alnus incana | - river alder |
| Populus balsamifera | - balsam poplar |

Understorey:

| | |
|---|---|
| Cornus stolonifera | - dogwood |
| Equisetum hiemale | - scouring rush |

This type occupies a very small proportion of the survey area and is confined to the edges of Recent Floodplains and Islands.

2. Balsam Poplar (Alder-Equisetum) Forest

This type is characterized by tall balsam poplar, with a dense shrub layer of river alder, rose, and dogwood and a herb layer dominated by horsetail. White spruce may be present in the understorey.

This type occurs on older surfaces within the flooding zone. The balsam poplar attains a large size on this type, growing to over 100 feet in height, but many of these older stands are decaying.

Characteristic Species:

Trees:

| | |
|---|---|
| Populus balsamifera | - balsam poplar |

Understorey:

| | |
|---|---|
| Picea glauca | - white spruce |

High Shrubs:

| | |
|---|---|
| Alnus incana | - river alder |
| Cornus stolonifera | - dogwood |
| Rosa acicularis | - wild rose |

Herbs:

| | |
|---|---|
| Equisetum hiemale | - scouring rush |
| E. pratense | - horsetail |

3. (Riparian) White Spruce Forest

This type is characterized by tall, moderately dense, mature and over-mature white spruce. There are two subtypes, white spruce-balsam poplar, in which the balsam poplar is old and decaying, and white spruce-white birch, in which white birch is present in the understorey. The former represents the climax stage of uninterrupted successional development on new alluvial deposits. The latter reflects fire origin. In both types the shrub, herb, and moss layers are dense.

Characteristic Species:

Trees - Major Species:

| | |
|---|---|
| Picea glauca | - white spruce |

Associated Species:

| | |
|---|---|
| Populus balsamifera | - balsam poplar |
| Betula papyrifera | - white birch |

High Shrubs:

| | |
|---|---|
| Alnus incana | - river alder |
| Cornus stolonifera | - dogwood |

Medium Shrubs:

| | |
|---|---|
| Rosa spp. | - wild rose |
| Virburnum edule | - low bush cranberry |

Herbs:

| | |
|---|---|
| Equisetum pratense | - horsetail |
| Mitella nuda | - mitrewort |
| Rubus pubescens | - dewberry |
| Cornus canadensis | - bunchberry |

Mosses:

| | |
|---|---|
| Hylocomium splendens | - feathermoss |

This type includes the most productive forest stands in the area. It occurs on Recent Floodplains or islands just within or above the zone of flooding.

4. Channel Shrub

This vegetation type occurs in wet channels of the Recent Floodplain and has sparse to thick stands of an arborescent shrub community.

Characteristic Species:

Shrubs:

| | |
|---|---|
| Salix bebbiana | - willow |
| Alnus incana | - river alder |

Herbs:

| | |
|---|---|
| Equisetum spp. | - horsetail |

Grass:

| | |
|---|---|
| Calamagrostis canadensis | - marsh reed grass |

Sedge:

Carex spp.

This type occupies abandoned channels, but is small in area.

B. Vegetation Types of the Abandoned Floodplain

1. Floodplain Mixedwood

This type has tall, moderately dense stands of large trembling aspen and white spruce, with white birch and balsam poplar commonly associated. The stands commonly have a two-storied structure, with the taller, top-crowned aspen in the higher storey and white spruce and occasionally white birch the main species of the lower storey. Stands are tall (80-120 feet). This forest is rich in understorey species and all layers except for bryophytes and lichens are well developed. The moss layer is discontinuous.

Characteristic Species:

Trees:

| | |
|---|---|
| Populus tremuloides | - trembling aspen |
| Picea glauca | - white spruce |

High Shrubs:

| | |
|---|---|
| Alnus crispa | - alder |
| Salix bebbiana | - beaked willow |
| Cornus stolonifera | - dogwood |

Medium Shrubs:

| | |
|---|---|
| Rosa acicularis | - wild rose |
| Viburnum edule | - low bush cranberry |

Herbs:

| | |
|---|---|
| Cornus canadensis | - bunchberry |
| Equisetum spp. | - horestail |
| Rubus pubescens | - dewberry |
| Mitella nuda | - miterwort |
| Linnaea borealis | - twin flower |

Mosses:

| | |
|---|---|
| Hylocomium splendens | - feathermoss |
| Pleurozium schreberi | |

This type is most common on the Abandoned Floodplains.

2. Floodplain Leaftree

Aspen dominated Mixed Leaftree Forests with white spruce in the understorey are also found on the Abandoned Floodplains. These stands have a similar understorey component as the Mixedwood Forest, except that a moss layer is absent. This type is believed to be an earlier successional stage of the Mixedwood Forest.

3. Meadow (including Meadow-Shrub)

The meadows of the floodplain are unique, in that they have fairly sharp boundaries defined by the channel scars in which they occur. There is either a sharp transition from Mixedwood Forest to straight meadow, dominated by sedges or a gradation of willow and bog birch, a distinct ring of Calamagrostis spp. and an inner, wetter centre of Carex aquatilus and rostrata. Other common species are Eriophorum spp. (cottongrass), Ledum groenlandicum (Labrador tea), and Carex atherodes.

## C. Upland Forests (Lacustrine, Morainal, and Deltaic Deposits)

There is a wide variety of forest stands on these Physiographic Districts. However, there is a pattern of occurrence. Generally, Mixedwood or Mixed Leaftree stands characterize moderately well to imperfectly drained mineral soils, while single species stands are more typical on dry (jack pine) and wet (black spruce) extremes (Lavkulich *et al*, 1972).

### 1. Mixedwood Forest

The Mixedwood Forests which occur mainly on well-drained soils of the Lacustrine Benchland are very similar to the Floodplain Mixedwood in floristic compositions. They may be as tall and productive in the southern part of the survey area. Generally, however, they are more variable, particularly in productivity, age, height, and species compositions, and in the range of soil and topographic positions they embrace.

Characteristic Species:

Trees:

| | |
|---|---|
| *Populus tremuloides* | - trembling aspen |
| *Picea glauca* | - white spruce |
| *Betula papyrifera* | - white birch |

Shrubs, Herbs, Mosses: Generally similar to Floodplain Mixedwood, but more variable.

### 2. Mixed Leaftree Forest

The Mixed Leaftree Forest is common in the area and, like the Mixedwood Forest, is quite variable. In many cases, it represents an earlier successional stage of mixedwood stands. In other cases, spruce does not seem to establish, even if fire is kept out. Vegetation composition is similar to the Mixedwood Forest, but there is a greater variability in the underwood layer and a moss and lichen layer is absent.

Characteristic Species:

Trees:

| | |
|---|---|
| Populus tremuloides | - trembling aspen (dominant) |
| Betula papyrifera | - white birch |
| Populus balsamifera | - balsam poplar |

(Picea glauca may be present in understorey.)

Tall Shrubs:

| | |
|---|---|
| Alnus crispa | - alder |

Medium Shrubs:

| | |
|---|---|
| Sherperdia canadensis | - buffalo berry |
| Viburnum edule | - low bush cranberry |
| Rosa spp. | - rose |

Herbs:

| | |
|---|---|
| Rubus pubescens | - dewberry |
| Cornus canadensis | - bunchberry |
| Linnaea borealis | - twin flower |

Moss: Generally absent

3. Pine Forest

This type is characterized by rapidly growing jack pine stands on well-drained to rapidly drained sites, usually sands or upland tills. This type establishes directly after fire on these sites, but it may succeed to aspen and white spruce. Often aspen (Mixed Leaftree) forest occurs closely associated with this type on moister north and east facing slopes.

Characteristic Species:

Trees:

| | |
|---|---|
| Pinus banksiana | - jack pine |
| P. contorta (rarely) | |
| Populus tremuloides | - trembling aspen (associated) |

Medium Shrubs:

| | |
|---|---|
| Sheperdia canadensis | - buffalo berry |
| Alnus crispa | - green alder |
| Rosa spp. | - wild rose |

Low Shrubs:

| | |
|---|---|
| Vaccinium vitis-idaea | - bog cranberry |
| Arcostaphylos rubra | - alpine bearberry |
| A. uva-ursi | - common bearberry |

Herbs:

| | |
|---|---|
| Linnaea borealis | - twinflower |

Mosses:

Hylocomium splendens (on moist sites)

Lichens:

Peltigera apthosa (on drier sites)
Cladonia spp. (on drier sites)

4. Black Spruce Forest

This type is the dominant tree cover on peaty Gleysols, developed on water-receiving lower slopes. The constancy of black spruce on these types makes the identification of poorly-drained Gleysolic soils primarily an identification of the dark-toned black spruce forest on air photos.

Black spruce is the main tree species; larch is commonly associated; and white spruce and white birch form minor components in some areas. Black spruce stands are generally

Fig. 6 - Pine Forest near Fort Simpson. Note the associated aspen.

Fig. 7 - Black Spruce Forest in background and meadow with sedge and cottongrass in the foreground. The black spruce at this site is taller than usual in the area.

short, slow-growing, and often open, due to the small narrow crowns, although tree density may be high. Tall shrubs are rarely present, the usual understorey consisting of medium and short shrubs, especially ericaceous shrubs and a dense moss cover.

Characteristic Species:

Trees:

| | |
|---|---|
| Picea mariana | - black spruce |
| (Associated - Larix laricina | - larch) |

High Shrubs: Alder and/or willow occasionally

Medium Shrubs:

| | |
|---|---|
| Ledum groenlandicum | - Labrador tea |
| Potentilla fruticosa | - shrubby cinquefoil |
| Betula glandulosa | - bog birch |

Short Shrubs:

| | |
|---|---|
| Oxycoccus microcarpus | - bog cranberry |
| Empetrum nigrum | - crowberry |

Herbs:

Equisetum spp.

Mosses:

| | |
|---|---|
| Hylocomium splendens | - feathermoss |

The dense moss layer and accumulations of moderately decomposed organic matter under these forests combined with high water table leads to frequent occurrence of permafrost.

This type is very common in the area occurring on all Gleysolic soils.

5. Moist Seepage Forest (Shrub)

This vegetation type is relatively rare in the area, occurring mostly in local situations where seepage is occurring down slope and causing wet conditions. In this situation it is common to find dense stands of alder, white birch, and willow, occasional balsam poplar, and dogwood. The soil is wet in these telluric areas but there is little or no peat accumulation.

Fig. 8 - This photo is taken looking south onto the prominent scarp south of the Liard River. The combination of north-facing slope and seepage are producing a Moist Seepage Shrub on the lower slope. The upper slope supports Mixed Leaftree Forest and the southern face Pine Forest.

6. Brulé

The vegetation establishing itself on recent burns is varied, depending on the site type. However, certain species, such as pine, aspen, or fireweed, are particularly adapted as early colonizers.

D. Vegetation of Organic Soils

Organic soils occur throughout the survey area, and are generally divided into two main types, partly on the basis of vegetation.

1. Sedge Fens

The vegetation of fens is usually meadow with sedges or grasses predominant. Willow, bog birch, sweet gale, and scattered tamarack or birch may occur on ridges (in patterned fens) or near the margins of depressions. Feathermosses and sphagnum mosses adapted to the wet environment are also common. The variations in vegetation on different types of fens is discussed under Organic Soils.

Characteristic Species:

Trees:

| | |
|---|---|
| *Larix laricina* | - tamarack |
| *Betula papyrifera* | - white birch |

Medium Shrubs:

| | |
|---|---|
| *Salix spp.* | - willow |
| *Betula glandulosa* | - bog birch |
| *Myrica gale* | - sweet gale |
| *Potentilla fruticosa* | - shrubby cinquefoil |
| *Vaccinium spp.* | |

Herbs:

| | |
|---|---|
| *Parnassia palustris* | - grass of parnassus |
| *Equisetum spp.* | - horsetail |

Characteristic Species,(Continued)

Grasses and Sedges: Carex spp.
Eriophorum spp.

Mosses:

Drepanocladus spp.
Sphagnum spp.

2. Bog Forest

This type represents the vegetation of typical bog peat plateaus in the area. Bog Forest is typified by open stands of stunted black spruce with a dense shrub layer of labrador tea, leather leaf, bog rosemary, and cloudberry growing in dense sphagnum moss (lichens are common in more northern parts). The vegetation of bogs is discussed in more detail under the Grainger Association.

Fig. 9 - Vegetation types on this area of the Lacustrine Benchland in 95G are Mixed Leaftree on the well drained ridges and Bog Forest, with scattered black spruce and tamarack in the poorly drained depressions. The bogs have a distinctive purple hue in the autumn. The transition between the two types is fairly sharp but there is obviously a transition zone in mid-slope.

# CLIMATE

The map area has a continental climate, with long cold winters and short warm summers. The total precipitation is relatively low, but most of it falls during the summer months. The only long-term weather station within the area is located on the Fort Simpson island. Since 1963, data is also available from a station at the Fort Simpson airport on the mainland. Data is also available from stations south of the area in Fort Nelson, B.C., and Fort Vermillion, Alberta.

The annual precipitation at Fort Simpson is 13.1 inches (Table 1), with 7.9 inches coming in the May to September period. The precipitation pattern is very similar at the Fort Vermillion station, but Fort Nelson has higher annual and seasonal precipitation (17.1 and 10.0 inches respectively). The severity of the low seasonal precipitation in the Fort Simpson area is partially offset by a low May to September value for potential evapotranspiration (PE). The seasonal PE value for Fort Simpson is 12.7 inches, compared to 16.6 inches in Fort Vermillion, Alberta, and 21.5 inches for Saskatoon, Saskatchewan. This indicates a moisture deficit deficit during the growing season of 4.6 for Fort Simpson and 8.4 inches for Fort Vermillion. The mean annual temperature for Fort Simpson is 25°F compared to 29.1 and 35.7°F for Fort Vermillion and Beaverlodge, Alberta (Table 1). This difference is due to the colder winters experienced in the Fort Simpson area. The mean July and minimum July temperatures are higher for Fort Simpson than either Fort Vermillion or Beaverlodge. The longer day length and warmer mid-summer temperatures in the Fort Simpson area may be significant when considering whether cereal grains may be grown in the North. The growing degree days above

$42^{o}F$ for Fort Simpson are 1800, compared to 1900 and 2000 for Fort Vermillion and Beaverlodge. Fort Simpson tends to be cooler during May and September than the two Alberta stations, but warmer during June, July, and August (Coligado et al, 1968).

The frost-free period at Fort Simpson is 92 days, compared to 81 and 109 days for Fort Vermillion and Beaverlodge, respectively.

Estimates for temperature and other related agroclimatic elements have been calculated for the Great Plains Region with a regression equation that considered elevation latitude and longitude. These calculations (Table 2) indicate that oats and barley could be successfully grown at elevations of 650 feet near Fort Simpson, 1000 feet near the Blackstone River, and up to 1500 feet above sea level near Fort Liard.

Due to the long, cold winters, some soils remain frozen for long periods of time. Permafrost is more prevalent in soils with an insulating moss or organic cover. Most well drained soils are free of frost by mid-June, while poorly drained soils with a thin organic cover (15-40 cm) and most peat bogs will remain frozen all summer. When the tree and peat cover is removed, the poorly drained mineral soils will not remain frozen during the summer months, as evidenced by unfrozen soils in seismic cutlines.

TABLE 1

CLIMATIC DATA FOR PARTS OF NORTHWESTERN CANADA

| | Fort Simpson | Fort Simpson A* | Fort Vermillion | Fort Nelson | Beaverlodge |
|---|---|---|---|---|---|
| Annual Precipitation | 13.1 | 13.5 | 13.9 | 17.1 | 18.5 |
| May-Sept. Precipitation | 7.9 | 8.3 | 8.2 | 10.0 | 10.2 |
| May-Sept. PE** | 12.7 | 12.7 | 16.6 | 13.0 | 16.5 |
| Annual PE | 13.5 | -- | 18.6 | 19.5 | 18.5 |
| Mean Annual Temperature | 25.0 | 24.6 | 29.1 | 30.0 | 35.7 |
| Mean July Temperature | 62.1 | 61.0 | 61.7 | 62.0 | 60.2 |
| Maximum July Temperature | 73.5 | 72.7 | 74.7 | -- | 72.2 |
| Minimum July Temperature | 50.6 | 49.2 | 48.6 | -- | 48.1 |
| GDD+ May-September | 1827 | 1696 | 1973 | -- | 1951 |
| GDD June-August | 1540 | -- | 1560 | -- | 1461 |
| Frost-Free Period | 92 | 89 | 81 | 102 | 109 |
| Frost Risk, June 15 | 15% | -- | 23% | -- | 5% |
| Frost Risk, August 15 | 10% | -- | 28% | -- | 1% |
| Elevation | 422 | 567 | 915 | 1230 | 2500 |
| Years of Data | 29 | 7 | 29 | -- | 29 |
| Source of Data | 1 | 2 | 1 | 3 | 1 |

* Fort Simpson Airport
** PE - Potential evapotranspiration
\+ GDD - Growing degree days with temperature greater than 42°F.

Sources:

1. Risk Analyses of Weekly Climatic Data for Agricultural and Irrigation Planning. Tech. Bull. Prepared by Mauro C. Coligado, Wolfgang Baier, and Wilbur K. Sly. Agrometeorology Section, Plant Research Institute, Canada Agriculture.
2. Temperature and Precipitation, 1941-1970, The North, Y.T., and N.W.T. Environment Canada.
3. Soils of The Fort Nelson Area of British Columbia. K.W.G. Valentine. Canada Agriculture, Vancouver, B.C.

TABLE 2

CALCULATED CLIMATIC VALUES

FOR SELECTED SITES IN THE LIARD AREA

| Location | Latitude | Longitude | Elevation | GDD May-Sept. | Frost Free Period |
|---|---|---|---|---|---|
| Petitot River near B.C. Border | 60° | 122°44' | 1327 | 1715 | 70 |
| South of Fort Liard near B.C. Border | 60° | 123°26' | 1676 | 1501 | 56 |
| Near Flett Rapids | 60°40' | 123°26' | 1000 | 1818 | 78 |
| Near the Grainger River | 60°20' | 122°50' | 1000 | 1648 | 68 |
| Northwest of Fort Simpson | 62° | 121°34' | 500 | 1783 | 75 |

## SOIL FORMATION

Soil is a natural, dynamic, three-dimensional body on the earth's surface, containing living matter and supporting or capable of supporting plants.

A wide variety of soils are present in the map area. These differences result from the particular combination and interaction of the soil-forming factors, namely climate, parent material, relief, drainage, and biological activity, all acting through time.

Climate is more important at a regional level. For the sake of soil formation, the whole area is considered to have similar climate. Local differences in climate occur where a south-facing slope may be slightly arid, while a similar north-facing slope may be cool, wet, and poorly drained. To a large extent, climate also controls the rate and type of biological activity in an area. Vegetation is an important soil-forming factor, but is also a function of soil. Vegetation is rooted in the soil, withdraws nutrients from it, and in turn influences the micro-environment at the soil surface and releases gases and enzymes into the soil during growth. The remains of dead organisms are decomposed by micro-organisms in the soil and mineral elements are released to the nutrient cycle.

The parent material is the base on which the other factors act. All parent materials in this area are moderately calcareous but differ widely in their texture. The coarser textured soils tend to have Brunisolic profiles, while those with higher clay contents often have Luvisolic profiles. However, all the other factors interact to determine the type of soil profile finally developed.

The factors of relief and drainage are strontly related, as low, flat areas tend to have poor drainage, while higher or sloping areas tend to be well drained. However, even sloping areas can be poorly drained if the parent material is relatively impermeable to the downward movement of water.

The influence of time in this area is well documented by the occurrence or young soils (Regosols) on the low floodplains, medium age soils (thin Brunisols) on higher floodplains, and well developed Luvisols on the highest floodplains. Again, it is difficult to generalize because moderately developed Brunisols occur next to well developed Luvisols on similar parent material of similar age.

## SOIL CLASSIFICATION

### Soils of the Luvisolic Order

These are well and imperfectly drained soils formed under deciduous, coniferous, and mixed forest regions in moderate and cool climatic regions. All soils in this order have light-colored A horizons (Ae) and a B horizon in which clay has accumulated (Bt). The dominant subgroup occurring in the area is the Orthic Gray Luvisol with the horizon sequence L-H, Ae, Bt, and Ck. In addition, some soils belong to the subgroup Brunisolic Gray Luvisol, which have a brownish-colored Bm horizon between the Ae and Bt horizons. These subgroups occur mainly on the morainal uplands and on some of the fine-textured alluvial and lacustrine soils.

### Soils of the Brunisolic Order

These are well and imperfectly drained soils formed under forest vegetation, lacking a Bt horizon, and having instead a brownish-colored Bm horizon. The Brunisols in this area belong to the Eutric Brunisol great group. They are characterized by having a layer in the top meter with a pH greater than 5.5. Soils with Ae horizons belong to the Degraded Eutric Brunisol subgroup, while soils with little or no Ae belong to the Orthic Eutric Brunisol subgroup. The Brunisolic soils occur throughout the area on most types of parent material.

Soils of the Regosolic Order

These are well and imperfectly drained soils having horizon development too weak to meet the requirements of soils in any other order. They occur primarily on recent alluvial floodplains. Two subgroups occur throughout the area. The Cumulic Regosol subgroup has alternating mineral and organic layers caused by periodic flooding. The Orthic Regosol subgroup may have an organic-rich surface horizon, but the organic matter content decreases regularly with depth.

Soils of the Gleysolic Order

These are mineral soils that are saturated with water continuously or during some period of the year. These soils support hydrophytic vegetation and may have an organic surface layer of mixed peat up to 40 cm thick or fibric peat up to 60 cm thick. They may have distinct or prominent mottles of high chroma. They have matrix colors of low chroma in the top 50 cm. Most of the Gleysolic soils in this area belong to the Orthic and Rego Gleysol subgroups. The Orthic and Rego Gleysols are separated on the presence or absence of a B horizon. Most of the Gleysols in this area were mapped as peaty phases, having between 15 and 40 cm of mixed peat or less than 60 cm of fibric moss peat on the surface.

Soils of the Organic Order

Organic soils are formed under wet conditions and have a surface layer of 40 cm or more of mixed peat material, or 60 cm or more of fibric sphagnum moss material. The organic layer must contain more than 30% organic matter. The Organic soils are separated into great groups on the basis of the degree of decomposition of the organic material. Fibric material is relatively raw and undecomposed, mesic material is partly decomposed, and humic material is so well decomposed that very little of the organic fibres are discernable. The dominance of these three types determines the great group. Subdominant layers determine the subgroup.

If there is underlying material closer than 90 cm (120 cm if fibric) to the surface, this material determines the great group. The underlying material may be terric (mineral), hydric (water), any of which may be permanently frozen (cryic).

The organic soils in the survey area were not classified in detail. Most of the bogs have sphagnum-derived peat and are permanently frozen. They are mapped as Cryic Fibrisols. Fens, including fen-type areas in bog collapse scars, are usually moderately decomposed sedge peat, and are mapped as Typic Mesisols, Cryic Mesisosl, and Hydric Fibrisols.

## METHODS OF SURVEY

Soil survey is the systematic delineation of land areas in which the soils, the associated soil properties, and topography are all within defined limits. Within each working area there are concepts and limits of certain features, which must be defined to ensure uniformity of mapping. The methodology is also connected with the scale of mapping and the purpose of the survey. This survey was designed to aid in the development of an agricultural lands policy for the North and as such, is oriented to agricultural capability. Within limits, though, the information from this survey can be used for other types of interpretations.

Field Procedures and Access

In June, 1975, soil inspections were made along all improved roads in the area. During July and August, extensive use was made of a helicopter to land field parties and again to pick them up after each party had completed a 5-10 mile transect along seismic cutlines. Transects were chosen to cross boundaries on pretyped aerial photographs and were intended to cover representative soil types, both well and poorly drained. In addition, the helicopter was used for numerous spot checks and for sampling soils in remote areas. The map in Fig.10 shows the location of all transects, spot checks, and sampling sites. The soils were systematically studied in pits or by augering with a hand auger. The arrangement, thickness, and texture of soil horizons, characteristics of the landscapes, and vegetation were recorded on computer sheets for future data handling.

Field work was carried out with the aid of 1959 and 1973 aerial photographs at a scale of about 1 inch equals 1 mile. Boundaries between distinct areas, such as alluvial floodplains, lacustrine soils, morainal uplands, as well as poorly drained areas, were pretyped on the photos before going into the field. After field observations along selected transects, results were extrapolated on the basis of similarity of air photo patterns over the whole area.

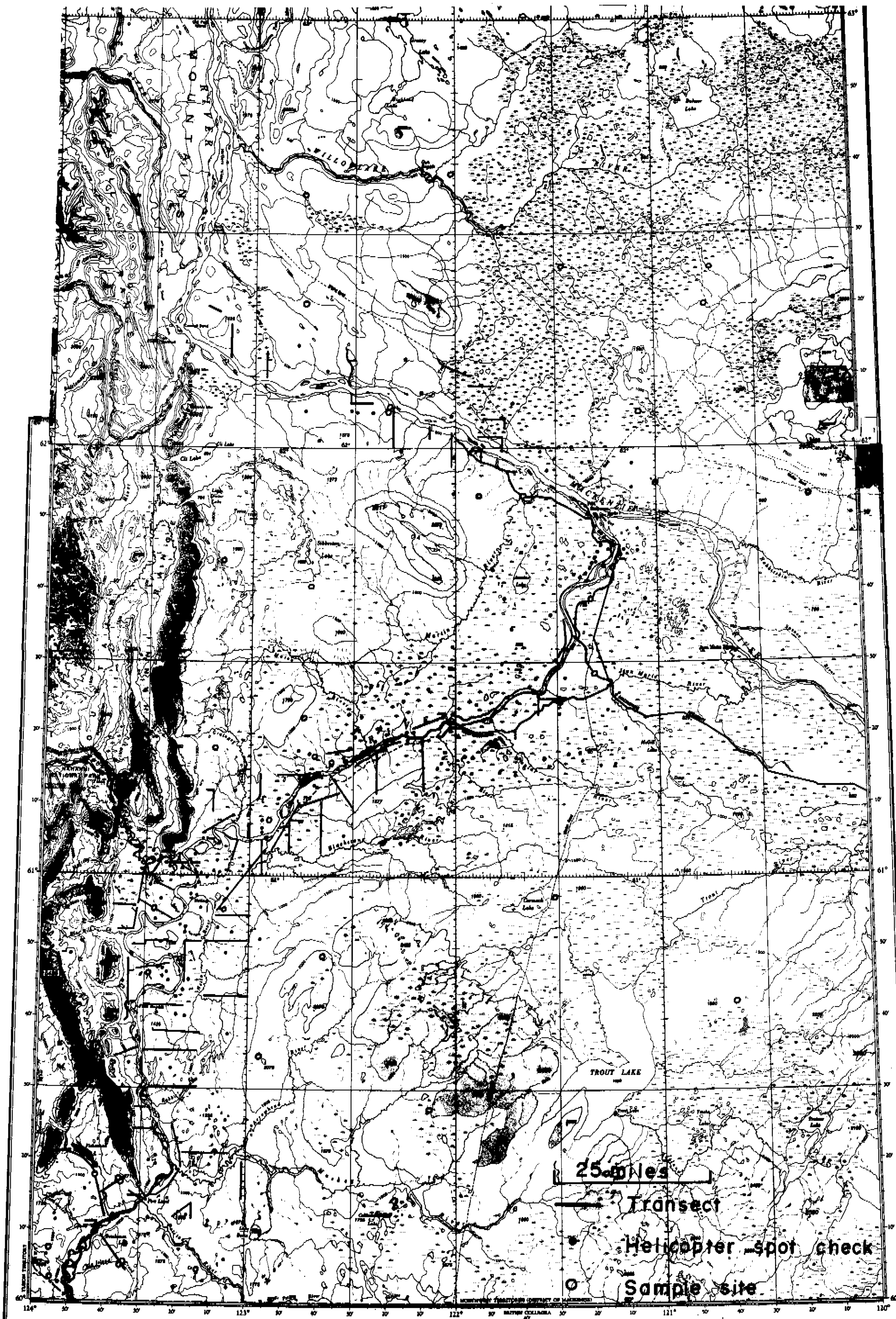


Fig. 10 - Location of transects and sample sites.

Problems Associated with Mapping

The area to be mapped extended over a large, relatively inaccessible, wilderness region. The north to south distance extended over $2^{O}N$ latitude. There were indications of change in regional climate that could not be quantified and were not recognized in different map units used. The regional climatic differences associated with changes in elevation were less of a problem, as physiographic districts representing floodplains, lacustrine, and morainal soils occurred at distinct elevations.

Conventions used in Mapping

Veneer - Shallow lacustrine, fluvial or alluvial material less than 1 meter thick over till or sand.

Organic soil - This is soil material of organic origin greater than 60 cm thick if fibric peat or greater than 40 cm if moderately decomposed.

Peaty phase - This is used for Gleysols that have a surface organic layer thicker than 15 cm but less than that required for an Organic soil.

Classification and Mapping Procedures

In a reconnaissance survey of this type, it is desirable to subdivide the landscape into units that are easily recognized on aerial photos and in the field and have practical significance for various interpretations. The three levels of subdivision of the landscape adopted here are:

1. Physiographic Districts

The first level of division is based on major differences in relief and geomorphic origin. Each district has a common pattern of landform and associated climate, soils, and vegetation. They are distinguishable at a scale of 1:250,000 to 1:500,000. There are four major Physiographic Districts defined in the survey area:

A. Alluvial Floodplain

B. Lacustrine Benchland

C. Deltaic Sand Plain

D. Morainal Uplands

These are described in detail elsewhere in the report. The boundaries between the different Physiographic Districts are not always distinct.

## II. Soil Associations

The Physiographic Districts are subdivided on the basis of soil profile characteristics, texture of the top meter of soil, and gross drainage (well and imperfectly versus poorly drained). The associations are given geographic place names for identification. In almost all cases, each association has one soil order as dominant, but may have significant members of other orders. The parent material of each association is defined as occurring within certain textural limits. The soil association, then, is a catenary sequence, reflecting differences in topography and drainage on a relatively homogeneous parent material.

In the reconnaissance soil survey of the Liard Valley by Day (1966) the mapping unit used was the soil series. Whenever possible, the names of series established by Day were used to name the association in which that series was dominant. In addition, new associations and series were established for soils encountered beyond the scope of the earlier survey.

## III. Soil Map Units

The soil association is subdivided into mapping units on the basis of the relative proportion and types of profiles occurring in each delineated area on the map. The map unit essentially represents different topography and drainage conditions within an association. Vegetation is not an integral part of the mapping unit but changes in drainage are reflected in vegetation changes.

Explanatory Notes of the Soil Map and Legend

Dominant soils and significant soils *- This refers to the relative proportion of soil series or subgroup profiles as they occur in a map unit. Dominant soils occupy over 40 per cent of the unit, while significant soils occupy more than 15, but less than 40 per cent. Other soils occupying less than 15 per cent may occur, but are not mentioned in the map unit description.

Soil Series - A soil series is a soil body such that any profile in that body has a similar arrangement of horizons with characteristics within a defined range. Groups of soil series occurring in a repetitive pattern on the landscape make up a soil association.

Complexes*- Complexes of two different associations can occur (for example, complexes of till with lacustrine). In these cases the first association is dominant and the second association is significant.

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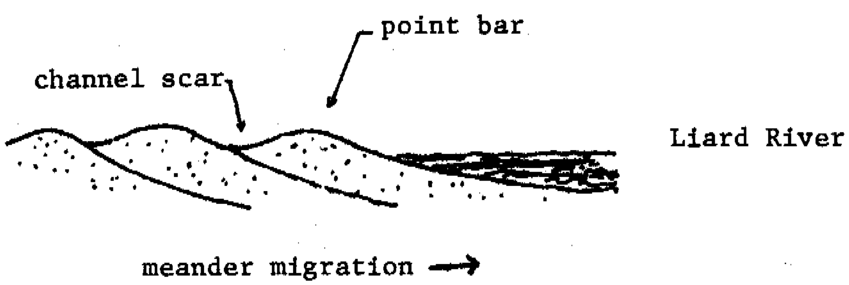
* Organic soils present a special case; organic soils can be significant in an association dominated by mineral soils but areas of dominant organic soils (Grainger or Trail River Associations) and significant mineral soils must be complexed. Where organic and mineral soils are complexed if the organic soil association appears first, it means organic soils are dominant; if the mineral soil association appears first, it means organic soils are co-dominant with mineral soils.

## ALLUVIAL FLOODPLAINS PHYSIOGRAPHIC DISTRICT

The extensive Alluvial Floodplains of the Liard and Mackenzie Rivers are a series of level or gently undulating terraces which are characterized by district formation features. The floodplain forms as a meander migrates outward and downstream, forming a terrace made up of a recurring series of point bar deposits, levees, and shallow channel scars in a scalloped or channelled pattern. These features may be in the process of formation, as on the low-lying active floodplains of the Liard River which are presently being built up. Here point bars form as a result of lateral accretion of alluvium on the inside of a meander bend. The material is usually gravelly to fine sandy. As the meander migrates outward, each successively formed point bar forms an arcuate shaped channel scar. A side view is depicted below:




If migration proceeds regularly, a smoothly channelled terrace forms. However, if meanders grow irregularly, the channel scars may vary in width, depth, and relative proportion of the landscape Plate 1. In addition, meanders may become cut-off, forming abandoned channels or oxbows. These gradually fill in with finer deposits but remain poorly drained and eventually form peat bogs or fens, accentuating their distinct pattern. Backswamps are longer, irregularly-shaped depressional areas, usually formed in inundated areas behind levees. They are also usually poorly drained and peaty. These individual features cannot usually be drawn out at the scale of mapping used, and are therefore mapped as terraces or parts of terraces with patterns of recurring features.

Older floodplains which become abandoned above the level of active flooding, due to progressive downcutting of the river, maintain these typical floodplain features in distinctive patterns of soil, topography, and vegetation.

For the main part of the Liard floodplain, the terraces formed do not occur in a regular age sequence on each side of the river, due to constant meandering of the river cutting back old terraces and forming new ones. However, on the basis of height, age, soils, and vegetation, the alluvial deposits have been divided into Recent Floodplains and Abandoned Floodplains, corresponding to Jeffrey's (1964) description of "Recent" and "Ancient Floodplains."

All the floodplains occur within 100 feet of the present river level, but the Abandoned Floodplains include those terraces which are older, higher above river level (generally greater than 40 feet), and are characterized by mature soils developed on a fine silty cap over sands. The Recent Floodplain is more recent in origin, including those terraces presently forming, lower (15-40 feet above river level), and is characterized by sandy or coarse silty soils with buried organic layers. These lower terraces are generally found closest to the present river channel. Where the Abandoned Floodplain occurs adjacent to the Recent Floodplain, they are always separated by a steep escarpment (20-50 feet) (Fig. 11 ).

Fig. 11 - Photograph at river level showing an escarpment between a Recent Floodplain on the right and an abandoned terrace on the left. Note the different forest on the two types, with aspen and spruce on the higher terrace and predominantly spruce on the lower.

Thus, although the Alluvial Floodplains are treated as one Physiographic District, it is convenient to talk about the soils using this separation. Unfortunately, this separation is not always as clear as in Fig. 11. In several places, particularly where a terrace has been in formation for considerable time there is a gradual drop in elevation or series of small escarpments from the oldest to the youngest deposits. Jeffrey (1964) identified a minor "Indeterminate Floodplain" which, although it is not clear from his description, may correspond to this situation. In this survey the Poplar Association includes the floodplains that are in this intermediate category, between Recent and Abandoned Floodplains. The Poplar Association is also distinct in that it is developed on coarse silty alluvial material. It should be appreciated that, although each association is explained as an independent unit, understanding is aided by general discussion of the characteristics of the floodplain.

Abandoned Floodplains

Fine Silty - Older,finer-textured alluvial sediments occur abandoned at higher elevations on the floodplain. Abandoned Floodplains are often marked by steep cut banks (Fig. 11). The typical meander plain landscape is still evident and often accentuated by differing soil and vegetation development. However, the channeled landform is usually more subdued than on Recent Floodplains.

The soils developed on old point bars and levees are predominately Eutric Brunisols and/or Luvisols. Gleyed soils occupy imperfectly drained channel scars. Gleysols and Organic soils develop in poorly drained and very poorly drained backswamps and channels.

The soil texture is silty clay loam or less commonly silty clay, overlying sand usually within one meter of the surface. The soil is generally more acidic in reaction than Recent Floodplain soils.

The thickness of the underlying sand is undetermined but cut banks along the Liard River expose up to 20 meters of sandy alluvium. Underlying bedrock is exposed at Flett Rapids and near the mouth of the Grainger River. A Granular Survey of the area found gravels

Fig. 12 - This photograph is a close-up of the Abandoned Floodplain shown in Fig. 11 . Here the silty clay loam cap is somewhat over one meter thick and the boundary with the underlying sand is abrupt.

under the floodplain near Flett Creek (Minning et al, 1972). Gravel deposits were observed under the floodplains of the Nahanni River as well.

The predominant forest types are Floodplain Mixedwood (white spruce and trembling aspen) and Mixed Leaftree (aspen and white birch), in contrast to the Balsam Poplar and White Spruce Forests of the Recent Floodplain. The forest stands are tall, moderately dense, and even aged. Black Spruce Forest, Bog, and Meadow-Shrub vegetation types occur in the poorly drained channels and backswamps.

Fig. 13 - This photo was taken looking west on the large floodplain immediately north of Flett Rapids. The area in the foreground and to the left is particularly badly cut up by old channel scars and is mapped as the Flett Association. Such areas are downgraded for agricultural capability because of undesirable soil or landform patterns.

The Abandoned Floodplains occur mainly along that stretch of the Liard River from Flett Creek to Dehdjida Island.

The Soil Associations mapped on the Abandoned Floodplain are Netla, Swan Point, and Flett Associations (plus Organics). All of the above are fine silty deposits. Poplar Association, which is a coarse, silty deposit, represents a separate case.

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Recent Floodplain

The Recent Floodplain includes those formed in comparatively recent times or in the process of formation at present. Most of the Recent Floodplain is still subject to periodic flooding. In its lowest-lying Riparian portions, flooding is annual, occurring during peak flows in spring, while higher areas would be flooded only sporadically. Fort Liard has experienced flooding above its 25 foot banks at least twice in the last century.

Flooding is the major environmental factor influencing soil and vegetation and soils are subject to continual build-up through flooding and deposition.

For an example of the patterns of landform, soils and vegetation on the floodplains, see Plate 1, Appendix I.

Liard Association

The Liard Association occurs on Recent Floodplains and Islands along the Liard and Mackenzie River throughout the length of the survey area. This association consists mainly of Cumulic Regosols developed on moderately well to well drained alluvium. The texture of the alluvial deposits is variable, ranging from sandy to silty, with sandy loam most frequent. Often there is a gradation from coarse textured, even gravelly deposits in the subsoil to finer textured sands and silts on the surface. This is a function of its deposition, coarser textured material being deposited first on sand bars.

Liard soils are characterized by a thin L-H horizon over stratified mineral alluvial and organic deposits. The buried organic layers represent accumulations of surface organic litter that have been buried by periodic flooding and deposition of new alluvium on the surface. Such soils form when the interval between periods of flooding is sufficient to allow significant build-up of organic matter. Therefore, the youngest, lowest-lying portions of the Liard Association may lack significant build-up of an organic layer on the surface or in the profile. These soils are also coarser textured.

The Liard Association is characterized by the distinct channelled pattern common on all the floodplains. The channels are usually deeper, especially on the lowest-lying portions. Levelling occurs with flooding and subsequent deposition over time.

The channels may be imperfectly or poorly drained, but insufficient time has elapsed for significant profile development or accumulations of peat normally associated with such sites, although thicker peat accumulations were noted in some backswamps. Gleyed Cumulic Regosols and Rego Gleysols are the only significant members mapped in the Liard Association.

The vegetation of the Liard Association is unique and reflects the dominant environmental influences of flooding, alluvial deposition, and ice-scouring. Riparian Shrub, Balsam Poplar Forest, and White Spruce Forest are the successional stages of uninterrupted development on new alluvium. The resulting vegetation pattern is best exemplified at the edges of Recent Floodplains (Plate 1). The dominant vegetational type is White Spruce Forest, either white spruce-balsam poplar, the climax of the above successional sequence, or white spruce-white birch forest, which is more likely of fire origin. In both types the shrub and herb layers are generally dense and unlike the Balsam Poplar Forests, have a dense moss layer. The main species are shrub-alder, rose, dogwood, and low bush cranberry; herb-horsetail, mitrewort, dewberry, and bunchberry; moss-feathermoss and plume moss.

The forests, because of the moister environment and natural barriers such as channels and escarpments, are less susceptible to fire and dominantly mature and over-mature stands of white spruce and balsam poplar occur. Brulés and mixed leaftree stands representing successional stages in regeneration after fire do occur in a few small areas.

The success of white spruce and balsam poplar on the flood-susceptible Liard soils is due to their ability to put out new roots when the base is buried by alluvium. Aspen does not have this ability and is rarely found on the Liard soils.

Thus, the Liard Association has special characteristics because it is still actively forming. The Riparian portion of this Association has a gradually changing environment, both in time and space, away from the river. The Riparian vegetation is particularly rich in wildlife habitat quality due to the mosaic effect of the banded growth. Many of the plant species, particularly willow, are valuable forage species for moose.

Map Units

L1 - Dominantly Cumulic Regosols.

This unit occurs mainly on islands and recent floodplains still within the zone of frequent flooding. Although they may flood regularly, the water is able to drain off easily after the flood recedes. The topography is gently channelled with point bar structure generally well defined.

L2 - Dominantly Cumulic Regosols and significant Gleyed Cumulic Regosols.

This unit occurs on young islands and terraces with an irregular pattern of imperfectly drained channel scars. These channels may be impeded from external drainage by levees (plugged channels).

L3 - Dominantly Cumulic Regosols and significant Rego Gleysols.

This unit is similar to L2 but the channel scars are poorly-drained.

Approximately 123,000 acres of the Liard Association were mapped.

Fig. 14 - This photo of Swan Point, below the junction of the Nahanni and Liard Rivers was taken during high water in July, 1975. Many of the channels and lowest-lying portions of the Liard Association were flooded at this time. The forested area in the background is more typical of the vegetation of the Liard Association than the wet, Salix shrub community in the foreground.

Blackstone River Association

The Blackstone River Association occurs in conjunction with Poplar soils in the area between the Netla and Poplar Rivers. This association consists mainly of peaty Rego Gleysols developed on poorly drained variable textured alluvium.

The Blackstone River soils are characterized by an organic horizon over gleyed,grayish brown,fine sandy to silty alluvium. There may be buried organic layers. This association occurs in abandoned channels of areas mapped as Poplar Association and also in the large abandonded channel in which the Netla River flows. (Fig.15). The vegetation is either Black Spruce Forest or Channel Shrub (willow, alder, bog birch, Equisetum and sedge).

As with the Poplar Association this association is quite variable. The Blackstone River soil mapped in the large abandoned channels on the meander floodplain is fairly recent alluvium supporting Channel Shrub Vegetation. This area is very wet, occasionally receiving flood waters from the Liard. In contrast the areas of Blackstone River soils mapped east of the Blackstone River have a thicker peat layer on the surface and support Black Spruce Forest.

Map Units

There is only one map unit in this association.

Brl - Dominantly Rego Gleysols, peaty phase.

Fig. 15 - Abandoned Channel of the Liard River in which the Netla River now flows for part of its course. The area is very wet and the dominant vegetation types are sedge Meadow and Channel Shrub. The Lacustrine Benchland to the right is separated from the floodplain by a steep escarpment.

Poplar Association

The Poplar Association occurs on Abandoned Floodplains of the Liard and Mackenzie rivers but represents those terraces intermediate between the more recent Liard Association and older Netla Association. This Association consists mainly of Orthic Eutric Brunisols developed on well drained, coarse silty alluvium over sandy alluvium. The coarse silty alluvial cap is less than 1 meter thick and ranges in texture from very fine sandy loam to silt loam. The material is moderately calcareous.

The dominant profile in Poplar soils is the Orthic Eutric Brunisol although sufficient Ae development to make a Degraded Eutric Brunisol does occur in places. The average depth of the solum for 16 observations is 33 cm but this is quite variable. Often the Brunisolic development is quite weak and the profile is shallow. In these areas Orthic Regosols are often a significant member of the map unit.

The Poplar Association is the most variable of the floodplain soils in terms of its occurrence and characteristics. Basically however, it occurs in two different types of situations. On the floodplains and islands south of the Blackstone River it occurs most often in association with the Liard Association and in several instances is complexed with it. Here it occurs on terraces that suggest an intermediate development between Liard and Netla in terms of age. These terraces are fairly low in relation to the other abandoned terraces but they are higher than the Liard deposits adjacent to them and above the level of flooding.

In this situation the coarse silty deposit is usually thin and profile development is weak. Occasionally soils were found with a shallow Bm beginning to form on parent material with distinct cumulic banding. These factors would suggest a relatively young soil. It is not known how long a cumulic profile would remain once it is abandoned above the level of inundation, and how long it takes before other soil forming factors begin to transform the profile and develop a solum. Often a reddish layer is found in the top 5 - 10 cm of these profiles, which may be a mixture of ash and the newly forming B horizon. Jeffrey (1964) made similar observations of "slightly acid loam" soils with a reddish enriched layer often on a parent material with buried organic layers. These Poplar soils are closely associated with Liard soils and may represent older deposits similar to Liard that have received coarse silty deposition while in a position of infrequent flooding. The terraces are gently channelled with arcuate channel scars.

The other area in which the Poplar Association is mapped is the narrow stretch of alluvial deposits along the "Long Reach" of the Liard. This stretches from where the Liard River ceases to meander, near Dehdjida Island to the Birch River where the floodplain ends. There is also some of this type along the Mackenzie River. These soils are coarse silty alluvial over sandy alluvial similar to the other area of Poplar Soils, but they appear to be older, in terms of their height above the river. It is speculated (Cook, 1974) that this section of the Alluvial Floodplain represents deposits of the Liard River when it was a braided channel in this section before and during the time it cut down to its present channel. The patterns of elliptical shaped "islands" of well drained soils and poorly drained channels between them supports this contention. Abandoned channels are linear and parallel to the river, but are less distinct. Typically there is a gradual drop with several small escarpments from the highest level of these terraces, 1 - 2 miles back from the river to the present river channel.

Orthic Regosols, Gleyed Eutric Brunisols, Gleysols and Organics are significant members in the Poplar Association.

Most of the areas mapped as the Poplar Association have been recently burnt and support leaftree stands of white birch and trembling aspen with a dense shrub and herb layer. Older stands are mixedwoods. The Poplar Association mapped along the Long Reach of the Liard River and the Mackenzie River has mostly Mixedwood Forest stands, but growth is slower than on the main floodplain near Nahanni Butte.

Map Units

Po1 - Dominantly Orthic Eutric Brunisols.

This unit occurs in only a few scattered areas on narrow terraces adjacent to the river (along the Long Reach) which are dominantly well drained. Channel scars are indistinct.

Po2 - Dominantly Orthic Eutric Brunisols and significant Orthic Regosols.

This unit occurs in several scattered areas on terraces with weakly developed Brunisols.

Po3 - Dominantly Orthic Eutric Brunisols and significant Orthic Regosols and Rego Gleysols, peaty phase.

This unit is similar to Po2, but has significant poorly drained areas in abandoned channels.

Po4 - Dominantly Orthic Eutric Brunisols and significant Rego Gleysols, peaty phase.

This unit occurs only on the floodplain between Nahanni Butte and the Nelta River and is closely associated with soils of the Liard Association in this area.

Po5 - Dominantly Orthic Eutric Brunisols and significant Rego Gleysols, peaty phase and Organics.

This unit occurs on the older narrow terraces along the Liard and Mackenzie rivers.

Approximately 66,940 acres of the Poplar Association were mapped.

Netla Association

The Netla Association occurs on abandoned floodplains of the Liard River between Big Island and the Matou River. This association consists mainly of Eutric Brunisols developed on well and moderately well drained, fine silty alluvial over sandy alluvial material. The silty alluvial cap is usually less than 1 meter thick with an average thickness of 62 cm. The texture of the solum is silty clay loam in the B and BC or upper C horizons and grades through silt loam and very fine sandy loam to loamy sand in the II C.

Both Orthic and Degraded Eutric Brunisols are mapped as dominant in the Netla Association with the former more prevalent. Degraded Eutric Brunisols are present on well drained crests but even in their best development the Ae is thin and faint. The B horizon of Netla soils is distinct and characteristic. The depth of the Bm averages $33 \pm 16$ cm. It is characteristically dark reddish brown to dark brown in color grading into a more drab olive or gray colored C horizon. The solum is generally strongly acid in reaction.

The Netla Association is characterized by the channelled pattern found on all floodplain soils although the expression is more subdued than on terraces presently in formation. The long linear swales or channel scars vary in width and in depth but are always a significant proportion of the landscape. Depending on their size and the severity of drainage these channels may have Gleyed Eutric Brunisols, peaty Rego Gleysols or Organic soils developed within them.

The distinct pattern of soils and landform is also reflected

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The distinct pattern of soils and landform is also reflected

in the vegetation. The well drained point bars support tall, moderately dense, even aged stands of Floodplain Mixedwood forest. These stands are typically dominated by tall straight trembling aspen. Two storied structure is common with white spruce being the main species of the understorey with occasional white birch. The spruce may be considerably younger than the leaf trees and suggests successional take-over. Understory species include low bush cranberry, alder, rose, bunchberry and feathermoss.

The vegetation of the channel scars depends on the width, depth and resulting drainage condition. Narrow, shallow, imperfectly drained channels may have Mixedwood Forest with moist site understorey species. Wider, poorly drained channels usually have Black Spruce Forest. Very poorly drained sites have Meadow Shrub vegetation.

Map Units

Ne1 - Dominantly Orthic Eutric Brunisols and significant Gleyed Orthic Eutric Brunisols.

This unit is mapped on alluvial terraces which were formed by regular meander migration leaving a smooth pattern of point bars and relatively shallow channels. The terrace are very gently channelled and the channels are imperfectly or rarely poorly drained.

Ne2 - Dominantly Degraded Eutric Brunisols and significant Gleyed Orthic Eutric Brunisols.

This unit is mapped on areas like the above only Degraded Eutric Brunisols are more prevalent than Orthic.

Ne3 - Dominantly Orthic Eutric Brunisols and significant Rego Gleysols, peaty phase.

This unit is mapped on alluvial terraces with a somewhat irregular but distinct pattern of narrow curvilinear channel scars or with depressional backswamp areas. The topography is gently undulating.

Ne4 - Dominantly Orthic Eutric Brunisols and significant Rego Gleysols, peaty phase and Organics.

This unit is similar to Ne3, but the poorly drained abandoned channels and backswamps occupy a greater proportion of the area and many have thicker peat deposits. The topography is gently undulating but the pattern of wet channels and backswamps makes this unit very irregular.

Ne5 - Dominantly Degraded Eutric Brunisols significant Gleyed Degraded Eutric Brunisols and Organics.

This unit is like Ne2, except that it has a significant proportion of small irregular abandoned channels which have accumulated thick peat deposits and now support fen meadows.

Approximately 42,500 acres of the Netla Association were mapped in the survey area.

Swan Point Association

The Swan Point Association occurs on Abandoned Floodplains often in conjunction with areas of Netla soils or slightly higher. and back from them, forming the highest of the floodplain soils. This, plus the development of Orthic Gray Luvisolic profiles on the fine silty alluvial material indicate that this association is the oldest floodplain soil.

The texture of the material is silty clay loam to silty clay in the B and C. As in Netla soils this fine silty material overlies sand usually within 1 meter. However, on several sites the deposit was greater than 1 meter over sand and these sites were observed to be finer textured (silty clay). The parent material is generally weakly to moderately calcareous although a few non-calcareous profiles were examined. Orthic Gray Luvisols develop on the moderately well to well drained ridges which represent the original point bars. The Luvisolic development of Swan Point is often weak. The average thickness of the Ae is 7cm but in many sites examined was very thin. The Bt is brown to grayish brown in color with an average depth of 40 cm. The structure is usually strong subangular blocky. The peds are firm and often have a waxy lustre when cut. The solum depth averages 50 cm. It is moderately acidic in reaction.

The Swan Point Association occurs on terraces which are usually gently channelled to level. The occurrence of significant members of this association is related to the channelled pattern. Degraded Eutric Brunisols occur closely associated with Luvisols on moderately well drained upper slopes and crests of remnant point bars. Gleyed Orthic Gray Luvisols occupy imperfectly drained shallow channel scars. Peaty Rego Gleysols occur in poorly drained channels. Organic soils occurring in larger channels are drawn out separately, but it is likely that they are also present in small amounts with Gleysols.

The pattern of soils and landform is also reflected in the vegetation. Tall, moderately dense stands of Floodplain Mixedwood Forest are dominate on this association. The stands are similar to those occurring in the Netla Association but spruce is more commonly dominant in this association in mature stands. Black Spruce Forest or Meadow-Shrub vegetation occurs in poorly drained channels.

Map Units

Sw1 - Dominantly Orthic Gray Luvisols and significant Degraded Eutric Brunisols.

This unit occurs on smooth,faintly channelled terraces, formed by regular meander migration. The topography is level and the soil is well to moderately well drained.

Sw2 - Dominantly Orthic Gray Luvisols and significant Gleyed Orthic Gray Luvisols.

This association occurs on very gently channelled terraces with significant imperfectly drained channel scars.

Sw3 - Dominantly Gray Luvisols, significant Degraded Eutric Brunisols and Gleyed Orthic Gray Luvisols.

This unit is similar to Sw1, but it occurs on more distinctly channelled terraces with significant imperfectly drained channels. The topography is level to very gently undulating.

Sw4 - Dominantly Orthic Gray Luvisols, significant Gleyed Orthic Gray Luvisols and Rego Gleysols, peaty phase.

This unit occurs on gently channelled terraces irregularly cut up by imperfectly and poorly drained channels. The wide, poorly drained channel scars are sinuous throughout the landscape and are conspicuous by their meadow-shrub vegetation. Many of these poorly drained areas have permafrost at shallow depths associated with thick peat deposits.

Sw5 - Dominantly Orthic Gray Luvisols, significant Degraded Eutric Brunisols and Rego Gleysols, peaty phase.

This unit occurs on smoothly to irregularly channelled terraces in which the channel scars are wide and poorly drained.

Approximately 34,000 acres of the Swan Point Association were mapped.

Flett Association

The Flett Association occurs on Abandoned Floodplains in poorly drained abandoned channels and backswamps associated with Netla and Swan Point Associations. The Flett Association consists mainly of peaty Rego Gleysols developed on silty clay loam alluvial material over sand. The fine silty material is usually less than 1 meter thick over sand.

The dominant soil in this association is the peaty Rego Gleysol, although Orthic Humic, and Rego Humic Gleysols were observed. The peat accumulations are variable in thickness depending on the type of vegetation. Significant members of this association are Luvisols, Brunisols and Organics. Flett Association occurs in basically three types of areas; in large backswamps at the back of the highest abandoned floodplains, in old abandoned channels which cut through terraces, and on terraces where poorly drained, arcuate shaped channel scars are prevalent. For an example of this latter type see Fig. 13. Channel scars are quite variable. The soil is a less important function than the drainage of these sites, as they are low flat areas or slightly dished surrounded by higher areas on which well drained soils occur. In some channels there is an abrupt transition from well drained Brunisols or Luvisols supporting tall stands of white spruce and aspen to poorly drained Gleysols supporting meadow vegetation (Fig. 31). In others the transition is gradual. Well drained soils with tall trees grade into imperfectly to poorly drained Gleysols supporting shrubs (bog birch and willow), through various types of meadow. In wide channels, grasses like Calamagrostis in the drier edges give way to a wetter inner centre with sedges (Carex aquatilus and C. rostrata). The separation

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Map Units

F1 - Dominantly Rego Gleysols, peaty phase.

This unit occurs in poorly drained backswamps and abandoned channels.

F2 - Dominantly Rego Gleysols, peaty phase, significant Orthic Gray Luvisols.

This unit is mapped in only one large area near Flett Rapids and represents a terrace in which the poorly drained channel scars are wide and irregular, severely cutting up and dominating the land surface (Fig.13).

F3 - Dominantly Rego Gleysols peaty phase and significant Gleyed Orthic Eutric Brunisols.

This unit is similar to F1 but differs in that there are significant ridges which are somewhat higher and better drained and have developed Gleyed Orthic Eutric Brunisols.

F4 - Dominantly Rego Gleysols, peaty phase and significant Organics.

This unit is in abandoned channels which are fairly wide and deep. In such channels organic deposits build up in the wetter central area. These were usually mapped as Cryic Fibrisols.

F5 - Dominant Rego Gleysols, peaty phase and significant Orthic Eutric Brunisols.

This unit is mapped in an area similar to F2, but the well drained areas are Orthic Eutric Brunisols. This unit is mapped in only one area in association with Netla.

Flett is mapped in complex with Grainger in large abandoned channels where Organics form the central part and Gleysols near the margins.

Approximately 16,219 acres of the Flett Association were mapped.

## DELTAIC SAND PLAIN PHYSIOGRAPHIC DISTRICT

The Deltaic Sand Plain is an extensive area of proglacial fluvial deposits that formed near the mouth of the ancestral Liard River as it emptied into Glacial Lake McConnell. The Deltaic Sand Plain extends on both sides of the Liard River over the full width of the survey area from the Birch River to the Mackenzie River. The area is low-lying for the most part, dropping from an elevation of 900 feet above sea level in the south to 500 feet in the north.

The boundaries of the area are indistinct. From the southwest the Lacustrine Benchland, with its gentle slope towards the river, gradually levels out into the broad Deltaic Sand Plain just east of the Birch River. This is also the point on the Liard River where the last trace of a floodplain ends and the river becomes sharply downcut through till and bedrock deposits. For the next 25 miles down river from the Birch River to Jean Marie Creek, the sand deposits are a thin veneer over morainal deposits, with the till occasionally exposed on ridges or strongly influencing the landscape with its striated pattern (see Fig.24 ). Soils developed on this sandy fluvial veneer are mapped as the Sibbeston Association (well drained) and the Scotty Creek Association (poorly drained). There are also large flat depressional areas with well developed peat plateaus mapped as the Grainger Association.

Quite abruptly, at about a line running northwest to southeast from Antoine Lake to Jean Marie Creek, the sandy veneers give way to deeper sand deposits, which prevail from here northeast to the Mackenzie River. Over a large part of the area these deposits have been extensively wind-modified into longitudinal and parabolic dunes. Soils developed on these sandy fluvial and wind-modified deposits are mapped as the Martin River(well drained) and Antoine (poorly drained) Associations. Although these soil materials are highly permeable, there are extensive flat areas away from the Liard River, where the water table is high and the area appears like a gigantic swamp. In these areas mostly fens have developed, dotted by innumerable small sloughs in interdune depressions and over extensive flats.

The Organic deposits change abruptly from predominantly bogs associated with the sandy fluvial veneers to predominantly fens associated with the deep sandy fluvial and dune deposits. There are organic deposits in several intermediate stages of development between bogs and fens as well. In most cases, however, the peat deposits are thick. Bogs are usually permanently frozen and elevated above the surrounding area.

The sand deposits are an average of 20 feet thick over till in this area, to as much as 50 feet in dunes (Rutter et al, 1973). The sand deposits end abruptly at the Mackenzie River and the northeast side of the river is a stony eroded till plain.

Throughout the Deltaic Sand Plain the Liard River is incised into the relatively level plain through till and even into bedrock deposits. The steep sloping walls are several hundred feet high. This is in sharp contrast to the low Alluvial Floodplains upstream.

North from Fort Simpson, along the Mackenzie River, the sands gradually pinch out into coarse silty deposits associated with the Lacustrine Benchland. Beyond this point towards Camsell Bend, the Martin River and Antoine Associations are mapped north of the Mackenzie River. These areas are slightly different from the main area of Deltaic Sands, in that they represent very old terraces of the Mackenzie River. They are usually wind modified and, as such, are similar to the soils near Fort Simpson.

Thus, the Deltaic Sand Physiographic District is not a sharply-defined area like the Alluvial Floodplains but, rather, grades into lacustrine and morainal deposits in several areas. Also, apart from the dominant deposits of the area described above, there are smaller areas of mixed lacustrine and fluvial (Winter Road and Anderson Mill Associations) and strictly lacustrine deposits (Gros Cap and Bluefish Associations). The former are considered as part of the Deltaic Sand Plain Physiographic Districts, while the latter are discussed with the Lacustrine Benchland. These deposits occur mainly along the Liard River, near its mouth and their presence in close proximity to this point on the river suggests that the lacustrine deposition occurred in association with water from the Liard River where it flowed into Glacial Lake McConnell.

Throughout the area mapped as veneers (Sibbeston, Scotty Creek, and Winter Road Associations), examination in soil pits and road cuts showed a gravelly contact between the sands and the underlying till, suggesting erosion or flushing by moving water. Above this contact, there was often a thin layer of cross-bedded, silts and sands, and finally the surface deposit of fine sandy loam to loamy sand. For an example of the landscape of the Deltaic Sands, see Plate 4, Appendix I.

Sandy Fluvial and Wind Modified Fluvial Deposits

Martin River Association

The Martin River Association occurs over the full width of the survey area, southwest of the Mackenzie River, to the Martin River on the west and Jean Marie Creek to the south (95H). It also occurs on old terraces on the north side of the Mackenzie River towards Camsell Bend (95I and 95J). This Association consists mainly of Degraded Eutric Brunisols, developed on sandy fluvial deposits. The parent material is mainly loamy sand in texture, moderately to strongly calcareous, and represents proglacial fluvial deposits of the Liard and Mackenzie River.

Some of the deposits remain as gently undulating fluvial deposits, but over a large part of the area, wind has reworked these sands into parabolic and longitudinal dunes. These dunes are presently stable and vegetated. These gently to strongly sloping dunes of permeable sands create well to rapidly drained conditions on the crests and flanks. The Degraded Eutric Brunisol is the dominant profile on these dunes and well to moderately well drained fluvial plains. This soil usually has a thin (10 $\pm$ 5cm) organic litter layer (L-H) over an average of 10 cm of light gray Ae over a yellowish brown Bm. The solum averages 58 cm in depth, but this varies considerably.

The significant members of the Martin River Association are Gleyed Orthic Eutric Brunisols, peaty Rego Gleysols, and Organic soils. Gleyed Degraded Eutric Brunisols and peaty Rego Gleysols occur on imperfectly drained lower slopes and poorly drained depressions respectively. Although the soil materials are rapidly permeable, the soil profiles may be imperfectly and poorly drained, due to the influence of a high ground water table in these soils. Organic soils, mostly fen type and often with ponded water, occur in larger interdune depressions.

The vegetation on the well to rapidly drained slopes and crests is Pine Forest with moderately dense, rapidly-growing jack pine stands. Aspen may be present on moister north and east-facing slopes and moderately well drained positions. The understorey consists of rose, buffalo berry, twinflower, bunchberry, bearberry, and bog cranberry and a moderate groundcover of feathermoss. Lichens may be present on drier sites. Under aspen stands the shrubs are usually taller and more dense. White spruce may be present with aspen as well, but the frequency of fires on these dry soils usually keeps white spruce out. Poorly drained depressions have black spruce, larch, ericaceous shrubs, and mosses (Black Spruce Forest). These often grade into fens with larch,willow and sedges in very wet depressions.

Mapping Units

Mr1 - Dominantly Degraded Eutric Brunisols.

This unit occurs near Fort Simpson on gently undulating wind-modified sands, where the smoother relief and proximity to the river bank creates predominantly well drained conditions.

Mr2 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase.

Mapping Units

Mr2 (Continued) -

This unit represents the largest proportion of Martin River Soils. It occurs on gently undulating to moderately rolling fluvial and wind-modified landforms with significant poorly drained depressions.

Mr3 - Dominantly Degraded Eutric Brunisols and significant Gleyed Orthic Eutric Brunisols.

This unit occurs under similar conditions to Mr1, but significant imperfectly drained conditions are present.

Mr4 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysol, peaty phase, and Organics.

Martin River Association is mapped on 191,165 acres. Martin River occurs complexed with Trail River Organic deposits over large areas where scattered dunes are present, in a matrix of wet fen deposits. It also occurs complexed with Arrowhead Association in the northwest corner of 95H, where the deltaic sands grade into lacustrine deposits. Near Fort Simpson, Martin River is complexed with Anderson Mill Association.

Antoine Association

The Antoine Association occurs over the full width of the survey area, southwest of the Mackenzie River to the Martin River on the west and Jean Marie Creek to the south. This Association consists mainly of peaty Rego Gleysols developed on sandy fluvial deposits. The calcareous, loamy sand parent material represents deep deposits of deltaic sands. This Association represents the poorly drained equivalent of Martin River and occurs closely associated with it.

The peaty Rego Gleysols of the Antoine Association have a thick layer of decomposing organic matter (10-40 cm) over mottled grayish brown calcareous loamy sand. They occupy the lowest portion of the flanks of dunes and depressions and drainageways in level fluvial deposits. Although the soil materials are rapidly permeable, the soil profiles are poorly drained because of the influence of a high ground water table. Peaty Rego Gleysols often grade into Organic soils in very poorly drained interdune depressions and water receiving flats. Degraded Eutric Brunisols are also included in this association, occurring on knolls and dune ridges within a predominantly poorly drained area.

The topography of the Antoine Association is level to gently undulating or hummocky.

The vegetation is predominantly Black Spruce Forest, with short, dense stands of black spruce, larch, ericaceous shrubs, and mosses. Undisturbed areas with thick insulating moss layers are permanently frozen for most of the summer.

Map Units

An1 - Dominantly Rego Gleysol, peaty phase.

This unit occurs infrequently in the area and in all but one case occurs in complex with organic soils. In these areas it represents an intergrade between extensive organic deposits and well drained soils.

An2 - Dominantly Rego Gleysols, peaty phase, and significant Degraded Eutric Brunisols.

This unit is common in the Deltaic Sands and represents dominantly poorly drained areas with a significant proportion of well drained soils on scattered dune ridges and knolls. It frequently occurs complexed with the Trail River Association.

An3 - Dominantly Rego Gleysol, peaty phase, and significant Degraded Eutric Brunisols and Organics.

This unit represents the most typical Antoine landscape. Dominantly Gleysolic soils with significant areas of well drained Brunisols on dune ridges and very poorly drained Organic soils, often with ponded water, occur in this map unit.

An4 - Dominantly peaty Rego Gleysols and significant Organics.

This unit is mapped on only one small area. Organics usually occupy greater than 25% of areas of Antoine and these areas are mapped as complexes of Antoine (An1) and Organic soils.

The Antoine Association is mapped on 53,572 acres, mostly in the Fort Simpson sheet. Of this, about 44,000 acres were mapped in complex with Trail River and Grainger Associations.

## Sandy Fluvial Veneer

### Sibbeston Association

The Sibbeston Association occurs over the full width of the survey area, starting at the Birch River and continuing north and east to Jean Marie Creek, where it grades into the Martin River Association. The Sibbeston Association consists mainly of Degraded Eutric Brunisols developed on sandy fluvial veneer overlying till. The veneer ranges from sandy loam to loamy sand in texture and varies from 40 cm to 1 meter thick. The material is moderately to strongly calcareous.

The Degraded Eutric Brunisol usually has a thin organic litter layer over 5 to 10 cm of light grey Ae over a yellowish-brown Bm (Fig.16 ). The Bm varies from 30 to 90 cm and usually is underlain directly by the IIC·till. There may be a gravelly or stony contact with the till.

Fig. 16 - Degraded Eutric Brunisolic profile on fluvial sand deposits. Iron stains and carbonate concentrations visible in the lower part of the profile are common in these deposits.

The Sibbeston Association is usually gently undulating to hummocky with the underlying morainal surface covered but not masked. Often the surface is ridged and striated, with morainal flutings running east-west. South of the Liard River some of these areas are fairly distinct and here Sibbeston is complexed with Trout Lake till deposits.

The vegetation of the Sibbeston Association varies from Pine Forest to Mixedwood, pine, and mixed pine-aspen stands, with alder, buffalo berry, rose, and bearberry in the understorey are common on well drained ridges. Aspen and spruce-aspen stands are frequently found on moister sites. The underlying till and its influence on the moisture regime as well as the frequency of fires seem to be determinants of the vegetation. Drier, fire-prone areas tend to maintain Pine Forest.

Map Units

Sb1 - Dominantly Degraded Eutric Brunisols.

This unit is confined to a few relatively small areas which represent well drained ridges or knolls.

Sb2 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase.

This unit occurs on gently undulating or faintly ridged topography with significant poorly drained soils in the depressions.

Sb3 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase, and Organics.

This unit is usually associated with strongly ridged areas with Gleysols and Organics occupying the inter-ridge depressions.

The Sibbeston Association is mapped on 138,132 acres, of which 96,000 acres are well-drained.

The Sibbeston Association occurs complexed with Bovie Lake soils where the deltaic sands grade into the lacustrine deposits near the Birch River. Other minor areas of complexes are the following:

- Sibbeston Association occurs complexed with Gros Cap Association, near the Liard River, where there has been some lacustrine deposition.

- Sibbeston Association occurs complexed with Martin River Association, where there are significant areas of sand dunes developed on a predominantly sandy veneer.

- Sibbeston and Trout Lake soils are complexed in the strongly striated till area in the south of 95H.

Scotty Creek Association

The Scotty Creek Association occurs over the full width of the survey area, starting at the Birch River and continuing north and east to Jean Marie Creek. This Association consists mainly of peaty Rego Gleysols developed on sandy fluvial veneer overlying till. This Association represents the poorly drained equivalent of Sibbeston Lake Association and occurs closely associated with it.

The peaty Rego Gleysol of the Scotty Creek Association has a thick layer of decomposing organic material over mottled grayish brown, calcareous sandy loam to loamy sand. These soils are formed in water-receiving positions and are poorly drained. Gleysols are found on lower slopes, depressions, and drainageways, where they often grade into Organic soils. Degraded Eutric Brunisols are also included in this Association, occurring on ridges as knolls within a predominantly poorly drained area.

The topography of the Scotty Creek Association is level to gently undulating or hummocky.

The vegetation, as on all Gleysols in the area, is predominantly Black Spruce Forest, with short dense stands of black spruce, ericaceous shrubs, and mosses. Undisturbed areas with thick insulating moss layers are frozen for a large part of the summer.

Map Units

Sc1 - Dominantly Rego Gleysols, peaty phase.

This unit occurs in only a few small areas and is associated with drainageways.

Sc2 - Dominantly Rego Gleysols, peaty phase, and significant Degraded Eutric Brunisols.

This unit represents the most typical Scotty Creek landscape. It occurs in large depressional areas, with significant areas of well drained soils on ridges and knolls.

Sc3 - Dominantly Rego Gleysols, peaty phase, and significant Degraded Eutric Brunisols and Organics. This unit occurs on a north-sloping area, where significant areas of organics and well drained ridges are interspersed throughout the dominant matrix of Gleysols.

There are 80,325 acres of the Scotty Creek Association mapped. Scotty Creek Association occurs in complex with Martin River Association in an area where dunes are scattered throughout a large area of gleysols. It also occurs complexed with Trail River and Grainger Associations in drainageways and with Jean Marie Association in large outwash areas.

Sandy Fluvial and Lacustrine Deposits

Winter Road Association

The Winter Road Association occurs in the Deltaic Sand Plain in close association with the Sibbeston Association, but usually close to the Liard River. This Association consists mainly of Degraded Eutric Brunisols, with lesser amounts of Luvisols and Gleysols developed on well drained sandy fluvial and silty lacustrine veneer overlying till. The deposit is sandy loam to loamy fine sand with silt loam and silty clay loam bands through the B and/or C horizons. These bands are thin (1-5 cm) and spaced several centimeters apart. In some of these soils there is sufficient clay in these bands to meet the requirements of a Bt horizon, in which case it is recognized as an Orthic Gray Luvisol.

This Association is defined as a veneer, although the depth to the underlying till is slightly more than one meter in some areas. Often there is a gravelly contact with the till, suggesting that the till was eroded or flushed before fluvial and lacustrine deposition occurred. These deposits are all bordering on the Liard River and it seems most likely that their deposition was associated with the Liard River before it cut down in its present channel. Faint abandoned channels are recognizable but these are very old and can not be associated with alluvial floodplains.

The Degraded Eutric Brunisol profile is characterized by a well-developed Ae (average depth 11 cm $\pm$ 4 cm) and a Bm or Btj usually with banding. The average depth of the solum is 50 cm $\pm$ 15 cm.

Fig. 17 - Degraded Eutric Brunisol profile on fluvial sands, with silty lacustrine bands in the parent material.

The Winter Road Association is level to gently undulating. Most of the areas are well drained, due in part to their proximity to the Liard River, although poorly drained areas with peaty Rego Gleysols do occur. The presence of the finer textured lacustrine bands and the more impermeable underlying till give this soil a better waterholding capacity than comparable sandy soils in the area.

The moister site is reflected in the vegetation. The main area of Winter Road Association, northwest of the Liard River, has moderately dense stands of mature Mixedwood Forest. The understorey of these stands is most commonly alder, rose, lowbush cranberry, bog cranberry, bunchberry, and feathermoss. Where these areas are burnt, they are regenerating to dense pine and aspen stands in which white spruce may establish in the understorey. The area of Winter Road south of the Liard River has dense young stands of aspen and pine similar to the Sibbeston Association which surrounds it. This area seems to have poorer productivity. Gleysols are characterized by Black Spruce Forest.

Map Units

Wr1 - Dominantly Degraded Eutric Brunisols and significant Orthic Gray Luvisols.

This unit occurs on well drained areas next to the Liard River.

Wr2 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase.

This unit has significant poorly drained areas with peaty Rego Gleysols.

Approximately 33,325 acres of the Winter Road Association were mapped and 4430 of these were poorly drained.

Anderson Mill Association

The Anderson Mill Association is set up as part of the Deltaic Sand Plain and is found on a small area near Fort Simpson (near Anderson Sawmill). However, it does occur in several small scattered areas of the survey area, on the Lacustrine Benchland.

This association consists mainly of Degraded Eutric Brunisols developed on well drained, moderately calcareous sandy fluvial and silty lacustrine deposits. The deposit is loamy sand to sandy loam with silt loam and silty clay loam bands in the B and C horizons. These bands are thin (1-5 cm) and spaced several centimeters apart.

The Degraded Eutric Brunisol profile is characterized by a well-developed Ae (10-20 cm) over a thick brownish Bm, usually with banding. The profile is similar to Martin River except for the finer textured bands.

The topography of the Anderson Mill Association is as variable as the areas it occurs in, ranging from level to moderately inclined.

Anderson Mill is similar in texture to Martin River and in one instance occurs in complex with it. However, the finer textured bands in the profile give this soil a better water-holding capacity and a moister site, which is reflected in the vegetation. Near Fort Simpson the main area of Anderson Mill supports good stands of white spruce - aspen forest (which is currently being harvested).

The other areas of Anderson Mill in 95B support tall Mixed Leaftree Forest. In particular, the large hill west of the Netla River, where Anderson Mill occurs in complex with Bluefish Association, has unique mature birch and aspen stands.

Map Units

Ad1 - Dominantly Degraded Eutric Brunisols.

This unit is mapped in all but one instance where Anderson Mill occurs.

Ad2 - Dominantly Degraded Eutric Brunisols and significant Orthic Gray Luvisols.

This unit is mapped in only one small area on an old terrace north of the Mackenzie River, towards Camsell Bend.

Approximately 2,272 acres of the Anderson Mill Association were mapped near Fort Simpson.

Sandy Fluvial Veneer over Gravelly Fluvial

Jean Marie Association

The Jean Marie Association occurs near Jean Marie Creek and along the Mackenzie Highway, south of the Liard River (Fig. 18).

The parent material is highly calcareous gravelly sand, covered by less than one meter of loamy sand fluvial material.

The dominant profile is the Degraded Eutric Brunisol with a thin bleached Ae over a brown-colored Bm horizon. The surface texture is loamy fine sand, while the C horizon contains mostly gravel in the 2-4 mm size range.

The vegetation is jack pine with an understorey of alder, rose, buffalo berry and bog cranberry. Most of the area has been recently burnt.

Map Units

Jm1 - Dominantly Degraded Eutric Brunisols.

Approximately 11,000 acres were mapped in one gently undulating outwash plain, and 5450 acres were mapped in complex with other soils in an abandoned glacial spillway.

Fig. 18 - Fluvial gravel and sand deposits of the Jean Marie Association. This photo is taken looking northwest on the Mackenzie Highway, two miles north of Jean Marie Creek. Note the scattered pine, aspen, and spruce which have escaped a recent fire in the area.

## LACUSTRINE BENCHLANDS PHYSIOGRAPHIC DISTRICT

During retreat of the Laurentide ice sheet, major lakes were formed in the Liard and Mackenzie River valleys. Silt and clay lacustrine materials of variable thickness were deposited at this time. These deposits occur at the surface above 500, 650, and 750 feet above sea level at Fort Simpson, Nahanni Butte, and Fort Liard, respectively. The upper limit of the lacustrine deposits varies from about 1000 feet in the north and central sections to approximately 1400 feet above sea level near Fort Liard. The majority of the lacustrine deposits are less than one meter thick over till (Bovie Lake and Bulmer Associations). Thicker deposits occur only in a thin band next to the floodplains on both sides of the river (Arrowhead and Petitot Associations).

Silt loam is the usual texture occurring in the lacustrine deposits. Two important areas are different in that they tend to have silty clay loam and silty clay textures. One is the area of Petitot soils mapped on the northwest side of the Liard River in map sheet 95G. The soils here are thicker than one meter and have silty clay to silty clay loam textures. The other area of finer textured lacustrine soils occurs in the Fisherman Lake area and consists of less than one meter of silty clay loam material over till (Celibeta Association).

Occasionally, some of the silt loam material overlies sandy material (Bluefish Association). In some cases, the sand layer may only be a few feet thick over till. In other areas, such as near Fort Simpson and on the upland area west of the Netla River, the sand may be considerably thicker.

The thicker lacustrine deposits (Arrowhead, Petitot, and Gros Cap) usually have subdued local relief, broken occasionally by eroded channels near the edge of the floodplain. The thinner deposits (Bovie Lake Association) have variable topography, usually reflecting the underlying morainal deposits. Topography varies from gently sloping to roughly undulating ridged and striated patterns.

The vegetation is dominantly Mixedwood or Mixed Leaftree Forests on the well drained sites and Black Spruce Forest on the poorly drained and very poorly drained sites.

The well drained areas have developed Brunisolic and Luvisolic soils. The Luvisols have developed primarily in the finer textured soils (except Petitot) and where the B horizon develops in the underlying till. The largest well drained areas occur mostly on sloping terrain next to the Liard River and its tributaries. Away from the streams and rivers the drainage system is immature and Gleysols and Organic soils occur on poorly to very poorly drained, long, gentle slopes, drainageways, and depressional areas. Organic soils do occur in separate, distinct areas, but more commonly are in very poorly drained areas within other soil types.

The boundary between the lacustrine and till deposits is not well defined and complexes of lacustrine veneer with till do occur on rougher terrain at higher elevations. The lacustrine deposits also grade into fluvial sand deposits that occur near the mouth of the Liard River. On the other hand, the boundary between the Lacustrine Benchland and the Alluvial Floodplains is usually quite sharp. In many places the alluvial action has cut into the Lacustrine Benchland and there is a steep escarpment down to the floodplain. Where there are no floodplains and the Lacustrine Benchland abuts the Liard River, there is a steeply sloping bank, usually mapped as Hillwash. Tributaries that dissect lacustrine deposits produce a combination of steep eroding banks with a variety of soils and narrow floodplains in the valleys. These areas are treated as miscellaneous land types (Tributary Floodplain and Hillwash).

The Lacustrine Benchland represents the largest proportion of land in the area. For an example of the landscapes common on the Lacustrine Benchland, see Plates 2 and 3, Appendix 1.

## COARSE SILTY LACUSTRINE

### Arrowhead Association

The Arrowhead Association is mapped on either side of the Liard, Mackenzie, and Muskeg Rivers just above the floodplain. It consists chiefly of Degraded and Orthic Eutric Brunisols developed on coarse silty lacustrine material. It is similar to the Bovie Lake Association except that till is not encountered in the top meter of soil. Also included in the Arrowhead Association are Gleyed Brunisols, peaty Rego Gleysols, and Organics.

The Degraded Eutric Brunisols have Ae horizons about 7 cm thick over brownish Bm horizons over moderately calcareous silt loam or very fine sandy loam material. Degraded Eutric Brunisols usually occur in areas of better than average drainage, such as near streams or areas with moderately undulating topography. Nearly level areas are dominated by Gleyed Orthic Eutric Brunisols. The vegetation on well drained Brunisols is Mixedwood or Mixed Leaftree Forests. Mixedwood stands are usually quite tall and fast growing. Understorey vegetation is commonly alder, low bush cranberry, and rose and a variety of herbs, especially bunchberry. Feathermoss occurs under spruce.

### Map Units

Ar1 - Dominantly Degraded Eutric Brunisols and significant Orthic Eutric Brunisols.

Ar2 - Dominantly Orthic Eutric Brunisols with significant Degraded Eutric Brunisols.

Map Units (Continued)

Ar3 - Dominantly Degraded Eutric Brunisols and significant Gleyed Orthic Eutric Brunisols.

Ar4 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase.

Ar5 - Dominantly Orthic Eutric Brunisols and significant Rego Gleysols, peaty phase.

Ar6 - Dominantly Gleyed Orthic Eutric Brunisols and significant Rego Gleysols, peaty phase.

Ar7 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase and Organics.

Ar8 - Dominantly Degraded Eutric Brunisols and significant Gleyed Orthic Eutric Brunisols and Rego Gleysols, peaty phase.

Approximately 131,120 acres of the Arrowhead Association were mapped, 90,000 of which are well drained.

Shale Creek Association

The Shale Creek Association occurs in poorly drained depressional areas adjacent to areas of Arrowhead soils. The dominant soils are peaty Rego Gleysols with significant Brunisols and Organics.

The peaty Rego Gleysols have an organic surface layer, 25 $\pm$ 12 cm thick over mottled gray silt loam or very fine sandy loam lacustrine material. Sheltered areas with an insulating moss cover remain frozen for a large part of the summer season. The Brunisols have the same characteristics as those occurring in the Arrowhead Association. The vegetation on the poorly drained sites is usually Black Spruce Forest.

Map Units

Sh1 - Dominantly Rego Gleysols, peaty phase.

Sh2 - Dominantly Rego Gleysols, peaty phase and significant Orthic Eutric Brunisols.

Sh3 - Dominantly Rego Gleysols, peaty phase and significant Orthic Eutric Brunisols and Organics.

Sh4 - Dominantly Rego Gleysols, peaty phase and significant Organics.

Fifty three thousand acres of the Shale Creek Association were mapped, of which 7800 were Organic soils and 8500 were Orthic Eutric Brunisols.

## COARSE SILTY LACUSTRINE VENEER OVER TILL

### Bovie Lake Association

The Bovie Lake Association occurs throughout the map area at elevations just above the Arrowhead and Petitot soils but below the Morainal Uplands. This association consists chiefly of Degraded Eutric Brunisols developed on coarse silty lacustrine material less than one meter thick over till. Also included in the Bovie Lake Association in significant amounts are Orthic Eutric Brunisols, Brunisolic Gray Luvisols, Orthic Gleysols, Rego Gleysols peaty phase, and Organic soils.

The parent material is silt loam and very fine sandy loam, moderately calcareous lacustrine material 40 $\pm$ 19 cm* thick over calcareous till. The dominant profile occurring in this association is the Degraded Eutric Brunisol (Fig. 19). It has a weak Ae horizon less than 5 cm thick and a B horizon 30 $\pm$ 15 cm* thick. If the B extends into the underlying till, the profile is commonly a Brunisolic Gray Luvisol and the lower B horizon tends to have an accumulation of clay. Many of the Brunisols have very thin ($<$ 2 cm) Ae horizons and are classified as Orthic Eutric Brunisols. The pH varies from 4.5 - 6.0 in the B horizon, to 7.0 - 8.0 in the C. Soil drainage of the Brunisols and Luvisols is generally good, while the Gleysols and Organics are continuously wet.

The vegetation on the well drained sites is Mixed Leaftree or Mixedwood Forests. Aspen and birch are most prevalent in the leaftree stands that are regenerating on large burnt-over areas

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* The mean and standard deviation was calculated, using at least 24 observations.

that are common on Bovie Lake soils. A few mature mixedwood stands occur near Fort Liard. The most common understorey species are alder, rose, and bunchberry. Poorly drained Gleysolic soils are almost always covered by Black Spruce Forest.

Fig. 19 - A profile of a Degraded Eutric Brunisol developed on silt loam lacustrine over till.

Map Units

Bv1 - Dominantly Degraded Eutric Brunisols. Mapped in upland or sloping areas where there are very few poorly drained areas present.

Bv2 - Dominantly Degraded Eutric Brunisols and significant Orthic Eutric Brunisols.

Map Units (Continued)

Bv3 - Dominantly Degraded Eutric Brunisol and significant Brunisolic Gray Luvisols.

This unit is mapped in upland areas usually in combination with the Trout Lake Association (till). Higher portions of the landscapes are till, the midslope is the Brunisolic Gray Luvisols, and lower slopes with the thicker silt loam material includes the Degraded Eutric Brunisol profiles.

Bv4 - Dominantly Degraded Eutric Brunisols and significant Orthic Gleysols.

This unit is similar to Bv5, except that the Gleysols are not as poorly drained and have a thinner organic cover. These soils occur on the long sideslopes where the wetter portions of the landscape are saturated by seepage from upslope.

Bv5 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase.

This unit is widespread over the whole area. The Gleysols occur in the poorly drained depressions and have an organic cover from 10 - 50 cm thick.

Bv6 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase and Organics.

This unit is similar to Bv5, except for a larger amount of poorly drained areas, some of which have more than 60 cm of organic material on the surface.

Map Units (Continued)

Bv7 - Dominantly Degraded Eutric Brunisols and significant Brunisolic Gray Luvisols and Rego Gleysols, peaty phase.

This unit occurs dominantly in an area of linear ridges or drumlinoid topography. The upper slopes are till or shallow (less than 30 cm) lacustrine material and have Brunisolic Gray Luvisol profiles. The Eutric Brunisols occur on the side slopes and the peaty Rego Gleysols in the swales between the ridges.

Approximately 480,000 acres of the Bovie Lake Association were mapped. Of this total, 319,500 were well drained, 101,000 were Gleysols, and 21,000 were classified as Organic soils. Bovie Lake Association occupies the largest acreage of any soil type in the map area (approximately 15% of the total area).

Bluebill Association

The Bluebill Association is of limited extent occurring in two areas on both sides of the Liard River. It consists mainly of Gray Luvisols developed on silt loam lacustrine material less than one meter thick over till. One Bluebill area occurs on the south-facing slope of the high bedrock ridge southeast of the Liard River. Parts of this area are of finer texture, approaching silty clay loam in the lower solum. The other Bluebill area occurred west of the Liard River, also on a gentle south-facing slope. The improved drainage in these two areas may be responsible in part for the formation of Luvisolic soils.

The vegetation on the Bluebill soils west of the river is dominantly tall spruce and aspen (Mixedwood Forest). The Bluebill area on the south side of the river has stands of jack pine at higher elevations and mixedwood stands at lower elevations.

The Orthic Gray Luvisol profile has 6 cm of a black L-H (organic) layer over a leached Ae (14 cm) over a reddish brown Bt horizon. The mean solum thickness is $37 \pm 11$ cm.

Map Units

Bb1 - Dominantly Orthic Gray Luvisols and significant Degraded Eutric Brunisols.

Bb2 - Dominantly Brunisolic Gray Luvisols and significant Degraded Eutric Brunisols and Rego Gleysols, peaty phase.

Approximately 21,250 acres of the Bluebill Association were mapped.

## Bulmer Association

The Bulmer Association consists dominantly of peaty Rego Gleysols developed on very fine sandy loam and silt loam lacustrine material less than one meter thick over till. It occurs on long gentle slopes (Fig. 20 ) and in depressional areas on level to strongly ridged and rolling landscapes.

The vegetation is mainly black spruce with occasional larch, dense ericaceous shrubs, and mosses. Undisturbed areas with thick insulating moss layers are frozen for a large part of the summer, particularly in the Camsell Bend area.

Fig. 20 - The dark-colored area is short black spruce growing on peaty Rego Gleysols of the Bulmer Association. This area is a north-facing slope, southeast of the Liard River in 95G. The ridge in the background where the seismic line disappears is a bedrock high. The steeper slope down from the ridge to where the gleysols begin is well-drained near the top, but has considerable seepage water affecting it. It is mapped as Bv4. A close-up of the vegetation on this slope is shown in Fig. 6 . Over the ridge on the south-facing slope, the Bluebill Association occurs.

Also in the Bulmer areas are minor amounts of well-drained Orthic Eutric Brunisol, Gleyed Orthic Eutric Brunisols, and Organics. The peaty Rego Gleysol has a $24 \pm 8$ cm* thick organic layer over mottled gray material (Fig. 21). There is considerable variability in the thickness of the lacustrine deposit, ranging from a high of 100 cm to as low as 10 cm with a mean of 40.5 cm.

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* Standard deviation determined with 34 samples.

Fig. 21 - A profile of a Rego Gleysol, peaty phase, developed on silt loam lacustrine.

Map Units

Bu1 - Dominantly Rego Gleysols,peaty phase.

Bu2 - Dominantly Rego Gleysols,peaty phase, and significant Orthic Eutric Brunisols.

This unit occurs in sloping or depressional areas where there are"islands"of well drained soils, either on topographic highs or next to a drainageway.

Bu3 - Dominantly Rego Gleysols, peaty phase, and significant Gleyed Orthic Eutric Brunisols.

This unit is similar to Bu2, except that the better drained areas show evidence of gleying or imperfect drainage.

Bu4 - Dominantly Rego Gleysols, peaty phase, and significant Organics.

Bu5 - Dominantly Rego Gleysols, peaty phase, and significant Orthic Eutric Brunisols and Organics.

Over the whole area mapped, the Bulmer Association contains about 254,000, 37,700, 21,000, and 54,000 acres of Peaty Rego Gleysols, Orthic Eutric Brunisols, Gleyed Brunisols, and Organics, respectively.

Bulmer soils often occur complexed with morainal deposits (Rabbit Creek or Trout Lake Associations) near the upper, outer edges of the Lacustrine Benchland. In these cases, the till is exposed on ridges and topographic highs, while the Bulmer lacustrine veneer occupies the lower slopes and depressions.

## COARSE SILTY LACUSTRINE VENEER OVER SAND

### Bluefish Association

The Bluefish Association occurs in widely scattered areas of the map area and in different environments. It consists chiefly of Degraded Eutric Brunisols with minor amounts of peaty Rego Gleysols developed on silt loam lacustrine material less than one meter thick over fluvial sands.

The Bluefish soils mapped in the Fort Simpson area occur next to the Liard River in association with fluvial sands of deltaic origin. Surface textures in this area are finer than usual, with some in the silty clay loam range. Bluefish is also mapped southwest of the Liard River, on the sloping area at elevations intermediate between Arrowhead and Bovie Lake soils. In this area the fluvial sands may be thin over till. Another unique area of Bluefish soils occurs on a height of land partially encircled by the Liard River, located west of the Netla River. The unique vegetation of this area is dominantly large white birch and aspen with mountain ash noted. Some seepage slopes have a dense growth of willow and alder. Evidence from eroded channels indicates the sand is at least a few meters thick over till. The fourth major occurrence of Bluefish soils is on the west side of the Liard River, between the floodplains and the Franklin Mountains. The Bluefish soils mapped in this area tended to be more variable in texture, depth, and profile type than was usual for this Association.

Map Units

Bf1 - Dominantly Degraded Eutric Brunisols

Bf2 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase.

Approximately 39,016 acres of the Bluefish Association were mapped with about 8000 acres mapped on the hill west of the Netla River and 24,000 acres mapped west of the Liard River.

Babiche Association

The Babiche Association occurs throughout the map area in association with the Bluefish soils. It consists of peaty Rego Gleysols and significant Degraded Eutric Brunisols developed on coarse silty lacustrine material less than one meter thick over fluvial sand.

The dominant soil consists of 15-50 cm of a black organic layer over a wet grayish silt loam material.

The vegetation is short, dense black spruce, ericaceous shrubs, and feathermosses.

Map Units

Bc1 - Dominantly Rego Gleysols, peaty phase, and significant Degraded Eutric Brunisols.

Approximately 16,000 acres of the Babiche Association are mapped.

## FINE SILTY LACUSTRINE

### Petitot Association

The Petitot Association occurs in two distinct areas of the Lacustrine Benchland, north of and parallel to the Liard River from Dehdjida Creek to the Birch River and in the Fisherman Lake Area. This Association consists mainly of Degraded Eutric Brunisols, developed on fine silty lacustrine deposits. The parent material is grayish brown, moderately calcareous silty clay loam to silty clay.

The profile is fairly shallow, with an average solum depth of 32 cm. The mean depth of the Ae is 7 cm, but this is quite variable. Orthic Eutric Brunisols (thin Ae) were recorded in some places. Significant members of the Petitot Association are Orthic Gray Luvisols, peaty Rego Gleysols, and Organics.

The Petitot Association is characterized by level or gently undulating topography. Drainage is well to moderately well on crests and long gentle slopes where Brunisols and Luvisols develop. Lower slopes are imperfectly drained and often moist from seepage conditions. These grade into poorly or very poorly drained depressions, which have peaty Rego Gleysols and Organic soils developed in them.

The vegetation of the Petitot Association is variable. The most common vegetation type is a young Mixed Leaftree Forest with short, dense, even-aged stands of trembling aspen and white birch, with alder, buffalo berry, willow, and usually white spruce in the understorey. Herbs and mosses are sparse. These stands are of fire origin and, given time, white spruce would most likely succeed.

Another vegetation type common on imperfectly to poorly drained lower slopes of the Petitot Association, but also present on seepage slopes of other soils, is a short, dense stand of birch, alder, and willow in about equal height and proportion.

Black spruce,alone, or in combination with tamarack and birch, usually occurs adjacent to wet depressions. The depressions themselves usually support sedge with scattered tamarack, willow, and birch. On the small area of Petitot soils mapped in the Fisherman Lake area, there is tall aspen forest.

Map Units

Pel Dominantly Degraded Eutric Brunisols and significant Orthic Gray Luvisols.

This unit has dominantly well to moderately well drained soils on gentle slopes.

Pe2 - Dominantly Degraded Eutric Brunisols and significant Orthic Gray Luvisols and Rego Gleysols, peaty phase.

This unit is similar to Pel, in that external drainage is developed, but there are significant, poorly drained depressions and drainageways.

Pe3 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase.

This unit is dominantly well drained, with scattered small depressions.

Map Units (Continued)

Pe4 - Dominantly Degraded Eutric Brunisols and significant Rego Gleysols, peaty phase, and Organics.

This unit has poor external and internal drainage, and has numerous small depressions and sloughs scattered throughout.

Approximately 31,300 acres of Petitot soils were mapped in 95G and 9,600 acres were mapped in the Fisherman Lake area.

Gros Cap Association

The Gros Cap Association is a silty clay loam lacustrine deposit and occurs near the Liard River. The dominant soil is the well drained Orthic Gray Luvisol. It has $7.2 \pm 1.3$* cm organic layer (L-H) over a $12.4 \pm 7.4$ cm leached Ae horizon over a reddish brown Bt horizon.

The Gros Cap soils are similar to the Petitot soils in texture and parent material, but have a more strongly developed B horizon and a thicker solum.

The topography is level to gently undulating, and there are generally few poorly drained sites in the landscape (Fig. 22).

The vegetation is Mixedwood Forest--aspen and white spruce, with buffalo berry, alder, raspberry, bunchberry, and feathermoss as common plants in the understorey.

Map Unit

Gc1 - Dominantly Orthic Gray Luvisols.

Approximately 3700 acres are mapped alone, near Fort Simpson, and 1700 acres occur complexed with Sibbeston soils, between the Mackenzie Highway and the Liard River.

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* The mean and standard deviation were calculated from 12 observations.

Fig. 22- A landscape of the Gros Cap Association
with a mixedwood forest stand.

Big Island Association

Big Island soils occur in two distinct areas of the Lacustrine Benchland, north of and parallel to the Liard River from Dehdjida Creek to the Birch River and in the Fisherman Lake Area.

This association consists mainly of peaty Rego Gleysols developed on fine silty lacustrine deposits. It represents the poorly drained equivalent of the Petitot Association. The parent material is grayish brown, moderately calcareous, silty clay loam to silty clay.

The peaty Rego Gleysols of the Big Island Association have a thick (10-50 cm) layer of decomposing organic material (L-H), over mottled brownish gray calcareous silty clay loam or silty clay (Ck).

These soils are formed on poorly drained lower slopes, depressions and drainageways, and often grade into Organic terrain. Degraded Eutric Brunisols are also significant in this association, occurring on knolls within a predominantly poorly drained area.

The topography of the Big Island Association is level to gently undulating.

Vegetation is predominantly Black Spruce Forest, with short dense stands of black spruce, ericaceous shrubs, and mosses. More open meadow areas, with sedges, grasses and scattered shrubs, tamarack, and black spruce are common in depressional areas, where Gleysols grade into Organic soils.

Big Island soils occur in two types of areas. In 95G it occurs in small depressions surrounded by better drained soils. In the Fisherman Lake Area it is more common in large sloping depressional basins and drainageways.

Map Units

Bg1 - Dominantly Rego Gleysols, peaty phase.

This unit occurs mainly on a large inclined area in the Fisherman Lake basin.

Bg2 - Dominantly Rego Gleysol, peaty phase, and significant Degraded Eutric Brunisols and Organics.

This unit occurs in enclosed depressions with well drained soils interspersed in it, or in drainageways.

Map Units (Continued)

Bg3 - Dominantly Rego Gleysols, peaty phase, and significant Organics.

This unit occurs in the large depressional basins and drainage-ways around Fisherman Lake.

Approximately 4500 acres of Big Island soils were mapped in 95G and 19,300 acres were mapped in the Fisherman Lake area.

## FINE SILTY LACUSTRINE VENEER OVER TILL

### Celibeta Association

The Celibeta Association consists chiefly of Orthic Gray Luvisols developed on silty clay loam lacustrine material, less then one meter thick over till. Also included in this association are lesser amounts of Gleyed Orthic Eutric Brunisols, Brunisolic Gray Luvisols, and peaty Rego Gleysols.

The Celibeta Association is mapped in the Fisherman Lake Area. Associated with it are clayey lacustro till (Pointed Mountain Association) and fine silty lacustrine deposits (Petitot Association). Landforms are usually gently sloping or undulating. The well drained soils support mainly tall, dense stands of trambling aspen or aspen-white spruce, with alder, rose, bunchberry, and twinflower common understorey species.

### Map Units

Cb1 - Dominantly Orthic Gray Luvisols and significant Brunisolic Gray Luvisols and Gleyed Orthic Eutric Brunisols.

This unit occurs on gently sloping upland areas between Fisherman Lake and the Liard River. The land slopes gradually to the river, with very little local relief. Minor depressions tend to be wetter and contain Gleyed Orthic Eutric Brunisols. The area tends to appear very uniform, with similar vegetation occurring on all soils.

Cb2 - Dominantly Orthic Gray Luvisols and significant Rego Gleysols, peaty phase.

This unit occurs in areas with more local relief and thus a greater proportion of poorly drained areas (peaty Rego Gleysols).

Approximately 46,000 acres of the Celibeta Association were mapped, of which 39,000 acres were well or imperfectly drained, and 6800 acres were poorly drained.

## Coty Mountain Association

The Coty Mountain Association is of limited extent,comprising only 1455 acres near the Muskeg River. It is dominantly Orthic Eutric Brunisols, with significant Gleyed Brunisols developed on silty clay loam lacustrine material, less than one meter thick over till. This soil is similar to the Petitot Association, except that till is encountered in the top meter of soil.

The dominant vegetation is tall stands of white spruce and aspen.

## Map Units

Ct1 - Dominantly Orthic Eutric Brunisols

Ct2 - Dominantly Orthic Eutric Brunisols and significant Gleyed Orthic Eutric Brunisols.

## MORAINAL UPLANDS

Morainal deposits (till) cover the bedrock over the entire Interior Plains region, up to the base of the Franklin Mountains. In this survey the morainal soils marked the outer edge of the sphere of interest and thus were not studied in much detail.

The till is of variable texture, ranging from sandy loam to heavy clay.

The coarser-textured tills (Rabbit Creek Association) occur northeast of Fort Simpson and near the mountains and uplands in 95G. Silty clay loam and clay loam textures are common for the Trout Lake Association, which occur scattered over the whole map area. The stone content of the till is variable, but is usually highest in the Rabbit Creek soils.

An unusual deposit of lacustrine-like till of clay to heavy clay texture occurs in the area west of Fort Liard, between the B.C. border and Mount Coty. This lacustro till material (Pointed Mountain Association) is dark colored, moderately calcareous with very few stones or pebbles.

Soil development has produced a wide variety of profile types. The dominant soils on well drained sites are the Gray Luvisols with prominent Ae horizon (4-12 cm thick) over a Bt horizon. Gleyed Brunisols tend to occur on some of the moist side slopes on the clayey lacustro till deposits. The depressional areas on all types of till materials are poorly drained, with Rego Gleysols, peaty phase, the dominant soil.

The vegetation on the loam and clay loam tills has mostly been recently burned and is regenerating to pine and aspen on the well drained sites (Fig. 23).

Fig. 23 - Pine and aspen regeneration on a strongly ridged morainal area east of Fort Liard.

The clayey lacustro till area has older medium-dense stands of large white spruce and aspen.

The landform on the loam and clay loam morainal areas is gently undulating to strongly ridged, with drumlins and flutings (Fig. 24). They are generally oriented northeast to sourthwest and indicate the direction of the movement of glacial ice. Luvisols and Brunisols occur on the well drained ridges with peaty Gleysols and Organic soils in the interridge depressions. The landforms in the lacustro till

Fig. 24 - Strongly-ridged morainal landscape, southeast of Fort Simpson.

area are usually on a larger scale, with large rolling hills or high broad ridges (Fig. 25). See also Plate 5, Appendix I.

The Harris Association, mapped northeast of the Mackenzie River, is also included in the Morainal Uplands Physiographic District. It is a morainal deposit which has been severely eroded by the Mackenzie River, leaving a stony boulder pavement on the surface.

Clayey Lacustro Till

Pointed Mountain Association

The Pointed Mountian Association consists chiefly of Luvisols with minor amounts of Brunisols and Gleysols developed on clay and heavy clay lacustro till deposits. This Association occurs only in the Fisherman Lake area, west of the Liard River and south to the B.C. border.

The parent material is a dark-colored, clay-rich material with very few stones. The source of this material is unknown. In some areas at higher elevations, a brown-colored, lighter-textured till was found over the Pointed Mountain till.

The landscape is characterized by large rolling hills, with very long slopes (Fig. 25 ). There are also some high, steep, bedrock controlled ridges.

Mixedwood Forest is the predominant vegetation, with mature and over-mature stands of large and tall white spruce and aspen. The main understorey species are alder, rose, lowbush cranberry, bunchberry, and feathermoss.

Map Units

Pd1 - Dominantly Orthic Gray Luvisols.

Pd2 - Dominantly Orthic Gray Luvisols and significant Brunisolic Gray Luvisols.

This unit was mapped on steep slopes or high ridges that included only well drained soils.

Fig. 25 - Rolling landscape commonly associated with Pointed Mountain soils.

Pd3 - Dominantly Orthic Gray Luvisols and significant Brunisolic Gray Luvisols and Gleyed Degraded Eutric Brunisols.

This unit occurs on the long sideslopes with the Luvisols in the higher well drained areas and the Gleyed Brunisols on the lower seepage slopes.

Pd4 - Dominantly Orthic Gray Luvisols and significant Rego Gleysols, peaty phase.

This unit occurs in areas of shorter, steep slopes that consist primarily of well drained upper slopes and poorly drained depressions.

Approximately 42,083 acres of the Pointed Mountain Association were mapped. Seventeen per cent of the area had steep (9-15%) slopes, while 11% had poorly drained soils.

Fisherman Lake

The Fisherman Lake Association consists of poorly drained (Rego Gleysols, peaty phase), imperfectly drained (Gleyed Degraded Eutric Brunisol), and very poorly drained (Organic) soils. The parent material is the same as the Pointed Mountain Association (clay to heavy clay lacustro till).

The Fisherman Lake Association occurs only in the Fisherman Lake area on long gentle north-facing slopes, or in broad (1 - 3 miles), wide basins (Fig. 26 and Plate 5). The vegetation is usually dense, medium-height Black Spruce Forest.

Fig. 26 - Large basin area of extensive Rego Gleysols, peaty phase, (Fisherman Lake Association) south of the Kotaneelee River. The vegetation is dominantly Black Spruce Forest.

Map Units

Fs1 - Dominantly Rego Gleysols, peaty phase.

Fs2 - Dominantly Rego Gleysols, peaty phase, and significant Gleyed Degraded Eutric Brunisols.

This unit occurs in level to undulating areas where a slight rise will have better drainage and the formation of a Gleyed Brunisol soil.

Fs3 - Dominantly Rego Gleysols, peaty phase, and significant Organics.

This unit is mapped in a large basin area, where the lowest portions are very poorly drained and contain Organic soils.

Approximately 17,000 acres of Fisherman Lake soils were mapped.

## Fine Loamy Till

### Trout Lake Association

The Trout Lake Association occurs throughout the entire map area. It is composed dominantly of Orthic Gray Luvisols (Fig. 27 ), with significant Brunisols and Gleysols developed on clay loam till.

The Orthic Gray Luvisol profile consists of a grayish brown Ae horizon 11 ± 7 cm thick, over a reddish brown Bt about 20 cm thick, over an olive gray moderately calcareous till.

The largest area of Trout Lake soils is mapped southeast of Fort Liard, where it occurs primarily on strongly-ridged and rolling topography, often complexed with Bovie Lake soils.

The vegetation on the Trout Lake soils is dominantly Mixed Leaftree, but white spruce occurs on moister sites and jack pine on drier sites.

Fig. 27 - An Orthic Gray Luvisol with a highly-leached Ae horizon, 12 cm thick, over a brown-colored Bt.

Map Units

Tk1 - Dominantly Orthic Gray Luvisols.

This unit occurs primarily in complex with Bovie Lake soils in the Fort Liard area. The Trout Lake soils occupy the crests of ridges or tops of the knoll, while the Bovie Lake lacustrine veneer occupies the side slopes and depressions.

Tk2 - Dominantly Orthic Gray Luvisols and significant Rego Gleysols, peaty phase.

This unit is mapped in a strongly ridged upland area, east of the Netla River.

Tk3 - Dominantly Orthic Gray Luvisols and significant Brunisolic Gray Luvisols and Gleyed Degraded Eutric Brunisols.

This unit occurs on isolated hills in the upland area southeast of Fort Liard. The highest parts of each hill are Gray Luvisols, with the Gleyed Brunisols occurring on the lower imperfectly drained slope position.

There are 105,324 acres of the Trout Lake Association,occurring alone, although a large acreage occurs in complex with Bovie Lake and Bulmer soils.

Cormack Lake Association

The Cormack Lake Association occurs mainly east of the Netla River and on the northern slope of the Martin Hills, and consists chiefly of peaty Rego Gleysols, with minor amounts of Orthic Gray Luvisols and Organics. The parent material is a moderately calcareous clay loam till, similar to the Trout Lake Association.

The vegetation is dominantly stunted black spruce. Since these soils usually occur at higher elevations, they tend to be colder and remain frozen longer than most Gleysols

Map Units

Cm1 - Dominantly Rego Gleysols, peaty phase.

Cm2 - Dominantly Rego Gleysols, peaty phase, and significant Organics.

Cm5 - Dominantly Rego Gleysols, peaty phase, and significant Orthic Gray Luvisols and Organics.

## Coarse Loamy Till

### Rabbit Creek Association

The Rabbit Creek Association occurs in the uplands north of the Liard River in 95G, beyond the extent of the lacustrine deposits. The soils are dominantly Orthic Gray Luvisols, with lesser amounts of Brunisols and Gleysols, all developed on sandy loam and loam-textured moderately calcareous till.

The topography varies from gently undulating to strongly ridged, usually sloping towards the river valley.

The vegetation is dominantly Mixed Leaftree, with Pine Forest on drier, fire-prone areas.

### Map Units

Ra1 - Dominantly Orthic Gray Luvisols, with significant Degraded Eutric Brunisols.

This unit is usually mapped in complex with the Bulmer Association. The peaty Gleysol on lacustrine veneer (Bulmer) occurs in interridge depressions with the Brunisols and Luvisols occurring on the well drained till ridges.

Ra2 - Dominantly Orthic Gray Luvisols and significant Degraded Eutric Brunisols and Rego Gleysols, peaty phase.

This unit is mapped in upland areas above the occurrence of lacustrine deposits.

The Rabbit Creek Association occupies 34,601 acres, including complexes.

## Eroded Stony Till

### Harris Association

The Harris Association occurs on the northeast side of the Mackenzie River, near Fort Simpson. The parent material is a very stony eroded till. Included in the Harris Association are Brunisols, peaty Gleysols, and Organic soils.

The Harris Association is characterized by its gently inclined surface, sloping southwest towards the Mackenzie River.

In most cases there is no mineral soil over the stony boulder pavement, just varying depths of organic material. Nearer the river alluvial deposits have covered the Harris soils. These deposits are mapped as the Poplar Association. Another area has fluvial sands, less than one meter thick over the till, forming Sibbeston soils.

### Map Units

Hr1 - Dominantly Orthic Eutric Brunisols.

This unit occurs on the well drained higher sites.

Hr2 - Dominantly Orthic Eutric Brunisols and significant Rego Gleysols, peaty phase.

Hr3 - Dominantly Orthic Eutric Brunisols and significant Rego Gleysols, peaty phase, and Organics.

This unit contains large amounts of poorly-drained and very poorly drained areas with varying thickness of an organic layer.

Hr4 - Dominantly Rego Gleysols, peaty phase, and significant Orthic Eutric Brunisols and Organics.

Approximately 55,484 acres of the Harris Association were mapped.

## ORGANIC SOILS

There are two principal types of organic soils in the area--bogs and fens. Both types occur throughout the area, generally increasing in occurrence from south to north. They occur in separate distinct areas, particularly in the Deltaic Sand Plain, but commonly are associated with mineral soils, occurring in very poorly-drained depressions or on gentle slopes.

Fens are low-lying, sparsely treed depressions, usually formed under the influence of mineral rich groundwater (minerotrophic). There is little permafrost in fens because they are wet, low, and sparsely treed, except where strings and mounds may build up.

Bogs are raised above surrounding terrain and thus rely on precipitation for moisture and nutrients (ombrotrophic). The dry elevated surface acts as an effective insulator and permafrost is therefore widespread.

### Grainger Association

The Grainger Association consists mainly of Cryic Fibrisols developed on bogs. The most common type of bog encountered in the survey area is the peat plateau. It has frozen sphagnum derived peat deposits, with hummocky surfaces raised 1-2 meters above surrounding minerotrophic fen deposits or lakes with which they are usually associated. The most important feature is the thick, permanently frozen stratum. The peat deposits are one to several meters thick, and are usually frozen below 60 cm. They may be underlain at times by moderately decomposed forest and/or fen peat. Bog soils are low in fertility and low in pH.

The peat plateau often has a pock-marked appearance, due to thaw pockets or collapse scars (thermokarst) which have a lower, wetter surface. These thaw pockets are often fen-like but cottongrass, sphagnum, and leather leaf usually predominate rather than sedges, as in a true fen (Lavkulich et al, 1972). The collapsed fen part of the peatland has a high water table and the collapsing edge forms a steep bank, often with leaning, dead trees. The peat materials vary in origin. The surface peat is usually of the fen type, but the underlying disturbed peat originates from the collapsed peat. These thaw pockets may be in various states of collapse, ponding, and infilling with aquatic vegetation, which eventually lead to build-up again. Thus, depending on the stage and size of thaw pockets, permafrost may be lower than in the surrounding peat plateau, or it may be absent. In any case, the material is usually sufficiently decomposed to be mesic rather than fibric. Peat plateaus develop on flats between streams or as build-up areas beside or in fens. Thus, in any peat plateau there are usually associated areas of fens and ponds. Narrow channel fens and marshy drainage channels are most often found in peat plateaus in this area.

Bogs are part of a continuum in the landscape, representing the very poorly drained portions. Therefore, they grade into peaty Gleysols which occupy the mid-slope positions between depression and well drained ridges. Where Gleysols are significant, they are complexed with Grainger.

The usual vegetation on peat plateaus is Bog Forest open stands of stunted black spruce, a dense ground cover of abrador tea, cowberry, bog rosemary, bog cranberry, sphagnum mosses, and, in the northern parts of the area, lichens. Thaw pockets have cotton grass, sphagnum,leather leaf, sedges,and aquatic sphagnum. Associated fen areas have willow, bog birch, scattered tamarack, mosses, and sedge.

The peat plateau is identified by its dark pattern (black spruce), pock-marked with white collapse scars. Often channel fens occur in a dendritic pattern. In more northern areas the black spruce is usually thin and the Cladonia lichens give a white tone to the bogs.

Palsa bogs are also mapped in the area. Palsas are ice-cored peat mounds, usually occurring as islands within fen areas. They are steeply domed, 3-4 meters in height, and generally less than 50 meters in diameter. Vegetation is similar to peat plateaus.

Mapping

As suggested, the dominant type of bog landform is the peat plateau, usually with thermokarst collapse scars. This is symbolized on the map as Bpc. At the large scale, a peat plateau is usually patterns of smaller units, flat bogs, domed bogs, and bowl bogs. At the scale of mapping used, these are not usually separated. Blanket bogs with no collapse features are not common. Palsa bogs usually occur in association with Trail River fen deposits and are symbolized in the landform of Trail River as Bd (domed bog).

Map Units

G1 - Dominantly Cryic Fibrisols and significant Typic Mesisols.

Peat plateau with extensive collapse scars and adjacent fen areas.

G2 - Dominantly Cryic Fibrisols and significant Cryic Mesisols.

Straight bog plateau with smaller, less extensive collapse scars. Permafrost is usually present, even under collapse scars, but at a lower depth.

The Grainger Association was mapped on 290,000 acres on the survey area, with 140,000 of these in 95H.

Fig. 28 - Peat plateau with wetter collapse scar noticeable at the centre. The area has been partially burnt recently and is predominantly covered by Labrador tea, with scattered young jack pine and black spruce (note charcoal in foreground). The wetter collapse scar has sphagnum and other mosses with tamarack and black spruce around the edge.

Trail River Association

The Trail River Association consists mainly of Mesisols developed on fens. Fens are peat-covered areas with a high water table, usually groundwater which has percolated through mineral soils and is therefore mineral-rich. In this area fens have shallow to deep, well to moderately well-decomposed sedge peat. The associated soils are dominantly Typic Mesisols, with an average of 15 cm of fibric peat over mesic peat. There is little permafrost in fens, although it does occur where fens are in the process of building up transitional to a bog landform. In these areas the above profile may be frozen at shallow depths (Cryic Mesisols) or if the material is dominantly fibric (Cryic Fibrisols). Hydric Fibrisols occur associated with wet pond areas.

Vegetation on the fens is predominantly sedges, grasses, willow, dwarf birch, and sometimes sparse tamarack and black spruce.

There are several types of fens in the area, described as follows:

1. Horizontal Fen

Horizontal fens are extensive, flat low-lying areas which have a smooth (light-shaded) appearance on air photos. These areas are relatively dry types of fen, composed of closely-set mossy mounds with water between.

Vegetation - Scattered tamarack, willow and dwarf birch shrub or sedge meadow predominate. Underneath the dominant cover, the mossy mounds are mixtures of Aulacomnium palustre and Tomenthypnum nitens with occasional feathermosses and sphagnum.

Soils - Typic Mesisols are most common; Hydric Fibrisols and Cryic Mesisols are significant in some areas.

2. Patterned Fen

Patterned fen occurs in gently sloping areas with raised ridges in a matrix of water-saturated hollows. The ridges build up enough above the water level with the establishment of sphagnum mosses, ericaceous shrubs, and trees, that permafrost forms.

a) String fen - Ridges are usually parallel strings running across the slope, perpendicular to water movement.

b) Net fen - Net-like pattern of interconnected ridges and hollows (Fig. 29).

Vegetation

In both types the ridges are usually treed with stunted black spruce and tamarack, dwarf birch, willow, ericaceous shrubs and mosses. The hollows usually have shallow ponds with light brown algae or sedge mats with aquatic mosses.

Soils

Hollows - Typic Mesisol

Ridges - Cryic Mesisol and/or Cryic Fibrisol

3. Pond Fens (Floating fens)

Pond Fens are complexes of deep ponds and fen flats.

Vegetation

Floating sedge mats and sedge meadow, with shrubs on low mounds and ridges or trees (black spruce, tamarack, birch) on topographic highs. The ponds usually have green or brown algae, often disguising the extent of water visible.

Soil

Typic Mesisols and Hydric Fibrisols

4. Channel Fens (Stream fens)

Channel fens are grassy drainageways, usually a minor component of peat plateaus.

Mapping

The following represent the type of fens mapped in the area and their landform designation on the soil map:

Nh - Horizontal fen - flat

Na - Patterned fen - pattern of ridges and hollows

Nf - Floating fen - floating (on ponds)

Nt - Stream fen - following drainageways, usually mapped as a component of the Grainger Association.

Nc - Collapse fen - usually part of bog matrix, usually mapped as a component of the Grainger Association.

Map Units

The Trail River map units are intended to reflect these different types of fens, plus significant occurrences of bog plateaus or palsas which often occur in fen areas but cannot be mapped out at the scale of 1:50,000.

Tr1 - Dominantly Typic Mesisols and significant Cryic Fibrisols.
Patterned fens. In some areas of shallow deposits Terric Mesisols occur.

Tr2 - Dominantly Typic Mesisols and significant Cryic Fibrisols.
Dominantly horizontal fen areas with significant permafrost build-up areas (palsas and small peat plateous).

Tr3 - Dominantly Typic Mesisol and significant Hydric Fibrisols and Cryic Fibrisols.
Very wet fen areas with ponds (open and infilling) and scattered ice-cored palsas or peat plateau areas, too small to be mapped out. These small, usually rounded treed domes often have collapse holes in the centre.

The Trail River Association is mapped on 272,000 acres in the survey area, with 220,000 acres in Map sheet 95H alone, where it occurs over extensive flat areas with innumerable ponds and often scattered sand dunes.

Fig. 29 - Patterned fen on the north side of the Mackenzie River. Note the higher elevation of the Deltaic Sand Plain on the south side of the Mackenzie River in the background.

## MISCELLANEOUS LAND TYPES

### Alluvium

Deposits of alluvial sand and gravel occur on sand bars and islands. These deposits are presently being formed and reshaped by river action. Vegetation is sparse (equisetum, grass, and willow) or absent, due to scouring action of ice and water.

Sandbars occur on point bars on the inside of meander bends throughout the area. Usually they are small and are included as part of the river channel. The only area where this type is mapped is in the extensive braided channel area of the lower South Nahanni River, better known as "The Splits."

### Colluvium

The Colluvium unit includes areas that have accumulations of loose, heterogeneous and incoherent mass of material deposited by mass wasting at the base of a steep slope or cliff.

It was mapped west of the Liard River at the base of the Franklin Mountains. The material is extremely variable, sometimes composed only of larger rock fragments.

### Exposure

The Exposure unit is used for bedrock outcrops occurring near the Franklin Mountains and along deep river valleys. Considerable bedrock is exposed along the Petitot and Kotaneelee Rivers. In the case of the river valleys, the rock cliffs are almost vertical and usually devoid of tree vegetation.

Hillwash

The Hillwash unit is a complex of Brunisolic, Luvisolic, and Regosolic soils of variable texture developed on eroded slopes of valleys and escarpments. The main areas of Hillwash occur along the Liard, Petitot, and Kotaneelee Rivers.

The parent material is variable in texture and composition, since it represents eroded sediments of a variety of glacial sediments. The topography is usually steeply sloping, with slopes usually greater than 15%.

The vegetation is variable, but most slopes are treed with aspen and white spruce.

Tributary Floodplain

The many tributaries of the Liard River flow across several of the different types of deposits as described herein. On the uplands these streams are usually small with steep eroding banks. As the streams flow along the gentle gradient of the Lacustrine Benchland and Alluvial Floodplains, the stream valleys are wider and often have a small floodplain. The floodplains are variable in texture, usually sandy loam materials over gravels. Often there are poorly drained backswamps and abandoned channels. The slope failures along the banks of the tributaries represent a complex of soil materials, depending on the surrounding deposits. Regosolic and Gleysolic soils are most common in these situations. Likewise, vegetation is quite variable, ranging from Riparian Shrub to Mixedwood Forest.

The Tributary Floodplains are prime recreational areas and wildlife habitats. Moose,in particular,like the riparian habitat and often follow these streams in their migrations from winter (Liard River) to summer (upland) habitat.

Yohin Lake

The Yohin Lake Complex occurs west of the Liard River, near the base of the Franklin Mountains. It is a complex of Brunisolic, Gleysolic, and Regosolic soils developed on recent alluvial materials emanating from the higher mountain slopes. The alluvial materials have been deposited over older lacustrine deposits and in some areas they cover portions of the floodplain of the Liard River.

The parent material is variable in texture, varying from gravel to silts and clays.

The landform generally takes the shape of a broad fan or apron gently sloping away from the mountains.

The vegetation is variable, depending on drainage.

## SOIL CAPABILITY FOR AGRICULTURE

The soils of the area were arranged in capability classes on the basis of soil, landscape, and climatic characteristics that affect their suitability for agricultural use. Only permanent soil and landscape factors such as permeability, erosion, fertility, hazard from flooding, low moisture holding capacity, wetness, degree of slope and stoniness, and the limitation imposed by the regional climate, affect the classification. Economic factors such as distance from markets, cost of clearing, etc., do not affect this classification. The first three capability classes are suitable for sustained agriculture; class 4 is marginal for arable agriculture; class 5 is suitable for improved hay or grazing; class 6 for unimproved grazing; and class 7 is for land considered incapable of use for agriculture.

The soils within a capability class are similar only with respect to degree, but not kind, of limitation. Each class contains many different kinds of soils, which may require different types of management. All limitations may be applied at different class levels. The limitations and the criteria used in their application are listed in Table 3.

There are no soils in class 1 or 2 in the map area because of adverse climate.

### Capability Class 3

About 23% of the survey area belongs to this class. This class includes all well drained soils of silt loam or finer texture on slopes less than 9%. The silt loam soils (Arrowhead, Bovie, and Bluefish associations) have a low moisture holding capacity (M) limitation, while all Luvisolic soils (Trout Lake, Celibeta, Pointed Mountain, and Bluebill associations) have a poor structure (D) in the surface horizon after cultivation. The finer textured soils (Petitot, Coty Mountain, and Netla associations) and the Liard soil, which has a high organic matter content, have no significant limitation except for climate.

Capability Class 4

Only 12% of the soils belong in this class. These soils are marginal for growing cultivated grain crops. The Anderson Mill, Winter Road, and Sibbeston soils are in this class because of their low moisture-holding capacity. Well drained soils of silt loam and finer texture on slopes of 10 to 15% are also rated as capability class 4 because of topographic limitations.

Capability Class 5

Class 5 lands include those areas suitable only for improved hay or pastures because of low moisture holding capacity or poor drainage. This includes all Gleysol soils and most of the Martin River soils. They comprise about 36% of the area. Improvement practices could include clearing, breaking, and drainage.

Capability Class 6

About 7% of the soils belong to this class. Soils in this class have characteristics such that improvement practises are not feasible. These soils have some natural sustained grazing capacity for farm animals. This class includes sandy soils susceptible to wind erosion, steep slopes, and some sedge-covered organic soils.

Capability Class 7

About 22% of the soils in the area belong to this class. These soils have limitations so severe that they are not capable of use for even permanent pasture. All organic soils that are treed or very wet are considered non-arable. Very steep eroded slopes along the major streams were also considered as class 7.

A summary of the number of acres of each capability class for each association is included in Appendix III.

TABLE 3

SUBCLASS LIMITATIONS AND CRITERIA

USED IN APPLICATION

CA - Climatic limitation due to aridity or low seasonal precipitation.

CH - Climatic limitation due to short growing season and cool temperatures.

3CA - The highest class level over the whole area.

3CH - The class and limitation present on areas above the floodplains.

5CH - Applies to areas at higher elevations, too short a growing season for grain crops.

M - Low soil moisture-holding capacity.

3M - Soils with a silt loam or loam texture.

4M - Soils with a sandy loam texture or loamy fine sand soil with a finer textured substrata.

5M - Soils with a loamy sand texture.

D - Poor soil structure.

3D - Soils with a highly leached surface horizon (Luvisols with well developed Ae)

F - Fertility limitation difficult to correct.

5F - Loamy sand and sand textured soils.

E - Erosion hazard if culitivated.

3E - Soils with few shallow gullies.

4E - Soils with many shallow or few deep gullies.

5E - Steeply sloping areas.

6E, 7E - Creek and river banks.

W - Wetness.

4W - Imperfectly drained soils

5W - All poorly drained gleysols.

6W - Sedge covered organic soils suitable for grazing.

7W - Most organic soils.

TABLE 3 (Continued)

T - Topographic limitations.

3T - Slopes of 6 to 9% and areas of irregular pattern of bogs and ridges as might occur on the floodplain.

4T - Slopes of 10 to 15% and floodplain with very bad topographic pattern.

5T - Slopes of 16 to 30%.

I - Inundation or flooding by overflow of streams.

3I - Flooding more than 2 years in 10, but for short periods.

4I - Annual flooding, but for short periods.

5I - Flooding in spring runoff and under storm conditions.

7I - Sandbars where flooding is so regular that vegetation does not occur.

P - Stoniness.

S - Adverse soil characteristics. It is used in a collective sense in place of subclasses M and F where these two occur in addition to some other limitation. For example, $6^S_E$ has limitations M, F coupled with erosion hazard E.

TABLE 4: Capability Classes and Subclasses used for various soils of the area

| Soil Association | Capability Rating | Comments |
|---|---|---|
| Antoine An | 5W | |
| Anderson Mill Ad | 4M | low moisture holding capacity |
| Arrowhead Ar | 3M | Gleyed soils are 4W |
| Babiche Bc | 5W | |
| Big Island Bg | 5W | |
| Blackstone River Br | 5W | |
| Bluebill Bb | 3D | poor structure in the surface horizon |
| Bluefish Bf | 3M | slight moisture holding capacity limitation |
| Bovie Lake Bv | 3M | same limitation as Bluefish |
| Blumer Bu | 5W | |
| Celibeta Cb | 3D | |
| Cormack Lake Cm | 5W | |
| Coty Mountain Ct | 3CH | main limitation is cool, short growing season |
| Fisherman Lake Fs | 5W | |
| Flett F | 5W | |
| Grainger G | 7W | Organic soil, native vegetation unsuitable for forage, excessive water, permafrost |
| Gros Cap Gc | 3D | |
| Harris Hr | 6P | too stony to cultivate |
| Jean Marie Jm | $5^{M}_{F}$ | very droughty and low fertility |
| Liard L | 3CA | often 3I or 4I because of flooding hazard or $3^{I}_{T}$ because of many poorly drained channels |
| Martin River Mr | $5^{M}_{F}$ | class $6^{S}_{E}$ if topography shows effects of wind modifications |
| Netla Ne | 3CA | class 3T if cut up by poorly drained channels |
| Petitot Pe | 3CH | soil is similar to Netla but occurs at higher elevations |
| Pointed Mountain Pd | 3D | sometimes reduced to 4T or 5T because of steep slopes, some 5H at higher elevations |
| Poplar Po | 3M | low moisture holding capacity |
| Rabbit Creek Ra | 3D | often 4T because of steep slopes, some 5H |
| Scotty Creek Sc | 5W | |
| Shale Creek Sh | 5W | |
| Sibbeston Sb | 4M | |
| Swan Point Sw | 3D | Gleyed soils are 4W, Brunisols are 3A |
| Trail River Tr | 7W | drier sedge covered areas are 6W |
| Trout Lake Tk | 3D | often reduced to 4T because of steep slopes |
| Winter Road Wr | 4M | |

Description of the area

Sheet 95I, J and G16

This area has dominantly poorly and very poorly drained soils. The total land area classified was 346,475 acres. Of this total 42.7% were 5W (Gleysols) and 22% were classified as 7W or Organic soils. There were only 51,587 acres or about 15% that were class 3. The class 3 soils are primarily in the Bovie Lake Association with lesser amounts of Arrowhead and Poplar soils right next to the Mackenzie River.

There appeared to be a greater occurrence of permafrost in this map sheet, which would indicate a less favorable climate for agriculture. The lower elevations close to the Mackenzie River may have a climate suitable for short season agricultural crops.

Sheet 95H

This sheet encompasses a wide range of soils from the very best Liard Association to the poor, sandy, erodable Martin River and very stony Harris Associations.

The Class 3 soils of any significance for agriculture amount to approximately 12,000 acres of Liard, Gros Cap, Bluefish and Poplar soils near Fort Simpson. In the whole map area there are 174,359 acres of class 3 and 4 soils, with 185,588 acres of Gleysols and 352,622 acres of Organic soils. In addition there are 155,633 acres of the very droughty and erodable Martin River and Jean Marie soils. The remainder of the area is comprised of Harris (stony), Hillwash and Tributary Floodplain soils.

Climatic data from Fort Simpson indicates that most grain crops can be successfully grown in this area. Agricultural development at sites of higher elevation than on Fort Simpson Island would have to contend with cooler temperatures and slightly shorter frost free periods. The main limitation for the better soils of the area is a lack of summer rainfall, which would be more severe in the silt loam and sandy loam soils. The Liard soils with its high organic matter content will store more water than other soils of similar texture.

Sheet 95G

Approximately 50% of the soils mapped on this sheet are classified as capability classes 3 or 4. The class 3 soils with the highest potential for agriculture are the Arrowhead, Petitot, Poplar, Liard, Nelta and Swan Point Associations located at lower elevations near the Liard River. The Bovie Lake soils are usually at higher elevations and are often associated with large areas of Gleysolic or Organic soils.

Some of the Liard soils close to the river are subject to occassional flooding (Class 3I or 4I). The main limitation affecting the Petitot soils is the short cool growing season (3CH) while the silt loam textured Arrowhead and Poplar soils have the additional limitation of low moisture holding capacity (3M). The main limitation affecting the Netla and Liard soils is one of limited summer rainfall (3CA) while the Swan Point soils have the additional limitation of poor structure in the surface layer after cultivation (3D).

Approximately 24% of the areas is comprised of peaty Gleysols, and Organic soils make up 20.3% of the area. The acreage of all the associations is shown in appendix III.

Sheet 95B

The mapped area in 95B is bounded on the west by the Liard Range of the Franklin Mountains and on the east by the morainal uplands. Soils at elevations higher than 1200 to 1400 feet above sea level are classified as 5CH due to the short frost free period. Most of the well drained soils at lower elevations were classified as class 3. Of the 1.2 million acres in this sheet 34%, 36% and 12% were classes 3, 5, and 7 respectively.

The best agricultural soils are on the floodplains and lacustrine soils just above the floodplain. Many of the Liard soils have a limitation due to occassional flooding. Certain parts of the floodplain also have topographic limitations associated with many long, narrow abandoned channels. These areas would be difficult to bring under cultivation because of the irregular field shapes that would result.

The area between the Netla and Muskeg Rivers contains a high proportion of poorly drained Gleysolic and Organic soils. Most areas mapped as the Bovie Lake Association contain from 30 to 50 per cent poorly and very poorly drained soils.

The area south of the Muskeg River to the B.C. border has a high proportion of land with steeper slopes classified as 4T or 5T.

The area west of the Liard River, between the B.C. border and the Franklin Mountains contains predominantly Luvisols and Gleysols, so consequently the majority of the soils are class 3D or 5W. Some of the steeper slopes are 4T and 5T while the land at higher elevations is 5CH.

North of Fort Liard to Flett Rapids the area west of the Liard River is confined to a narrow strip between the river and the mountains. This area is gently to strongly sloping towards the river and with run-off from the mountains has many gullies dissecting it. The east bank of the Liard River and major tributaries also have steep slopes. Both of these areas have an erosion limitation which clearing would aggravate.

# SOILS AND FORESTRY

## Introduction

Several evaluations of forest types and forest productivity have been carried out in the study region. These have been concentrated mainly in the southern section of the Liard Valley, 95B and 95G/2, 3, 4, covering the areas considered to have the best potential forest resources. These are the following:

1. 1959('64) - Forest Types along Lower Liard River, N.W.T., Jeffrey. Department of Forestry. Forest typology for lower Liard River area. Recognition of major physiographic land types and ecosystem types within them. Discussion of vegetational change in the floodplains and use of the typology in forest management. No maps.
2. 1955('68) - Report on Forest Conditions in the Lower Liard River Basin. Hirvonen. Forest Management Institute, Ottawa. 3.6 million acres partly in Yukon. Estimates 21 million cunits (cu. ft.) merchantable timber. 1.3 million acres of productive forest land (37% of area) has 16 million cunits, other site information rudimentary, mainly along the Liard River. Based on plot samples (6 weeks in field in 1955) and photo interpretation.
3. 1969 - Forest Inventory Lower Liard River Area. Wallace and Peaker. Forest Management Institute, Ottawa. Concentrates on the most important part of previously referenced area. Surveyed 550,782 acres (75% productive, 11% nonproductive, 14% waste and water). Based on additional plot samples plus photo interpretation. Other site information limited to alluvium, river terraces, well drained, poorly drained, moderate slopes, steep slopes.

4. 1969 - Forest Inventory Survey and Development Study of Lower Liard River Area. F.F. Slaney & Co. Additional forest site data and estimated volumes. Non-forest site information base same as Wallace (1969).
5. 1972 - Forest Inventory Report, Lower Liard River area C - 1970, Reid, Collins and Associates. Concentrates on extractive aspects of forest industry development. 390 sample plots plus 180 Slaney plots used. Federal Forestry data not used. No non-forest site classification. Maps at 1:32,000 of Liard Valley, B.C. border to Dehdjida Island. Their estimates for survey area of 1.2 million acres were: 8.0 billion board feet of timber suitable for saw-log production and a total soundwood volume of 2.2 billion cu. ft. (pulp production).
6. 1974 - Vegetation Types of the Mackenzie Corridor. Forest Management Institute. Section VI, Fort Liard, and Section I, Fort Simpson, cover a large part of the survey area. Prepared maps showing vegetation type and species cover. Recommends the establishment of forest reserves, covering most of the survey area in 95B, 95G/2, 3, 4, 7 and 95H/11.

An attempt has been made to integrate some of the above data along with field observations of forest cover with the soils base. This correlation of soils and forest resources covers most of the survey area, but, like the above surveys, will concentrate on those areas and soil types considered to have the most potential for forestry, particularly saw-timber production. This includes all of the Alluvial Floodplain and some of the Lacustrine Benchland areas in 95B and 95G and the lacustro till deposits in 95B/4. There are also other scattered areas of some potential, near Fort Simpson, some of which are currently being exploited.

From a production point of view, the most important information is the stand height, ages, diameters, and densities. This data has been gathered in previous surveys. However, if forest management is to be undertaken, the aim should be to understand the site and how that affects its use and management for forestry, as well as other uses. Jeffrey (1964) came closest to evaluating the forest site, whereas other surveys have been primarily mensurative, with classification of site classes only on the basis of productivity. The concepts of Jeffrey (1964) have been valuable in the present survey, but he did not attempt to produce a map of the area, and to that extent, his descriptions are abstract.

No pretense will be given here that the authors are now in a position to supply detailed information on the forest resource. Given the number and type of previous surveys,that would be redundant. The survey was designed to map soils, primarily for agricultural potential, not for forestry. The limitations of such a survey affect its applicability to forest management. Soil survey only directly assesses one component of the ecosystem amongst all those affecting plant growth, even though soil does reflect the interaction of other environmental factors. The evaluation of the total site is much more important to forestry, which must work within the living ecosystem, than in agriculture, which is most concerned with the physical base.

## SOIL TYPE AND FORESTRY

The physiographic districts and soil associations described in the present survey will be the bases of discussion of the forest resource. For detailed descriptions of the soils and landforms, refer to pertinent sections of the preceding report.

### A. Alluvial Floodplain

The most heavily forested areas occur in the valley floodplain environment of the Liard and South Nahanni Rivers and most smaller streams where the moisture regime and soil conditions are most suitable for sustained growth. The rich alluvial soils of the Liard floodplain, in particular, support the best timber stands in the N.W.T.

1. Recent Floodplain

The Recent Floodplain described herein, and mapped as the Liard Association, corresponds closely with the description of the same by Jeffrey (1964). The association is confined to islands and narrow strips bordering the river, but it supports the most productive forest in the area.

On the Recent Floodplain it is particularly important to have an understanding of the dynamic forces at work in the formation and development of the alluvial deposits. Unlike other forest types in the area, where fire is the dominant environmental influence, the main factors at work in this riparian environment are ice-scouring, flooding, and continuing alluvial deposition, resulting in gradual aggradation of the terraces. Vegetation colonizing new fluvial deposits shows a catenulate progression with increasing distance from the river. This progression can be divided into ecological units. Those identified here are a simplified presentation of Jeffrey's forest types.

Riparian Shrub - Salix is the first shrub to colonize new alluvium on sandbars. As soil build-up progresses away from the river, Alnus incana becomes a main species along with Salix. The next stage in the sequence is a vigorous arborescent shrub, dominated by balsam poplar and Alnus, with Equisetum hiemale dominating in the herb layer. This latter type represents the earliest layered community structure and the development of an organic layer in the soil. These are all habitats of extreme disturbance by flooding and ice-scouring. The soils lack a build-up of organic layers in the profile because annual flooding doesn't allow any significant organic build-up in the interim. This vegetation group has no forestry potential, but it is very high quality moose habitat. It is recognizable by its banded appearance, representing the stages described above.

Balsam Poplar Forest - Balsam Poplar Forest dominates older surfaces within the flooding zone. It is characterized by tall balsam poplar, with a dense shrub layer of *Alnus incana* (plus *Rosa* spp. and *Cornus stolonifera*), and a herb layer dominated by *Equisetum hiemale* and *E. pratense*. White spruce becomes established under this forest cover and stands with white spruce in the understorey or co-dominant in the main storey are common.

The balsam poplar attains a large size on this type, growing to over 100 feet in height and up to as much as 3 feet d.b.h. The mean d.b.h. for 90-110 foot trees is 13 inches, with heights of 100 feet reached in less than 100 years. Many of the older stands (> 90 years) show considerable crown dieback and heart rot. The affected trees are characterized by defoliated and broken tops.

White Spruce Forest - White Spruce eventually dominates on older surfaces, just within or above the zone of peak flooding. This Riparian Spruce Forest has some of the best timber stands in the area. Two sub-types of this forest are identified by Jeffrey. They are the following: 1) white spruce-balsam poplar, in which the balsam poplar is usually old and decaying; and 2) white spruce-white birch, with white spruce dominant in the main storey and white birch in the understorey.

In both types the shrub and herb layers are generally dense and, unlike the balsam poplar forests, have a dense bryophyte layer. The main species are the following: shrub - *Alnus incana*, *Rosa spp.*, *Cornus stolonifera*, and *Viburnum edule*; herb - *Equisetum pratense*, *Mitella nuda*, *Rubus pubes-*

cens, Cornus canadensis; and moss - Hylocomium splendens, Pleurozium schreberi, and Ptilium crista-castrensis. These stands are thought to represent a climax stage in uninterrupted development from the colonizing Riparian Shrub. However, buried charcoal layers have been found under some of the white spruce-white birch forest stands, indicating fire origin in that type.

Mixed Leaftree Forest (Brulé) - This forest is characteristically dominated by white birch, with trembling aspen associated or co-dominant. White spruce is present in the understorey. This forest is of fire origin and represents those areas of the Recent Floodplain which have been burnt and are regenerating to white spruce. However, white spruce is not always present, showing that development to white spruce forest is not always assured.

Channel Shrub - Arborescent shrub, 10-30 foot, sparse to thick stands of Salix bebbiana, Alnus incana, and balsam poplar with Equisetum, Calamagrostis, and Carex in the understory. This type occupies abandoned channels, but is small in area.

Summary- Although all of the above six vegetative types can be identified on the Liard Association, White Spruce Forests (with balsam poplar or white birch) occupy a very large proportion of Liard soils. The Riparian Shrub and Balsam Poplar are mostly confined to narrow bands along the margins of terraces and islands where point bars are newly forming. Mixed Leaftree forests and Brulés are also rare on Liard soils. The "moist" site, proximity to the river, and protective barriers, like water-filled channels and escarpments, all act to protect Recent Floodplain forests from fire.

Riparian White Spruce Forest then occurs over most of the Recent Floodplains, which are mapped as the Liard Association. These forests represent the greatest concentrated source of white spruce timber in the area. Most of the stands are mature or over-mature. After 120 years, growth is very slow (Jeffrey, 1964). Reid, Collins and Associates (1972) placed most of these stands into age classes 14 (121-160 years) and 17 (161+ years), with a small proportion of younger stands representing balsam poplar-white spruce stands, in which the white spruce will eventually dominate. These stands are dominantly in height class 9 (81-100 feet), with a significant number of stands greater than 100 feet, especially on the islands and floodplains in the southern half of 95B. (Fig. 30).

Reid, Collins and Associates (1972) mapped most of the balsam poplar and white spruce stands on Liard soil as site productivity class I, which is defined as "very good, recent alluvium, well drained." The Liard Association includes all of the areas mapped as site class I, especially in 95B. In 95G some of the Liard soils (for example, along the South Nahanni River), either because of climate or soil, are placed in site class II.

The Recent Floodplains, then, are the most productive forest areas. Cumulic Regosols of the Liard Association are fertile because of the buried organic matter, neutral to mildly alkaline in pH, and although coarse textured, are moist because of their relation with the river.

Flooding is annual in lowest-lying portions, but at longer intervals during abnormal peak flows under the main areas of spruce forests. The success of white spruce and balsam poplar on recent floodplains is related to their ability to put out new roots when the base is buried by alluvium.

Fig. 30 Exceptional growth of balsam poplar and white spruce on the floodplain.

Fig. 31 Mixedwood Forest with two storied structure of aspen and white spruce. This is a typical forest on abandoned Floodplains. Note the meadow in the channel in foreground and and sharp transition to forest.

The occurrence of degenerating stands of white spruce forest shows that the perpetuation of this forest,in the absence of catastrophic change such as fire or flood, is not assured.

Forests of the Recent Floodplain have been considered by previous forest inventories to be the most commercially important forests. They are readily accessible, they have the largest volume of white spruce, and growth is greater than in other types.

2. Abandoned Floodplains

These floodplains are composed of terraces, representing alluvial deposits that were laid down at an earlier age and are now well above the present river level. This corresponds to the Ancient Floodplain described by Jeffrey (1964). In the present survey Swan Point, Netla, and Poplar are the three soil associations representing well drained soils on this type, (see pages 63 to 72 .) and the dominant forest type is Mixedwood. The Floodplain Mixedwood Forest has tall, moderately dense stands of trembling aspen and white spruce. White birch and balsam poplar are commonly associated species, but are rarely dominant. In the understorey the high shrubs, Alnus crispa and Salix bebbiana and medium shrubs Rosa Acicularis, Viburnum edule, and Cornus stolonifera, are common. Sheperdia canadensis is often present but less common. In the herb layer, Cornus canadensis, Equisetum pratense, Rubus pubescens, Mitella nuda, Linnaea borealis, and Aralia nudicaulis are most common. The bryophyte layer is discontinuous with Hylocomium splendens, the most common species. This forest is rich in species, especially shrub and herb,and all layers, except for bryophytes and lichens, are well-developed.

The Floodplain Mixedwood forests do not contain a large volume of white spruce per unit area in comparison with recent floodplains. In general, there is a higher proportion of leaftrees, notably trembling aspen.

Black Spruce Forests are found in backswamps and abandoned channels and Meadow-shrub vegetation in long arcuate channel scars. These poorly drained channels are often a significant proportion of the area and they occur interspersed with well drained ridges. (Fig. 31).

All high terrace forests are of fire origin. These areas have all been subject to burning in the past. Many fire lines are visible on the air photos and charcoal is frequently encountered in the soil profile. The forests on the abandoned floodplain seem to be less susceptible to fire, due to their location near to the river and a moister site than lacustrine and upland soils, but they are definitely more affected by fire than the recent floodplain.

Because of the influence of fire, forests of several different ages and stages of succession are encountered. Jeffrey (1964) describes several vegetation types. It is useful to discuss these from the point of view of age.

Mature stands of trembling aspen and white spruce are most common. These are placed dominantly in height class 7 (60-80 feet) by Reid, Collins and Associates (1974) and Hirvonen (1968) in their forest surveys. Jeffrey(1964) notes heights of aspen of 80-100 feet at less than 100 years on some sites.

White spruce rarely attains heights over 100 feet and is usually around 80 feet. A two-storied structure is common, with tall, straight-trunked,top-crowned aspen in the higher storey, and white spruce and occasionally white birch being the main species of the lower storey. (Fig. 31) The spruce may be considerably younger than the leaf trees, and its presence suggests successional takeover. The Reid, Collins (1972) survey shows that in these mixedwood stands, sites of age class 10 (81-120 years) generally have greater stand volume of spruce than aspen, even though on appearance the aspen seems dominant, due to its height. Although only a couple of areas with height class 14 (121-160 years) are mapped on the high terraces, white spruce is definitely dominant at this age.

Jeffrey (1964), in his description of these older stands, indicates that trembling aspen begins to decay and disintegrate at this age, owing to heart-rot, and the longer-lived white spruce assumes dominance.

Aspen dominated mixed leaftree forests with white spruce in the understorey are also found on abandoned floodplains. These stands have a similar understorey component as mixedwood stands, except that a moss layer is absent. This type is believed to be an earlier successional stage of the mixedwood forest, and the slower growing but longer lived white spruce, in time, assumes co-dominance or dominance.

Brulés of white birch and/or willow, aspen, and alder also usually have white spruce in the understorey. Thus, on the abandoned floodplain, succession to white spruce dominated mixedwood is most probable.

A comparison of forest types with the soils map indicates some difference in the type of forests occurring on Netla and Swan Point soils. From previous forest inventories and field observations, the areas of Netla soil in the main support mixedwood stands with aspen dominant, whereas Swan Point is the reverse. This may be more an accident of fire history and age than actual soil differences.

There are also climatic differences with latitude, with the southern end being warmer and possibly more moist. Not enough is known about the climate at this stage.

Areas within a few miles width of the Liard River and its major tributaries, such as the Muskeg and Petitot Rivers, are well drained externally. The incidence of Gleysolic and Organic soils in these locations is low. These areas have the best forest stands.

Rivers and steep banks form major barriers to fire. The majority of the area on the east side of the Liard River has been burnt by major fires, mostly in 1942. These fires have not, for the large part, burnt up to the Liard, Petitot, or Muskeg Rivers, leaving mature stands concentrated within a few miles on either side. The lacustrine areas on the west side of the river bordered by both the river and the mountain have fewer burnt-over areas.

Given these other factors, the correlation of forests with soils may be meaningless, but the present forest stands can still be discussed by Soil Associations. Only the well drained soils are discussed here; the poorly drained soils support non-productive black spruce forest, for the most part.

1. Bovie Lake Association - The large area of Bovie Lake soils occupying most of the area east of the Liard River has been mostly burnt-over in recent years. (Fig. 32). For the most part, it is classified by Reid, Collins and Associates (1972) as site productivity class III-fair, with large areas of class V representing the large proportion of poorly drained soils in this area.

The well drained slopes of the banks bordering the Liard, Muskeg, and Petitot Rivers are in site class II. These support aspen-dominated mixedwoods, with stand heights of 60-100 feet. These areas also represent

Where younger stands occur (less than 80 years), hardwoods dominate, but where older stands--greater than 100 years--are recorded, spruce is present without significant aspen. However, the majority of the stands fall in between these two ages, and are mixedwood with spruce or aspen dominant.

B. Lacustrine Benchland

The Lacustrine Benchland (identified as Lacustrine Terrace by Jeffrey, 1964) occupies large areas, both east and west of the river above the floodplains, and is usually gently to steeply sloping towards the river. The forest cover contains a higher proportion of leaftrees and a greater variety of species than the alluvial soils. There are two main vegetation types on the lacustrine soils. These are Mixed Leaftree and Mixedwood, the former being most prevalent. The species in these are similar to comparable types on the floodplain but, due to more variable soils, topography and fire occurrence, stands are more irregular and variable. Height growth is less than in floodplain forests. For a more detailed description of the forest types occurring on the Lacustrine Benchlands, see section on vegetation.

The most productive forest stands are concentrated along the valley of the Liard River and its major tributaries just above the Alluvial Floodplain. Forest productivity on lacustrine deposits cannot be so easily correlated with soil types,as other environmental factors seem to play a large role. These are: 1) elevation, 2) climate, 3) drainage, and 4) fire.

The elevation of lacustrine deposits varies from 650 feet to 1600 feet a.s.l. The effect of elevation is mainly shown in climate, the lower elevations along the river valleys being in a warmer climate zone.

Fig. 32 Burnt over area on Bovie Lake Soils of the Lacustrine Benchland east of the Liard River in 95B. Stands of unburnt aspen and spruce occur scattered throughout.

Fig. 33 Tall aspen stands on fine textured Luvisols (Mixed Leaftree Forest). Photo taken looking west along the Pointed Mountain road. Pure aspen stands are common in this area.

soils on steeper slopes, with a high degree of erodability, if cleared.

Even though large areas of Bovie Lake soils have been burnt, and proven productivity cannot be measured, it seem likely that this soil is the least productive of the lacustrine soils discussed here. It is medium-textured and generally occurs at higher elevations. It is often a very thin veneer over till, with a strongly ridged landform, and it has a high proportion of poorly-drained soils.

2. Arrowhead Association

Although the Arrowhead Association has the same coarse silty texture as Bovie Lake deposits, the Arrowhead soils are thicker deposits (greater than one meter). Whereas Bovie Lake soils occur as a thin veneer over till on the higher areas, Arrowhead is chiefly found at lower elevations along tributary valleys and adjacent to the Alluvial Floodplain of the Liard River. The Arrowhead soils appear to have higher productivity than the Bovie Lake soils due to better climate and drainage .

From Flett Rapids south, the Arrowhead Association has 60-100 foot stands of mixedwood forest, and corresponds to major areas of site productivity class II, mapped by Reid, Collins and Associates (1972). North of Flett Rapids, areas of Arrowhead have 50-80 foot stands, and are mostly in site class III. This difference may be climatic, as the forests generally are shorter and slower-growing in the north, as compared to the southern part of the area.

There are 64,345 acres of Arrowhead in 95B and 42,900 acres in 95G/2 and 3 and it is estimated that over 60% of these support mixedwood stands in height classes 7 and 9.

3. Celibeta Association

The only area where the Celibeta Association is mapped is the large area around Fisherman Lake, west of Fort Liard. Here, it occurs with Pointed Mountain and Big Island Associations. From Fisherman Lake south and east to the Liard River, Celibeta soils support dominantly pure hardwood stands. These stands are tall (61-80 feet) with some 80-100 foot stands and dense (predominantly 61-80% canopy density). Stands are of various ages, from 50-140 years. (Fig. 33)

West of Fisherman Lake the stands are younger, with a more significant spruce component.

4. Petitot Association

There is a small area of the Petitot Association near the mouth of the Kotaneelee River. The stands found on this association are similar to the Celibeta Association.

5. Bluefish Association

The large area of Bluefish soils between the Liard River and the mountains supports good hardwood and mixedwood stands. Stands are dense (41-80% cover) and tall. Heights of 61-80 feet are most common.

The coarser texture and long-sloping relief from the mountains to the river may cause an erosion hazard on this soil association.

6. Tributary Floodplain Complex

Floodplains and valleys associated with tributaries are variable, but generally support stands of white spruce and trembling aspen or balsam poplar. The small flats contiguous to streams are susceptible to flooding and usually support productive stands of white spruce and/

or balsam poplar. The side slopes usually support predominantly spruce with aspen and birch. These slopes are quite erodable.

Summary

Most of the lacustrine soils are classified as site productivity class III by Reid, Collins, and Associates (1972). Significant areas of site class II occur within a mile or two width of the Liard River from Fort Liard to Flett Rapids and along the Muskeg and Petitot Rivers. However, since site class is based on proven productivity, many of the boundaries between the site classes are strictly fire boundaries. Jeffrey (1964) considered Mixedwood Forests on the Lacustrine Benchland in the Fort Liard area to be almost as productive as the equivalent forest type on the Abandoned Floodplains. He found white spruce reaching heights of 70-80 feet around age 80-90 years.

Accessibility is good, although areas of good stands are more scattered. Erosion could be more of a problem on steep slopes along the Liard, Muskeg, and Petitot Rivers.

C. Morainal Uplands

1. Morainal Deposits - Trout Lake Association. The morainal deposits occurring above the level of lacustrine depositions are in a relatively cool climate zone because of their higher elevation. The soils are more variable. Well drained ridges support pine and aspen with poorly drained depressional areas supporting black spruce forest. Forestry potential is low.

2. Lacustro Till Deposits - Clay textured lacustro till deposits are mapped west of the Liard River, from the B.C. border to Mount Coty. These soils, mapped as the Pointed Mountain Association, support very good mixed-wood forest. White spruce is the dominant species, with trembling aspen and white birch as the common hardwood component. The most common understorey species are: high shrub - *Alnus crispa*, *Viburnum edule*, and *Rosa acicularis*; herb - *Cornus Canadensis*, *Linnaea borealis*, *Equisetum scirpoides*, and *Mitella nuda*; and moss - dense *Hylocomium splendens*.

Growth of white spruce is good, with heights of 70-80 feet being reached around 80-90 years. Reid, Collins, and Associates (1972) mapped most of these stands as spruce-hardwood mixtures, 81-100 feet in height, and moderately stocked. Present stands are mature and over-mature, many greater than 160 years old. This area was rated as site Class II, by the Reid, Collins survey, despite its high elevation.

This area has the largest continuous stands of spruce, apart from the floodplain. One of the problems associated with forestry might be erosion on the long slopes found in this area.

D. Deltaic Sand Plain - 95H

The Deltaic Sand Plain is pretty well confined to map sheet 95H, the Fort Simpson area. This area has received less attention than the southern area, although Hirvonen (1968) mapped areas adjacent to the Liard River, from field work done in 1956 and the Forest Management Institute (1974) mapped the vegetation types mainly be aerial photo interpretation.

The forest stands are generally poor in comparison to southern sections of the Liard River. The sandy fluvial Martin River and Sibbeston associations support mainly Pine and Mixed Leaftree Forest. A large proportion of these areas have been burnt in this century and stands are mostly less than 60 feet in height.

There are a few productive stands of Mixedwood Forest near Fort Simpson, concentrated mainly on soils with a better moisture-holding capacity. These include Anderson Mill and Winter Road associations, with finer textured bands in the profile and the small areas of lacustrine deposits, i.e., Gros Cap and Bluefish associations.

Data on productivity was not taken, but stands were observed up to 16 in. d.b.h. at less than 100 years.

The area of Winter Road Association mapped northwest of the Liard River, along the Nahanni winter road has spruce-aspen stands, a good proportion of which are over 60 feet in height. The small area of Anderson Mill, southwest of Fort Simpson Airport, has spruce stands which are currently being harvested.

The other good spruce-aspen stands are on the areas mapped as Bluefish and Gros Cap associations, both of which occur next to the Liard River, and both of which represent a good proportion of the Class III agricultural soils in the area. There is also a large island in the Liard River, south of the airport, which has spruce stands greater than 60 feet, which are also being selectively harvested.

The only other significant area of productive spruce stands is along the Martin River, a prime recreational site near Fort Simpson.

Summary of Forestry Potential

Maps of forest cover were prepared for Map Sheets 95B, G, and H. The location of the best forest stands are summarized here as follows.

From Fort Liard south, extensive mature spruce-aspen stands cover the area between the Liard River and the western border of the survey area. At the corresponding latitude, the east side of the Liard River is a large burn area with only young and immature growth, except for a few large mixedwood stands near its confluence with the Petitot River.

Further north, the mixedwoods are largely replaced by hardwood stands, although there still are several good mixedwood stands in the area between Fisherman Lake and the Liard River. At this latitude, on the east side of the Liard, there are several good stands of both softwoods and hardwoods. The softwood stands are generally adjacent to the river and the hardwood stands beyond them. Still further back from the river, large areas of old burn with young or immature growth dominate.

For about the next 30 miles down river to Flett Rapids, where the Liard changes from a braided to a meandering stream, the merchantable timber is confined to a few miles on either side. From this point until the Blackstone River, the merchantable stands become larger, covering mainly the floodplains which extend several miles on both sides of the river.

North of the Blackstone River there are a few mature mixedwood stands which soon disappear, giving way to a large burned-over area. Most of the burn is apparently regenerating to a hardwood or mixedwood forest. This condition prevails right down to the Mackenzie River.

The merchantable timber along the Nahanni River is generally confined to the alluvial flats, but the mature mixedwood stands near the

Jackfish River have a slightly greater extent. Most of the remaining area is covered by young or immature growth, establishing itself on an old burn.

Correlation of Site Productivity (Reid, Collins and Assoc., 1972) and Soil Associations

| | |
|---|---|
| Class I | Liard Association, (Recent floodplain) |
| Class II | Netla, Swan Point and some areas of the Poplar Association (Abandoned Floodplain) |
| | Pointed Mountain Association and some areas of Arrowhead and Celibeta soils. |
| Class III | Well drained soils of the Lacustrine Benchland. |

Fig. 34. Regenerating, pine aspen and dense shrub on burnt-over area. Such brulé stands are common on the fire prone morainal and sandy soils in 95G and 95H.

## Conclusions

As soon as the Liard Highway is constructed into this area, there will likely be strong pressure to exploit forestry resources. Information on which to base decisions on land use and cutting rights is necessary. A number of surveys of the forestry potential have been carried out but no steps have been taken towards forest management, other than fire control.

Present data on the forest resource in the survey is incomplete, and often conflicting. It would be helpful if the available forestry data were compiled and summarized. To some extent, that is attempted here, but the main intent is to relate present forestry information to soils.

## Forestry Management Problems

1. The vegetation communities and forest typology on the Alluvial Floodplain have been well documented by Jeffrey (1964). Less attention has been paid to the Lacustrine, Morainal, and Deltaic Sand districts, and particularly areas such as the lacustro till deposits. More specific site information is required on these areas for forest management.
2. Forest fires have had a major ecological influence and most of the stands are of fire origin, except for the riparian environment of the floodplain. Large areas have been burnt east of the Liard River (1942) and are mainly regenerating to hardwood or mixedwood. Not enough is known about the effect of fires or their suppression in the northern environment.
3. There is an imbalance of age classes in present growing stock, with a high proportion of over-mature stands, especially on the floodplain.
4. Erosion. Areas on steep slopes, particularly those mapped as Hillwash Complex, have a serious erosion hazard and should be protected. There

may also be a problem of erosion on islands and low floodplains, where a good proportion of the best timber occur. Verschuren (1974) studied erosion along the Liard River near Watson Lake, Yukon Territory, and recommended that trees be left standing near the edge on low floodplains, where the roots act to reduce erosion. River characteristics in the study area would need to be investigated.

Land Use Conflicts

1. Ecological Reserves. There is an area of 115 square miles, proposed as an I.B.P. Ecological Reserve, along the Liard River south of Fort Liard (from Big Island Creek to the Kotaneelee River). The area has dense productive white spruce and large balsam poplar forests on the islands and floodplains. Conflict with forestry is high. There is minimal conflict with agriculture.

2. Agriculture. The land best suited for agriculture is also some of the best forest land. Before undertaking any major development, these competing uses should be weighed.

3. Wildlife and Trapping. Forestry operations can be compatible with preservation of wildlife, provided sufficient care is taken. In this regard the islands and low floodplains with Riparian Shrub vegetation near their margins are very important moose habitats and harvesting could greatly interfere with the moose population. Synergy West Ltd. (1975) recommended these areas not be disturbed. Wildlife was not a direct concern of this survey, but it is obvious that before any land use decisions are made, considerable attention needs to be paid to wildlife and its importance as a source of livelihood for local inhabitants.

4. Forest Reserves. The forests are important because of their scientific, recreational, and aesthetic value, as well as their important roles in the northern ecosystem. The Forest Management Institute (1974) recommended the establishment of forest reserves for conservation and management of forests in the area. One area proposed, the Liard-Nahanni Forest, covers a large part of the survey area 95B and 95G/2, 3, 4, and 7. It includes areas of the best timber and has high scenic values. The other proposed reserve that lies within the present study area is south and east of the Liard River, near Fort Simpson. The area does not have a high forestry potential but, because of its proximity to Fort Simpson, demands on it are high and some parts of it are currently being harvested locally.

5. The large hill in 95B 14, partially enclosed by the Liard River, and west of the Netla River has unique stands of large white birch and aspen. Mountain ash was noted in this area as well. The area has some large spruce, but does not appear to be a significant forestry area. Clearing is not desirable because of the erosion hazard on its long slopes. This area should be protected.

An Assessment of the Grazing Potential of the Liard River Basin for Domestic Livestock and the Possibility of Producing Forage Crops for Winter Feed
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W.L. Pringle

From July 23 - July 27 (1975) the grazing and forage potential was studied on sites selected as possible ranging areas by the soil survey team under Dr. H. Rostad. A rather cursory examination of 12 sites was undertaken by dropping into each location in an Alouette II helicopter*. The vegetation of the Area has been very adequately described by W.W. Jeffrey, 1959 and 1964.

No livestock grazing exists in the valley at present. The potential in the forested areas is low. The tree canopy is too well developed. Under aspen very little grazable vegetation grows. Under mixedwood stands, Alnus sp. often forms an impenetrable barrier and at higher elevation under black spruce there is little ground cover except for dense moss and a few patches of sedge and reedgrass. These areas are often soft and wet and cattle could become mired in them.

Meadow areas on the recent floodplains offer some palatable forage but these are of limited scope, mainly in the vicinity of Nahanni Butte. Control of water on such areas would present a problem as they could not be safely grazed until they had been drained to some degree. In addition, frost occurs at about 40 cm. The dry sandy ridges of pine offer limited livestock grazing but are of very low yield and could easily be overused. Seismic lines and man-made clearings in some areas come into reedgrass and sedge and offer a limited range resource. Over most of the area, north of

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* For the most part the landing was made on an established seismic line and observations were made both on the line and in the adjacent undisturbed forest area.

Nahanni Butte, these lines are mainly too wet for grazing and south of this they are revegetating to alder, aspen and willow, thus they could offer an interim use only.

On some areas where domestic grasses and legumes had been seeded such as on seismic lines, a field at Ft. Liard and an airport clearing, the grasses and legumes were producing poorly. Timothy was short and spindly and alsike clover appeared low and unthrifty. Bromegrass appeared better adapted and at Ft. Liard it was producing about 1 ton of hay/A. The plots on the beam site at Ft. Simpson* on a Bluefish silt loam were showing the effects of a dry year. The bromegrass and timothy were the most productive grasses while the block of Kentucky bluegrass had maintained a solid healthy stand. Of the legumes, Rambler alfalfa was still visible in the plots and was up to 36 inches high while in mixture with bromegrass it was present only at the edges of the plot. The birdsfoot trefoil was in solid plots and was about 12 inches high in seed. The ground was very dry and the dandelions had shrivelled and appeared dead. The plot area generally was becoming weedy with fireweed, raspberry and foxtail. Grasses by their color indicated nitrogen deficiency.

In any area that is as dominated by tree cover, such as is found in the Liard Basin, very little native grazing will be found. The forest tends to fill in burns and man made openings very rapidly hence grazing by domestic stock would be very limited.

From inspection of the various sites it is obvious that the lower flood plains and terraces grow the best trees. These also are the areas

*Forage plots were seeded in 1966 on the Radio Beam site, five miles South of the Ft. Simpson Experimental Farm on the airport road.

where clearing produces the greatest amount of forage from native grasses and forbs.

If and when these lands are cleared it will be these soils upon which community pastures could be established or which could be used for forage production. The gleysolic soils, where cleared, appeared to lack productivity of palatable vegetation being too cool and wet for good production. The sandy ridges under pine are too dry and so also are incapable of producing much forage.

Each site as observed is described briefly and the salient vegetation is listed. Emphasis is placed upon the plants that could be used for domestic livestock grazing. In some cases the full botanical name is given whereas in others the genus name only is written down. It was felt that the 12 sites that were observed were representative of most of the area on which a forage potential could exist. The ocular estimate of forage yields given are based on experience and are in terms of pounds of dry matter per acre.

A map of the area gives the approximate locations of the various sites visited.

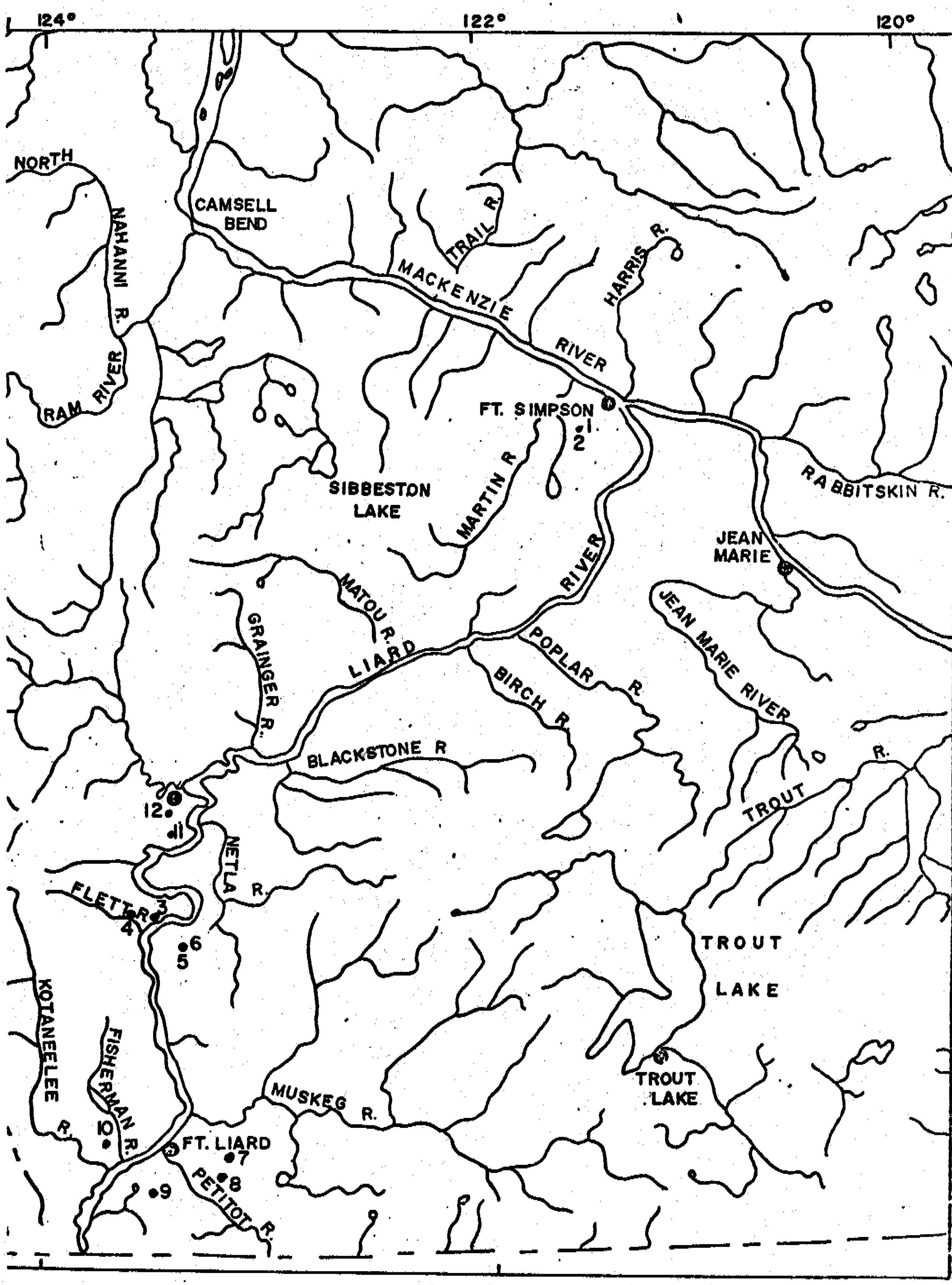


Fig. 35 Location of sites examined for grazing potential

Site 1. NW of Ft. Simpson, 5 miles West on the new Mackenzie Highway. Martin River Association, loamy sand texture.

Trees:
_Pinus banksiana_
_Populus tremuloides_
_Picea glauca_
_Picea mariana_

Brush and Shrubs:

_Alnus crispa_
_Viburnum edule_
_Rosa acicularis_
_Rubus strigosus_
_Salix bebbiana_
_Salix arbuscolides_

Forbs:

_Cornus canadensis_
_Epilobium angustifolium_
_Fragaria glauca_
_Vaccinium vitis-idaea_
_Lathyrus ochroleucus_

Grasses:

_Bromus pumpellianus_
_Trisetum spicatum_
_Oryzopsis pungens_
_Poa pratensis_
_Agrostis scabra_
_Carex_ sp.

Along the cutline there would be between 300 - 400 pounds per acre of forage. In the treed area 100 - 200 pounds. This site was typical of all sandy soil types occurring on the Deltaic Sand Plain. This pine-aspen type would be classed as poor grazing even though animals could range through it relatively easily. Pockets throughout this type of low boggy land or Gleysolic soils which were on site 2 would offer some grazing of sedges and grasses and this could increase the value of this dry range type to some extent. Figure 36, is a view looking west along a cutline showing the vegetation type and extent of ground cover.

Because of the low forage yield and the yearly fluctuation of growth that could be expected, this type could not be relied upon to support a major grazing industry but could be used as a summer range if it was grazed very lightly. The fencing and management necessary to make use of such land would hardly justify its use as a range.

Fig. 36 Site 1. - Seismic line looking west on a sandy area west of Ft. Simpson. Mainly pine, aspen, alder and sparse grass cover.

Site 3. Mining airport near Flett River.
Liard Association, silt loam texture.

An area where the trees had been "walked down" to provide aerial access to the landing strip.

Trees: *Picea glauca* 12-16" diameter
*Populus tremuloides* 8-18" diameter
*Populus balsamifera*
*Betula papyrifera*

Brush and Shrubs:

*Alnus incana*
*Cornus stolonifera*
*Amelanchier alnifolia*
*Viburnum edule*
*Salix* sp.
*Ribes oxyacanthoides*
*Ledum groenlandicum*
*Rubus strigosus*

Forbs:

*Actaea rubra*
*Equisetum pratense*
*Lathyrus ochroleucus*
*Vicea americana*

Grass:

*Calamagrostis canadensis*
*Arctagrostis* sp.
*Carex atherodes* (in wet areas)

A very productive site which is producing between 1500 and 3000 pounds of forage per acre in the open but very little in the rather dense forest. This area may be subject to flooding as it was very near river level.

Site 4. West end of old landing strip near Flett River. Eutric Brunisol gravelly subsoil. Yohin Lake Complex.

Trees: *Populus tremuloides* (mainly)
*Populus balsamifera*
*Betula papyrifera*

Brush and Shrubs:

*Alnus incana*
*Cornus stolonifera*
*Viburnum edule*
*Rosa acicularis*
*Rubus acaulis*
*Salix arbusculoides*
*Salix* sp.

Forbs:

*Epilobium angustifolium*
*Lathyrus ochroleucus*
*Vicea americana*
*Aquilegia* sp.
*Galium boreale*

Grass:

*Calamagrostis canadensis*

The airstrip and roadway had been revegetated with creeping red fescue, brome and sweetclover. Some poor alsike clover was also observed. The introduced grasses and legumes were not vigorous. Some moose browsing had occurred on balsam poplar and red osier dogwood.

Productivity of this area was about 700 pounds per acre of palatable vegetation.

Site 5 and 6. On top of hill east side of the Liard River. Site 5 was on a seismic line with black spruce on a Gleysolic soil. Bulmer Association, silt loam texture. Elevation 1500'.

Trees: *Picea mariana*
*Larix laricina*
*Betula papyrifera*

Brush and Shrubs:

*Alnus crispa*
*Amelanchier alnifolia*
*Ledum groenlandicum*
*Viburnum edule*
*Rosa acicularis*
*Salix* sp.

Forbs:

*Epilobium angustifolium*
*Equisetum* sp.
*Geocaulon* sp.
*Castilleja* sp.
*Linnaea borealis*
*Petasites palmatus*
*Rubus pubescens*
*Vaccinium vitis-idaea*
*Parnassia* sp.

Grass:

*Agrostis scabra*
*Calamagrostis canadensis*
*Calamagrostis* sp.
*Carex* sp.
*Eriophorum* sp.
*Luzula* sp.

Fig. 37. Site 5 - Seismic line on Gleysolic soil, with black spruce, larch and alder. The grass is short and of low volume. Ground is very soggy.

This area was producing about 400 pounds per acre of mainly sedge (Fig. 37). An area 200 yards to the north (Site 6) in an aspen stand was producing about 900 pounds per acre mainly *Calamagrostis canadensis*. These lines were revegetating to both willow and alder. Range in this type of area is non-existent.

Site 7. A 50 acre meadow south of the Muskeg River typical of the small sedge bogs throughout the area. The area graded from a sphagnum peat at the edge through a poplar, willow, spruce area to *Carex aquatalis* and finally to *Carex rostrata* in the centre.

Trees:
- *Betula papyrifera*
- *Larix laricina*
- *Picea mariana*
- *Populus balsamifera*
- *Populus tremuloides*

Brush and Shrubs:
- *Betula glandulosa*
- *Ledum groenlandicum*
- *Salix* sp.

Forbs:
- *Geum triflorum*
- *Empetrum nigrum*
- *Rubus chamaemorus*
- *Vaccinium vitis-idaea*
- *Vaccinium uliginosum*

These Gleysolic meadows occur infrequently throughout the spruce-aspen uplands (Fig. 38). Production of forage would average 1200 pounds per acre. These meadows are too few and too wet to rely on for ranging livestock.

Fig. 38. Site 7 - A small Gleysolic meadow surrounded by poplar and spruce. The sedges and reed grass would produce 1200 pounds of usable forage annually but the small size and isolation of these infrequent meadows makes their use by livestock improbable.

Site 8. South east of Fort Liard, 5 miles north of Petitot River at an elevation of 1200 feet. This area consisted of black spruce forest with pockets of very mature aspen-poplar. One tree observed was 30 inches d.b.h. Arrowhead Association, silt loam texture.

Trees: Betula papyrifera (decadent)
Picea glauca
Picea mariana
Populus balsamifera
Populus tremuloides

Brush and Shrubs:

Alnus crispa
Viburnum edule
Rosa acicularis
Rubus acaulis
Salix sp.

Forbs:

Cornus canadensis
Epilobium angustifolium
Linnaea borealis
Pyrola secunda
Vaccinium vitis-idaea
Vicea americana

Grass:

Calamagrostis canadensis
Carex aquatilis
Carex sp.
Eriophorum sp.

Seismic lines are revegetating to alder and willow. There is very little grazeable forage in the forest with about 400 pounds per acre on the line. It is such areas as this at medium elevation which could be utilized for forage production in the future.

Site 9. One mile east of Betalamea Lake on an area that had been burned over about 5 years previously. This site was on a Gleysol. Mosses prevailed at ground level in the forest while grasses and sedges were dominant on the seismic line (Fig. 39). Bulmer Association, silt loam texture.

Trees: Picea glauca
Picea mariana
Populus tremuloides

Brush and Shrubs:

Ledum groenlandicum
Shepherdia canadensis
Potentilla fruticosa
Salix sp.

Forbs:

Epilobium angustifolium
Parnassia sp.
Geocaulon lividum
Fragaria virginia
Arcostaphylos rubra
Rubus pubescens
Vaccinium uliginosum

Grass:

Agrostis scabra
Calamagrostis canadensis
Calamagrostis inexpansa
Carex sp.
Luzula sp.
Carex paupercaulis

This line had been seeded. Creeping red fescue and timothy were present but lacked vigor. This type would not be valued as a range for domestic livestock.

Fig. 39. Site 9. A seismic line through a recent burn near Betalamea Lake. The elevation here is 1700 feet. Forage yield is less than 400 pounds per acre.

Site 10. Pointed Mountain Road about 2 miles west of the Liard River at 1100 feet. This area was on a silty clay loam, Orthic Gray Luvisol. On the road clearing forage production was fair with about 600 pounds of forage per acre. Under the large vigorous aspen some spruce and alder was present with very little palatable forage (Fig.40). Celibeta Association, silty clay loam.

Trees: _Populus tremuloides_
_Picea glauca_

Brush and Shrubs:

_Alnus incana_
_Rubus acaulis_
_Salix_ sp.

Forbs:

_Equisetum arvense_
_Epilobium angustifolium_

Grass:

_Agropyron trachycaulum_
_Arctagrostis_ sp.
_Beckmannia syzigachne_
_Carex_ sp.

The roadsides had been seeded down to creeping red fescue, brome and alsike clover. The seeded species showed signs of being N deficient. Soils were wet. White spruce seedlings were prevalent on the roadsides. This appeared to be a very productive soil for tree production. Grazing on this type would only be possible if the trees were removed and farming carried out.

Fig. 40. Pointed Mountain road which has been cleared from a heavy aspen forest. The roadside had been seeded to fescue and brome but even though moisture was good production was not excessive.

Site 11 and 12. Flood plains south of Nahanni Butte. Both sites were on Cryic Fibrisols and were meadow types. Site 11 was on a large meadow on which bog birch was dominant with much *Ledum* and willow. The large sedge were prevalent in patches (Fig.41).
Site 12 was on a smaller meadow directly under Nahanni Bluff. Here there was a definite outer ring of bog birch and willow a distinct ring of *Calamagrostis* sp. and an inner wetter centre of *Carex aquatilis* and *rostrata* (Fig.42).

Trees: nil

Brush and Shrubs:

*Betula glandulosa*
*Ledum*
*Salix* sp.

Forbs:

(Trailing potentilla)

Grass:

*Calamagrostis inexpansa*
*Carex aquatilis*
*Carex rostrata*
*Eriophorum* sp.

These meadow types appear to have some grazing potential but they are very wet. Ice occurs at 12-15 inches and on the larger meadow vegetation is rather sparse yielding about 300 pounds per acre. On the smaller meadow yields were higher averaging 1500 pounds per acre. These areas are limited to the flood plain in the vicinity of Nahanni Butte and in total are of rather limited acreage. Some form of drainage would be necessary in order to use them as haylands or even as pasture. Areas such as this could not be relied upon to support a livestock industry.

Fig. 41. Site 11 - A fairly extensive Cryic Fibrisol flood plain meadow consisting of a filled river channel. Bog birch and Carex aquatilis predominate.

Fig. 42. Site 12 - A small Cryic Fibrisol pocket on the flood plain. Bog birch, *Calamagrostis canadensis* and *Carex aquatilis* predominate.

## FERTILITY STATUS AND CROPPING RECOMMENDATIONS OF THE MAJOR SOILS

In general, the soils of the area are low to very low ($<$ 2.5 ppm) in nitrate nitrogen and most are low to very low ($<$ 7.5 ppm) in phosphorous (Table 5 ). Thus, nitrogen and phosphorous applications would be required for optimum performance from all crops. In addition, the sandy and silt loam textured soils will require potash applications for all crops and some of the clay loam and clay soils will require potash for barley, grasses, and legumes production. Applications of sulphur will be required on some of the soils for all crops and on a number of soils for legumes and oilseeds production. A soil test analysis is highly recommended before any crops are grown on a specific site because the nutrient status of the soils is variable and a general fertilizer recommendation cannot be given.

With the possible exception of the Liard soils (Cumulic Regosols), applications of lime will be required to raise the soil pH, if production of alfalfa is to be successful. Lime applications may also be required on many of the soils for successful production of grasses, cereals, and oilseeds.

Poor crops on acid soils are related to many factors. Toxic quantities of aluminum (Al) and manganese (Mn) are a major cause of damage to crops by soil acidity. At pH values above 5.5, Al and Mn toxicity is generally not a problem. Low pH in itself affects the growth of legume crops by inhibiting the ability of the nitrogen-fixing Rhizobium bacteria to form nodules on the roots.

Grasses are generally more tolerant to acidity than legumes. Among the grasses the fescues are especially tolerant and among the legumes red clover is considered more tolerant than alsike clover, which is more tolerant than alfalfa. Timothy and bromegrass do fairly well on acid soils but Russian Wild Rye is quite sensitive. Of the cereals, oats are the most tolerant to acidity and barley is the least tolerant, while wheat is intermediate. Rapeseed is similar to wheat in tolerance.

Alfalfa and sweet clover have reduced yields at pH values between 5.5 and 6.0. Between 5.0 and 5.5, yields of alfalfa are reduced to ½ or less, while yields of barley, wheat, and rapeseed are also reduced. At pH values between 4.5 and 5.0, alfalfa barely grows, yields of all other crops are reduced to some degree.

Fertilizer applications can compound the acidity problem. For example, 100 pounds (45 kg) of ammonium sulphate require 110 pounds (50 kg) of lime to neutralize the acidity caused by the fertilizer. By comparison, urea, ammonium nitrate, and anhydrous ammonia require 84, 59, and 148 pounds (38, 27, and 67 kg) of lime to neutralize the acidity caused by 100 pounds (45 kg) of fertilizer material.

There are two main methods of overcoming soil acidity problems. One method is to grow acid-tolerant crops, the other is to lime the soil in order to raise the pH. A combination of the two methods can broaden the range of crops grown while minimizing the expensive procedure of liming.

An application of lime should last at least seven years and probably ten years or more in the Liard River area. Substantially less lime would be required for subsequent applications. The amount of lime required increases with increasing acidity. The less acid-tolerant crops will give a greater response to liming than the more tolerant crops. High organic-matter soils require more lime than soils with low organic matter. Soils with a high clay content require more lime than sandy soils. The actual amount of lime required may vary from ½ to 6 tons per acre. The usual amount required for growing cereal and oilseed crops on soils containing toxic quantities of Al or Mn is about 1 ton per acre (2.2 tonnes per ha.). An application of 1 ton per acre (2.2 tonnes per ha.) can also correct the acidity for growing alfalfa on soils with a pH of 5.5.

A soil test is highly recommended to determine whether liming of a specific field is necessary. Species vary considerably in their sensitivity to Al and Mn toxicity and a soil test will indicate how much Al and Mn is present. An area can have non-acid soils, even though the surrounding soils are acid, and conversely, an area of non-acid soils may contain some acid soils.

In general, vegetables can be grown very successfully in the north, if proper precautions are taken. The 1947-1953 Progress Report for the Dominion Experimental Substation at Fort Simpson describes the methods to use for successfully growing a large variety of vegetables.

TABLE 5
SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) | | | | | | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ca | Mg | Na | K | Cl | $SO_4$ | | | | | | |
| | | Arrowhead Association, Gleyed Orthic Eutric Brunisol | | | | | | | | | | | | |
| 26-2 | Bm | 0-28 | 50 | 10 | 14 | 1 | 17 | 70 | 1 | 0 | 20 | 2.2 | 0.5 | SiL |
| 26-3 | $Ck_1$ | 28-40 | 40 | 5 | 17 | 1 | 13 | 65 | 1 | 0 | 25 | 1.4 | 0.4 | Si |
| 26-4 | $Ck_2$ | 40-60 | 35 | 5 | 15 | 2 | 19 | 65 | 1 | 0 | 20 | 1.5 | 0.4 | Si |
| | | Arrowhead Association, Gleyed Orthic Brunisol | | | | | | | | | | | | |
| 28-2 | Bmg | 0-20 | 65 | 15 | 12 | 1 | 100 | 85 | 1 | 1 | 45 | 4.6 | 0.6 | SiL |
| 28-3 | Ckg | 20-45 | 50 | 5 | 12 | 1 | 19 | 75 | 2 | 2 | 25 | 3.7 | 0.4 | SiL |
| | | Bluebill Association, Brunisolic Gray Luvisol | | | | | | | | | | | | |
| 24-2 | Ae | 0-7 | 10 | 5 | 12 | 4 | 25 | 90 | 1 | 0 | 65 | 5.5 | 5.5 | L |
| 24-3 | Bm | 7-18 | 5 | 1 | 10 | 4 | 14 | 60 | 1 | 0 | 80 | 3.6 | 3.6 | CL |
| 24-4 | IIBt | 18-36 | 10 | 5 | 11 | 2 | 21 | 65 | 1 | 0 | 85 | 2.3 | 2.3 | CL |
| 24-5 | IIIBt | 36-70 | 10 | 1 | 11 | 3 | 14 | 65 | 1 | 8 | 100 | 2.0 | 2.0 | |
| 24-7 | IVCk | 83-95 | 45 | 5 | 11 | 3 | 20 | 70 | 1 | 2 | 105 | 1.5 | 1.5 | CL |
| | | Bluefish Association, Orthic Eutric Brunisol | | | | | | | | | | | | |
| 18-1 | L-H | 5-0 | | | | | | | | | | | | |
| 18-2 | $Bm_1$ | 0-15 | 30 | 5 | 9 | 1 | 16 | 70 | 1 | 1 | 40 | 3.7 | 0.3 | SiL |
| 18-3 | $Bm_2$ | 15-32 | 20 | 5 | 7 | 1 | 10 | 60 | 1 | 0 | 30 | 1.3 | 0.2 | SiL |
| 18-4 | Ck | 32-70 | 40 | 10 | 9 | 1 | 9 | 65 | 1 | 0 | 20 | 1.3 | 0.4 | SiL |

TABLE 5 (Continued)
SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) Ca | Mg | Na | K | Cl | $SO_4$ | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Bovie Lake Association, Orthic Eutric Brunisol** | | | | | | | | | | | | |
| 8-2 | $Bm_1$ | 0-20 | 20 | 5 | 8 | 1 | 12 | 60 | 1 | 0 | 40 | 1.5 | 0.3 | SiL |
| 8-5 | $IICk_2$ | 56-66 | 45 | 5 | 9 | 1 | 10 | 70 | 2 | 1 | 65 | 1.7 | 0.4 | L |
| | | **Bovie Lake Association, Degraded Eutric Brunisol** | | | | | | | | | | | | |
| 27-2 | Ae | 0-7 | 35 | 10 | 10 | 2 | 19 | 80 | 1 | 1 | 50 | 5.2 | 0.3 | SiL |
| 27-3 | Bm | 7-28 | 20 | 10 | 9 | 2 | 14 | 60 | 1 | 0 | 35 | 3.0 | 0.3 | SiL |
| 27-4 | Ck | 28-40 | 40 | 15 | 11 | 1 | 11 | 70 | 1 | 0 | 40 | 3.0 | 0.4 | SiL |
| 27-5 | IICk | 40-60 | 35 | 15 | 12 | 2 | 8 | 80 | 1 | 0 | 55 | 2.6 | 0.4 | SiL |
| | | **Bulmer Association, Rego Gleysol** | | | | | | | | | | | | |
| 17-1 | L-H | 12-0 | | | | | | | | | | | | |
| 17-2 | Ac | 0-35 | 20 | 5 | 52 | 1 | 12 | 80 | 1 | 1 | 25 | 1.8 | 0.4 | FL |
| 17-3 | IICk | 35-50 | 20 | 5 | 69 | 3 | 7 | 75 | 1 | 0 | 100 | 2.0 | 0.4 | CL |
| | | **Celibeta Association, Brunisolic Gray Luvisol** | | | | | | | | | | | | |
| 33-1 | L-H | 6-0 | | | | | | | | | | | | |
| 33-2 | Ae | 0-10 | 15 | 5 | 8 | 3 | 16 | 45 | 1 | 2 | 95 | 1.6 | 0.2 | SiL |
| 33-3 | Bm | 10-20 | 15 | 5 | 11 | 2 | 25 | 50 | 1 | 1 | 105 | 1.9 | 0.2 | SiCL |
| 33-4 | $IIBt_1$ | 20-40 | 5 | 1 | 10 | 3 | 10 | 35 | 1 | 0 | 135 | 0.8 | 0.2 | HC |
| 33-5 | $IIBt_2$ | 40-50 | 20 | 5 | 13 | 1 | 55 | 35 | 1 | 3 | 120 | 1.0 | 0.3 | |
| 33-6 | IICk | 50-65 | 45 | 15 | 18 | 2 | 16 | 65 | 1 | 1 | 90 | 1.9 | 0.5 | HC |

TABLE 5 (Continued)

SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) | | | | | | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ca | Mg | Na | K | Cl | $SO_4$ | | | | | | |
| | | Cormack Lake Association, Orthic Gleysol peaty phase | | | | | | | | | | | | |
| 16-1 | F-H | 30-15 | 50 | 15 | 12 | 2 | 20 | 130 | 2 | 1 | 30 | 48.8 | 0.5 | |
| 16-2 | H | 15-0 | 60 | 15 | 12 | 1 | 19 | 125 | 2 | 0 | 35 | 20.0 | 0.5 | |
| 16-3 | Bg | 0-20 | 45 | 10 | 11 | 1 | 15 | 70 | 2 | 1 | 75 | 3.0 | 0.4 | |
| 16-4 | Ckg | 20-40 | 50 | 15 | 18 | 4 | 31 | 70 | 3 | 1 | 85 | 2.4 | 0.5 | L |
| | | Gros Cap Association, Orthic Gray Luvisol | | | | | | | | | | | | |
| 10-1 | L-H | 10-0 | | | | | | | | | | | | |
| 10-2 | Ae | 0-12 | 25 | 5 | 8 | 2 | 26 | 80 | 1 | 3 | 55 | 3.4 | 0.3 | SiL |
| 10-3 | Bt | 12-32 | 15 | 5 | 8 | 2 | 21 | 65 | 1 | 1 | 90 | 2.5 | 0.2 | SiC |
| 10-4 | Ck | 32-56 | 50 | 20 | 12 | 2 | 8 | 75 | 2 | 2 | 60 | 2.4 | 0.5 | SiCL |
| | | Jean-Marie Association, Degraded Eutric Brunisol | | | | | | | | | | | | |
| 11-1 | Ae | 0-7 | 25 | 5 | 9 | 2 | 16 | 80 | 1 | 3 | 40 | 2.0 | 0.3 | |
| 11-2 | Bm | 7-45 | 20 | 2 | 8 | 2 | 9 | 70 | 1 | 2 | 55 | 1.8 | 0.3 | LFS |
| 11-3 | $Ck_1$ | 45-62 | 70 | 5 | 8 | 2 | 11 | 85 | 2 | 2 | 25 | 1.6 | 0.5 | |
| 11-4 | $Ck_2$ | 62-82 | 50 | 2 | 8 | 1 | 22 | 75 | 1 | 1 | 20 | 1.1 | 0.4 | LCS |
| | | Liard Association, Cumulic Regosol | | | | | | | | | | | | |
| 19-1 | Ac | 0-20 | 60 | 20 | 14 | 2 | 27 | 100 | 1 | 3 | 70 | 8.5 | 0.5 | SiCL |
| 19-2 | FHb | 20-30 | 65 | 15 | 13 | 3 | 25 | 100 | 1 | 7 | 85 | 11.7 | 0.5 | |
| 19-3 | ACb | 30-38 | 60 | 15 | 17 | 1 | 16 | 95 | 1 | 3 | 40 | 7.3 | 0.5 | |

TABLE 5 (Continued)
SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) Ca | Mg | Na | K | Cl | $SO_4$ | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Liard Association, Cumulic Regosol (Continued) | | | | | | | | | | | | |
| 19-4 | IIBb | 38-60 | 70 | 15 | 26 | 1 | 48 | 90 | 2 | 1 | 75 | 6.4 | 0.6 | |
| 19-5 | IICk | 60-75 | 90 | 25 | 26 | 2 | 8 | 290 | 1 | 0 | 90 | 82.0 | 0.7 | SiC |
| | | Liard Association, Cumulic Regosol | | | | | | | | | | | | |
| 42-1 | L-H | 20-0 | | | | | | | | | | 1.2 | | |
| 42-2 | AC | 0-20 | 85 | 20 | 18 | 2 | 21 | 75 | 2 | 1 | 40 | 6.3 | 0.6 | SiL |
| 42-3 | $Ck_1$ | 20-35 | 50 | 10 | 12 | 4 | 10 | 60 | 1 | 1 | 40 | 2.0 | 0.4 | |
| 42-4 | $Ck_2$ | 35-50 | 45 | 10 | 21 | 4 | 18 | 55 | 1 | 1 | 40 | 2.1 | 0.5 | SiL |
| | | Martin River Association, Orthic Eutric Brunisol | | | | | | | | | | | | |
| 1-1 | L-H | 7-0 | | | | | | | | | | | | |
| 1-2 | $Bm_1$ | 0-10 | 25 | 5 | 10 | 7 | 16 | 55 | 1 | 35 | 50 | 2.3 | 0.3 | LFS |
| 1-3 | $Bm_2$ | 12-25 | 10 | 1 | 9 | 3 | 10 | 40 | 1 | 29 | 30 | 1.0 | 0.2 | LFS |
| 1-4 | BC | 25-60 | 10 | 1 | 9 | 2 | 7 | 35 | 1 | 10 | 30 | 0.7 | 0.2 | FS |
| 1-5 | C | 60-80 | 10 | 2 | 9 | 2 | 8 | 40 | 1 | 5 | 25 | 0.6 | 0.2 | FS |
| | | Martin River Association, Degraded Eutric Brunisol | | | | | | | | | | | | |
| 9-1 | L-H | 5-0 | | | | | | | | | | | | |
| 9-2 | Ae | 0-5 | 25 | 5 | 13 | 2 | 31 | 85 | 1 | 14 | 30 | 4.5 | 0.3 | SiL |
| 9-3 | $Bm_1$ | 5-10 | 25 | 5 | 9 | 2 | 19 | 75 | 1 | 9 | 30 | 3.9 | 0.3 | |
| 9-4 | $Bm_2$ | 10-56 | 15 | 5 | 9 | 1 | 10 | 60 | 1 | 3 | 30 | 1.9 | 0.2 | LFS |
| 9-5 | Ck | 56+ | 40 | 5 | 11 | 2 | 8 | 70 | 1 | 1 | 20 | 1.5 | 0.4 | LFS |

TABLE 5 (Continued)

SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) Ca | Mg | Na | K | Cl | $SO_4$ | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Netla Association, Orthic Eutric Brunisol | | | | | | | | | | | | |
| 31-1 | L-H | 8-0 | | | | | | | | | | | | |
| 31-2 | $Bm_1$ | 0-10 | 50 | 15 | 11 | 4 | 25 | 80 | 22 | 43 | 100 | 4.6 | 0.6 | SiCL |
| 31-3 | $Bm_2$ | 10-30 | 15 | 5 | 9 | 3 | 19 | 70 | 2 | 13 | 105 | 2.6 | 0.3 | SiCL |
| 31-4 | BC | 30-45 | 60 | 15 | 11 | 2 | 33 | 60 | 1 | 11 | 70 | 1.9 | 0.5 | SiCL |
| 31-6 | $Ck_2$ | 45-60 | 50 | 10 | 11 | 2 | 31 | 70 | 2 | 2 | 60 | 1.6 | 0.4 | SiL |
| 31-7 | $Ck_3$ | 60-70 | 40 | 10 | 10 | 1 | 28 | 50 | 2 | 2 | 55 | 1.3 | 0.4 | |
| | | Netla Association, Orthic Eutric Brunisol | | | | | | | | | | | | |
| 37-1 | L-H | 5-0 | | | | | | | | | | | | |
| 37-2 | $Btj_1$ | 0-9 | 15 | 1 | 8 | 2 | 18 | 50 | 1 | 24 | 105 | 3.1 | 0.3 | SiCL |
| 37-3 | $Btj_2$ | 9-24 | 10 | 1 | 8 | 2 | 12 | 30 | 1 | 10 | 85 | 0.7 | 0.2 | SiCL |
| 37-4 | BC | 24-46 | 40 | 10 | 10 | 1 | 21 | 50 | 1 | 13 | 65 | 0.9 | 0.4 | |
| 37-5 | IICk | 46-60 | 40 | 5 | 14 | 2 | 14 | 60 | 1 | 3 | 45 | 1.7 | 0.4 | SiL |
| | | Petitot Association, Orthic Eutric Brunisol | | | | | | | | | | | | |
| 34-1 | LF | 27-10 | | | | | | | | | | | | |
| 34-3 | $B_1$ | 0-10 | 40 | 15 | 12 | 2 | 18 | 75 | 1 | 0 | 75 | 5.9 | 0.4 | SiL |
| 34-4 | $B_2$ | 10-20 | 50 | 20 | 14 | 2 | 24 | 70 | 1 | 0 | 75 | 6.0 | 0.4 | |
| 34-5 | C | 20-30 | 50 | 20 | 16 | 2 | 11 | 120 | 1 | 0 | 85 | 11.5 | 0.5 | SiCL |

TABLE 5 (Continued)

SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) | | | | | | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ca | Mg | Na | K | Cl | $SO_4$ | | | | | | |
| | | Petitot Association, Degraded Eutric Brunisol | | | | | | | | | | | | |
| 43-2 | Ae | 0-10 | 35 | 15 | 7 | 4 | 27 | 55 | 1 | 2 | 140 | 4.3 | 0.4 | SiC |
| 43-3 | Btj | 10-32 | 30 | 15 | 9 | 1 | 10 | 55 | 1 | 1 | 70 | 2.2 | 0.4 | SiC |
| 43-4 | $Ck_1$ | 32-45 | 65 | 30 | 16 | 1 | 56 | 170 | 1 | 0 | 45 | 23.0 | 0.7 | SiC |
| 43-5 | $Ck_2$ | 45-70 | 40 | 25 | 30 | 1 | 5 | 170 | 2 | 0 | 75 | 24.0 | 0.6 | SiC |
| | | Pointed Mountain Association, Orthic Gray Luvisol | | | | | | | | | | | | |
| 30-1 | L-H | 6-0 | | | | | | | | | | | | |
| 30-2 | Ae | 0-18 | 15 | 5 | 16 | 4 | 18 | 65 | 1 | 1 | 50 | 1.7 | 0.2 | |
| 30-3 | $Bt_1$ | 18-34 | 10 | 5 | 12 | 4 | 14 | 65 | 2 | 1 | 165 | 1.8 | 0.2 | |
| 30-4 | $Bt_2$ | 34-49 | 10 | 5 | 11 | 2 | 11 | 70 | 2 | 2 | 140 | 1.4 | 0.2 | |
| 30-5 | BC | 49-57 | 75 | 20 | 17 | 2 | 36 | 65 | 2 | 3 | 110 | 2.2 | 0.6 | |
| 30-6 | Ck | 57-70 | 50 | 10 | 17 | 2 | 12 | 605 | 2 | 1 | 100 | 2.0 | 0.5 | |
| | | Pointed Mountain Association, Orthic Eutric Brunisol | | | | | | | | | | | | |
| 32-1 | L-H | 6-0 | | | | | | | | | | | | |
| 32-2 | $Bm_1$ | 0-20 | 15 | 5 | 7 | 6 | 27 | 65 | 1 | 3 | 160 | 5.3 | 0.2 | C |
| 32-3 | $Bm_2$ | 20-40 | 5 | 1 | 9 | 5 | 15 | 50 | 1 | 6 | 125 | 1.0 | 0.2 | C |
| 32-4 | BC | 40-80 | 35 | 10 | 11 | 3 | 102 | 50 | 1 | 13 | 100 | 0.5 | 0.4 | |
| 32-5 | Ck | 80-100 | 50 | 15 | 11 | 3 | 60 | 30 | 1 | 5 | 90 | 1.0 | 0.5 | C |

TABLE 5 (Continued)

SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) Ca | Mg | Na | K | Cl | $SO_4$ | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rabbit Creek Aasociation, Orthic Eutric Brunisol | | | | | | | | | | | | | | |
| 21-1 | $Bm_1$ | 0-11 | 60 | 20 | 9 | 1 | 20 | 80 | 1 | 0 | 25 | 6.4 | 0.5 | SL |
| 21-2 | $Bm_2$ | 11-22 | 55 | 20 | 9 | 1 | 66 | 70 | 1 | 0 | 25 | 3.6 | 0.6 | |
| 21-3 | $Ck_1$ | 22-34 | 160 | 45 | 14 | 2 | 340 | 70 | 1 | 1 | 20 | 2.2 | 1.2 | SL |
| 21-4 | $Ck_2$ | 34-44 | 50 | 15 | 11 | 1 | 16 | 75 | 1 | 0 | 30 | 1.6 | 0.5 | SL |
| Rabbit Creek Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | |
| 38-2 | Ae | 0-4 | 5 | 1 | 35 | 2 | 51 | 70 | 1 | 2 | 40 | 2.9 | 0.3 | SiL |
| 38-3 | Btj | 4-22 | 10 | 1 | 9 | 2 | 18 | 30 | 1 | 1 | 40 | 1.5 | 0.2 | L |
| 38-4 | $Ck_1$ | 22-50 | 65 | 10 | 10 | 2 | 10 | 40 | 1 | 1 | 60 | 1.1 | 0.5 | |
| 38-5 | $Ck_2$ | 50-100 | 65 | 10 | 11 | 2 | 10 | 50 | 1 | 1 | 60 | 1.0 | 0.5 | L |
| Swan Point Association, Orthic Gray Luvisol | | | | | | | | | | | | | | |
| 41-1 | L-H | 7-0 | | | | | | | | | | | | |
| 41-2 | Ae | 0-8 | 25 | 5 | 8 | 5 | 38 | 65 | 1 | 21 | 190 | 4.6 | 0.3 | SiCL |
| 41-3 | $Bt_1$ | 8-16 | 15 | 1 | 9 | 3 | 22 | 50 | 1 | 6 | 150 | 2.9 | 0.2 | SiCL |
| 41-4 | $Bt_2$ | 16-34 | 20 | 5 | 8 | 1 | 31 | 50 | 1 | 7 | 80 | 1.6 | 0.3 | SiC |
| 41-5 | $Ck_1$ | 34-60 | 50 | 10 | 10 | 2 | 8 | 55 | 1 | 3 | 90 | 1.4 | 0.5 | SiC |
| 41-6 | $Ck_2$ | 60-110 | 50 | 15 | 13 | 3 | 30 | 55 | 1 | 2 | 115 | 1.2 | 0.5 | SiC |

TABLE 5 (Continued)
SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) | | | | | | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ca | Mg | Na | K | Cl | $SO_4$ | | | | | | |
| Trout Lake Association, Orthic Gray Luvisol | | | | | | | | | | | | | | |
| 5-1 | L-H | 9-0 | | | | | | | | | | | | |
| 5-2 | Ae | 0-4 | 20 | 5 | 8 | 3 | 22 | 65 | 1 | 1 | 65 | 4.3 | 0.3 | SiL |
| 5-3 | $Bt_1$ | 4-25 | 15 | 2 | 7 | 2 | 21 | 55 | 2 | 0 | 55 | 5.5 | 0.2 | CL |
| 5-4 | $Bt_2$ | 25-58 | 10 | 2 | 7 | 2 | 16 | 50 | 1 | 0 | 50 | 3.2 | 0.2 | CL |
| 5-5 | Ck | 58-68 | 60 | 10 | 10 | 2 | 51 | 60 | 1 | 0 | 60 | 1.9 | 0.5 | CL |
| Trout Lake Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | |
| 20-2 | Ae | 0-10 | 115 | 40 | 13 | 2 | 25 | 270 | 1 | 0 | 45 | 75.0 | 0.8 | |
| 20-3 | Bm | 10-30 | 250 | 80 | 23 | 1 | 17 | 700 | 1 | 0 | 40 | 26.0 | 1.4 | |
| 20-4 | $Ck_1$ | 30-51 | 155 | 60 | 25 | 1 | 20 | 495 | 1 | 0 | 40 | 16.0 | 1.1 | CL |
| 20-5 | $Ck_2$ | 51-70 | 85 | 30 | 22 | 1 | 10 | 240 | 1 | 0 | 35 | 15.0 | 0.7 | L |
| Trout Lake Association, Orthic Gray Luvisol | | | | | | | | | | | | | | |
| 14-1 | L-H | 7-0 | | | | | | | | | | | | |
| 14-2 | Bt | 0-30 | 60 | 20 | 9 | 1 | 14 | 115 | 1 | 1 | 65 | 7.9 | 0.5 | CL |
| 14-3 | BC | 30-65 | 110 | 30 | 15 | 2 | 8 | 305 | 1 | 1 | 70 | 35.0 | 0.8 | |
| 14-4 | Ck | 65-80 | 155 | 40 | 20 | 2 | 7 | 470 | 1 | 0 | 75 | 61.0 | 1.0 | L |
| Winter Road Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | |
| 2-1 | L-h | 9-0 | | | | | | | | | | | | |
| 2-2 | Ae | 0-10 | 25 | 5 | 10 | 1 | 46 | 70 | 1 | 4 | 25 | 5.4 | 0.3 | SiL |

TABLE 5 (Continued)
SOIL FERTILITY OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Water Soluble Ions (ppm) | | | | | | $NO_3$-N ppm | P ppm | K ppm | $SO_4$-S ppm | Cond. mmhos/cm | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ca | Mg | Na | K | Cl | $SO_4$ | | | | | | |
| | | | Winter Road Association, Degraded Eutric Brunisol (Continued) | | | | | | | | | | | |
| 2-4 | $Btj_2$ | 30-56 | 20 | 5 | 9 | 2 | 27 | 50 | 1 | 1 | 30 | 4.6 | 0.2 | VL |
| 2-5 | $C_1$ | 56-100 | 35 | 10 | 10 | 1 | 10 | 50 | 1 | 1 | 25 | 2.9 | 0.3 | |
| 2-6 | $IIC_2$ | 100+ | 105 | 40 | 18 | 4 | 8 | 365 | 2 | 1 | 60 | 55.0 | 0.9 | L |

# ENGINEERING USES OF SOILS

Some soil properties such as permeability, shrink-swell characteristics, grain size, plasticity, and pH are of special interest to engineers because they affect the construction and maintenance of roads, building foundations and sewage disposal systems. Tables 6 and 7 give the engineering interpretations of the major soils of the area. The interpretations can be used for many purposes, but they are based on a small number of samples and they do not eliminate the need for specific on-site sampling and testing. The interpretations given in Tables 8 and 9 merely give an indication of the general engineering properties that may be expected in the soils of the map area.

## Engineering Classification Systems

Two systems of classifying soils for engineering purposes are used in this report (Tables 6 and 7 ). The American Association of State Highway Officials System (AASHO) classifies soils into seven principal groups ranging from A-1, consisting of gravelly soils of high bearing capacity, to A-7, consisting of clayey soils having low strength when wet. The Unified Soil Classification System (Unified) identifies soil material as coarse-grained (eight classes), fine-grained (six classes), or highly organic (one class).

## Soil Test Data

A number of soils in Map Sheets 95A, B, G, H, I, and J were sampled and tested according to standard procedures to evaluate the soils for engineering purposes. Data resulting from these tests are shown in Table 6 .

Tests for liquid limit and plastic limit measure the effect of water on the consistency of soil material. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semi-solid to a plastic state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Engineering Properties of Soils

Some of the estimated soil properties that are important in engineering are shown in Table 7. The data are based on results of the soil tests shown in Table 6 and on information from other parts of the survey.

Depth to bedrock has been omitted from the tables because the layer of glacial drift in most of the area is thick enough that the bedrock has little direct influence on the development of soils.

Soil reaction is given in pH values, which indicate the degree of acidity or alkalinity of the soil materials. Values above 7.3 (in $H_2O$) indicate alkalinity, while values below 6.6 (in $H_2O$) indicate acidity. The intermediate values are neutral.

Shrink-swell potential is an indication of the change in volume of the soil material when the moisture content changes. Soils that have a high shrink-swell potential are normally undesirable for some engineering purposes.

Engineering Interpretations of Soils

In Table 8, the soils are rated according to their suitability as a source of top soil, sand and gravel, and road fill. In addition, the degree and kinds of limitations for septic tank absorption fields, sewage lagoons, trench type sanitary landfills, area-type sanitary landfills, sources of cover material, shallow excavations, dwellings with basements, roads and streets, and campsites are shown in Table 9 . Susceptibility to frost action and features affecting highway location are also shown in Table 8 . The ratings are based on the data in Tables 6 and 7 . Following are explanations of the data in Tables 8 and 9 .

The thickness, texture, and natural fertility of the surface layer determine the suitability of a soil as a source of topsoil. The amount, quality, and accessibility of coarse-grained materials are the most important features that affect the suitability of a soil as a source of sand and gravel. Well-graded, coarse-grained material, or a mixture of clay and coarse-grained material is suitable as a source of roadfill. Highly plastic clays, poorly graded silts, and soil material that has a high content of organic matter are difficult to compact, are low in stability, and consequently are undesirable for roadfill.

Soil limitations for septic tank absorption fields, sewage lagoons, trench type sanitary landfills, area type landfills, and campsites are concerned with soil permeability, drainage, slopes, and stones. Limitations for dwellings with basements, and streets and roads, include shrink-swell potential, plasticity, and presence of high water tables. The location of highways is affected by susceptibility to flooding, high water table, steepness of slopes, and stability of the soil material.

Table 6 Engineering Test Data.

| Series | Samp. No. | Hori-zon | Dpth. Cm. | Seive Analyses % Passing Through No.4 | No.10 | No.40 | No.200 | Classification AASHO | Unified | USDA Texture | Bulk Density | Hydraul. Conduct. cm/hr | Shrink-age | Atterberg Limits Liquid | Plastic | Plastic Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead (Ar) | 26-4 | $CK_2$ | 40-60 | 100 | 100 | 100 | 98.2 | A-4 | ML | Si | 1.83 | 0.05 | 0.58 | | NP | |
| | 28-3 | CKg | 20-45 | 100 | 100 | 99.5 | 97.3 | A-4 | ML | SiL | 1.79 | 0.13 | 0.85 | 24.8 | 22.3 | 2.5 |
| Bluebill (Bb) | 24-5 | III Bt | 36-70 | 97.1 | 93.5 | 36.5 | 69.5 | A-4 | ML | CL | | | | 37.4 | 24.0 | 13.4 |
| | 24-7 | IV CK | 83-95 | 98.7 | 96.8 | 93.9 | 76.2 | A-6 | CL | CL | 2.10 | 0.21 | 17.63 | 37.9 | 22.2 | 15.7 |
| Bluefish (Bf) | 18-4 | CK | 32-70 | 100 | 99.5 | 98.8 | 92.9 | A-4 | ML | SiL | 1.61 | 0.61 | 0.00 | | NP | |
| Bovie Lake (Bv) | 8-5 | $CK_2$ | 56-66 | 91.2 | 84.0 | 75.1 | 55.7 | A-6 | CL | L | | | | 35.0 | 20.1 | 14.9 |
| | 27-4 | CK | 28-40 | 99.6 | 99.6 | 99.1 | 95.2 | A-4 | ML | SiL | | | | 27.0 | 23.0 | 4.0 |
| | 27-5 | II CK | 40-60 | 99.0 | 96.8 | 81.0 | 52.1 | A-4 | CL | SL | 1.90 | 2.13 | 1.39 | 27.4 | 18.5 | 8.9 |
| | 40-3 | Bm | 4-20 | 100 | 100 | 98.5 | 92.0 | A-4 | ML | SiL | | | | 23.3 | 21.5 | 1.8 |
| | 40-5 | II CK | 37-50 | 90.2 | 84.5 | 72.5 | 49.6 | A-6 | CL | L | 1.97 | 11.43 | 1.78 | 30.2 | 19.0 | 11.2 |
| Bulmer (Bu) | 17-2 | AC | 0-35 | 96.9 | 94.9 | 91.8 | 41.7 | A-4 | SM | FL | 2.05 | 0.83 | 0.00 | | | |
| | 17-3 | II CK | 35-50 | 90.4 | 84.2 | 75.9 | 60.3 | A-4 | CL | CL | 2.19 | 0.00 | 1.08 | 28.2 | 16.0 | 10.2 |
| Celibeta (Cb) | 33-3 | Bm | 10-20 | 98.3 | 98.1 | 97.6 | 94.9 | A-6 | ML | SiCL | | | | 34.6 | 22.9 | 21.7 |
| | 33-6 | II CK | 50-65 | 100 | 100 | 99.6 | 98.3 | A-7 | CH | HvC | 1.68 | 3.69 | 10.41 | 50.0 | 27.5 | 22.5 |
| Cormack Lake (Cm) | 16-4 | CKg | 20-40 | 94.7 | 90.1 | 78.0 | 59.3 | A-6 | CL | L | 2.32 | 5.34 | 7.84 | 30.1 | 17.6 | 12.5 |
| Gros Cap (Gc) | 10-4 | CK | 32-56 | 100 | 100 | 99.9 | 97.2 | A-6 | CL | SiCL | | | | 36.7 | 24.7 | 12.0 |
| Jean Marie (Jm) | 11-2 | Bm | 7-45 | 100 | 100 | 99.9 | 18.1 | A-3 | SM | LFS | | | | | NP | |
| | 11-4 | $CK_2$ | 62-82 | 97.3 | 27.0 | 15.0 | 4.4 | A-1-a | GW | LCS | | | | | | |
| Liard (L) | 19-1 | AC | 0-20 | 100 | 100 | 99.6 | 85.8 | A-4 | ML | SiCL | | | | 33.9 | 26.3 | 7.6 |
| | 19-5 | II CK | 60-75 | 99.3 | 98.6 | 96.6 | 90.5 | A-5 | ML | SiC | 2.06 | 0.30 | 11.48 | 44.0 | 23.3 | 10.7 |
| | 42-2 | AC | 0-20 | 100 | 100 | 97.5 | 85.2 | A-4 | ML | SiL | | | | | NP | |
| | 42-4 | $CK_2$ | 35-40 | 100 | 100 | 99.8 | 87.0 | A-4 | ML | SiL | | | | | NP | |

Table 6. Engineering Test Data.

| Series | Samp. No. | Hori-zon | Dpth. Cm. | Seive Analyses % Passing Through No.4 | No.10 | No.40 | No.200 | Classification AASHO | Unified | USDA Texture | Bulk Density | Hydraul. Conduct. cm/hr | Shrink-age | Atterberg Limits Liquid | Plastic | Plastic Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Martin River (Mr) | 1-5 | C | 60-80 | 100 | 100 | 99.2 | 8.4 | A-3 | SW | FS | | | | | NP | |
| | 9-4 | $Bm_2$ | 10-56 | 100 | 100 | 99.8 | 20.2 | A-2-4 | SM | LFS | | | | | NP | |
| | 9-5 | CK | 56 | 100 | 100 | 99.9 | 16.1 | A-2-4 | SM | LFS | | | | | NP | |
| Netla (Ne) | 31-6 | $CK_2$ | 45-60 | 100 | 100 | 99.7 | 98.7 | A-4 | ML | SiL | | | | 26.8 | 23.3 | 3.5 |
| | 31-7 | $CK_3$ | 60-70 | | | | | | | | 1.60 | 0.70 | 3.67 | | | |
| | 37-3 | $Btj_2$ | 9-24 | 100 | 100 | 99.5 | 91.8 | A-4 | ML | SiCL | | | | 28.4 | 21.8 | 6.6 |
| | 37-5 | II CK | 46-60 | 100 | 100 | 99.7 | 89.7 | A-4 | ML | SiL | | | | 25.8 | 23.3 | 2.5 |
| Petitot (Pe) | 34-3 | $B_{11}$ | 0-10 | 100 | 100 | 99.8 | 96.5 | A-4 | ML | SiL | | | | 29.6 | 24.0 | 5.6 |
| | 34-5 | C | 20-30 | 100 | 100 | 99.5 | 95.5 | A-6 | CL | SiCL | | | | 33.0 | 21.6 | 11.4 |
| | 43-3 | Btj | 10-32 | 100 | 100 | 99.8 | 98.2 | A-7 | CL | SiCL | | | | 43.6 | 25.5 | 18.1 |
| | 43-5 | $CK_2$ | 45-70 | 100 | 100 | 99.7 | 99.2 | A-6 | CL | SiCL | 1.79 | 9.79 | 9.41 | 39.0 | 24.2 | 14.8 |
| Pointed Mountain (Pd) | 30-6 | CK | 57-70 | 100 | 100 | 99.0 | 15.5 | A-7 | CH | HvC | 2.42 | 0.94 | 21.11 | 52.2 | 25.9 | 26.3 |
| | 32-5 | CK | 80-100 | 97.4 | 94.8 | 90.3 | 72.3 | A-7 | CL | C | | | | 45.2 | 22.7 | 22.5 |
| Rabbit Creek (Ra) | 21-3 | $CK_1$ | 22-34 | | | | | | | | 2.11 | 3.18 | 0.61 | | | |
| | 21-4 | $CK_2$ | 34-44 | 72.5 | 61.5 | 44.3 | 23.9 | A-1-b | SM | SL | | | | 23.8 | 19.8 | 4.0 |
| | 38-5 | $CK_2$ | 50-100 | 89.1 | 81.9 | 70.1 | 51.2 | A-6 | CL | L | | | | 30.2 | 18.8 | 11.4 |
| Trout Lake (Tk) | 3-5 | CK | 35-50 | 98.3 | 94.9 | 90.2 | 75.3 | A-6 | CL | CL | | | | 40.2 | 20.8 | 19.4 |
| | 4-3 | CK | 30-90 | 97.7 | 93.5 | 84.7 | 68.7 | A-6 | CL | L | | | | 36.5 | 22.5 | 14.0 |
| | 5-3 | $Bt_1$ | 4-25 | 98.7 | 96.5 | 89.9 | 67.3 | A-4 | ML | CL | | | | 34.7 | 27.4 | 7.3 |
| | 5-5 | CK | 58-68 | 97.1 | 90.6 | 83.7 | 65.9 | A-6 | CL | CL | | | | 35.5 | 20.1 | 15.4 |
| | 12-4 | CK | 40-55 | 92.1 | 85.9 | 74.3 | 56.8 | A-4 | ML | L | | | | 35.1 | 24.8 | 10.3 |

Table 6. Engineering Test Data.

| Series | Samp. No. | Hori-zon | Dpth. Cm. | No.4 | Seive Analyses % Passing Through No.10 | No.40 | No.200 | Classification AASHO | Unified | USDA Texture | Bulk Density | Hydraul. Conduct. cm/hr | Shrink-age | Atterberg Limits Liquid | Plastic | Plastic Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trout Lake (Tk) (cont.) | 14-4 | CK | 65-80 | 95.1 | 90.6 | 80.5 | 65.2 | A-6 | CL | L | 1.96 | 0.19 | 2.57 | 35.4 | 21.2 | 14.2 |
| | 15-3 | Bt | 6-25 | 96.6 | 91.7 | 81.8 | 60.8 | A-7-5 | CL | CL | | | | 43.4 | 23.4 | 20.0 |
| | 15-5 | $CK_2$ | 40-60 | 93.2 | 87.0 | 73.3 | 54.3 | A-6 | CL | L | 1.96 | 1.51 | 2.66 | 31.2 | 18.7 | 12.5 |
| | 20-4 | $CK_1$ | 30-51 | | | | | | | | 2.03 | 3.50 | 2.70 | | | |
| | 20-5 | $CK_2$ | 51-70 | 97.8 | 94.5 | 89.3 | 68.2 | A-4 | ML | L | | | | 23.6 | 18.9 | 4.7 |
| | 22-4 | Bt | 10-40 | 97.0 | 93.4 | 86.7 | 78.9 | A-7-5 | ML | SiC | | | | 44.9 | 28.9 | 16.0 |
| | 22-6 | CK | 55- | 97.8 | 94.7 | 85.7 | 67.3 | A-6 | ML | SiCL | 1.92 | 0.18 | 4.93 | 38.7 | 25.3 | 13.4 |
| | 23-4 | CK | 50-65 | 78.4 | 86.5 | 71.8 | 54.3 | A-4 | CL | L | 1.84 | 2.66 | 0.44 | 30.0 | 21.3 | 8.7 |
| | 25-5 | II Bt | 38-43 | 91.6 | 86.0 | 80.5 | 69.2 | A-7 | MH | C | | | | 52.2 | 27.7 | 24.5 |
| | 25-6 | III CK | 43-60 | 82.2 | 77.7 | 74.7 | 61.6 | A-6 | CL | CL | 1.98 | 0.04 | 6.72 | 34.9 | 20.5 | 14.4 |
| | 29-6 | CK | 58-70 | 91.4 | 85.7 | 76.6 | 61.7 | A-6 | CL | CL | 1.90 | 0.51 | 4.81 | 36.2 | 20.7 | 15.5 |
| | 39-6 | CK | 50-75 | 93.5 | 88.5 | 75.0 | 51.8 | A-6 | CL | L | 1.97 | 2.81 | 1.48 | 37.0 | 21.1 | 15.9 |
| Winter Road (Wr) | 2-4 | $Btj_2$ | 30-56 | 100 | 100 | 99.2 | 46.6 | A-4 | SM | VL | | | | | NP | |
| | 2-5 | $C_1$ | 56-100 | 100 | 100 | 99.0 | 17.2 | A-2-4 | SM | | | | | | NP | |
| | 2-6 | II $C_2$ | 100+ | 88.8 | 79.0 | 67.6 | 48.8 | | SC | L | | | | 26.9 | 17.4 | 9.5 |

TABLE 7: ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

| Soil Material | Soil Series | Layer (cm) | Classification: USDA* Texture | Unified | AASHO | % Passing Sieve: No.4 (4.7 mm) | No.10 (2.0 mm) | No.40 (0.42 mm) | No.200 (0.074mm) | Liquid Limit | Plastic Index | Reaction pH | Shrinkage %** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sandy Fluvial | Mr | 50-80 | LS | SM | A-2-4 | 100 | 100 | 99 | 18 | NP | NP | 4.2-7.9 | 1 |
| Sandy Fluvial over Till | Sb | 0-50<br>75-100 | SL<br>SiCL | SM<br>CL | A-2-4<br>A-6,A-4 | 100<br>95 | 100<br>90 | 99<br>80 | 30<br>60 | NP<br>35 | NP<br>13 | 4.2-6.0<br>7.0-8.0 | 1<br>3-5 |
| Sandy Lacustrine | Ad | 0-100 | VL | SM | A-4 | 100 | 100 | 99 | 36 | NP | NP | 4.3-7.9 | 1 |
| Coarse Silty Lacustrine | Ar | 0-100 | SiL | ML | A-4 | 100 | 100 | 99 | 93 | 26 | 4 | 4.0-8.0 | 1 |
| Coarse Silty Lacustrine over Till | Bv | 0-40<br>60-100 | SiL<br>L-SiCL | ML<br>CL | A-4<br>A-6,A-4 | 100<br>95 | 100<br>90 | 99<br>80 | 93<br>60 | 26<br>35 | 4<br>13 | 4.0-8.0<br>7.0-8.0 | 1<br>3-5 |
| Fine Silty Lacustrine | Pe,Gc | 0-100 | SiCL-SiC | CL-ML | A-6,A-7 | 100 | 100 | 99 | 96 | 36 | 14 | 5.0-8.0 | 5-10 |
| Fine Silty Lacustrine over Till | Cb | 0-40<br>60-100 | SiCL<br>SiCL | CL-ML<br>CL | A-6<br>A-6 | 100<br>95 | 100<br>90 | 99<br>80 | 95<br>65 | 36<br>36 | 14<br>15 | 5.0-7.0<br>7.0-8.0 | 5-10<br>3-5 |
| Coarse Loamy Till | Ra,Cm | 20-100 | L-SL | CL-ML | A-6,A-4 | 92 | 86 | 74 | 54 | 31 | 11 | 4.0-8.0 | 1-5 |
| Fine Loamy Till | Tk,Bg | 20-100 | SiCL | CL | A-6,A-7 | 95 | 91 | 84 | 66 | 36 | 15 | 4.0-8.0 | 3-7 |
| Clayey Till | Pd | 20-100 | SiC-HvC | CH-CL | A-7 | 97 | 95 | 91 | 83 | 49 | 23 | 5.0-8.0 | 10-20 |
| Fine Silty Alluvial over Sandy Alluvial | Ne,Sw | 0-70<br>90-120 | SiCL<br>SL-SiL | ML,CL<br>SM,ML | A-6<br>A-2-4,A-4 | 100<br>100 | 100<br>100 | 99<br>99 | 94<br>33,70 | 36<br>NP | 14<br>NP | 4.0-6.0<br>7.0-8.0 | 5-10<br>1 |
| Coarse Silty Lacustrine over Sandy Fluvial | Bf | 0-50<br>75-100 | SiL<br>LS | ML<br>SM | A-4<br>A-2-4 | 100<br>100 | 100<br>100 | 99<br>99 | 93<br>18 | 26<br>NP | 4<br>NP | 4.0-8.0<br>8.0 | 1<br>1 |

* USDA Textures: LS-Loamy Sand, SL-Sandy Loam, VL-Very Fine Sandy Loam, SiL-Silt Loam, L-Loam, SiCL-Silty Clay Loam, SiC-Silty Clay, HvC-Heavy Clay

* The volume change from a saturated condition to ovey dryness.

Table 8. Engineering Interpretations of the Soils.

| Soil Series[1] | Soil Material | Suitability as a source of . . . Topsoil[2] | Sand or Gravel | Roadfill | Features Affecting Highway Location | Susceptibility to Frost Action |
|---|---|---|---|---|---|---|
| Martin River (Mr) Jean-Marie (Jm) | Sandy Fluvial | Poor: Sandy | Fair: Fine sand; Jm has gravel below 1 meter | Good | Droughty cut slopes | Slight |
| Sibbeston (Sb) | Sandy Fluvial over till | Poor: Sandy | Poor: Sand less than 1 meter thick | Fair: Clay loam till below 1 meter | Cut slopes subject to erosion; droughty | Moderate; high in subsoil |
| Winter Road (Wr) | Sandy Lacustrine over till | Good | Poor: Mixed layering of silts and clays | Fair: Clay loam till below 1 meter | Moderately slow permeability; moderate potential frost action | Moderate; high in subsoil |
| Anderson Mill (Ad) | Sandy Lacustrine | Good | Poor: Mixed layering of silts and clays | Good | Potential frost action is high | High |
| Bluefish (Bf) | Coarse silty Lacustrine over Sandy Fluvial | Good | Poor: Limited fine sand between silty Lacustrine and lower till | Fair: Unfavorable texture; fine sand below 1 meter | Variable subgrade material, silt, sand, and till | High |
| Arrowhead (Ar) | Coarse, silty Lacustrine | Good | Unsuited: no sand | Fair; unfavorable texture | Potential frost action is high | High |
| Bovie Lake (Bv) Bluehill (Bb) | Coarse silty Lacustrine over till | Good | Unsuited: no sand | Fair; clay loam till below 1 meter | Potential frost action is high | High |
| Petitot (Pe) Gros Cap (Gc) | Fine silty Lacustrine | Fair: high clay content | Unsuited: no sand | Fair: unfavorable texture | High silt and clay content; potential frost action is high | High |
| Celibeta (Cb) Coty Mountain (Ct) | Fine silty Lacustrine over till | Fair: high clay content | Unsuited: no sand | Fair: unfavorable texture | High silt and clay content; potential frost action is high | High |
| Poplar (Po) Liard (L)[3] | Coarse silty Alluvial over variable sandy and silty Alluvial | Good: Liard soil is high in organic matter | Poor: may be fine sand below 1 meter | Fair: may be fine sand below 1 meter | Often associated with abandoned channels and meander scars; potential frost action is high | High |

Table 8. Engineering Interpretations of the Soils.

| Soil Series[1] | Soil Material | Suitability as a source of. . . | | | Features Affecting Highway Location | Susceptibility to Frost Action |
|---|---|---|---|---|---|---|
| | | Topsoil[2] | Sand or Gravel | Roadfill | | |
| Netla (Ne) Swan Point (Sw) | Fine silty Alluvial over sandy Alluvial | Fair: high clay content | Poor: fine sand below 1 meter | Fair: fine sand below 1 meter | Fair roadfill below 1 meter; associated with abandoned channels; potential frost action is high | High |
| Rabbit Creek (Ra) | Coarse loamy till | Fair: coarse fragments and stones | Unsuited: no sand | Fair: may be stony | May be stony; associated with poorly drained areas; potential frost action moderate to high | Moderate to High |
| Trout Lake (Tk) | Fine loamy till | Fair: high clay content | Unsuited: no sand | Fair: unfavorable texture | Some steep slopes; potential frost action is high | High |
| Pointed Mountain (Pd) | Clayey till | Poor: high clay content | Unsuited: no sand | Poor: very high clay content | Steep slopes; very high clay content; potential frost action moderate | Moderate |
| Harris (Hr) | Stony eroded till | Poor: very shallow over stones | Unsuited: no sand | Poor: very stony | Very stony | Moderate |

[1] All gleysol series have poor drainage, high water table, and 10-60 cm of peat cover and are often frozen throughout the year; thus, they are not suitable for any of the uses listed in this table.

[2] Only the Liard soils have significant Ah horizon and many soils have a leached surface horizon (Ae) which has poor structure.

[3] Some of the Liard soils may suffer from occasional flooding.

Table 9. Degree and Kind of Limitations for Land Use Planning.

| | | | | | Degree and Kind of Limitations for. . . | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Soil Series[1] | Soil Material | Septic Tank Absorption Fields | Sewage Lagoon | Trench type Sanitary Landfills | Area Type Sanitary Landfills | Source of Cover Material | Shallow Excavations | Dwellings with Basements | Roads and Streets | Campsites |
| Bovie Lake (Bv) Bluehill (Bb) | Coarse silty Lacustrine over till | Severe: Moderately slow permeability in subsoil | Moderate to slight: moderate permeability to 1 meter | Slight | Slight | Good | Slight | Slight | Slight to moderate: moderately plastic clays below 1 meter | Moderate: moderate permeability |
| Petitot (Pe) Gros Cap (Gc) | Fine silty Lacustrine | Severe: moderately slow permeability | Slight | Moderate: high silt and clay content | Slight | Fair: sticky and plastic when wet | Slight | Moderate: moderate shrink-swell potential | Moderate: moderately plastic clays | Severe: moderately slow permeability |
| Celibeta (Cb) Coty Mountain (Ct) | Fine silty Lacustrine over till | Severe: Moderately slow permeability | Slight | Moderate: high silt and clay contents | Slight | Fair: sticky and plastic when wet | Slight | Moderate: moderate shrink-swell potential | Moderate: moderately plastic clays | Severe: moderately slow permeability |
| Poplar (Po) Liard (L)[3] | Coarse silty Alluvial over variable sandy and silty Alluvial | Moderate: moderate permeability | Moderate to severe: variable amounts of sand and organic matter with depth | Moderate: possibility of permeable sands below 1 meter | Slight | Good | Moderate: variable sandy material at depth | Slight | Moderate: Liard soils may be subject to occasional floods | Moderate: moderate permeability |
| Netla (Ne) Swan Point (Sw) | Fine silty Alluvial over sandy Alluvial | Slight[2]: fine sandy material below 1 meter | Severe: rapid permeability below 1 meter | Moderate: possibility of permeable sand below 1 meter | Slight | Fair: sticky and plastic when wet; good material below 1 meter | Moderate: sandy material below 1 meter | Slight | Moderate: good subgrade material below 1 meter | Moderate: moderate permeability |

Table 9. Degree and Kind of Limitations for Land Use Planning.

| Soil Series[1] | Soil Material | Degree and Kind of Limitations for. . . | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Septic Tank Absorption Fields | Sewage Lagoon | Trench Type Sanitary Landfills | Area Type Sanitary Landfills | Source of Cover Material | Shallow Excavations | Dwellings with Basements | Roads and Streets | Campsites |
| Martin River (Mr) Jean Marie (Jm) | Sandy fluvial | Slight[2] | Severe: Rapid permeability | Severe: Rapid permeability | Severe: Rapid permeability | Fair: Easily eroded | Severe: Sidewall instability | Slight | Slight | Slight |
| Sibbeston (Sb) | Sandy fluvial over till | Severe: Moderately slow permeability below 1 meter | Moderate: Permeable material to 1 meter | Slight | Slight | Good | Moderate: Firm till below 1 meter | Slight | Slight to moderate: moderately plastic clays below 1 meter | Slight |
| Winter Road (Wr) | Sandy Lacustrine over till | Severe: Moderately slow permeability below 1 meter | Moderate: Permeable material to 1 meter | Slight | Slight | Good | Slight | Slight | Slight to moderate: moderately plastic clays below 1 meter | Slight |
| Anderson Mill (Ad) | Sandy Lacustrine | Slight[2] | Severe: Rapid permeability | Severe: Rapid permeability | Severe: Rapid permeability | Good | Slight | Slight | Slight | Slight |
| Bluefish (Bf) | Coarse silty Lacustrine over sandy fluvial | Slight[2] | Moderate to severe: depends on thickness of sandy layer between silt and till | Moderate: sandy material below 1 meter | Slight | Good | Moderate: Sandy material at 1 meter | Slight | Slight | Slight |
| Arrowhead (Ar) | Coarse silty Lacustrine | Moderate: moderate permeability | Moderate: moderate permeability | Slight | Slight | Good | Slight | Slight | Slight | Moderate: moderate permeability |

Table 9. Degree and Kind of Limitations for Land Use Planning.

| Soil Series[1] | Soil Material | Degree and Kind of Limitations for. . . Septic Tank Absorption Fields | Sewage Lagoon | Trench Type Sanitary Landfills | Area Type Sanitary Landfills | Source of Cover Material | Shallow Excavations | Dwellings with Basements | Roads and Streets | Campsites |
|---|---|---|---|---|---|---|---|---|---|---|
| Rabbit Creek (Ra) | Coarse loamy till | Moderate: moderate permea-bility | Moderate: may be stony; some steep slopes | Moderate: may be stony | Slight | Poor: may be stony | Moderate: may be stony | Slight to moderate: may be stony | Slight | Moderate: moderate permeability |
| Trout Lake (Tk) | Fine loamy till | Severe: Moderately slow per-meability | Slight: except for steeper slopes | Moderate: may be stony; some steep slopes; high silt and clay contents | Slight | Fair; sticky and plastic when wet | Moderate: may be stony | Slight to moderate: some steep slopes | Moderate: moderately plastic clay | Severe: moderately slow per-eability |
| Pointed Mountain (Pd) | Clayey till | Severe: slow per-meability | Moderate: usually has steep slopes | Severe: very high clay con-tent; steep slopes | Slight to Moderate: some steep slopes | Poor: very high clay content | Severe: high clay content; steep slopes | Severe: high shrink-swell poten-tial; low bearing strength; steep slopes | Severe: high shrink-swell potential; steep slopes | Severe: slow per-meability |
| Harris (Hr) | Stony eroded till | Severe: stony | Severe: stony | Severe: stony | Slight | Poor: stony | Severe: stony | Severe: stony | Severe: stony | Moderate: difficult to build access roads |

1 All gleysol series have poor drainage, high water table, and 10-60 cm of peat cover, and are often frozen throughout the year; thus, they are not suitable for any of the uses listed in this table.

2 Danger of pollution to underground water because of inadequate filtration characteristics.

3 Soma of the Liard soils may suffer occasional flooding.

## SOIL INTERPRETATIONS FOR RECREATION

The properties of the soil and features of the landscape are important in planning recreation facilities. Limitations of certain soils to support either low or high intensity recreation can be determined from the estimated soil properties listed in Table . The ratings applied to the Soil Series in Tables 8 and 9 will in most cases, also apply to recreation-related manipulation of the soil. The primary difference would be in the ratings regarding limitations for septic tank absorption fields. If the septic tanks were to be installed in cottage subdivisions near a lake or stream, special precautions would be necessary to prevent pollution of surface and underground waters. The highly permeable sandy fluvial, sandy lacustrine, and silty soils with sand at one meter depth would have a severe limitation for septic tank absorption fields.

No attempt was made during this survey to locate suitable sites of high recreation potential. However, it was noted that the shorelines of Cormack and Trout Lakes had alternating sandy and rocky beaches (Fig. 43).

Unfortunately, though, a good portion of Cormack Lake was surrounded by peaty Gleysols and Organic soils. In some cases there was a narrow strip of well-drained soils with pine trees right next to the beach.

Sibbeston Lake was also observed to have a sandy shoreline at the south end.

Most of the tributaries of the Liard, the banks of the Liard River itself and the mountains bordering the region have a high recreational value. The river valleys especially are scenic, have diverse terrain and vegetation, abundant freshwater and most offer fishing potential. Wildlife are also usually more abundant next to the streams as well. The Tributary Floodplain soils mapped along these streams may have limitations for camping and cottaging due to flooding topography and wetness. For such uses site specific examinations are necessary. Synergy (1975), in their study along the Liard Highway, recommended specific recreational sites. Near Fort Simpson the Martin River offers a prime recreational site which needs to be protected.

Fig. 43. The beach on the south side of Trout Lake. The bay areas are usually sandy, while the points are often stony.

## Priority Rating for Farm Development

Before recommendations can be given on developing wilderness areas into agricultural land many questions have to be resolved. (1) Why should an agricultural industry be developed, (2) Is it economically feasible, (3) Are there other better uses for the land and (4) Who should benefit from any development?

The results of the study to date would indicate that the soils and climate are suitable to support agricultural development on approximately one million acres. The first question to answer is "Why have agricultural development?" There is not a great need for Canada to produce more grain and livestock at the present time. It would be easier and cheaper to develop marginal land in northern Saskatchewan and Alberta if more production is needed. There isn't a large local population anxious to start farming. While theremay be a movement of the native population "back to the land" it is not to farm but to trap, fish and hunt. While, for example, only a small local population derives a marginal livelihood from trapping and hunting on the Liard flood plains near Nahanni Butte, this is probably better than destroying this industry and replacing it with a dozen subsistence farms.

It may be desirable to have limited agricultural development sufficient to produce food for local distribution rather than shipping it in from the south. It may not mean lower prices but at least competitive prices and fresher produce as well as boosting the self-sufficiency of the north. Rather than large scale agricultural production, market gardens and livestock production near the larger settlements may be feasible.

In order to advise on farm development on lands scattered over such a large area (3.3 million acres), it was necessary to apply a semi-rigid classification and rate all of the soils. The Soil Capability classification rates all soils according to their inherent limitations such as poor structure, low fertility or landscape limitations. No allowance is made for location, size or other economic factors affecting the land.

The priority rating attempts to recognize factors other than soil limitations that might hinder or advise against farm development. The rating system is objective in that specific limits are set on such parameters as distance from roads, size of area or height of tree growth. On the other hand it is obviously very subjective when trying to account for other conflicting uses such as recreation, trapping or wildlife habitat.

All land areas have been divided in seven priority classes (Table 10). The first three classes relate to the ease or relative cost of bringing land into agricultural production. While class 1 lands are the easiest and most suitable for agricultural development, it may still not be economically feasible because of high costs and poor market conditions. The rating is only a comparative index of land within the Liard-Mackenzie area.

Class 4 land is considered marginal for intensive agriculture. The reason for land being in this class may be inherent soil factors, purely economic reasons or competing land uses. A land area with a class 4 rating may have potential to be excellent farm land but in the opinion of the authors may also have a high priority for other uses such as trapping or moose wintering habitat.

Class 5 and 6 ratings are similar to those in the Agriculture Capability classification. Class 5 land is suitable for improved pasture while class 6 land is suitable only for unimproved grazing. These two classes would include poorly drained peaty Gleysols and very sandy soils.

Class 7 lands are those considered not suitable for any type of agriculture and those areas with a strongly competing land use such as recreation or wildlife and trapping. Very steep slopes and organic soils are class 7. Lands in class 7 because of strongly competing land uses include all river bottoms and valleys, islands and some lake shores.

Priority subclasses are used to indicate the reason for placing land in a class lower than class 1. The soil, landscape and climate limitations are not too controversial in their application. The distance limitation may not be valid if local governments are willing to build access roads. Also, other roads may be in the planning stage or roads may be built for other users thus changing the ratings. If the distance (d) limitation is removed from a parcel of land, then the second limitation will apply, likely at a higher class. The forestry or f subclass is applied both as a limitation and as an alternate use. An area that has been recently burned could probably be cleared at less cost than a stand of 100 foot tall 18 inch diameter spruce. Also it makes practical and hopefully economic sense to harvest a mature forest for its timber before clearing land for farming. Agriculture could perhaps follow in areas that have been cut over.

Subclasses r (recreation) and u (other uses) are much more difficult to apply and also are very subjective in their application. In regards to recreation, it was felt that all riverbanks and small stream flood plains should not be allowed to have an agricultural or other disrupting use. The rivers and streams have a high potential for boating and canoeing. Any disturbance to the vegetation along steep banks will drastically increase erosion and susceptibility to slumping. The preceding areas were usually placed in class 7. Other areas such as flat lands next to the Liard River and upland areas with unique forest types were placed in class 4. The u subclass was perhaps the most difficult to apply. While it is difficult enough to put a value on wildlife habitat, it is even more difficult to pinpoint the most valuable areas without more surveys and study. It has been stated by Prescott et al (1973) that the recent floodplains and islands in the Liard River are excellent moose wintering habitat. They also state that any disturbance of their wintering habitat will greatly reduce their numbers. It is for this reason that the recommendation is made that no development occur on the islands or recent floodplains of the Liard River or close to any of the streams flowing into the Liard. Areas that are flooded by seasonal high water exclusive of ice jams would be classed as recent floodplains and would support riparian vegetation suitable for browsing by moose. Trapping of various furbearing animals occurs across the whole map area. The assumption was made that the highest potential occurs along the Liard River and all tributaries. Land use maps show that the low lying wet areas east of the Liard and between the Netla and Muskeg Rivers are excellent beaver habitat and should be preserved. It is possible that trapping and agriculture could function in the same general area if the density of cleared farms is controlled. All wetlands and drainageways could remain the property of the crown with only isolated well drained soils leased for agriculture.

If only limited agriculture is allowed to develop, the first sites chosen should be the alluvial floodplains close to population centres. These soils have near neutral pH and are usually high in organic matter. They should be reserved for intensive type agriculture such as market gardens. These areas are at lower elevations and would tend to have more suitable climate. Calculations from a regression equation shows that a change in elevation of 350 feet causes the frost-free period to decrease by 14 days and a 12% reduction in the number of growing degree days. The soils of the Liard Association would be the easiest to manage and require the least inputs of lime and fertilizer. The strongly acid Brunisols and Luvisols may require significant inputs of lime for certain crops.

A livestock industry utilizing locally grown forages and coarse grains could be established on Capability Class 3 and 4 soils. Although poorly drained peaty Gleysols are suitable for production of forages it would probably be wiser to use the well and imperfectly drained soils provided they are not heavily forested. The wet Gleysol soils will remain cold longer in the spring and thus forage yield may be low. With proper fertilization the silt loam and silty clay loam soils will produce good forage yields. In the Fort Simpson area the sandy loam soils (Winter Road, Anderson Mill and Sibbeston) would also be excellent for forages.

A general recommendation for the Fort Simpson area would be to reserve all Liard, Poplar, Bluefish and Gros Cap soils for agriculture since there is very little high class soil in the area. Unfortunately all the above mentioned souls occur close to the Liard River and are in demand as industrial, forestry or recreational land. There is also a problem of erosion or slumping if clearing of forests is carried out too close to the river banks. Special effort should be made to see that this limited acreage of high quality land is not committed to irreversible uses such as industrial sites or suburban expansion of Fort Simpson as has happened on Fort Simpson Island.

Table 10 Priority Rating Subclasses

s - soil limitations; low moisture holding capacity, low fertility, poor soil structure

t - topography; steep slopes

w - wetness; poor drainage
5w - Gleysols
7w - Organic soils

e - erosion hazard

p - soil pattern; land is broken up by numerous wet areas or sharp steep slopes

c - adverse climate; differing from regional climate such as north facing slopes

d - distance from highway or road or on the other side of the river
2d - 5 to 10 miles from a road
3d - more than 10 miles from a road or across a river

f - forestry potential; high clearing costs and potential for lumber development
2f - 40 to 80 foot trees
3f - taller than 80 foot trees

r - recreation; river valleys, lake shores, unique forest stands

u - well suited for other uses; high priority as a trapline area or moose wintering habitat

x - already in non-agricultural use; towns, airports, etc.

# RECOMMENDATIONS FOR FARM DEVELOPMENT

## Location of Farm Units

Considering only the soil and climate, coarse grains (oats and barley) forage and vegetable crops can be successfully grown on all soils rated as Capability Class 3 or 4. In addition, Class 5 lands could be used to grow forages if recommended improvement practices are utilized. However, there are many factors other than soil and climate that determine where a farm should be located and whether that farm will be economically feasible. The Priority Rating for Farm Development map attempts to delineate areas suitable for agriculture considering factors in addition to climate and soils.

If there was a shortage of agricultural land in the Northwest Territories, it could be recommended that livestock enterprises utilize Class 4 and 5 land, grain production concentrate on Class 3 land and market gardens be the only agricultural enterprise allowed on the organic rich alluvial soils (Liard soil). However, unless Class 3 lands have a better agricultural or non-agricultural use, they would naturally make better pasture lands than Class 5, the point being that cleared lands can always be converted to a more intensive use but not reverted to their natural state.

## Livestock Production

There is very little potential for grazing livestock on native vegetation in the study area. The area is heavily forested and very little grazeable vegetation grows except in sloughs or meadows which are often excessively wet. Man-made clearings will produce some forage for a short time but they revegetate quickly to alder, aspen or willow.

Evidence from other attempts at raising livestock in the north indicate that the climate (long, cold winters), predators, insects, equipment costs and lack of markets are strong factors working against it being a successful enterprise. If there is to be a livestock industry in the area, the pasture and forages would need to be planted on previously cleared Class 3, 4 or 5 soils. Although forages for pasture and hay could be grown on Class 5 lands, they would be more productive on the Class 3 and 4 soils. The sandy Winter Road, Sibbeston and Anderson Mill soils would be excellent soils for forage crops.

Due to the long winter feeding period (October to May) approximately 2 tons of hay would be required per cow. In addition about 3 acres of good quality seeded pasture would be needed to sustain a cow for the summer months. On the average it would require from 5-10 acres of seeded forage as pasture and hay per cow in any livestock operation. In addition to the forage acreage, some land would be needed for oats and barley as supplemental feed during the winter.

## Grain Production

Production of oats and barley for grain is possible on soils classified as 3 or 4 agricultural capability. The frost-free period is too short to consistently mature wheat. After forests have been cleared and land broken, adequate additions of fertilizer (see Fertilizer Section) will produce good average yields of oats and barley. The average yield at Fort Simpson Experimental Farm was about 70 bushels per acre for oats and 45 bushels for barley. These yields were similar to those obtained at Fort Vermillion but less than yields at Beaverlodge, Alberta for similar crops. All available data on crops and yields have been obtained on the Liard soil on Fort Simpson Island. The soil and climate at this site are probably the best available in the area. Most other areas would be located at higher elevations and thus be cooler with more risk attached to cereal production. All soils other than the Liard Association will need high annual inputs of nitrogen and phosphorus fertilizer.

If markets were available for oats and barley, a viable grain farm would probably need between 500 and 800 acres of cultivated land. The machinery investment needed for a farm of this size would be about $30,000 to $50,000. In addition to this cost is the expense of clearing land which may vary from $80 to $200 per acre.

Gardening

Successful home gardens were encountered in the three communities of the survey area. Results from the Fort Simpson Experimental Farm (1947-1969) have demonstrated that with proper cultural practices, including windbreaks and irrigation most of the common vegetables yield good crops of excellent quality. Cool-season crops do particularly well in the long summer days. General gardening practices for nothern gardens are similar to those used in northern regions of the prairies. Varieties and practices are well outlined in the following Canada Department of Agriculture publications: Fort Simpson Progress Report (1953) and Handbook for Northern Gardeners (1970).

Of the soil in the area, the Liard soils with their low elevation, proximity to the river (irrigation), silty or sandy texture and high organic matter content are considered to be the best soils for growing garden crops. Most of the experimental results for the Fort Simpson Experimental Station are for the Liard soil type (Fort Simpson Island). Experiments show that most crops respond well to applications of fertilizers containing all the essential elements, nitrogen, phosphorus and potassium. Irrigation was also quite advantageous as the summers were often droughty. Care should be taken when extrapolating the experimental farm results because the unique position of Fort Simpson on an island may have influenced the microclimate. Some tests were also carried out on the "Beam site" which has a Bluefish soil. Tests here were only carried out in the last few years of the experimental farm's operation and the results have never been compiled. However, in terms of soils, most of the medium textured lacustrine and alluvial soils (very fine sandy loam to silty clay loam) in the area would also be suitable for vegetable production but may require additions of organic matter. The abandoned Floodplain may have an advantage over lacustrine areas due to more uniform soils and lower elevation. Clay loam and heavier soils are harder to work and would require longer to warm up in the spring, creating some limitations for vegetable production.

Market garden production of vegetables for a local market should be possible with moderate management but to be successful would need to ensure a reliable supply. Conservative production estimates are 10 to 12 tons/acre for potatoes, carrots and beets and 12 to 15 tons/acre for cabbage and cauliflower. Production of tomatoes, cucumbers and corn would be less reliable due to frost hazard. Very little land is needed for vegetable production. It has been estimated that if residents of the north consume as much as the average Canadian and yields are 70 percent of those obtained further south, then a population of 5,000 could be supplied by 40 acres of potatoes, 5 acres of cabbages and other greens, 3 acres of carrots, and smaller acreages of rutabagas, salad crops, cauliflowers, beets, broccoli, strawberries, raspberries, greenhouse tomatoes and cucumbers (C.D.A., 1972).

W.J. Francl and Associates (1974) in their expansion study of

Fort Simpson recommended that areas near Fort Simpson suitable for gardening be reserved indefinitely. They considered a gardening operation potentially profitable at present, possibly carried out as government supervised co-operative if it is not initiated privately. The authors agree that local vegetable production is possible and desirable.

Irrigation Requirements

Most well drained soils could benefit from additions of water by irrigation. The coarser textured sandy loams and silt loam soils will occasionally suffer from midsummer droughts without irrigation. All of the Class 3 or 4 soils are suitable for some form of irrigation whether sprinkler or flood irrigation. Market gardens on level alluvial or lacustrine soils near the river would likely show the best returns from irrigation. There is not likely to be a salinity problem occurring if accepted irrigation practices are followed.

Community Pastures

Community pastures could be established on Class 3, 4 or 5 soils. Since the cost of establishing a pasture is high they should be on the better soils of the area (Class 3 and 4). In addition to high costs associated with clearing and preparing a seedbed, fencing costs are high. The pastures should be located away from rivers and streams which have a high potential for wildlife and trapping. Dugouts or wells could be used as a source of water for the livestock.

Fertilizer Recommendations

In general all of the soils of the area are low in available nitrogen and phosphorus. Soils with silt loam or coarser texture also appear to need some supplemental potassium.

Most soils tested had less than 10 lbs of nitrate nitrogen in the top 24 inches. According to recommendations of the Saskatchewan Soil Testing Laboratory these soils would require the addition of 75 lbs of nitrogen for grain, 80 lbs for potatoes and 50 lbs when planting forages.

Except for a few exceptions most soils tested were very low in available phosphorus (less than 10 lbs/acre in the top 6 inches). The recommended amount of phosphorus needed as $P_2O_5$ for oats and barley is 40 lbs/acre for the silt loam soils and 25 lbs for silty clay loam soils. Some soils (Netla, Swan Point and Martin River) had high values for available phosphorus. More soil testing is needed to determine the extent of these anomalously high phosphate values. Established stands of grass-legume mixtures would need 45 lbs of $P_2O_5$ per acre.

Most silt loam or coarser textured soils are low to very low in potassium (Less than 120 lbs per acre). A low value calls for 15 lbs of $K_2O$ for oats, 80 lbs for potatoes and 60 lbs for barley and forages.

In order to obtain optimum yield of oats planted in a silt loam soil with the above soil test results there would need to be an application of 150 lbs/acre of 10-30-10 and 180 lbs/acre of 34-0-0 fertilizer. Depending on the pH of the soil and the crop to be grown, additions of lime may be required.

The total amount of fertilizer required could be reduced by using various rotations incorporating forages or fallow.

<u>Drainage</u>

Large scale drainage is not considered feasible or necessary given the large amount of well drained land present in the area. Within any area chosen as a farming area, limited drainage could be carried out to square out cultivated areas. This might be feasible where Gleysols represent a significant proportion of landscapes occurring on gently sloping areas of the Lacustrine Benchland (especially Bovie Lake and

Arrowhead soils). In such areas the construction of roads and clearing may in inself bring about drainage if ditches and culverts are properly constructed. The construction of roads without sufficient attention to drainage can also have the reverse effect of blocking drainage. More extensive areas of Gleysols, especially Bulmer soils which often have Organic soils in association such as occurs on the north west facing slope south of the Liard River in 95G and in the Camsell Bend area, would appear best left alone. These areas, especially on north facing slopes have developed in response to cool and wet conditions and frequently harbor permafrost. Although clearing the dense black spruce and moss cover from these sites would undoubtedly eliminate permafrost little or nothing is known about the ecological effects due to sudden freezing of groundwater in these areas.

Gleysols occurring in abandoned channels and backswamps of the floodplains usually have a very high water table trapped by the surrounding well drained ridges of old point bars. There is little or no external drainage on the floodplain, there is very little elevational change, and the channelled or scalloped nature of the floodplain would make drainage difficult except where a channel abuts the Liard River. Clearing the floodplain would also increase runoff from the convex slopes of the point bars and aggravate the problem in the water-receiving areas.

One larger area of Gleysols which might be feasible to drain is the area of Sibbeston (significant Gleysols) and Scotty Creek (dominantly Gleysols) Associations which occur near the Liard River between the Birch River and Jean Marie Creek in 95H. These soils are sandy and would most likely be warmer than heavier textured soils when drained. However, they are still a Class 4 soil and would be best suited for forage production.

Land Clearing

Clearing costs were not calculated directly but the forest cover maps give the forest stand heights and densities which will affect clearing. Peeke (1974) estimated clearing costs in the Yukon (1974) were $80 per acre on high brushland to as much as $200 per acre on forested land depending on the tree cover. Pringle (1974) estimated $80 to $125 per acre adding that the isolated location, competitive work for bulldozers and shortness of season led to the high costs.

It has been noted (Day, 1966) that care would be required in clearing to prevent destruction and loss of the shallow upper soil layer. Indiscriminate removal of vegetation by large scale land clearing should be avoided to prevent the development of gully erosion. The extent of erosion that can occur just in limited clearing on cut lines and roads in the area gives ample evidence of this. Gullies were noted several feet deep in some cut lines on long, gentle and moderate slopes.

Maintenance of tree cover near natural water bodies, lakes, the Liard River, its larger tributaries and their feeder streams would contribute much to water conservation, wildlife and aesthetic values.

Forest growth on the well drained soils, especially on the floodplain is very heavy. Several burnt over areas present the easiest clearing. Clearing and breaking co-ordinated with forest harvestation would appear most desirable if agricultural development occurs on any large scale.

Land Use Conflicts

Forestry: No assessment of land capability for forestry was made in this study but existing information on the forest resource was correlated with the soils information as much as possible (see section on Soils and Forestry). The soils information will be useful for forest management. Although the soil properties were not interpreted with respect to forest growth, the physiographic districts delineate broad-scale ecological units and the soil associations provide a framework for more detailed study or correlation of ecosystem types.

Some of the best timber stands in the Northwest Territories occur in the survey area. The land best suited for agriculture is also some of the best forest land, particularly the section of the Liard Valley south of Nahanni Butte. If only local agricultural production is developed there need be little conflict with forestry as lands can be selected where present forest stands are young or poor, and thus where clearing costs would also be lower. Any large scale agricultural development would necessitate appraisal of these conflicting uses.

Forestry is more compatible with existing land use than agriculture.

<u>Wildlife</u>: Assessment of wildlife populations and habitat was not a direct concern of this survey but agriculture on any large scale represents a conflict to the present use of the land by wildlife which are in turn utilized by native people. For this reason wildlife was considered in the priority rating for farms and is discussed briefly here but it does not eliminate the necessity of consultation with or study by appropriate wildlife authorities. This information was obtained from the following sources: Canadian Wildlife Service, Habitat Inventory Maps (Dennington <u>et al</u>. and Prescott <u>et al</u>., 1973), Department of the Environment (1972) Land Use Maps, and Synergy West Ltd. (1975).

The most abundant species of big game is moose which is found throughout the area. Other species of particular importance are the fur-bearing mammals, especially muskrat and beaver (Synergy, 1975).

The distribution and movements of moose are mainly determined by the availability and quality of suitable habitat. Moose undertake seasonal migrations or movements in the Liard valley. During the winter and spring the moose are concentrated along the river, particularly the floodplains, river banks, and mid-channel islands where a mixture of preferred browse species such as willow, dogwood, aspen and balsam poplar together with adequate shelter are found. During the summer many moose move up the tributaries where they may browse along the banks and in small oxbow lakes and ponds. Others seek out brulé areas in the uplands where the early successional stages of growth provide more favorable browse.

In terms of the soil associations mapped, riparian portions of the Liard Association are most significant. Abandoned channels and large channel scars within the Netla and Swan Point Associations as well as Flett and Blackstone River associations are also important because of the dense shrubs in open canopy areas and aquatic plants in wet meadows and ponds. The diversity of vegetation pattern is an important factor. The other most important moose habitat is along the tributaries (Tributary Floodplain).

The beaver is one of the most important fur bearers in the Liard Valley and is widely distributed throughout the area occurring in conjunction with small streams and ponds, mainly in areas of Mixed Leaftree Forest. These conditions are found mostly on the Lacustrine Benchland, particularly the area of Bovie and Bulmer Associations east of the Liard River in 95B and in 95G along the Matou River.

Muskrat, mink, lynx, marten, bears and wolves also occur throughout the Liard Valley and are trapped in some quantity.

The area has generally limited water fowl nesting habitat. The numerous lakes and ponds, especially in 95H, are used as staging areas during spring and fall migrations. However, these areas are unlikely to be disturbed unless extensive drainage is carried out. Fish are fairly plentiful in most of the major streams and tributaries. Synergy (1975) gives a detailed discussion of species and locations.

The major conflicts between agricultural development and wildlife would be due to direct destruction of natural habitat by clearing, human interference such as hunting predatory animals and a resulting disruption of balance between species. Silting of streams by road construction and clearing would affect beaver and fish.

Archeology: Major potential and proven archeological sites should be investigated and protected before development. Synergy (1975) describes the locations of several known archaeological and historical sites.

Recreation: The area has significant recreational potential, particularly along the major tributary rivers, the banks of the Liard River and along the mountains to the west. The Department of Environment (1972) Land Use Maps give broad regional ratings of land capability for re- creations. There need be little conflict with agriculture, indeed farms can add diversity to the landscape. The best recreational areas are generally river valleys and areas of rougher terrain, unsuitable for farming. Recreational areas should be identified and protected.

## References

Acton, D.F. 1975. A landform mapping system for Canadian Soil Surveys. Sask. Institute of Pedology, University of Sask., Saskatoon. Publication M26.

Bostock, H.S. 1948. Physiography of the Canadian Cordillera with special reference to the area north of the fifty-fifth parallel. Geological Survey of Canada. Memoir No. 247.

Bostock, H.S. 1969. Physiographic regions of Canada. Geol. Surv. of Can. Map 1254 A

Canada Department of Agriculture. 1972. Farming potential of the Canadian Northwest. Publication 1466.

Coligado, M.C., B. Wolfgang, and W.K. Sly. 1968. Risk analysis of weekly climatic data for agricultural and irrigation planning. Agrometeorology Section, Plant Research Institute, Research Branch, Canada Department of Agriculture, Tech. Bull. 44, 46 and 58.

Cook, R.D. 1974. Report on geotechnical investigation Fort Liard Highway, mile 29.0 to mile 66.7. For Public Works Canada, Western Region.

Craig, B.G. 1965. Glacial Lake McConnel and surficial geology of parts of Slave River and Redstone River map areas. District of Mackenzie G.S.C. Bull. 122.

Crowe, K.J. 1974. A history of the original peoples of Northern Canada. Arctic Institute of North America, McGill-Queen's University Press. Montreal.

Day, J.H. 1966. Reconnaissance soil survey of the Liard River Valley, N.W.T. Research Branch, Canada Department of Agriculture.

Dennington, M.C., B.E. Johnson, and H.A. Stelfox. 1973. Atlas of Wildlife Habitat Inventory Map. Canadian Wildlife Service.

Department of the Environment. 1972. Land Use Information Series, prepared for Department of Indian Affairs and Northern Development. Maps 95B, 95G, 95H, 95I and 95J. Ottawa.

Francl, W.J. and Associates. 1974. Expansion study of Fort Simpson, N.W.T. Environmental-Social Committee, Northern Pipelines Task Force on Northern Oil Development, Report No. 74-27.

Forest Management Institute. 1974. Vegetation types of the Mackenzie Corridor. Environmental-Social Committee, Northern Pipelines Task Force on Northern Oil Development, Gov. Can. Rep. No. 73-46, 85 p.

Gilbey, J.A. 1954. Progress Report Dominion Experimental Substation, Fort Simpson, Northwest Territories. Canada Department of Agriculture.

Hage, C.O. 1945. Geological reconnaissance along Lower Liard River, N.W.T., Yukon and British Columbia. Geol. Surv., Canada, Dept. of Mines and Technical Surveys. Paper 45-22.

Higgins, G.M. 1968. The Lower Liard Region - An area economic survey. A.E.S.R. #63/3, Dept. of Indian Affairs and Northern Development.

Hirvonen, R.P. 1956 (68). Report on forest conditions in the Lower Liard River Basin, Yukon/N.W.T. For. Manage. Inst., N.S.R. No. 3.

Hirvonen, R.P. 1975. Forest resources of the Mackenzie River Valley, N.W.T. For. Manage. Inst. Inf. Report FMR-X-71.

Hume, G.S. 1923. Geology of the Norman oil fields, and a reconnaissance of a part of the Liard River. Geol. Surv. Canada Sum. Rept. for 1922, Pt. B: 47-64.

Jeffrey, W.W. 1959. Notes on plant occurrence along Lower Liard River, N.W.T. Nat. Mus. Can., Contrib. to Bot. 1959. Bull. No. 171: 32-115.

Jeffrey, W.W. 1964. Forest types along Lower Liard River, N.W.T. Dept. of Forestry Pub. No. 1035.

Lacate, D.S. 1969. Guidelines for bio-physical land classification. Dept. of Fisheries and Forestry, Canadian Forestry Service. Pub. No. 1264.

Lavkulich, L.M., J.S. Rowe, T. Lewis, and D.S. Lacate. 1972. ALUR 71-72. Soils, vegetation and landforms of the Fort Simpson area, N.W.T. Department Indian and Northern Affairs, Ottawa.

Leahey, A. 1944. Report of an exploratory soil survey made along the water route from Fort Nelson, B.C. to Waterways, Alta., via Fort Simpson, N.W.T. Experimental Farms Service, Ottawa. Mim.

Minning, G.V., J.A. Rennie, J.L. Dumanski, and A.N. Sartorelli. 1972. Granular resource inventory - Southern Mackenzie Valley - Sibbeston Lake 95G, Fort Liard 95B, Fort Simpson 95H, G.S.C., 1972.

Nowosad, F.S. 1970. Handbook for Northern Gardeners. Canada Department of Agriculture Publication 1081.

Patterson, R.M. The dangerous river. Grays Publishing Limited. 1966.

Parker, M.L., and L.A. Jozsa. 1973. Technical Report No. 10 to Glaciology Division, Water Resources Branch IN - Hydrologic aspects of northern pipeline development. Environmental-Social Committee Northern Pipelines, Report No. 73-46.

Peake, R.W. and P.H. Walker. 1975. Yukon agriculture: a policy proposal. Prepared for the Government of the Yukon Territory.

Prescott, W.H., G.L. Erickson, L.E. Walton, D.G. Smith. 1973. Atlas Of Moose Habitat Maps. Canadian Wildlife Service. For Environmental Social Program, Northern Pipelines.

Pringle, W.L. 1974. North of the 60th. In Northern Agriculture, Agrologist Vol. 3/6, 1974. Agricultural Institute of Canada.

Reid, Collins and Associates. 1972. Forest Inventory Report. Lower Liard River Area C - 1970. Vancouver.

Reid, D.E., and A. Janz. 1974. Vegetation of the Mackenzie Valley - Part two. Arctic Gas Biological Report Series Vol. 3.

Rowe, J.S. 1972. Forest Regions of Canada. Can. Forestry Service Pub. No. 1300.

Rowe, J.S. and J.L. Bergsteinsson, G.A. Padbury and R. Hermish. Fire studies in the Mackenzie Valley. Alur. - 1973-74. Dept. of Indian Affairs and Northern Development, Ottawa.

Rutter, N.W., A.N. Boydell, G.V. Minning, and J.A. Netterville. 1973. Preliminary drafts of surficial geology and geomorphology maps, District of Mackenzie (NTS 95A, B, G, H, I, J). Geol. Surv. Can., Open File No. 158.

Rutter, N.W., A.N. Boydell, K.W. Savigny, and R.O. van Everdingen. 1973. Terrain evaluation with respect to pipeline construction, Mackenzie transportation corridor. Environmental-Social Committee, Northern Pipelines, Task Force on Northern Oil Development. Report No. 73-36.

Slaney, F.F. and Co. 1969. Forest inventory survey and development study of Lower Liard River Area.

Synergy West Ltd. 1975. Liard Highway Study. For Public Works Canada, Western Region.

Tarnocai, C. 1973. Soils of the Mackenzie River Area. Environmental-Social Committee, Northern Pipelines. Report No. 73-26.

Verschuren, J.P. 1974. Run-off from Small Watersheds and River Bank Erosion, near Watson Lake, Y.T. Alur. 73-74-02. Department of Indian and Northern Affairs.

Wallace, W.L. and J.P. Peaker. 1969. Forest Inventory Lower Liard River Area. Yukon and N.W.T. For. Manage. Inst., NSR No. 3.

# APPENDIX I

## Reproductions of Aerial Photographs Showing Soil Map Units as Mapped in the Field

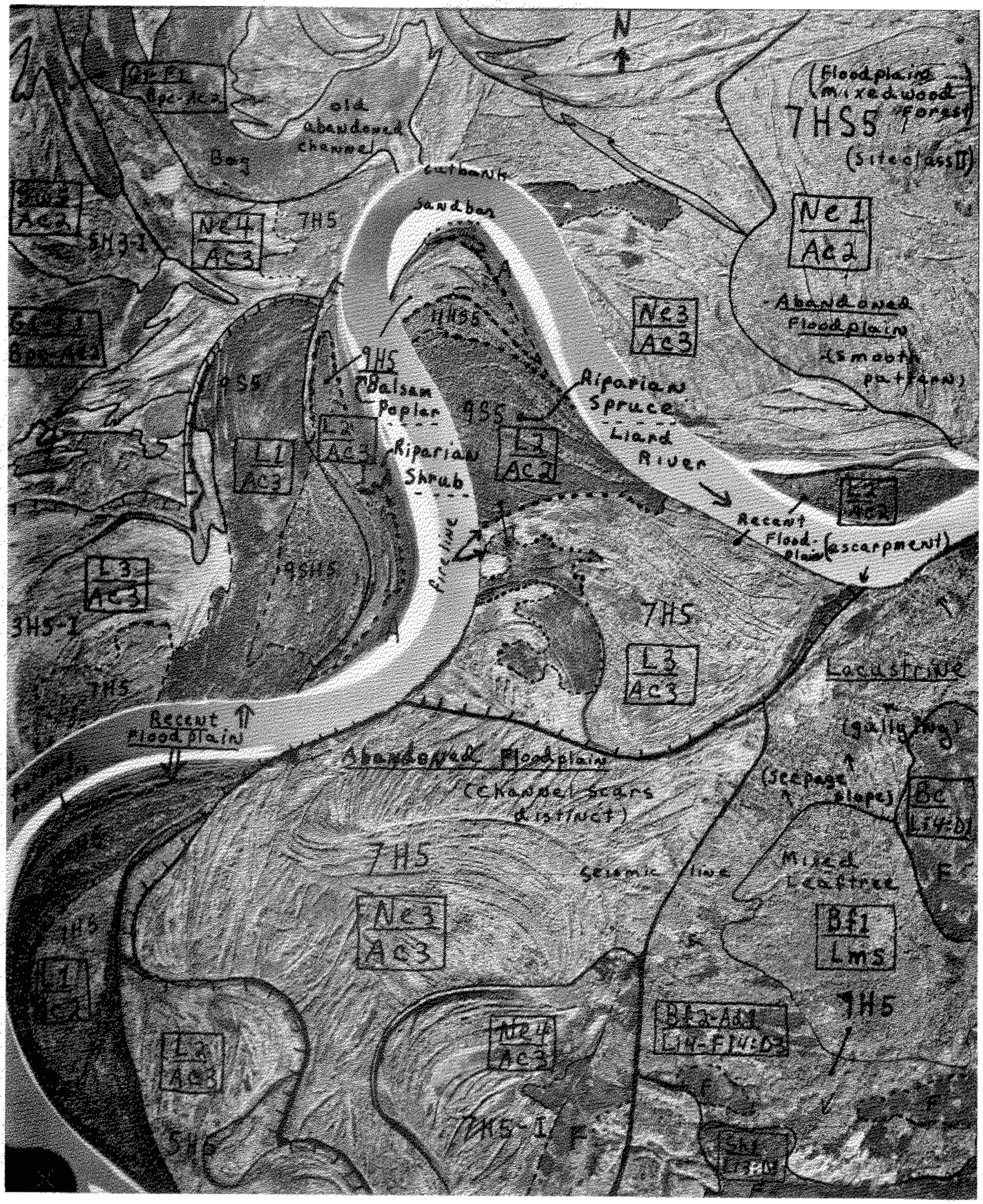


PLATE 1 - Alluvial Floodplains of the Liard River. A.P. #A17439-45. 1956; Lat. 60° 55', Long. 123° 30'; 95B/13, 14.

Note features of the recent and abandoned floodplains and adjacent lacustrine deposits.

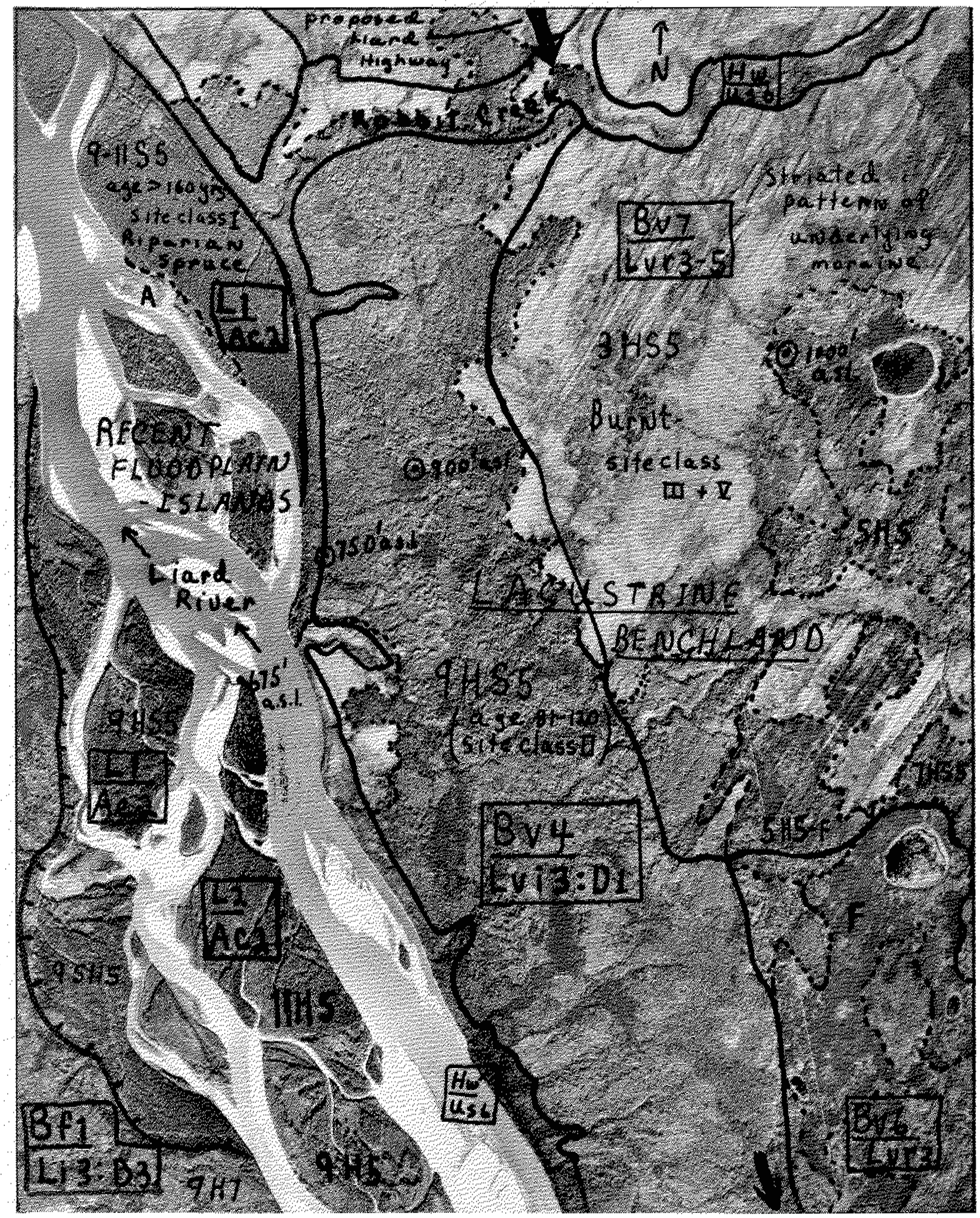


PLATE 2 - Lacustrine Benchland and Island Deposits of the Liard River. A.P. #A17437-66, 1956; Lat. 60° 25', Long. 123° 25'; 95B/6.

The Lacustrine Benchland borders the Liard River with steeply sloping banks from the Flett Rapids to the B.C. border. Poorly drained soils are more prevalent away from the river bank and tributaries. The proposed Liard Highway passes through this section. Note striated pattern of underlying till of the Bovie Association (Bv7/Lvr 3-5).

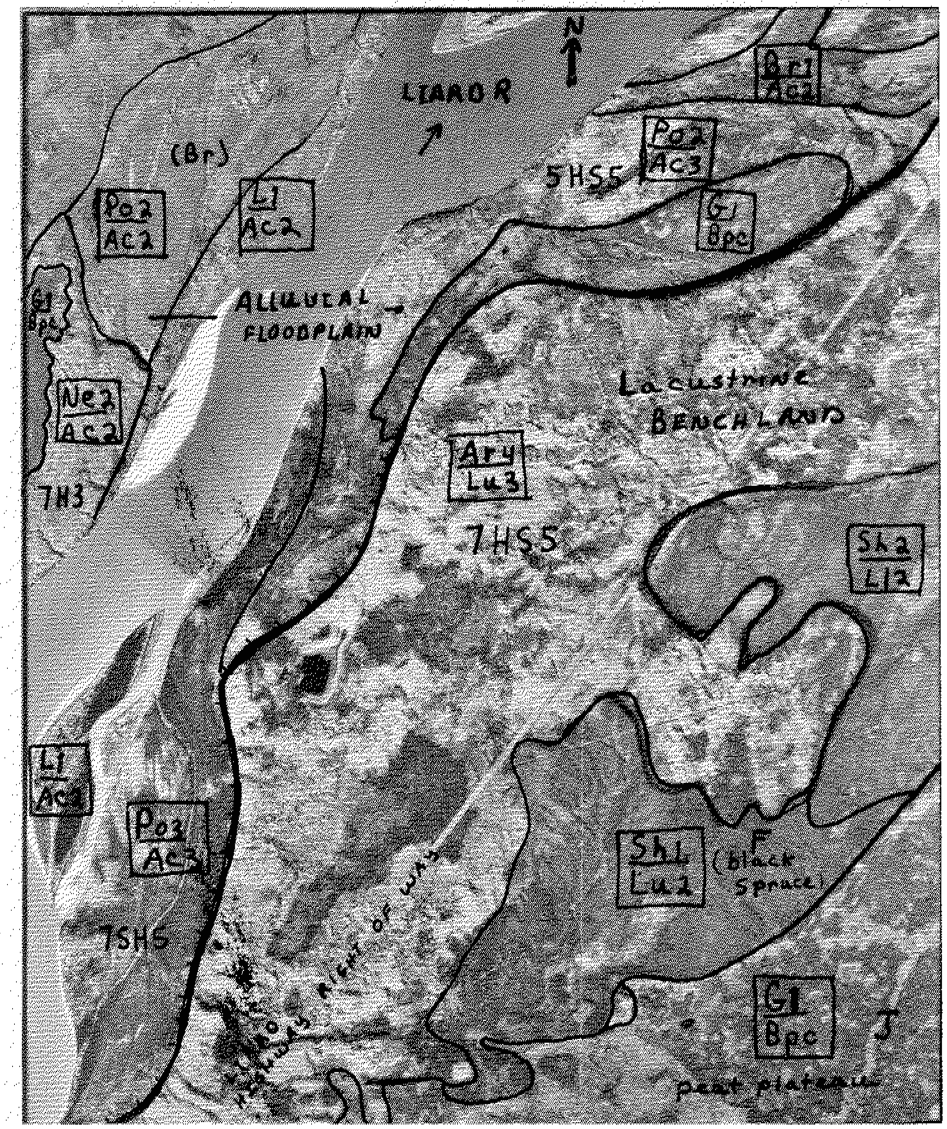


PLATE 3 - Lacustrine Benchland and Alluvial Floodplain, Liard River.
A.P. #A23588-134, 1973; Lat. 61° 10', Long. 122°, 45'; 95G/2.

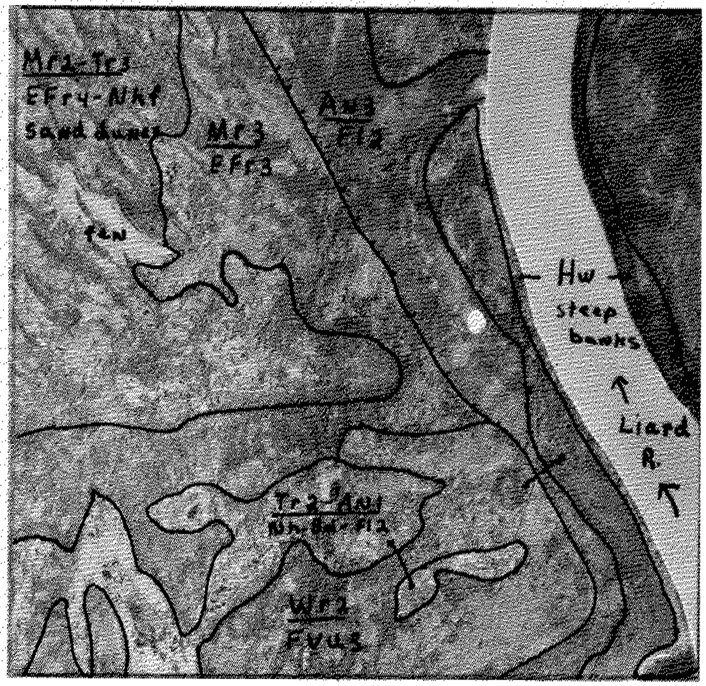


PLATE 4 - Deltaic Sand Deposits. A.P. #A23 490-61, 1973;
Lat. 61° 37', Long. 121° 32'; 95H/11, 12.

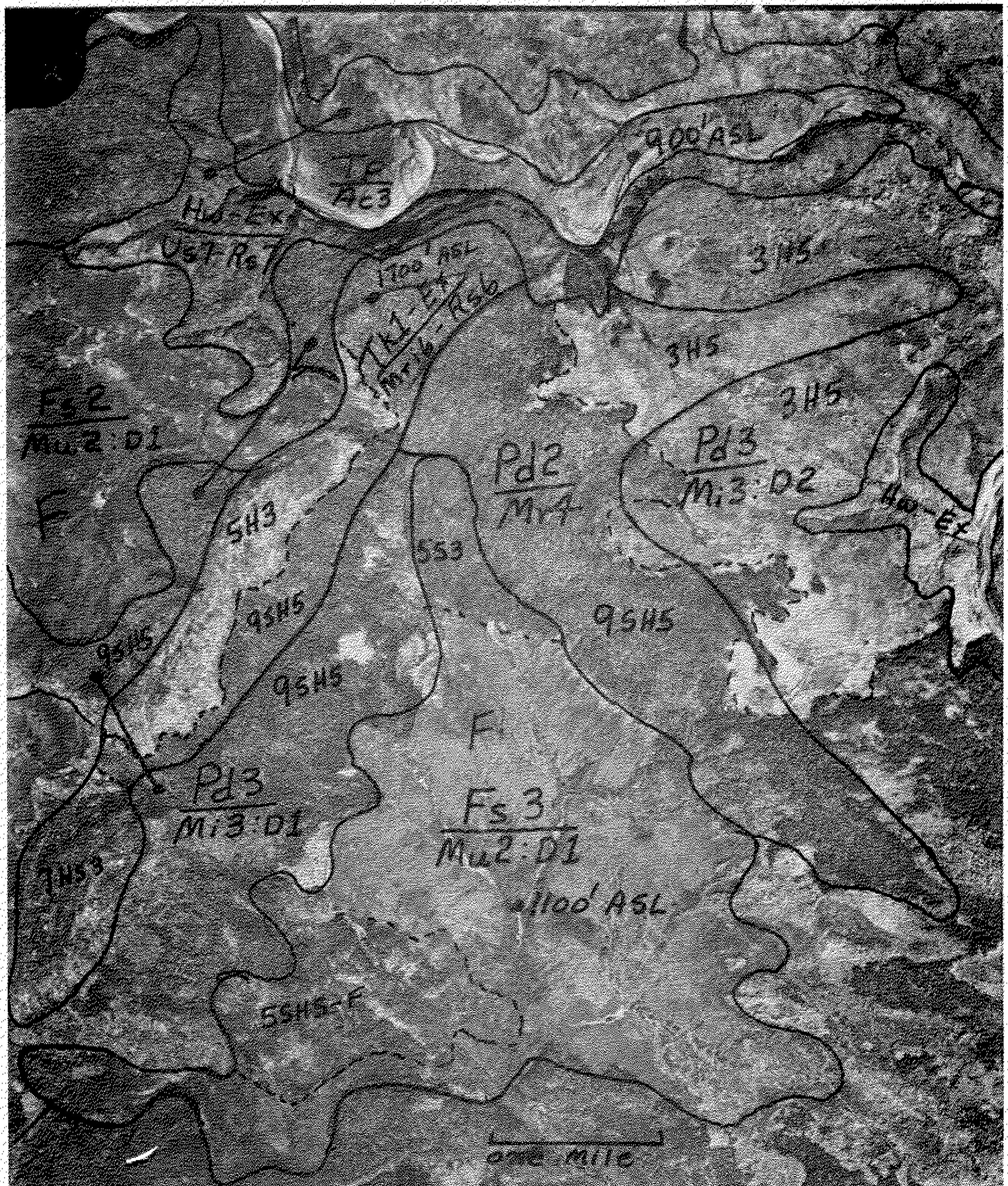


Plate 5 - morainal upland south of Fisherman Lake and just south of the Kolaneelee River. Air photo #A17442-65, 60°10' - 60°15' N and 123°50' - 124°00'W, 95B5.

The dominant soil material is the clay to heavy clay lacustro till (Pointed Mountain and Fisherman Lake Associations) with some clay loam till on a high ridge (Trout Lake Association). A recent fire has come in from the east and this area is now regenerating with aspen. The well drained soils are dominantly white spruce and the poorly drained (Fs) are black spruce. The Fs3 area has a high proportion of Organic soils.

# APPENDIX II

Chemical and physical analyses of
29 soil profiles sampled in the
Liard and Mackenzie area

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution % Total Sand | % 2-1mm | % 1-.5mm | % .5-.25mm | % .25-.1mm | % .1-.05mm | % Silt | % 2µ Clay | % 0.2µ Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meq/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bovie Lake Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 8.2 | $Bm_1$ | 0–20 | 9.2 | 0.2 | 0.4 | 0.5 | 1.4 | 6.7 | 73.7 | 17.2 | 6.6 | 0.05 | 1.0 | | 5.1 | 4.9 | 7.9 | 2.0 | 0.1 | 0.1 |
| 8-5 | II $Ck_2$ | 56–66 | 38.9 | 4.5 | 5.7 | 6.1 | 11.5 | 11.2 | 34.1 | 26.9 | 11.3 | 0.04 | 0.7 | 12.9 | 7.7 | 7.5 | | | | |
| | | Bovie Lake Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 27-2 | Ae | 0–7 | 6.6 | 0.2 | 0.6 | 0.7 | 1.2 | 3.9 | 78.8 | 14.6 | 6.0 | 0.07 | 2.0 | | 5.8 | 5.4 | 8.1 | 2.2 | 0.1 | 0.1 |
| 27-3 | Bm | 7–28 | 5.6 | 0.3 | 0.4 | 0.5 | 0.9 | 3.5 | 78.3 | 16.1 | 7.3 | 0.04 | 0.9 | | 5.6 | 5.5 | 7.2 | 3.2 | 0.1 | 0.1 |
| 27-4 | Ck | 28–40 | 8.6 | 0.5 | 0.2 | 0.4 | 1.5 | 5.9 | 72.7 | 18.7 | 8.1 | 0.07 | 1.2 | 15.0 | 7.9 | 7.5 | | | | |
| 27-5 | II Ck | 40–60 | 59.8 | 6.2 | 10.0 | 12.9 | 18.7 | 12.0 | 25.5 | 14.7 | 7.7 | 0.05 | 0.7 | 13.4 | 8.0 | 7.7 | | | | |
| | | Bulmer Association, Rego Gleysol | | | | | | | | | | | | | | | | | | |
| 17-1 | L-H | 12.0 | | | | | | | | | | 1.30 | 36.8 | | 7.0 | 6.5 | | | | |
| 17-2 | AC | 0–35 | 65.3 | 1.0 | 1.5 | 1.9 | 28.3 | 32.6 | 25.3 | 9.5 | 3.7 | 0.04 | 3.4 | 3.2 | 8.1 | 7.5 | 9.0 | 1.4 | 0.1 | 0.2 |
| 17-3 | II Ck | 35–50 | 32.2 | 4.6 | 5.0 | 4.2 | 8.6 | 9.8 | 40.5 | 27.3 | 11.0 | 0.03 | 0.2 | 11.3 | 8.2 | 7.6 | | | | |
| | | Celibeta Association, Brunisolic Gray Luvisol | | | | | | | | | | | | | | | | | | |
| 33-1 | L-H | 6–0 | | | | | | | | | | 1.98 | 64.0 | | 6.3 | 6.0 | | | | |
| 33-2 | Ac | 0–10 | 7.8 | 0.4 | 0.7 | 1.0 | 2.0 | 3.8 | 78.4 | 13.8 | 3.0 | 0.06 | 1.3 | | 5.6 | 4.9 | 4.7 | 1.9 | 0.2 | 0.1 |
| 33-3 | Bm | 10–20 | 2.7 | | | | | | 53.3 | 44.0 | 20.6 | 0.07 | 1.2 | | 5.1 | 4.4 | 10.8 | 4.2 | 0.3 | 0.1 |
| 34-4 | II $Bt_1$ | 20–40 | 1.6 | | | | | | 35.6 | 62.8 | 40.7 | 0.07 | 1.0 | | 4.9 | 4.1 | 13.2 | 5.5 | 0.3 | 0.2 |
| 33-5 | II $Bt_2$ | 40–50 | | | | | | | | | | 0.09 | 1.4 | | 5.3 | 4.7 | 16.8 | 6.5 | 0.3 | 0.2 |
| 33-6 | II Ck | 50–65 | 0.3 | | | | | | 39.1 | 60.6 | 26.6 | 0.13 | 0.3 | 14.0 | 7.8 | 7.6 | | | | |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution | | | | | | | | | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH | | $NH_4OAc$ meq/100 g | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % Total Sand | % 2-1mm | % 1-.5mm | %.5 -.25mm | %.25 -.1mm | %.1 -.05mm | % Silt | % 2u Clay | % 0.2u Clay | | | | $H_2O$ | $CaCl_2$ | Ca | Mg | K | Na |
| Arrowhead Association, Gleyed Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | | | |
| 26-2 | Bm | 0-28 | 7.3 | 0.0 | 0.2 | 0.2 | 0.8 | 6.1 | 78.7 | 14.0 | 6.4 | 0.04 | 0.6 | 7.6 | 7.9 | 7.6 | 17.1 | 1.9 | 0.1 | 0.1 |
| 26-3 | $Ck_1$ | 28-40 | 7.1 | 0.0 | 0.1 | 0.2 | 0.6 | 6.2 | 81.8 | 11.1 | 4.6 | 0.04 | 0.3 | 17.1 | 8.2 | 7.7 | | | | |
| 26-4 | $Ck_2$ | 40-60 | 6.5 | 0.0 | 0.1 | 0.1 | 0.5 | 5.7 | 83.5 | 10.0 | 3.8 | 0.03 | 0.5 | 16.2 | 8.2 | 7.7 | | | | |
| Arrowhead Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | | | |
| 28-2 | Bmg | 0-20 | 4.1 | 0.0 | 0.1 | 0.1 | 0.3 | 3.5 | 78.0 | 17.9 | 8.5 | 0.07 | | | 7.1 | 6.8 | 12.5 | 2.7 | 0.1 | 0.1 |
| 28-3 | Ckg | 20-45 | 5.5 | 0.3 | 0.3 | 0.2 | 0.6 | 4.0 | 77.2 | 17.3 | 7.5 | 0.04 | | 13.0 | 8.0 | 7.5 | | | | |
| Bluebill Association, Brunisolic Gray Luvisol | | | | | | | | | | | | | | | | | | | | |
| 24-2 | Ac | 0-7 | 40.0 | 2.8 | 6.2 | 6.9 | 12.2 | 11.9 | 41.1 | 18.9 | 9.9 | 0.10 | 3.1 | | 4.0 | 3.6 | 1.6 | 0.9 | 0.2 | 0.1 |
| 24-3 | Bm | 7-18 | 33.4 | 2.0 | 4.9 | 6.0 | 11.1 | 9.4 | 31.9 | 34.8 | 21.6 | 0.09 | 1.8 | | 4.3 | 3.8 | 2.6 | 1.2 | 0.2 | 0.1 |
| 24-4 | II Bt | 18-36 | 27.2 | 2.8 | 4.0 | 4.1 | 7.9 | 8.5 | 38.8 | 34.0 | 20.4 | 0.05 | 1.2 | | 4.8 | 4.1 | 7.3 | 1.9 | 0.2 | 0.1 |
| 24-5 | III Bt | 36-70 | | | | | | | | | | 0.07 | 1.0 | | 5.4 | 4.8 | 2.8 | 2.8 | 0.2 | 0.1 |
| 24-7 | IV Ck | 83-95 | 25.8 | 1.2 | 2.1 | 2.6 | 9.3 | 10.7 | 37.3 | 36.8 | 17.9 | 0.06 | 0.9 | 4.9 | 7.9 | 7.5 | | | | |
| Bluefish Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | | | |
| 18-1 | L-H | 5-0 | | | | | | | | | | 0.62 | 41.3 | | 5.0 | 4.6 | | | | |
| 18-2 | $Bm_1$ | 0-15 | 7.5 | 0.2 | 0.5 | 0.5 | 0.7 | 5.7 | 78.6 | 13.9 | 5.2 | 0.05 | 1.4 | | 5.8 | 5.2 | 8.9 | 2.2 | 0.1 | 0.0 |
| 18-3 | $Bm_2$ | 15-32 | 6.0 | 0.0 | 0.2 | 0.3 | 0.5 | 5.0 | 77.0 | 17.0 | 7.6 | 0.03 | 0.9 | | 6.2 | 5.4 | 10.0 | 2.6 | 0.1 | 0.0 |
| 18-4 | Ck | 32-70 | 16.8 | 0.2 | 0.7 | 0.6 | 0.6 | 14.7 | 75.1 | 8.1 | 2.9 | 0.04 | 0.5 | 14.8 | 8.0 | 7.3 | | | | |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution % Total Sand | % 2-1mm | % 1-.5mm | %.5 -.25mm | %.25 -.1mm | %.1 -.05mm | % Silt | % 2u Clay | % 0.2u Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meq/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bovie Lake Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 8.2 | $Bm_1$ | 0-20 | 9.2 | 0.2 | 0.4 | 0.5 | 1.4 | 6.7 | 73.7 | 17.2 | 6.6 | 0.05 | 1.0 | | 5.1 | 4.9 | 7.9 | 2.0 | 0.1 | 0.1 |
| 8-5 | II $Ck_2$ | 56-66 | 38.9 | 4.5 | 5.7 | 6.1 | 11.5 | 11.2 | 34.1 | 26.9 | 11.3 | 0.04 | 0.7 | 12.9 | 7.7 | 7.5 | | | | |
| | | Bovie Lake Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 27-2 | Ae | 0-7 | 6.6 | 0.2 | 0.6 | 0.7 | 1.2 | 3.9 | 78.8 | 14.6 | 6.0 | 0.07 | 2.0 | | 5.8 | 5.4 | 8.1 | 2.2 | 0.1 | 0.1 |
| 27-3 | Bm | 7-28 | 5.6 | 0.3 | 0.4 | 0.5 | 0.9 | 3.5 | 78.3 | 16.1 | 7.3 | 0.04 | 0.9 | | 5.6 | 5.5 | 7.2 | 3.2 | 0.1 | 0.1 |
| 27-4 | Ck | 28-40 | 8.6 | 0.5 | 0.2 | 0.4 | 1.5 | 5.9 | 72.7 | 18.7 | 8.1 | 0.07 | 1.2 | 15.0 | 7.9 | 7.5 | | | | |
| 27-5 | II Ck | 40-60 | 59.8 | 6.2 | 10.0 | 12.9 | 18.7 | 12.0 | 25.5 | 14.7 | 7.7 | 0.05 | 0.7 | 13.4 | 8.0 | 7.7 | | | | |
| | | Bulmer Association, Rego Gleysol | | | | | | | | | | | | | | | | | | |
| 17-1 | L-H | 12.0 | | | | | | | | | | 1.30 | 36.8 | | 7.0 | 6.5 | | | | |
| 17-2 | AC | 0-35 | 65.3 | 1.0 | 1.5 | 1.9 | 28.3 | 32.6 | 25.3 | 9.5 | 3.7 | 0.04 | 3.4 | 3.2 | 8.1 | 7.5 | 9.0 | 1.4 | 0.1 | 0.2 |
| 17-3 | II Ck | 35-50 | 32.2 | 4.6 | 5.0 | 4.2 | 8.6 | 9.8 | 40.5 | 27.3 | 11.0 | 0.03 | 0.2 | 11.3 | 8.2 | 7.6 | | | | |
| | | Celibeta Association, Brunisolic Gray Luvisol | | | | | | | | | | | | | | | | | | |
| 33-1 | L-H | 6-0 | | | | | | | | | | 1.98 | 64.0 | | 6.3 | 6.0 | | | | |
| 33-2 | Ac | 0-10 | 7.8 | 0.4 | 0.7 | 1.0 | 2.0 | 3.8 | 78.4 | 13.8 | 3.0 | 0.06 | 1.3 | | 5.6 | 4.9 | 4.7 | 1.9 | 0.2 | 0.1 |
| 33-3 | Bm | 10-20 | 2.7 | | | | | | 53.3 | 44.0 | 20.6 | 0.07 | 1.2 | | 5.1 | 4.4 | 10.8 | 4.2 | 0.3 | 0.1 |
| 34-4 | II $Bt_1$ | 20-40 | 1.6 | | | | | | 35.6 | 62.8 | 40.7 | 0.07 | 1.0 | | 4.9 | 4.1 | 13.2 | 5.5 | 0.3 | 0.2 |
| 33-5 | II $Bt_2$ | 40-50 | | | | | | | | | | 0.09 | 1.4 | | 5.3 | 4.7 | 16.8 | 6.5 | 0.3 | 0.2 |
| 33-6 | II Ck | 50-65 | 0.3 | | | | | | 39.1 | 60.6 | 26.6 | 0.13 | 0.3 | 14.0 | 7.8 | 7.6 | | | | |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution % Total Sand | % 2-1mm | % 1-.5mm | %.5 -.25mm | %.25 -.1mm | %.1 -.05mm | % Silt | % 2µ Clay | % 0.2µ Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meg/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cormack Lake Association, Orthic Gleysol peaty phase | | | | | | | | | | | | | | | | | | |
| 16-1 | F-H | 30-15 | | | | | | | | | | 1.26 | 47.9 | | 6.0 | 5.7 | | | | |
| 16-2 | H | 15-0 | | | | | | | | | | 1.02 | 29.6 | | 6.0 | 5.8 | | | | |
| 16-3 | Bg | 0-20 | | | | | | | | | | 0.10 | 2.4 | | 7.1 | 6.7 | 16.1 | 4.5 | 0.3 | 0.1 |
| 16-4 | Ckg | 20-40 | 38.1 | 4.9 | 6.7 | 6.7 | 11.1 | 8.7 | 36.6 | 25.3 | 11.4 | 0.04 | 1.0 | 15.8 | 7.8 | 7.5 | | | | |
| | | Gros Cap Association, Orthic Gray Luvisol | | | | | | | | | | | | | | | | | | |
| 10-1 | L-H | 10-0 | | | | | | | | | | 1.40 | 64.0 | | 6.0 | 5.7 | | | | |
| 10-2 | Ae | 0-12 | 6.1 | 0.1 | 0.3 | 0.2 | 0.4 | 5.1 | 79.3 | 14.6 | 4.2 | 0.04 | 1.1 | | 5.0 | 4.8 | 4.4 | 1.7 | 0.1 | 0.0 |
| 10-3 | Bt | 12-32 | 3.0 | | | | | | 54.2 | 42.8 | 23.2 | 0.07 | 1.2 | | 4.7 | 4.4 | 10.8 | 4.9 | 0.2 | 0.1 |
| 10-4 | Ck | 32-56 | 3.9 | | | | | | 61.9 | 34.2 | 11.8 | 0.10 | 2.0 | 22.0 | 8.0 | 7.6 | | | | |
| | | Jean-Marie Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 11-1 | Ac | 0-7 | | | | | | | | | | 0.09 | 1.1 | | 6.0 | 5.5 | 2.8 | 0.9 | 0.1 | 0.0 |
| 11-2 | Bm | 7-45 | 85.6 | 0.0 | 0.1 | 1.3 | 42.7 | 41.5 | 5.0 | 9.4 | 5.2 | 0.02 | 0.5 | | 6.0 | 5.5 | 3.4 | 1.1 | 0.2 | 0.0 |
| 11-3 | $Ck_1$ | 45-62 | | | | | | | | | | 0.06 | 1.5 | 27.0 | 7.9 | 7.5 | | | | |
| 11-4 | $Ck_2$ | 62-82 | 85.3 | 35.7 | 2.4 | 3.5 | 18.7 | 25.0 | 9.7 | 5.0 | 2.6 | 0.02 | 0.2 | 33.1 | 8.0 | 7.7 | | | | |
| | | Liard Association, Cumulic Regosol | | | | | | | | | | | | | | | | | | |
| 19-1 | Ac | 0-20 | 8.4 | 0.1 | 0.1 | 0.1 | 1.0 | 7.2 | 64.0 | 27.5 | 11.4 | 0.16 | 4.0 | 1.8 | 6.5 | 6.0 | 17.5 | 4.5 | 0.2 | 0.1 |
| 19-2 | $FH_6$ | 20-30 | | | | | | | | | | 0.83 | 14.8 | 1.8 | 6.6 | 6.1 | 58.5 | 14.2 | 0.2 | 0.2 |
| 19-3 | $AC_6$ | 30-38 | | | | | | | | | | 0.21 | 5.3 | 0.7 | 7.0 | 6.6 | 22.2 | 5.0 | 0.1 | 0.2 |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution % Total Sand | % 2-1mm | % 1-.5mm | % .5-.25mm | % .25-.1mm | % .1-.05mm | % Silt | % 2u Clay | % 0.2u Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meg/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Liard Association, Cumulic Regosol (Continued) | | | | | | | | | | | | | | | | | | |
| 19-4 | II Bb | 38-60 | | | | | | | | | | 0.12 | 1.0 | 0.7 | 7.4 | 7.1 | 23.4 | 6.8 | 0.3 | 0.3 |
| 19-5 | II Ck | 60-75 | 6.2 | 0.7 | 1.3 | 1.0 | 1.8 | 1.5 | 35.2 | 58.7 | 22.5 | 0.09 | 1.0 | 11.6 | 7.9 | 7.6 | | | | |
| | | Liard Association, Cumulic Regosol | | | | | | | | | | | | | | | | | | |
| 42-1 | L-H | 20-0 | | | | | | | | | | 0.66 | 25.6 | | 7.2 | 6.7 | | | | |
| 42-2 | AC | 0-20 | 6.4 | 0.0 | 0.2 | 0.2 | 1.0 | 5.0 | 71.3 | 22.4 | 9.0 | 0.24 | 12.2 | | 7.9 | 7.4 | 31.8 | 3.6 | 0.1 | 0.2 |
| 42-3 | $Ck_1$ | 20-35 | | | | | | | | | | 0.07 | 1.0 | 32.3 | 7.9 | 7.4 | | | | |
| 42-4 | $Ck_2$ | 35-50 | 31.5 | 0.0 | 0.1 | 0.2 | 2.5 | 28.7 | 58.9 | 9.6 | 3.5 | 0.07 | 1.0 | 34.3 | 8.1 | 7.5 | | | | |
| | | Martin River Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 1-1 | L-H | 7-0 | | | | | | | | | | 0.44 | 20.6 | | 6.5 | 6.3 | | | | |
| 1-2 | $Bm_1$ | 0-10 | 84.4 | 0.1 | 1.7 | 19.1 | 41.8 | 21.8 | 12.2 | 3.4 | 1.5 | 0.05 | 1.5 | | 5.3 | 5.0 | 1.9 | 0.8 | 0.1 | 0.0 |
| 1-3 | $Bm_2$ | 12-25 | 86.2 | 0.0 | 0.9 | 12.1 | 45.2 | 28.0 | 10.9 | 2.9 | 1.2 | 0.02 | 0.4 | | 5.0 | 4.6 | 1.3 | 0.7 | 0.1 | 0.0 |
| 1-4 | Bc | 25-60 | 91.3 | 0.0 | 0.6 | 19.7 | 49.4 | 21.5 | 4.4 | 4.3 | 1.7 | 0.02 | 0.3 | | 5.3 | 5.0 | | | | |
| 1-5 | C | 60-80 | 92.4 | 0.0 | 0.9 | 19.6 | 50.7 | 21.2 | 4.3 | 3.3 | 1.6 | 0.02 | 0.3 | | 5.3 | 5.5 | | | | |
| | | Martin River Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 9-1 | L-H | 5-0 | | | | | | | | | | 0.77 | 37.8 | | 5.5 | 5.3 | | | | |
| 9-2 | Ac | 0-5 | 44.3 | 0.0 | 0.3 | 3.3 | 14.7 | 26.1 | 50.9 | 4.8 | 1.6 | 0.05 | 1.9 | | 4.2 | 4.0 | 3.0 | 1.1 | 0.1 | 0.0 |
| 9-3 | $Bm_1$ | 5-10 | | | | | | | | | | 0.03 | 1.1 | | 5.2 | 4.7 | 3.9 | 1.3 | 0.1 | 0.0 |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution % Total Sand | % 2-1mm | % 1-.5mm | %.5 -.25mm | %.25 -.1mm | %.1 -.05mm | % Silt | % 2μ Clay | % 0.2μ Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meq/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Martin River Association, Degraded Eutric Brunisol (Continued) | | | | | | | | | | | | | | | | | | |
| 9-4 | $Bm_2$ | 10-56 | 82.0 | 0.0 | 0.3 | 8.2 | 51.7 | 21.8 | 10.9 | 7.1 | 4.4 | 0.03 | 0.5 | | 5.8 | 5.1 | 3.4 | 1.5 | 0.1 | 0.0 |
| 9-5 | Ck | 56+ | 89.3 | 0.0 | 0.3 | 5.9 | 57.8 | 25.4 | 7.7 | 3.0 | 1.4 | 0.04 | 0.1 | 13.6 | 7.9 | 7.6 | | | | |
| | | Netla Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 31-1 | L-H | 8-0 | | | | | | | | | | 1.49 | 67.2 | | 5.8 | 5.5 | | | | |
| 31-2 | $Bm_1$ | 0-10 | 3.2 | | | | | | 68.3 | 28.5 | 12.6 | 0.17 | 4.4 | | 4.5 | 4.0 | 0.7 | 2.7 | 0.2 | 0.1 |
| 31-3 | $Bm_2$ | 10-30 | 1.6 | | | | | | 58.2 | 40.2 | 16.8 | 0.11 | 2.0 | | 5.1 | 4.4 | 9.2 | 3.2 | 0.3 | 0.1 |
| 31-4 | BC | 30-45 | 1.0 | | | | | | 60.6 | 38.5 | 17.6 | 0.11 | 1.6 | 2.9 | 7.4 | 6.9 | 14.7 | 4.0 | 0.2 | 0.1 |
| 31-6 | $Ck_2$ | 45-60 | 2.8 | 0.2 | 0.1 | 0.1 | 0.3 | 2.2 | 73.2 | 23.9 | 9.5 | 0.09 | 1.7 | 10.0 | 7.9 | 7.4 | | | | |
| 31-7 | $Ck_3$ | 60-70 | | | | | | | | | | 0.09 | 1.6 | 11.0 | 7.9 | 7.5 | | | | |
| | | Netla Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 37-1 | L-H | 5-0 | | | | | | | | | | 1.41 | 63.6 | | 5.5 | 5.3 | | | | |
| 37-2 | $Btj_1$ | 0-9 | 8.2 | 0.0 | 0.1 | 0.4 | 1.9 | 5.9 | 53.3 | 38.5 | 13.1 | 0.13 | 2.4 | | 4.9 | 4.3 | 7.9 | 2.1 | 0.3 | 0.1 |
| 37-3 | $Btj_2$ | 9-24 | 11.8 | 0.0 | 0.0 | 0.1 | 2.3 | 9.3 | 58.2 | 29.9 | 13.3 | 0.06 | 1.1 | | 4.9 | 4.3 | 6.3 | 1.8 | 0.2 | 0.1 |
| 37-4 | Bc | 24-46 | | | | | | | | | | 0.07 | 1.0 | 0.8 | 6.0 | 5.6 | 10.1 | 2.7 | 0.1 | 0.1 |
| 37-5 | II Ck | 46-60 | 23.4 | 0.0 | 0.1 | 0.1 | 1.7 | 21.6 | 61.3 | 15.3 | 6.7 | 0.07 | 1.1 | 8.9 | 7.9 | 7.5 | | | | |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution: % Total Sand | % 2-1mm | % 1-.5mm | %.5 -.25mm | %.25 -.1mm | %.1 -.05mm | % Silt | % 2u Clay | % 0.2u Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meq/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Petitot Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 34-1 | LF | 27-10 | | | | | | | | | | 1.42 | 81.9 | | 6.4 | 6.1 | | | | |
| 34-3 | $B_1$ | 0-10 | 4.7 | 0.1 | 0.4 | 0.4 | 0.9 | 2.9 | 70.0 | 25.3 | 13.3 | 0.08 | 1.8 | | 7.1 | 6.7 | 11.6 | 4.4 | 0.2 | 0.1 |
| 34-4 | $B_2$ | 10-20 | | | | | | | | | | 0.07 | 1.5 | | 7.3 | 7.0 | 12.5 | 4.3 | 0.2 | 0.1 |
| 34-5 | C | 20-30 | 5.3 | 0.5 | 0.4 | 0.5 | 1.2 | 2.8 | 55.3 | 39.4 | 18.5 | 0.08 | 1.2 | 4.0 | 7.7 | 7.4 | | | | |
| | | Petitot Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 43-2 | Ac | 0-10 | 1.0 | | | | | | 58.8 | 40.2 | 13.2 | 0.11 | 3.2 | | 6.3 | 5.8 | 12.1 | 4.2 | 0.4 | 0.1 |
| 43-3 | Btj | 10-32 | 0.3 | | | | | | 40.3 | 59.4 | 25.8 | 0.09 | 1.4 | | 7.1 | 6.6 | 16.5 | 7.9 | 0.3 | 0.1 |
| 43-4 | $Ck_1$ | 32-45 | 0.8 | | | | | | 41.8 | 57.4 | 19.7 | 0.09 | 0.7 | 18.8 | 7.9 | 7.6 | | | | |
| 43-5 | $Ck_2$ | 45-70 | 0.1 | | | | | | 49.2 | 50.7 | 17.3 | 0.07 | 0.9 | 19.6 | 8.0 | 7.7 | | | | |
| | | Pointed Mountain Association, Orthic Gray Luvisol | | | | | | | | | | | | | | | | | | |
| 30-1 | L-H | 6-0 | | | | | | | | | | 1.76 | 71.6 | | 6.0 | 5.8 | | | | |
| 30-2 | Ae | 0-18 | 10.7 | 0.2 | 1.3 | 1.6 | 2.3 | 5.3 | 78.8 | 10.5 | 4.7 | 0.04 | 0.9 | | 5.0 | 4.2 | 2.5 | 1.1 | 0.1 | 0.1 |
| 30-3 | $Bt_1$ | 18-34 | 2.2 | | | | | | 1.2 | 96.6 | 44.8 | 0.08 | 1.1 | | 5.2 | 4.4 | 15.9 | 5.9 | 0.3 | 0.1 |
| 30-4 | $Bt_2$ | 34-49 | 1.2 | | | | | | 14.8 | 84.0 | 45.4 | 0.10 | 1.5 | | 5.7 | 4.9 | 22.5 | 8.3 | 0.4 | 0.2 |
| 30-5 | BC | 49-57 | 1.1 | | | | | | 16.5 | 82.4 | 42.8 | 0.12 | 0.4 | 1.0 | 7.1 | 6.7 | 30.0 | 8.9 | 0.3 | 0.2 |
| 30-6 | Ck | 57-70 | 5.2 | 0.7 | 0.9 | 0.8 | 1.6 | 1.1 | 34.4 | 60.5 | 29.9 | 0.10 | 1.4 | 10.7 | 7.9 | 7.6 | | | | |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution: % Total Sand | % 2-1mm | % 1-.5mm | %.5-.25mm | %.25-.1mm | %.1-.05mm | % Silt | % 2µ Clay | % 0.2µ Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meg/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pointed Mountain Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 32-1 | L-H | 6-0 | | | | | | | | | | 1.63 | 78.0 | | 5.1 | 4.8 | | | | |
| 32-2 | $Bm_1$ | 0-20 | 25.8 | 1.1 | 3.2 | 5.6 | 9.8 | 6.2 | 28.8 | 45.4 | 24.9 | 0.10 | 2.1 | | 4.7 | 4.0 | 9.6 | 4.2 | 0.4 | 0.1 |
| 32-3 | $Bm_2$ | 20-40 | 24.7 | 1.0 | 3.0 | 5.2 | 9.3 | 6.3 | 31.5 | 43.7 | 24.8 | 0.06 | 1.0 | | 4.8 | 4.0 | 8.4 | 3.8 | 0.2 | 0.1 |
| 32-4 | BC | 40-80 | | | | | | | | | | 0.06 | 1.1 | 0.4 | 5.7 | 5.3 | 14.3 | 4.8 | 0.3 | 0.1 |
| 32-5 | Ck | 80-100 | 28.0 | 1.5 | 3.5 | 5.6 | 10.2 | 7.3 | 31.7 | 40.2 | 2[illegible].4 | 0.06 | 0.9 | 4.0 | 7.7 | 7.4 | | | | |
| | | Rabbit Creek Association, Orthic Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 21-1 | $Bm_1$ | 0-11 | 58.1 | 6.1 | 11.2 | 12.3 | 16.9 | 11.6 | 26.8 | 15.1 | 9.0 | 0.06 | 1.8 | | 7.2 | 6.8 | 9.4 | 2.8 | 0.1 | 0.1 |
| 21-2 | $Bm_2$ | 11-22 | | | | | | | | | | 0.05 | 1.0 | 4.4 | 7.6 | 7.2 | 9.3 | 2.9 | 0.1 | 0.1 |
| 21-3 | $Ck_1$ | 22-34 | 64.6 | 11.1 | 13.2 | 12.2 | 16.4 | 11.7 | 27.9 | 7.6 | 3.3 | 0.03 | 0.3 | 12.9 | 7.8 | 7.5 | | | | |
| 21-4 | $Ck_2$ | 34-44 | 65.0 | 10.2 | 13.1 | 12.9 | 17.2 | 11.8 | 25.1 | 9.8 | 4.4 | 0.02 | 0.1 | 19.3 | 8.0 | 7.5 | | | | |
| | | Rabbit Creek Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 38-2 | Ae | 0-4 | 45.0 | 5.1 | 9.6 | 9.2 | 10.0 | 11.2 | 48.6 | 6.4 | 1.8 | 0.05 | 1.5 | | 4.2 | 3.5 | 1.2 | 0.3 | 0.1 | 0.1 |
| 38-3 | Btj | 4-22 | 39.0 | 5.4 | 7.8 | 7.7 | 10.3 | 7.9 | 41.3 | 19.7 | 8.2 | 0.03 | 1.0 | | 4.8 | 4.4 | 3.7 | 0.9 | 0.1 | 0.1 |
| 38-4 | $Ck_1$ | 22-50 | | | | | | | | | | 0.04 | 0.6 | 20.3 | 7.8 | 7.3 | | | | |
| 38-5 | $Ck_2$ | 50-100 | 43.4 | 6.0 | 7.4 | 7.6 | 12.5 | 9.9 | 32.3 | 24.3 | 10.4 | 0.03 | 0.4 | 21.4 | 7.8 | 7.4 | | | | |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution % Total Sand | % 2-1mm | % 1-.5mm | %.5 -.25mm | %.25 -.1mm | %.1 -.05mm | % Silt | % 2u Clay | % 0.2u Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meq/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Swan Point Association, Orthic Gray Luvisol** | | | | | | | | | | | | | | | | | | | |
| 41-1 | L-H | 7-0 | | | | | | | | | | 1.04 | 40.8 | | 5.4 | 5.0 | | | | |
| 41-2 | Ae | 0-8 | 4.2 | | | | | | 59.7 | 36.1 | 15.9 | 0.18 | 4.5 | | 5.3 | 4.8 | 11.3 | 2.8 | 0.6 | 0.1 |
| 41-3 | $Bt_1$ | 8-16 | 0.5 | | | | | | 60.5 | 39.1 | 18.6 | 0.12 | 2.0 | | 5.4 | 4.9 | 10.6 | 2.8 | 0.4 | 0.1 |
| 41-4 | $Bt_2$ | 16-34 | 0.7 | | | | | | 47.3 | 52.0 | 22.1 | 0.11 | 1.2 | | 6.1 | 5.5 | 15.4 | 4.0 | 0.3 | 0.1 |
| 41-5 | $Ck_1$ | 34-60 | 0.1 | | | | | | 50.3 | 49.6 | 18.3 | 0.15 | 2.6 | 8.5 | 7.7 | 7.4 | | | | |
| 41-6 | $Ck_2$ | 60-110 | 1.1 | | | | | | 52.4 | 46.5 | 18.6 | 0.15 | 2.1 | 5.3 | 8.0 | 7.5 | | | | |
| | **Trout Lake Association, Orthic Gray Luvisol** | | | | | | | | | | | | | | | | | | | |
| 5-1 | L-H | 9-0 | | | | | | | | | | 0.95 | 48.9 | | 3.9 | 3.3 | | | | |
| 5-2 | Ae | 0-4 | 21.5 | 1.5 | 3.2 | 3.6 | 6.2 | 7.0 | 63.8 | 14.7 | 3.5 | 0.12 | 2.7 | | 3.5 | 3.3 | 2.2 | 1.2 | 0.2 | 0.1 |
| 5-3 | $Bt_1$ | 4-25 | 28.1 | 2.9 | 4.3 | 5.2 | 8.5 | 7.2 | 32.7 | 39.2 | 23.4 | 0.10 | 2.2 | | 4.1 | 3.7 | 3.5 | 1.6 | 0.2 | 0.1 |
| 5-4 | $Bt_2$ | 25-58 | 30.0 | 3.2 | 5.3 | 5.6 | 8.7 | 7.2 | 36.0 | 34.0 | 11.5 | 0.06 | 1.3 | | 4.4 | 3.8 | 4.8 | 2.0 | 0.2 | 0.1 |
| 5-5 | Ck | 58-68 | 33.5 | 4.0 | 5.9 | 6.3 | 9.6 | 7.7 | 36.6 | 30.0 | 12.9 | 0.05 | 2.0 | 14.1 | 7.5 | 7.1 | | | | |
| | **Trout Lake Association, Degraded Eutric Brunisol** | | | | | | | | | | | | | | | | | | | |
| 20-2 | Ae | 0-10 | | | | | | | | | | 0.04 | 1.3 | | 5.8 | 5.4 | 5.7 | 2.2 | 0.2 | 0.1 |
| 20-3 | Bm | 10-30 | | | | | | | | | | 0.04 | 1.0 | | 6.8 | 6.6 | 13.6 | 5.2 | 0.2 | 0.2 |
| 20-4 | $Ck_1$ | 30-51 | 27.4 | 2.7 | 4.1 | 3.7 | 9.5 | 7.4 | 40.2 | 32.5 | 12.8 | 0.06 | 1.2 | 22.4 | 8.0 | 7.8 | | | | |
| 20-5 | $Ck_2$ | 51-70 | 38.4 | 2.8 | 3.3 | 3.6 | 10.3 | 18.3 | 46.7 | 14.9 | 5.6 | 0.03 | 0.6 | 9.9 | 8.1 | 7.8 | | | | |

ANALYSES OF CERTAIN SOILS IN THE LIARD AND MACKENZIE AREA

| Sample No. | Horizon | Depth cm | Particle Size Distribution % Total Sand | % 2-1mm | % 1-.5mm | %.5 -.25mm | %.25 -.1mm | %.1 -.05mm | % Silt | % 2μ Clay | % 0.2μ Clay | % Total N | % O.M. | % $CaCO_3$ Equiv. | pH $H_2O$ | pH $CaCl_2$ | $NH_4OAc$ meg/100 g Ca | Mg | K | Na |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Winter Road Association, Degraded Eutric Brunisol | | | | | | | | | | | | | | | | | | |
| 2-1 | L-H | 9-0 | | | | | | | | | | 1.74 | 82.4 | | 5.4 | 5.2 | | | | |
| 2-2 | Ae | 0-10 | 23.4 | 0.1 | 0.3 | 0.5 | 2.8 | 19.6 | 70.6 | 6.0 | 2.0 | 0.08 | 2.1 | | 4.3 | 3.8 | 4.8 | 1.6 | 0.1 | 0.1 |
| 2-3 | $Btj_1$ | 10-30 | 24.2 | 0.0 | 0.2 | 0.3 | 1.7 | 22.1 | 63.9 | 11.8 | 4.6 | 0.03 | 1.2 | | 4.5 | 4.1 | 4.2 | 1.5 | 0.1 | 0.1 |
| 2-4 | $Btj_2$ | 30-56 | 65.7 | 0.0 | 0.6 | 1.8 | 19.0 | 44.2 | 24.1 | 10.2 | 4.9 | 0.06 | 0.7 | | 4.8 | 4.3 | 3.7 | 1.7 | 0.1 | 0.1 |
| 2-5 | $C_1$ | 56-100 | | | | | | | | | | 0.02 | 0.4 | 11.8 | 7.7 | 7.2 | | | | |
| 2-6 | $IIC_2$ | 100+ | 45.1 | 6.6 | 8.2 | 7.9 | 12.0 | 10.3 | 35.5 | 19.4 | 7.8 | 0.03 | 0.4 | 25.3 | 7.9 | 7.6 | | | | |

# APPENDIX III

## Acreage Summary

## of Capability Classes

Acreage Summary of Capability Classes

| Association | Capability Classes 3 | 4 | 5 | 6 | 7 | Total |
|---|---|---|---|---|---|---|
| Alluvium | | | | | 2,350 | 2,350 |
| Anderson Mill | | 2,045 | 227 | | | 2,272 |
| Antoine | 493 | | 42,158 | 3,152 | 7,769 | 53,572 |
| Arrowhead | 82,717 | 20,121 | 23,571 | 1,380 | 3,331 | 131,120 |
| Babiche | 3,935 | | 11,765 | | 300 | 16,000 |
| Big Island | 1,388 | | 14,831 | 745 | 6,869 | 23,833 |
| Blackstone River | 170 | | 6,051 | 373 | 5,697 | 12,291 |
| Bluebill | 15,975 | | 5,275 | | | 21,250 |
| Bluefish | 24,128 | 8,738 | 6,150 | | | 39,016 |
| Bovie Lake | 278,685 | 40,885 | 139,820 | | 21,426 | 480,816 |
| Bulmer | 37,753 | 31,985 | 272,950 | | 54,356 | 397,044 |
| Celibeta | 25,817 | | 20,219 | | | 46,036 |
| Colluvium | | | | 5,229 | 14,566 | 19,795 |
| Cormack Lake | 994 | | 27,878 | | 7,810 | 36,682 |
| Coty Mountain | 1,019 | 436 | | | | 1,455 |
| Exposure | | | | | 1,648 | 1,648 |
| Fisherman Lake | | 2,440 | 12,394 | | 2,311 | 17,145 |
| Flett | 416 | 3,853 | 8,162 | 2,579 | 1,209 | 16,219 |
| Grainger | 505 | | 28,003 | 3,950 | 257,338 | 289,796 |
| Gros Cap | 5,676 | | 280 | | | 5,956 |
| Harris | | | | 49,845 | 5,639 | 55,484 |
| Hillwash | | | 1,170 | 44,431 | 33,342 | 78,943 |
| Jean Marie | | 1,090 | 15,485 | | | 16,575 |
| Liard | 54,482 | 44,793 | 23,262 | 102 | 600 | 123,239 |
| Martin River | 1,595 | 1,703 | 120,495 | 39,155 | 28,217 | 191,165 |
| Netla | 29,188 | 7,191 | 3,900 | 699 | 1,543 | 42,521 |
| Petitot | 35,092 | | 4,854 | | 1,047 | 40,993 |
| Pointed Mountain | 16,779 | 8,904 | 14,822 | 1,578 | | 42,083 |
| Poplar | 51,408 | 1,933 | 8,906 | 2,301 | 2,392 | 66,940 |
| Rabbit Creek | 1,880 | 9,108 | 17,629 | | 5,984 | 34,601 |
| Scotty Creek | | 17,684 | 59,975 | 270 | 2,396 | 80,325 |
| Shale Creek | 8,503 | | 36,981 | | 7,839 | 53,323 |
| Sibbeston | 11,020 | 85,249 | 31,246 | 1,185 | 9,432 | 138,132 |
| Swan Point | 23,746 | 5,047 | 4,474 | 844 | | 34,111 |
| Trail River | 350 | 1,340 | 48,978 | 22,516 | 199,402 | 272,586 |
| Tributary Floodplain | | 14,964 | 18,731 | 27,002 | | 60,697 |
| Trout Lake | 8,041 | 24,558 | 66,364 | 6,241 | 120 | 105,324 |
| Winter Road | | 28,895 | 4,430 | | | 33,325 |
| Yohin Lake | 1,742 | 3,418 | 7,578 | 862 | 892 | 14,492 |
| Total Soil Area | 723,497 | 365,882 | 1,109,512 | 214,439 | 685,825 | 3,099,155 |
| Liard River | | | | | | 75,603 |
| MacKenzie River | | | | | | 64,348 |
| South Nahanni River | | | | | | 3,650 |
| Fisherman Lake | | | | | | 3,235 |
| Goose Lake | | | | | | 674 |
| Antoine Lake | | | | | | 5,850 |
| Betalamea Lake | | | | | | 498 |
| Unclassified Islands | | | | | | 7,766 |
| Sloughs | | | | | | 27,964 |
| Total Area | | | | | | 3,288,743 |

# APPENDIX IV

Detailed profile descriptions of selected soils in the Liard and Mackenzie area

## Arrowhead Association

Subgroup Profile - Gleyed Orthic Eutric Brunisol

Location - 10V DB 68 59, 60° 05' N. 123° 35' W.

Profile # - 28

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 28-1 | L-H | 14-0 | Well and moderately decomposed organic material. |
| 28-2 | Bmg | 0-20 | Yellowish brown (10YR 5/4 m) silt loam; many medium faint mottles; slightly sticky; very weak coarse subangular blocky; pH 6.8; smooth clear boundary to |
| 28-3 | Ckg | 20-45 | Olive gray (5Y 4/2 m) silt loam; many medium faintmottles; slightly sticky; very weak coarse subangular blocky; calcareous; pH 7.5. |

## Bluefish Association

Subgroup Profile - Orthic Eutric Brunisol

Location - 10V ED 330 825, 62° 05' N. 122° 20' W.

Profile # - 18

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 18-1 | L-H | 5-0 | Moderately and well decomposed organic material; pH 4.6; smooth clear boundary to |
| 18-2 | Bm1 | 0-15 | Yellowish brown (10YR 5/4 m) silt loam; friable; weak medium to coarse subangular blocky; pH 5.2; smooth gradual boundary to |
| 18-3 | Bm2 | 15-32 | Olive brown (10YR 4/4 m) silt loam; friable weak coarse subangular blocky; pH 5.4; smooth clear boundary to |
| 18-4 | Ck | 32-70 | Brown (10YR 4/3 m) silt loam; friable; laminated; calcareous; pH 7.3. |
| 18-5 | IICk | 70-85 | Loamy sand; loose; calcareous. |

## Bovie Association

Subgroup Profile - Degraded Eutric Brunisol

Location - 10V DB 680 590, 60° 05' N. 123° 35' W.

Profile # - 27

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 27-1 | L-H | 5-0 | Moderately and well decomposed organic material. |
| 27-2 | Ae | 0-7 | Light yellowish brown (10YR 6/4 m) silt loam; very friable; very weak fine to medium subangular blocky; pH 5.4; smooth clear boundary to |
| 27-3 | Bm | 7-28 | Yellowish brown (10YR 5/4 m) silt loam; friable; weak medium subangular blocky; pH 5.5; irregular gradual boundary to |
| 27-4 | Ck | 28-40 | Dark brown (10YR 4/3 m) silt loam; friable; very weak medium subangular blocky; calcareous; pH 7.5; smooth abrupt boundary to |
| 27-5 | IICk | 40-60 | Dark grayish brown (2.5Y 4/2 m) sandy loam; friable; very weak medium to coarse subangular blocky; calcareous; pH 7.7. |

## Celibeta Association

Subgroup Profile - Brunisolic Gray Luvisol

Location - 10V DB 663 812, 60° 16' N. 123° 35' W.

Profile # - 33

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 33-1 | L-H | 6-0 | Moderately and well decomposed organic material; pH 6.0; smooth clear boundary to |
| 33-2 | Ae | 0-10 | Yellowish brown (10YR 5.5/4 m) silt loam; very friable; compound weak coarse platy and very weak fine to medium subangular blocky; pH 6.0; smooth gradual boundary to |
| 33-3 | Bm | 10-20 | Dark yellowish brown (10YR 4.5/4 m) silty clay loam; friable; compound very weak coarse subangular blocky and moderate fine to medium subangular blocky; pH 4.4; smooth diffuse boundary to |
| 33-4 | IIBt1 | 20-40 | Dark yellowish brown (10YR 4/4 m) heavy clay; friable; compound moderate very coarse subangular blocky and moderate fine to medium subangular blocky; pH 4.1; smooth diffuse boundary to |
| 33-5 | IIBt2 | 40-50 | Brown (10YR 4.5/3 m) heavy clay; friable; compound weak very coarse subangular blocky and weak medium subangular blocky; pH 4.7; smooth diffuse boundary to |
| 33-6 | IICk | 50-65 | Grayish brown (10YR 4.5/2 m) heavy clay; friable; massive; calcareous; pH 7.6. |

## Cormack Association

Subgroup Profile - Orthic Gleysol peaty phase

Location - 10V FE 16 22, 62° 25' N. 120° 43' W.

Profile # - 16

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 16-1 | F-H | 30-15 | Moderately to well decomposed organic material; pH 5.7; smooth gradual boundary to |
| 16-2 | H | 15-0 | Well decomposed organic material; pH 5.8; wavy diffuse boundary to |
| 16-3 | Bg | 0-20 | Dark grayish brown (2.5Y 4/2 m) loam; slightly sticky; weak very coarse subangular blocky; pH 6.7; smooth diffuse boundary to |
| 16-4 | Ckg | 20-40 | Dark grayish brown (10YR 4/2 m) loam; slightly sticky; weak very coarse subangular blocky; calcareous; pH 7.5. |

## Grainger Association

Subgroup Profile - Cryic Fibrisol

Location - 10V EC 22 94, 61° 17' N. 122° 33' W.

Profile # - 44

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 44-1 | OF | 0-34 | Yellowish red (5YR 4/6 m) fibrous peat; pH 3.3. |
| 44-2 | | 34-35 | Pink (7.5YR 8/4 m) ash layer. |
| 44-3 | OF | 35-80 | Dark reddish brown (5YR 3/4 m) fibrous peat; pH 3.3. |
| 44-4 | OF | 80-130 | Dark reddish brown (5YR 2/2 m) fibrous peat; pH 3.4. |

## Gros Cap Association

Subgroup Profile - Orthic Gray Luvisol

Location - 10V ED 93 44, 61° 43' N. 121° 15' W.

Profile # - 10

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 10-1 | L-H | 10-0 | Moderately and well decomposed organic material; pH 5.7. |
| 10-2 | Ae | 0-12 | Yellowish brown (10YR 5/4 m) silt loam; very friable; weak medium platy; pH 4.8; smooth abrupt boundary to |
| 10-3 | Bt | 12-32 | Dark brown (10YR 4/3 m) silty clay; friable; weak coarse subangular blocky breaking to moderate fine subangular blocky; pH 4.4; smooth clear boundary to |
| 10-4 | Ck | 32-56 | Grayish brown (10YR 5/2 m) silty clay loam; friable; weak moderate subangular blocky; calcareous; pH 7.6. |

## Jean-Marie Association

Subgroup Profile - Degraded Eutric Brunisol

Location - 10V ED 89 175, 61° 27' N. 121° 17' W.

Profile # - 11

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 11-1 | Ae | 0-7 | Yellowish brown (10YR 5/4 m) loamy sand; loose; single grain; pH 5.5; wavy gradual boundary to |
| 11-2 | Bm | 7-45 | Dark yellowish brown (10YR 4/4 m) loamy sand; loose; single grain; pH 5.5; smooth gradual boundary to |
| 11-3 | IICk | 45-62 | Very dark grayish brown (10YR 3/2 m) very gravelly loamy sand; loose; single grain; calcareous; pH 7.5. |

## Liard Association

Subgroup Profile - Cumulic Regosol

Location - 10V DC 791 663, 61° 2' N. 123° 23' W.

Profile # - 42

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 42-1 | L-H | 20-0 | Moderately and well decomposed organic material; pH 6.7. |
| 42-2 | AC | 0-20 | Very dark gray (10YR 3/1 m) silt loam; very friable; single grain; calcareous; pH 7.4. |
| 42-3 | Ck1 | 20-35 | Very dark grayish brown (10YR 3/2 m) silt loam; very friable; single grain; calcareous; pH 7.4. |
| 42-4 | Ck2 | 35-50 | Dark grayish brown (10YR 4/2 m) silt loam; very friable; single grain; calcareous; pH 7.5. |

## Martin River Association

Subgroup Profile - Orthic Eutric Brunisol

Location - 10V ED 89 37, 61° 40' N. 121° 20' W.

Profile # - 1

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 1-1 | L-H | 7-0 | Moderately and well decomposed organic material; pH 6.3. |
| 1-2 | Bm1 | 0-10 | Dark yellowish brown (10YR 4/4 m) loamy fine sand; loose; weak medium subangular blocky; pH 5.0; smooth gradual boundary to |
| 1-3 | Bm2 | 10-25 | Dark brown (7.5YR 4/4 m) loamy fine sand; loose; weak medium subangular blocky; pH 4.6; smooth diffuse boundary to |
| 1-4 | BC | 25-60 | Olive brown (2.5Y 4/4 m) fine sand; loose; single grain; pH 5.0; irregular diffuse boundary to |
| 1-5 | C | 60+ | Dark grayish brown (2.5Y 4/2 m) fine sand; loose; single grain; pH 5.5. |

## Martin River Association

Subgroup Profile - Degraded Eutric Brunisol

Location - 10V ED 72 62, 61° 53' N. 121° 37' W.

Profile # - 9

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 9-1 | L-H | 5-0 | Moderately and well decomposed organic material; pH 5.3. |
| 9-2 | Ae | 0-5 | Brown (10YR 5/3 m) sandy loam; loose; very weak coarse subangular blocky; pH 4.0; wavy clear boundary to |
| 9-3 | Bm1 | 5-10 | Dark brown (7.5YR 4/4 m) loamy fine sand; loose; moderate medium subangular blocky; pH 4.7; smooth gradual boundary to |
| 9-4 | Bm2 | 10-56 | Dark brown (7.5YR 4/4 m) loamy fine sand; loose; very weak coarse subangular blocky; pH 5.1; smooth gradual boundary to |
| 9-5 | Ck | 56+ | Dark grayish brown (2.5Y 4/2 m) loamy fine sand; loose; single grain; pH 7.6. |

## Netla Association

Subgroup Profile - Orthic Eutric Brunisol

Location - 10V DC 757 537, 60° 55' N. 123° 27' W.

Profile # - 31

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 31-1 | L-H | 8-0 | Moderately and well decomposed organic material; pH 5.5. |
| 31-2 | Bm1 | 0-10 | Dark reddish brown (5YR 4/2 m) silty clay loam; sticky; compound weak coarse subangular blocky and moderate fine to medium subangular blocky; pH 4.0; smooth gradual boundary to |
| 31-3 | Bm2 | 10-30 | Dark grayish brown (10YR 4/2 m) silty clay; sticky; compound weak coarse subangular blocky and moderate fine to medium subangular blocky; pH 4.4; smooth clear boundary to |
| 31-4 | BC | 30-45 | Dark brown (10YR 3/3 m) silty clay loam; sticky; very weak coarse subangular blocky; calcareous; pH 6.9; smooth clear boundary to |
| 31-5 | Ck1 | 45-60 | Brown (10YR 4.5/2.5 m) silt loam; friable; massive; calcareous; pH 7.4. |
| 31-6 | Ck2 | 60-70 | Grayish brown (10YR 5/2 m) silt loam; friable; massive; calcareous; pH 7.5. |

## Petitot Association

Subgroup Profile - Degraded Eutric Brunisol

Location - 10V EC 17 95, 61° 17' N. 122° 43' W.

Profile # - 43

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 43-1 | L-H | 7-0 | Moderately and well decomposed organic material; wavy abrupt boundary to |
| 43-2 | Ae | 0-10 | Brown (10YR 5/3 m) silty clay; friable; weak to moderate coarse platy; pH 5.8; smooth gradual boundary to |
| 43-3 | Btj | 10-32 | Grayish brown (10YR 4.5/2 m) silty clay; friable; moderate fine subangular blocky; pH 7.1; smooth clear boundary to |
| 43-4 | Ck1 | 32-45 | Dark grayish brown (10YR 4/2 m) silty clay; friable; weak to moderate fine to very fine subangular blocky; calcareous; pH 7.6; smooth gradual boundary to |
| 43-5 | Ck2 | 45-70 | Very dark grayish brown (10YR 3/2 m) silty clay; friable; weak fine subangular blocky; calcareous; pH 7.7. |

## Pointed Mountain Association

Subgroup Profile - Orthic Gray Luvisol

Location - 10V DB 614 843, $60^{\circ}$ 16' N. $123^{\circ}$ 37' W.

Profile # - 30

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 30-1 | L-H | 6-0 | Moderately and well decomposed organic material; pH 5.8. |
| 30-2 | Ae | 0-18 | Pale brown (10YR 6/3 m) silt loam; very friable; compound very weak coarse subangular blocky and weak coarse platy; pH 4.2; smooth clear boundary to |
| 30-3 | Bt1 | 18-34 | Dark grayish brown (10YR 4/2 d) heavy clay; friable; compound weak coarse subangular blocky and strong fine to medium subangular blocky; pH 4.4; smooth clear boundary to |
| 30-4 | Bt2 | 34-49 | Very dark gray (10YR 3/1 d) heavy clay; friable; compound weak to moderate subangular blocky and moderate fine to medium subangular blocky; pH 4.9; smooth gradual boundary to |
| 30-5 | BC | 49-57 | Very dark gray (10YR 3/1 d) heavy clay; friable; massive; calcareous; pH 6.7; smooth gradual boundary to |
| 30-6 | Ck | 57-70 | Brown (10YR 5/3 d) heavy clay; friable; massive; calcareous; pH 7.6. |

## Rabbit Creek Association

Subgroup Profile - Degraded Eutric Brunisol

Location - 10V EC 795 605, 60° 58' N. 121° 31' W.

Profile # - 38

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 38-1 | L-H | 5-0 | Moderately and well decomposed organic material. |
| 38-2 | Ae | 0-4 | Gray (10YR 5/1 m) sandy loam; very weak medium platy; pH 3.9. |
| 38-3 | Btj | 4-22 | Yellowish brown (10YR 5/4 m) loam; weak to moderate fine to medium subangular blocky; pH 4.4. |
| 38-4 | Ck1 | 22-50 | Brown (10YR 5/3 m) loam; massive; calcareous; pH 7.3. |
| 38-5 | Ck2 | 50-100 | Loam; massive; calcareous; pH 7.4. |

## Swan Point Association

Subgroup Profile - Orthic Gray Luvisol

Location - 10V EC 047 772, 61° 5' N. 122° 54' W.

Profile # - 41

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 41-1 | L-H | 7-0 | Moderately and well decomposed organic material; pH 5.0. |
| 41-2 | Ae | 0-8 | Dark gray (10YR 4/1 m) silty clay loam; friable; compound weak medium to coarse platy and moderate fine to medium subangular blocky; pH 4.8; wavy clear boundary to |
| 41-3 | Bt1 | 8-16 | Dark brown (10YR 4/3 m) silty clay loam; firm; compound moderate to strong very coarse subangular blocky and strong medium subangular blocky; pH 4.9; smooth clear boundary to |
| 41-4 | Bt2 | 16-34 | Dark reddish brown (5YR 3/4 m) silty clay; firm; compound moderate to strong coarse subangular blocky and moderate to strong fine subangular blocky; pH 5.5; smooth abrupt boundary to |
| 41-5 | Ck1 | 34-60 | Very dark grayish brown (10YR 3/2 m) silty clay; friable; weak fine subangular blocky; calcareous; pH 7.4; smooth diffuse boundary to |
| 41-6 | Ck2 | 60-110 | Dark brown (10YR 3/3 m) silty clay; friable; weak fine subangular blocky; calcareous; pH 7.5. |

## Trout Lake Association

Subgroup Profile - Orthic Gray Luvisol

Location - 10V FD 01 81, 62° 05' N. 121° 05' W.

Profile # - 14

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 14-1 | L-H | 7-0 | Moderately and well decomposed organic material; pH 4.6; boundary smooth clear. |
| 14-2 | Bt | 0-30 | Dark yellowish brown (10YR 3/4 d) clay loam; slightly hard; compound weak medium to coarse subangular blocky and strong fine subangular blocky; pH 6.1; smooth gradual boundary to |
| 14-3 | BCk | 30-65 | Dark grayish brown (10YR 4/2 m) loam; friable; compound weak medium to coarse subangular blocky and very weak fine subangular blocky; calcareous; pH 7.6; irregular diffuse boundary to |
| 14-4 | Ck | 65-80 | Dark brown (10YR 3/3 m) loam; friable; compound weak medium to coarse subangular blocky and very weak fine subangular blocky; calcareous; pH 7.8. |

## Trout Lake Association

Subgroup Profile - Orthic Gray Luvisol

Location - 10V ED 134 045, $61^{o}$ 72' N. $122^{o}$ 45' W.

Profile # - 22

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 22-1 | L-H | 3-0 | Moderately and well decomposed organic material; smooth clear boundary to |
| 22-2 | Ae | 0-5 | Brown (10YR 5/3 m) silt loam; soft; weak fine to medium subangular blocky; pH 3.9; smooth gradual boundary to |
| 22-3 | AB | 5-10 | Dark brown (7.5YR 4/4 m) silty clay loam; slightly hard; compound weak medium subangular blocky and moderate fine subangular blocky; pH 4.0; smooth gradual boundary to |
| 22-4 | Bt | 10-40 | Dark brown (7.5YR 4/4 m) silty clay; firm; compound strong coarse subangular blocky and weak fine subangular blocky; pH 4.5; smooth gradual boundary to |
| 22-5 | Bm | 40-55 | Dark grayish brown (2.5Y 4/2 m) silty clay loam; friable; compound very weak medium to coarse subangular blocky and weak fine subangular blocky; pH 6.7; smooth diffuse boundary to |
| 22-6 | Ck | 55+ | Dark grayish brown (2.5Y 4/2 m) silty clay loam; friable; compound very weak medium to coarse subangular blocky and weak fine subangular blocky; calcareous; pH 7.5. |

## Winter Road Association

Subgroup Profile -

Location - 10V ED 81 08, 61° 24' N. 121° 13' W.

Profile # - 2

| Sample No. | Horizon | Depth cm | |
|---|---|---|---|
| 2-1 | L-H | 9-0 | Moderately and well decomposed organic material; pH 5.2. |
| 2-2 | Ae | 0-10 | Grayish brown (10YR 5/2 m) silt loam; friable; weak to moderate medium platy; pH 3.8; smooth clear boundary to |
| 2-3 | Btj1 | 10-30 | Dark yellowish brown (10YR 4/4 m) silt loam; friable; weak medium subangular blocky; pH 4.1; smooth abrupt boundary to |
| 2-4 | Btj2 | 30-56 | Dark yellowish brown (10YR 4/4 m, 2.5YR 4/4 d) very fine sandy loam; friable; weak coarse subangular blocky; pH 4.3; smooth gradual boundary to |
| 2-5 | IC | 56-100 | Olive brown (2.5Y 4/4 m) loamy sand; loose; single grain; calcareous; pH 7.2; smooth gradual boundary to |
| 2-6 | IIC | 100+ | Olive brown (2.5Y 4/4 m) loam; friable; weak to moderate weak subangular blocky; calcareous; pH 7.6. |

# APPENDIX V

## List of Vegetation, Common and Scientific Names

LIST OF VEGETATION,

COMMON AND SCIENTIFIC NAMES

| Scientific Names | Common Names |
| --- | --- |
| Trees | |
| Betula papyrifera | white (paper) birch |
| Larix laricina | tamarack (larch) |
| Picea glauca | white spruce |
| Picea mariana | black spruce |
| Pinus banksiana | jack pine |
| Pinus contorta | lodgepole pine |
| Populus balsamifera | balsam (black) poplar |
| Populus tremuloides | trembling aspen |
| Sorbus scopulina | mountain ash |
| Tall Shrubs | |
| Alnus crispa | green alder |
| Alnus incana | river (speckled) alder |
| Amelanchier alnifolia | saskatoon berry |
| Betula pumila var. glandulifera | swamp birch |
| Cornus stolonifera | red osier dogwood |
| Salix athabascensis | willow |
| S. arbuscolides | " |
| S. barclayi | " |
| S. bebbiana | beaked willow |
| S. interior | sandbar willow |
| S. lasiandra | |
| S. myrtillifolia | low blueberry willow |
| S. pedicellaris | glacous bog willow |
| S. scouleriana | scouler's willow |
| S. pulchra | beautiful willow |
| S. planifolia | diamondleaf willow |

| Scientific Names | Common Names |
|---|---|
| Medium Shrubs | |
| Betula glandulosa | dwarf (bog) birch |
| Chamaedaphne calyculata | leatherleaf |
| Eleagnus commutata | wolf willow |
| Juniperus communis | ground juniper |
| Ledum groenladicum | common Labrador tea |
| L. decumbens | northern Labrador tea |
| Lonicera glaucescens | Honeysuckle |
| Myrica gale | sweet gale |
| Potentilla fruticosa | shrubby cinquefoil |
| Ribes glandulosum | skunk currant |
| R. hudsonianum | wild black currant |
| R. oxyacanthoides | wild gooseberry |
| R. triste | wild red currant |
| Rosa acicularis | wild rose |
| Rubus strigosus | wild red raspberry |
| Sheperdia canadensis | buffalo berry |
| Viburnum edule | lowbush cranberry |
| Short Shrubs | |
| Andromeda polifolia | bog rosemary |
| Arcostaphylos rubra | alpine bearberry |
| A. uva-ursi | common bearberry |
| Empetrum nigrum | crowberry |
| Juniperus horizontalis | creeping juniper |
| Kalmia polifolia | swamp laurel |
| Oxycoccus microcarpus | small bog cranberry |
| Vaccinium membranaceum | tall bilberry |
| V. uliginosum | bog bilberry |
| V. myrtilloides | blueberry |
| V. vitis-idaea | bog cranberry (lowberry) |

| Scientific Names | Common Names |
| --- | --- |
| Herbs | |
| Achillea nigrescens | yarrow |
| Actaea rubra | baneberry |
| Anemone multifida | Anemone |
| Aquilegia spp. | columbine |
| Aralia nudicaulis | sarsaparilla |
| Artemisia canadensis | wormwood |
| Arnica spp. | arnica |
| Aster spp. | aster |
| Astragalus tenellus | milkvetch |
| Calypso bulbosa | venus' slipper |
| Castilleja spp. | Indian paintbrush |
| Chenopodium capitatum | strawberry blite |
| Circaea alpina | enchanter's nightshade |
| Comandra livida | toad flax |
| Corallorhiza striata | striped coral root |
| Cornus canadensis | bunchberry |
| Corydalis spp. | corydalis |
| Delphinium glaucum | tall larkspur |
| Drosera anglica | sun dew |
| D. rotundifolia | roundleaf sundew |
| Dryas drummondii | yellow dryas |
| Epilobium angustifolium | fireweed |
| Equisetum arvense | common horsetail |
| E. hyemale | scouring rush |
| E. palustre | horsetail |
| E. pratense | meadow horsetail |
| E. scirpoides | dwarf scouring rush |
| E. sylvaticum | woodland horsetail |
| Fragaria virginiana | wild strawberry |
| Galium boreale | northern bedstraw |
| G. triflorum | sweet-scented bedstraw |
| Goodyera repens | rattlesnake plaintain |
| Geocaulon lividum | bastard toad flax |
| Habenaria spp. | bog orchid |
| Hedysarum mackenzii | hedysarum |

| Scientific Names | Common Names |
|---|---|
| Herbs (cont.) | |
| Lathyrus ochroleucus | pea vine |
| Linnaea borealis | twinflower |
| Lupinus spp. | lupine |
| Lycopodium annotinum | stiff club moss |
| L. clavatum | running club moss |
| L. complanatum | ground cedar |
| Maianthemum canadense | lilly of the valley |
| Menyanthes trifoliata | buckbear |
| Mertensia paniculata | bluebell |
| Mitella nuda | mitrewort |
| Monesis uniflora | wintergreen |
| Orchis rotundifolia | round-leaved orchid |
| Parnassia palustris | grass of parnassus |
| Pedicularis labradorica | lousewort |
| Petasites palmatus | palm-leaved coltsfoot |
| P. sagittatus | arrow-leaved coltsfoot |
| Potentilla norvegica | cinquefoil |
| P. fruticosa | shrubby cinquefoil |
| Pyrola asarifolia | common pink wintergreen |
| P. secunda | one-sided wintergreen |
| P. virens | green flowered wintergreen |
| Ranunculus spp. | buttercup |
| Rubus acaulis | dwarf raspberry |
| R. chamaemorous | baked appleberry (cloudberry) |
| R. pubescens | dewberry |
| Sarracenia purpurea | pitcher plant |
| Senecio spp. | senecio |
| Smilacina trifoliata | false solomon's seal |
| Solidago spp. | goldenrod |
| Streptopus amplexifolius | twisted stalk |
| Thalictrum sparsiflorum | meadow rill |
| Tofieldia pusilla | false asphodel |

| Scientific Name | Common Name |
|---|---|
| Herbs (cont.) | |
| *Tricularia spp.* | bladderwort |
| *Triglochin maritima* | arrow grass |
| *Viola renifolia* | kidney-leaved violet |
| *V. rugulosa* | Western Canada violet |
| *Vicia americana* | wild vetch |
| Graminoids (Grasses) | |
| Gramineae | |
| *Agrostis scabra* | ticklegrass |
| *Agropyron subsecundum* | bearded wheat grass |
| *A. trachycaulum* | slender wheat grass |
| *Arctagrostis arundinacea* | |
| *Beckmannia sysigachne* | sloughgrass |
| *Bromus spp.* | brome grass |
| *Calamagrostis canadensis* | marsh reed grass (bluejoint) |
| *C. inexpansa* | northern reed grass |
| *C. laponnica* | Lapland reed grass |
| *Cinna latifolia* | drooping wood reed |
| *Deschampsia caespitosa* | tufted hair grass |
| *Elymus canadensis* | Canada wild rye |
| *Glyceria pulchella* | manna grass |
| *Oryzopsis pungens* | rice grass |
| *Poa alpigena* | alpine blue grass |
| *Poa spp.* | bluegrass |
| *Trisetum spicatum* | |
| Cyperaceae (Sedges) | |
| *Eriophorum spp.* | cottongrass |
| *Eleocharis spp.* | spike rush |
| *Carex aquatilus* | sedge |
| *C. atherodes* | " |
| *C. rostrata* | " |
| *Carex spp.* | " |

| Scientific Name | Common Name |
|---|---|
| Marsh Plants | |
| Calla palustris | water arum |
| Juncus spp. | |
| Luzula spp. | |
| Sagittaria cuneata | arrowhead |
| S. latifolia | arrowhead |
| Scirpus spp. | bulrush |
| Sphagna | |
| Sphagnum spp. | sphagnum moss |
| Mosses | |
| Aulacomnium palustre | ribbed bog moss |
| Campthothecium nitens | |
| Dicranum spp. | broom moss |
| Drepanocladus uncinatus | |
| Eurhynchium pulchellum | |
| Hylocomium splendens | feathermoss |
| Mnium affine | |
| Pleurozium scheberi | Schrebers moss |
| Polytrichum commune | haircap moss |
| P. juniperinum | |
| Pylaisiella polyantha | |
| Ptilium crasta-castrensis | plume moss |
| Rhytidiadelphus triquestrus | |
| Timmia bavarica | |
| Tomenthypnum nitens | |
| Lichens | |
| Cladonia alpestris | reindeer moss |
| C. amaurocraea | " |
| C. cornuta | " |
| C. deformis | " |
| C. gracilis | " |
| C. mitis | " |

| Scientific Name | Common Name |
|---|---|
| Lichens (cont.) | |
| *Cladonia rangiferina* | reindeer moss |
| *C. sylvatica* | " |
| *Cetraria cuculata* | |
| *C. nivalis* | |
| *C. pinastri* | |
| *Peltigera apthosa* | spotted peltigera |
| *Stereocaulon paschale* | |

# APPENDIX V1

## Acreages of Soil Association and Capability Classes and Subclasses

These are the areas (in acres) of all Agricultural Capability Classes and Subclasses for each Soil Association and Complex in the Liard-Mackenzie River area. The areas are given for each 1:50,000 map sheet (95B3, 95B4, etc.) and also summarized for each 1:125,000 sheet (95B, 95G, 95H, and 95I,J).

The acreage shown for each Soil Association includes all soil areas in which that Soil Association was dominant in the map edit.

SUMMARY MAP SHEET 95B

| Association | 3CH | 3CA | 3M | 3D | 3I | 3T | 4W | 4T | 4I | 4E | 4M | 4D | 5T | 5W | 5I | 5CH | 6W | 6T | 7W | 7T | 7I | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anderson Mill | | | | | | | | | | | 785 | | | 87 | | | | | | | | 872 |
| Arrowhead | | | 39699 | | | 1948 | 7155 | | | 2524 | | | 526 | 12032 | | | | | 461 | | | 64345 |
| Babiche | | | 2698 | | | | | | | | | | | 8877 | | | | | 300 | | | 11875 |
| Big Island | | | 853 | | | | | | | | | | | 11961 | | | | | 6519 | | | 19333 |
| Blackstone River | | | | | | | | | | | | | | 746 | | | 373 | | 1813 | | 3884 | 6816 |
| Bluefish | | | 19316 | | | | 369 | 3762 | | | 4607 | | | 5665 | | | | | | | | 33719 |
| Bovie Lake | | | 149791 | 9255 | | 16488 | 105 | 24793 | | | 3371 | | 2934 | 70316 | | 24461 | | | 16277 | | | 317791 |
| Bulmer | | | 14516 | 1422 | | | 18407 | 3446 | | | 1374 | | | 101199 | | 5924 | | | 22856 | | | 169144 |
| Celibeta | | | | 18055 | | 7762 | | | | | | | | 6856 | | 13363 | | | | | | 46036 |
| Colluvium | | | | | | | | | | | | | | | | | | 2754 | | 12491 | | 15245 |
| Cormack Lake | | | 554 | | | | | | | | | | | 18024 | | 1809 | | | 3970 | | | 24357 |
| Coty Mountain | | 1019 | | | | | 436 | | | | | | | | | | | | | | | 1455 |
| Exposure | | | | | | | | | | | | | | | | | | | | 1498 | | 1498 |
| Fisherman Lake | | | | | | | 2440 | | | | | | | 12394 | | | | | 2311 | | | 17145 |
| Flett | | 416 | | | | | 1142 | | | | | 1444 | | 5204 | | | 2579 | | 1209 | | | 11994 |
| Grainger | | | | | | | | | | | | | | 4746 | | | | | 35679 | | | 40425 |

| Association | 3CH | 3CA | 3M | 3D | 3I | 3T | 4W | 4T | 4I | 4E | 4M | 4D | 5T | 5W | 5I | 5CH | 6W | 6T | 7W | 7T | 7I | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hillwash | | | | | | | | | | | | | 1170 | | | | | 26115 | | 21007 | | 48292 |
| Liard | | 11523 | | | 14244 | 9799 | 5087 | 3836 | 19470 | | | | | 7084 | 3128 | | 102 | | | | | 74273 |
| Netla | | 16951 | | | | 4343 | 3377 | 1315 | | | | | | 3823 | | | 219 | | 725 | 818 | | 31571 |
| Petitot | 6932 | | | 1783 | | 953 | | | | | | | | | | | | | | | | 9668 |
| Pointed Mountain | | | | 13865 | | 2914 | | 8904 | | | | | 5583 | 4790 | | 4449 | | 1578 | | | | 42083 |
| Poplar | | 2648 | 13842 | | 547 | | 819 | | | | | | | 3257 | | | | | 80 | | | 21193 |
| Shale Creek | | | 2763 | | | | | | | | | | | 13058 | | | | | 2952 | | | 18773 |
| Swan Point | | 2558 | 1299 | 4747 | | 759 | 326 | | | | | 2119 | | 2684 | | | 844 | | | | | 15336 |
| Trail River | | | | | | | | | | | | | | 1247 | | | 2175 | | 11361 | | | 14783 |
| Tributary Flood Plain | | | | | | | | 328 | 7181 | | | | 6513 | 219 | 4418 | 396 | | 13590 | | | | 32645 |
| Trout Lake | | | 1119 | 1492 | | 3085 | | 22553 | | | | | 4420 | 16635 | | 31559 | | 6241 | | | 120 | 87224 |
| Yohin Lake | | | 552 | | | | 921 | 1030 | | | 642 | | 398 | 3962 | | | | | 687 | | | 8192 |
| Totals | 6932 | 35115 | 247002 | 50619 | 14791 | 48051 | 40584 | 69967 | 26651 | 2524 | 10779 | 3563 | 21544 | 314866 | 7546 | 81961 | 6292 | 50278 | 107200 | 35814 | 4004 | 1186083 |
| Class Totals | 402510 | | | | | | 154068 | | | | | | 425917 | | | | 56570 | | 147018 | | | |

| | |
|---|---|
| Liard River | 34713 |
| Betalamea Lake | 498 |
| Fisherman Lake | 3235 |
| Unclassified Area | 467162 |
| Unclassified Islands | 2200 |
| Sloughs | 4857 |
| | 512665 |

SUMMARY MAP SHEET 95G

| Association | 3CH | 3CA | 3M | 3D | 3I | 4M | 4W | 4T | 4I | 4D | 5W | 5I | 5CH | 5M | 6I | 6W | 6T | 7W | 7T | 7I | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alluvium | | | | | | | | | | | | | | | | | | | | 2350 | 2350 |
| Arrowhead | | | 32890 | | | | 5342 | | | | 7548 | | | | | | | 2870 | | | 48650 |
| Bluebill | | | 1950 | 14025 | | | | | | | 2775 | | 2500 | | | | | | | | 21250 |
| Babiche | | | 1237 | | | | | | | | 2888 | | | | | | | | | | 4125 |
| Bluefish | | | 2290 | | | | | | | | 485 | | | | | | | | | | 2775 |
| Big Island | 535 | | | | | | | | | | 2870 | | | | | 745 | | 350 | | | 4500 |
| Bovie Lake | | | 60876 | 8087 | | 3440 | | 465 | | 5288 | 15430 | | | | | | | 2189 | | | 95775 |
| Blackstone River | | 170 | | | | | | | | | 5305 | | | | | | | | | | 5475 |
| Bulmer | | | 7804 | 3610 | | 735 | 2590 | | | 3450 | 51465 | | | | | | | 8646 | | | 78300 |
| Colluvium | | | | | | | | | | | | | | | | | 2475 | | 2075 | | 4550 |
| Exposure | | | | | | | | | | | | | | | | | | | 150 | | 150 |
| Flett | | | | | | 172 | 1095 | | | | 2958 | | | | | | | | | | 4225 |
| Grainger | 505 | | | | | | | | | | 5009 | | | | | 2500 | | 67386 | | | 75400 |
| Hillwash | | | | | | | | | | | | | | | | | 3250 | | 500 | | 3750 |
| Liard | | 5748 | | | 10377 | | 832 | 1690 | 13878 | | 4438 | 4262 | | | | | | | | 600 | 41825 |
| Netla | | 7894 | | | | | 2499 | | | | 77 | | | | | 480 | | | | | 10950 |
| Poplar | | 320 | 25064 | | | | 1004 | | | | 4200 | | | | | | | 812 | | | 31400 |

| Association | 3CH | 3CA | 3M | 3D | 3I | 4M | 4W | 4T | 4I | 4D | 5W | 5I | 5CH | 5M | 6I | 6W | 6T | 7W | 7T | 7I | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Petitot | 14286 | 7003 | | 4135 | | | | | | | 4854 | | | | | | | 1047 | | | 31325 |
| Rabbit Creek | | | | 1880 | | 1043 | | | | 8065 | 7563 | | 6540 | | | | | 3634 | | | 28725 |
| Scotty Creek | | | | | | 370 | | | | | 1480 | | | | | | | | | | 1850 |
| Shale Creek | | | 3355 | | | | | | | | 15258 | | | | | | | 4287 | | | 22900 |
| Sibbeston | | | 1590 | | | 7648 | | | | | 2442 | | | | | | | 870 | | | 12550 |
| Swan Point | | 4198 | | 10185 | | | 2602 | | | | 1790 | | | | | | | | | | 18775 |
| Trail River | | | 350 | | | | | | | 1090 | 917 | | | | | 10875 | | 14893 | | | 28125 |
| Tributary Flood Plain | | | | | | | | 3705 | | | 2470 | 1755 | | | 4450 | | 1320 | | | | 13700 |
| Trout Lake | | | | | | | | 1150 | | | | | 3125 | | | | | | | | 4275 |
| Yohin Lake | | | 1190 | | | 825 | | | | | 1780 | | | 1438 | | 862 | | 205 | | | 6300 |
| Totals | 15326 | 25333 | 138596 | 41922 | 10377 | 14233 | 15964 | 7010 | 13878 | 17893 | 144002 | 6017 | 12165 | 1438 | 4450 | 15462 | 7045 | 107189 | 2725 | 2950 | 603975 |
| Class Totals | 231554 | | | | | 68978 | | | | | 163622 | | | | 26957 | | | 112864 | | | |

| | |
|---|---|
| Liard River | 24125 |
| South Nahanni River | 3650 |
| Unclassified Area | 475031 |
| Sloughs | 2399 |
| | 505205 |

SUMMARY MAP SHEET 95H

| Association | 3CS | 3M | 3D | 4M | 4T | 4I | 5SE | 5T | 5W | 5CS | 6SE | 6W | 6TE | 6P | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antoine | | 493 | | | | | 10127 | 456 | 26085 | | | 2622 | | | 4639 | | 44422 |
| Anderson Mill | | | | 562 | | | | | 63 | | | | | | | | 625 |
| Arrowhead | | 3430 | | | | | | | 340 | | | | 1380 | | | | 5150 |
| Bluefish | | 2522 | | | | | | | | | | | | | | | 2522 |
| Bovie Lake | | 6623 | | 1060 | 2362 | | | | 2180 | | | | | | | | 12225 |
| Bulmer | | 635 | | 1485 | | | | | 7805 | | | | | | | | 9925 |
| Grainger | | | | | | | 2208 | | 13040 | | | 1450 | | | 123148 | | 139846 |
| Gros Cap | | | 3856 | | | | | | | | | | | | | | 3856 |
| Harris | | | | | | | | | | | | | | 51750 | 6909 | | 58659 |
| Hillwash | | | | | | | | | | | | | 11641 | | | 11560 | 23201 |
| Jean Marie | | | | 1090 | | | 14395 | | 1090 | | | | | | | | 16575 |
| Liard | 2122 | 669 | | | | | | | | | | | | | | | 2791 |
| Martin River | | 1595 | | 1703 | | | 71853 | | 26629 | | 28604 | 88 | | | 25843 | | 156315 |
| Poplar | | 5047 | | | | 110 | | | 139 | | | | | 2301 | | | 7597 |
| Rabbit Creek | | | | | | | | | | 3526 | | | | | 2350 | | 5876 |
| Sibbeston | | 2431 | 6999 | 76753 | 323 | | 1445 | | 24196 | 2900 | | 1185 | | | 8475 | | 124707 |
| Scotty Creek | | | | 17314 | | | 9475 | | 49020 | | | 270 | | | 2396 | | 78475 |
| Trail River | | | | 250 | | | 17408 | | 29096 | | 118 | 4932 | | 4416 | 165258 | | 221478 |
| Trout Lake | | | 1425 | 855 | | | | 1595 | | | | | | | | | 3875 |

| Association | 3CS | 3M | 3D | 4M | 4T | 4I | 5SE | 5T | 5W | 5CS | 6SE | 6W | 6TE | 6P | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tributary Flood Plain | | | | 990 | 2760 | | | 1485 | 1475 | | | 4327 | 3315 | | | | 14352 |
| Winter Road | | | | 28895 | | | | | 4430 | | | | | | | | 33325 |
| Totals | 2122 | 23445 | 12280 | 130957 | 5445 | 110 | 126911 | 3536 | 185588 | 6426 | 28722 | 14874 | 16336 | 58467 | 339018 | 11560 | 965797 |
| Class Totals | 37847 | | | 136512 | | | 322461 | | | | 118399 | | | | 350578 | | |

| Map Sheet | Liard River | MacKenzie River | Antoine Lake | Goose Lake | Unclassified Area | Unclassified Islands | Sloughs |
|---|---|---|---|---|---|---|---|
| 95H5 | 5900 | | | | | 149 | 5525 |
| 95H6 | 300 | | | 674 | | | 900 |
| 95H11 | 6689 | | | | | | 3200 |
| 95H12 | | | 5850 | | 24989 | | 1600 |
| 95H13 | | 8125 | | | 44067 | 100 | 1775 |
| 95H14 | 3876 | 9848 | | | | 292 | 5008 |
| Totals | 16765 | 17973 | 5850 | 674 | 69056 | 541 | 18008 |

SUMMARY MAP SHEET 95I, J & G16

| Association | 3M | 3DE | 3ME | 4M | 4E | 5W | 5I | 5CS | 5MF | 6TE | 6SE | 7W | 7TE | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anderson Mill | | | | 698 | | 77 | | | | | | | | 775 |
| Antoine | | | | | | 5290 | | | 200 | | 530 | 3130 | | 9150 |
| Arrowhead | 2480 | | 2270 | | 5100 | 3125 | | | | | | | | 12975 |
| Bovie Lake | 18998 | | 8568 | | | 13451 | | 11048 | | | | 2960 | | 55025 |
| Bulmer | 3964 | | 5802 | | | 94395 | | 12660 | | | | 22854 | | 139675 |
| Cormack Lake | | 440 | | | | 6505 | | 1540 | | | | 3840 | | 12325 |
| Grainger | | | | | | 3000 | | | | | | 31125 | | 34125 |
| Gros Cap | | 1820 | | | | 280 | | | | | | | | 2100 |
| Hillwash | | | | | | | | | | 3425 | | | 275 | 3700 |
| Liard | | | | | | | 4350 | | | | | | | 4350 |
| Martin River | | | | | | 7649 | | | 14364 | 2775 | 7688 | 2374 | | 34850 |
| Poplar | 3940 | | | | | 1310 | | | | | | 1500 | | 6750 |
| Shale Creek | 1575 | | 810 | | | 8665 | | | | | | 600 | | 11650 |
| Sibbeston | | | | 525 | | 263 | | | | | | 87 | | 875 |
| Trail River | | | | | | 310 | | | | | | 7890 | | 8200 |
| Trout Lake | | 920 | | | | 3750 | | 5280 | | | | | | 9950 |
| Totals | 30957 | 3180 | 17450 | 1223 | 5100 | 148070 | 4350 | 30528 | 14564 | 6200 | 8218 | 76360 | 275 | 346475 |
| Class Totals | 51587 | | | 6323 | | 197512 | | | | 14418 | | 76635 | | |

| Map Sheet | MacKenzie River | Unclassified Area | Unclassified Islands | Sloughs |
|---|---|---|---|---|
| 95G16 | | 137292 | | |
| 95I4 | 4625 | 109020 | | 1475 |
| 95J1 | 12750 | 37470 | | 725 |
| 95J2 | 13400 | 114320 | | |
| 95J3 | 11200 | 149295 | 2125 | |
| 95J6 | 4400 | 129016 | 2900 | 500 |
| Totals | 46375 | 676413 | 5025 | 2700 |

MAP SHEET 95B3

| Association | 3T | 3CA | 3M | 3D | 3I | 3ME | 4W | 4T | 4E | 4M | 5T | 5W | 5I | 5CH | 6T | 7W | 7T | 7TR | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | 1096 | | 822 | | | 3262 | | | 548 | | | | | | | | | | 5728 |
| Anderson Mill | | | | | | | | | | 785 | | 87 | | | | | | | 872 |
| Bulmer | | | 5413 | | | | 2166 | 3446 | | 1374 | | 23863 | | 1225 | | 3575 | | | 41062 |
| Bovie Lake | | | 28759 | 4975 | | 3357 | | 844 | | | | 12302 | | 13939 | | 1360 | | | 65536 |
| Cormack Lake | | | | | | | | | | | | 433 | | | | 289 | | | 722 |
| Grainger | | | | | | | | | | | | 2848 | | | | 6763 | | | 9611 |
| Hillwash | | | | | | | | | | | 523 | | | | 2191 | | 14517 | | 17231 |
| Poplar | | 677 | 1084 | | 236 | | 169 | | | | | | | | | | | | 2166 |
| Shale Creek | | | | | | 613 | | | | | | 1429 | | | | | | | 2042 |
| Trout Lake | 3085 | | 276 | 368 | | | | 21609 | | | 4420 | 5699 | | 6350 | 951 | | | 120 | 42878 |
| Tributary Flood Plain | | | | | | | | | | | | | 1893 | | | | | | 1893 |
| Trail River | | | | | | | | | | | | | | | | 199 | | | 199 |
| Totals | 4181 | 677 | 36354 | 5343 | 236 | 7232 | 2335 | 25899 | 548 | 2159 | 4943 | 46661 | 1893 | 21514 | 3142 | 12186 | 14517 | 120 | 189940 |
| Class Totals | | | 54023 | | | | | 30941 | | | | 75011 | | | 3142 | | 26823 | | |

Liard River 374
Sloughs 853

1227

MAP SHEET 95B4

| Association | 3T | 3CA | 3M | 3D | 3I | 3ME | 3CS | 4W | 4T | 4I | 5T | 5W | 5I | 5CH | 6TI | 6T | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | 125 | | | | | | | | | | | | | | | | | | 125 |
| Bluefish | | | | | | 1659 | | | | | | 184 | | | | | | | 1843 |
| Big Island | | | | | | | | | | | | 249 | | | | | 249 | | 498 |
| Bulmer | | | | | | | | 8890 | | | | 18869 | | 2341 | | | 1349 | | 31449 |
| Bovie Lake | | | 20078 | 3889 | | 2599 | | 105 | 5405 | | | 5708 | | 1534 | | | | | 39318 |
| Celibeta | | | | 4392 | | | | | | | | 488 | | | | | | | 4880 |
| Fisherman Lake | | | | | | | | 2440 | | | | 7127 | | | | | 2311 | | 11878 |
| Graifiger | | | | | | | | | | | | | | | | | 373 | | 373 |
| Hillwash | | | | | | | | | | | 299 | | | | | 12376 | | 4358 | 17033 |
| Liard | | 2099 | | | 4952 | | | 1984 | | 4023 | | 388 | 324 | | | | | | 13770 |
| Pointed Mountain | 2914 | | | 13865 | | | | | 8904 | | 5583 | 4790 | | 1892 | | 374 | | | 38322 |
| Petitot | | | | 1783 | | | 6932 | | | | | | | | | | | | 8715 |
| Poplar | | 747 | 1595 | | 311 | 1196 | | | | | | 187 | | | | | | | 4036 |
| Trout Lake | | | | | | | | | 944 | | | 176 | | | | 3885 | | | 5005 |
| Tributary Flood Plain | | | | | | | | | | | | | 179 | | 3760 | 269 | | | 4208 |
| Totals | 3039 | 2846 | 21673 | 23929 | 5263 | 5454 | 6932 | 13419 | 15253 | 4023 | 5882 | 38166 | 503 | 5767 | 3760 | 16904 | 4282 | 4358 | 181453 |
| Class Totals | 69136 | | | | | | | 32695 | | | 50318 | | | | 20664 | | 8640 | | |

| | |
|---|---|
| Unclassified Islands | 1096 |
| Betalamea Lake | 498 |
| Liard River | 8120 |
| | 9714 |

MAP SHEET 95B5

| Association | 3T | 3M | 3D | 3ME | 4ME | 4T | 5W | 5I | 5CH | 6TI | 6T | 7W | 7T | 7TR | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Babiche | | 40 | | 351 | | | 1505 | | | | | 10 | | | 1906 |
| Bluefish | | 344 | | 722 | | | 138 | | | | | | | | 1204 |
| Big Island | | 853 | | | | | 11712 | | | | | 6270 | | | 18835 |
| Bovie Lake | 1141 | 1343 | 100 | 1444 | 3371 | 715 | 965 | | | | | | | | 9079 |
| Celibeta | 7762 | | 13347 | | | | 6333 | | 13363 | | | | | | 40805 |
| Colluvium | | | | | | | | | | | | | 2031 | 1279 | 3310 |
| Exposure | | | | | | | | | | | | | | 752 | 752 |
| Fisherman Lake | | | | | | | 5267 | | | | | | | | 5267 |
| Grainger | | | | | | | | | | | | 2433 | | | 2433 |
| Hillwash | | | | | | | | | | | 100 | | 2132 | | 2232 |
| Pointed Mountain | | | | | | | | | 2557 | | 1204 | | | | 3761 |
| Trout Lake | | | | | | | | | 5617 | | 1405 | | | | 7022 |
| Tributary Flood Plain | | | | | | | | 552 | | 2383 | | | | | 2935 |
| Trail River | | | | | | | | | | | | 2884 | | | 2884 |
| Totals | 8903 | 2580 | 13447 | 2517 | 3371 | 715 | 25920 | 552 | 21537 | 2383 | 2709 | 11597 | 4163 | 2031 | 102425 |
| Class Totals | 27447 | | | | 4086 | | 48009 | | | 5092 | | 17791 | | | |

| | |
|---|---|
| Unclassified Area | 83683 |
| Fisherman Lake | 3235 |
| Liard River | 226 |
| Sloughs | 150 |
| | 87294 |

MAP SHEET 95B6

| Association | 3T | 3CA | 3M | 3D | 3I | 3ME | 3MT | 4W | 4T | 4I | 4E | 4M | 5T | 5W | 5I | 5CH | 6T | 7W | 7TR | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrow-head | 727 | | 4374 | | | 8277 | | | | | 1976 | | | 271 | | | | | | 15625 |
| Babiche | | | 1488 | | | 251 | | | | | | | | 4341 | | | | 290 | | 6370 |
| Blue-fish | | | 3669 | | | 6548 | | 93 | | | | 677 | | 1728 | | | | | | 12715 |
| Bulmer | | | 1168 | | | | | | | | | | | 7125 | | 241 | | 3278 | | 11812 |
| Bovie Lake | 870 | | 40670 | 291 | | 7908 | 6564 | | 5149 | | | | 853 | 20885 | | 2295 | | 5807 | | 91292 |
| Celibeta | | | | 316 | | | | | | | | | | 35 | | | | | | 351 |
| Coty Mountain | | 1019 | | | | | | 436 | | | | | | | | | | | | 1455 |
| Colluvium | | | | | | | | | | | | | | | | | | | 125 | 125 |
| Grainger | | | | | | | | | | | | | | | | | | 4438 | | 4438 |
| Hillwash | | | | | | | | | | | | | | | | | 6520 | | | 6520 |
| Liard | | 2588 | | | 1078 | | | 647 | | 5593 | | | | | 376 | | | | | 10282 |
| Petitot | 953 | | | | | | | | | | | | | | | | | | | 953 |
| Poplar | | 612 | 765 | | | | | 153 | | | | | | | | | | | | 1530 |
| Shale Creek | | | | | | | | | | | | | | 632 | | | | 271 | | 903 |
| Trout Lake | | | 843 | 1124 | | | | | | | | | | 842 | | | | | | 2809 |
| Tributary Flood Plain | | | | | | | | | | 4785 | | | | | | | 7178 | | | 11963 |
| Trail River | | | | | | | | | | | | | | | | | | 1605 | | 1605 |
| Totals | 2550 | 4219 | 52977 | 1731 | 1078 | 22984 | 6564 | 1329 | 5149 | 10378 | 1976 | 677 | 853 | 35859 | 376 | 2536 | 13698 | 15689 | 125 | 180748 |
| Class Totals | | | | 92103 | | | | | | 19509 | | | | | 39624 | | 13698 | 15814 | | |

Liard River 7241
Sloughs 1730

8971

MAP SHEET 95B11

| ASSOCIATION | 3T | 3CA | 3M | 3D | 3I | 4W | 4T | 4I | 4D | 4M | 5T | 5W | 5I | 5CH | 6W | 6T | 6I | 7W | 7T | 7I | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | | | 3908 | | | | | | | | 401 | 1374 | | | | | | 461 | | | 6144 |
| Bluefish | | | 1098 | | | | | | | | | 682 | | | | | | | | | 1780 |
| Bulmer | | | 3639 | | | 883 | | | | | | 30063 | | 2117 | | | | 12154 | | | 48856 |
| Bovie Lake | 376 | | 45285 | | | | 7320 | | | 5159 | 125 | 25511 | | 3901 | | | | 7477 | | | 95154 |
| Flett | | | | | | | | | 40 | | | | | | 60 | | | | | | 100 |
| Grainger | | | | | | | | | | | | 482 | | | | | | 6942 | | | 7424 |
| Hillwash | | | | | | | | | | | | | | | | 2433 | | | | | 2433 |
| Liard | 334 | | | | 1683 | | | 2182 | | | | 1068 | 226 | | | | | | | | 5493 |
| Netla | | 120 | | | | 30 | | | | | | | | | | | | | | | 150 |
| Shale Creek | | | 557 | | | | | | | | | 5051 | | | | | | 1089 | | | 6697 |
| Swan Point | | 421 | | 702 | | | | | | | | 281 | | | | | | | | | 1404 |
| Trout Lake | | | | | | | | | | | | 1324 | | 1987 | | | | | | | 3311 |
| Tributary Flood Plain | | | | | | | | 918 | | | 2142 | | | | | | | | | | 3060 |
| Trail River | | | | | | | | | | | | 351 | | | 1254 | | | 602 | | | 2207 |
| Totals | 710 | 541 | 54487 | 702 | 1683 | 913 | 7320 | 3100 | 40 | 5159 | 2668 | 66187 | 226 | 8005 | 1314 | 2433 | | 28725 | | | 184213 |
| Class Totals | | | 58123 | | | | 16532 | | | | | 77086 | | | 3747 | | | 28725 | | | |

| | |
|---|---|
| Liard River | 2811 |
| Sloughs | 1228 |
| | 4039 |

MAP SHEET 95B12

| Association | 3T | 3CA | 3M | 3D | 3I | 3ME | 4ME | 4W | 4T | 4I | 4M | 5T | 5W | 5I | 6T | 7W | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | | | | | | | | | | | | 125 | | | | | 125 |
| Babiche | | | 416 | | | | | | | | | | 1665 | | | | 2081 |
| Bluefish | | | 2509 | | | 2076 | 482 | 276 | | | | | 1405 | | | | 6748 |
| Bulmer | | | | 1422 | | | | 1422 | | | | | 1896 | | | | 4740 |
| Bovie Lake | 263 | | | | | | | | 201 | | | 1956 | 113 | | | | 2533 |
| Colluvium | | | | | | | | | | | | | | | 2182 | | 2182 |
| Grainger | | | | | | | | | | | | | | | | 100 | 100 |
| Hillwash | | | | | | | | | | | | | | | 828 | | 828 |
| Liard | 1979 | 782 | | | 2218 | | | 963 | | 1746 | | | 1015 | | | | 8703 |
| Netla | 1766 | 2739 | | | | | | 1294 | | | | | 120 | | | | 5919 |
| Tributary Flood Plain | | | | | | | | | | | | | | 426 | | | 426 |
| Yohin Lake | | | | | | | | | | | 642 | | 161 | | | | 803 |
| Totals | 4008 | 3521 | 2925 | 1422 | 2218 | 2076 | 482 | 3955 | 201 | 1746 | 642 | 2081 | 6375 | 426 | 3010 | 100 | 35188 |
| Class Totals | 16170 | | | | | | 7026 | | | | | 8882 | | | 3010 | 100 | |

| | |
|---|---|
| Unclassified Area | 146668 |
| Liard River | 5292 |
| Unclassified Islands | 1104 |
| | 153064 |

MAP SHEET 95B13

| Association | 3T | 3CA | 3M | 3D | 3I | 4W | 4T | 4I | 4DT | 5T | 5W | 5I | 6W | 6T | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blackstone River | | | | | | | | | | | 224 | | 373 | | 149 | | 746 |
| Colluvium | | | | | | | | | | | | | | 572 | | 9056 | 9628 |
| Flett | | 416 | | | | 1008 | | | 528 | | 3038 | | 1007 | | 547 | | 6544 |
| Grainger | | | | | | | | | | | 1366 | | | | 10127 | | 11493 |
| Hillwash | | | | | | | | | | | | | | 249 | | | 249 |
| Liard | 1445 | 1530 | | | 1005 | 866 | | 1642 | | | 301 | 497 | 102 | | | | 7388 |
| Netla | 2577 | 3066 | | | | 518 | 434 | | | | 1836 | | 219 | | 432 | | 9082 |
| Poplar | | 254 | 423 | | | | | | | | 169 | | | | | | 846 |
| Swan Point | 336 | 398 | 202 | 746 | | | | | 995 | | 1229 | | | | | | 3906 |
| Tributary Flood Plain | | | | | | | | | | | | 1368 | | | | | 1368 |
| Trail River | | | | | | | | | | | | | | | 1792 | | 1792 |
| Yohin Lake | | | 552 | | | 921 | 1030 | | | 398 | 3801 | | | | 687 | | 7389 |
| Totals | 4358 | 5664 | 1177 | 746 | 1005 | 3313 | 1464 | 1642 | 1523 | 398 | 11964 | 1865 | 1701 | 821 | 13734 | 9056 | 60431 |
| Class Totals | 12950 | | | | | 7942 | | | | 14227 | | | 2522 | | 22790 | | |

| | |
|---|---|
| Unclassified Area | 123034 |
| Liard River | 2986 |
| Sloughs | 373 |
| | 126393 |

MAP SHEET 95B14

| Association | 3T | 3CA | 3M | 3D | 3I | 3ME | 4ME | 4W | 4T | 4I | 4DT | 4MT | 5T | 5W | 5I | 5CH | 6W | 6T | 7W | 7T | 7I | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | | | 9114 | | | 7890 | | 4202 | | | | | | 8924 | | | | | | | | 30130 |
| Babiche | | | 152 | | | | | | | | | | | 1366 | | | | | | | | 1518 |
| Bluefish | | | 691 | | | | 3448 | | | | | 3762 | | 1528 | | | | | | | | 9429 |
| Blackstone River | | | | | | | | | | | | | | 522 | | | | | 1664 | | 3884 | 6070 |
| Bulmer | | | 1852 | | | | | 4165 | | | | | | 14040 | | | | | 1067 | | | 21124 |
| Bovie Lake | | | 1382 | | | | | | | | | | | 210 | | | | | 50 | | | 1642 |
| Cormack Lake | | | 554 | | | | | | | | | | | 5158 | | 159 | | | 1269 | | | 7140 |
| Exposure | | | | | | | | | | | | | | | | | | | | 746 | | 746 |
| Flett | | | | | | | | 134 | | | 876 | | | 2166 | | | 1512 | | 662 | | | 5350 |
| Grainger | | | | | | | | | | | | | | 50 | | | | | 4503 | | | 4553 |
| Hillwash | | | | | | | | | | | | | 348 | | | | | 323 | | | | 671 |
| Liard | 6041 | 4524 | | | 3308 | | | 627 | 1985 | 4284 | | 1851 | | 4312 | 1705 | | | | | | | 28637 |
| Netla | | 11026 | | | | | | 1535 | 881 | | | | | 1867 | | | | | 293 | 818 | | 16420 |
| Poplar | | 358 | 8779 | | | | | 497 | | | | | | 2901 | | | | | 80 | | | 12615 |
| Shale Creek | | | 1548 | | | | | | | | | | | 5812 | | | | | 1547 | | | 8907 |
| Swan Point | 423 | 1739 | 1097 | 3299 | | | | 326 | | | 1124 | | | 1174 | | | 844 | | | | | 10026 |
| Trout Lake | | | | | | | | | | | | | | 926 | | 1712 | | | | | | 2638 |
| Tributary Flood Plain | | | | | | | | | | 1478 | | | 3448 | | | | | | | | | 4926 |
| Trail River | | | | | | | | | | | | | | 896 | | | 921 | | 4279 | | | 6096 |
| Totals | 6464 | 17647 | 25169 | 3299 | 3308 | 7890 | 3448 | 11486 | 2866 | 5762 | 2000 | 5613 | 3796 | 51852 | 1705 | 1871 | 3277 | 323 | 15414 | 1564 | 3884 | 178638 |
| Class Totals | 63777 | | | | | | 31175 | | | | | | 59224 | | | | 3600 | | 20862 | | | |

Liard River 7663
Sloughs 523
8186

MAP SHEET 95B15

| Association | 3M | 4W | 4T | 5T | 5W | 5CH | 6T | 7W | Total |
|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | 2052 | 2953 | | | 1463 | | | | 6468 |
| Bulmer | 2444 | 881 | | | 5343 | | | 1433 | 10101 |
| Bovie Lake | 4240 | | | | 4622 | 2792 | | 1583 | 13237 |
| Cormack Lake | | | | | 12433 | 1650 | | 2412 | 16495 |
| Hillwash | | | | | | | 1095 | | 1095 |
| Shale Creek | 45 | | | | 134 | | | 45 | 224 |
| Trout Lake | | | | | 7668 | 15893 | | | 23561 |
| Tributary Flood Plain | | | 328 | 923 | 219 | 396 | | | 1866 |
| Totals | 8781 | 3834 | 328 | 923 | 31882 | 20731 | 1095 | 5473 | 73047 |
| Class Totals | 8781 | 4162 | | 53536 | | | 1095 | 5473 | |

Unclassified Area 113777

113777

MAP SHEET 95G1

| Association | 3M | 4W | 5W | 5CH | 7W | Total |
|---|---|---|---|---|---|---|
| Arrowhead | 300 | | 100 | | 100 | 500 |
| Babiche | 472 | | 1103 | | | 1575 |
| Bluefish | 1240 | | 310 | | | 1550 |
| Bulmer | 1387 | 560 | 3153 | | 925 | 6025 |
| Bovie Lake | 6180 | | 1545 | | | 7725 |
| Shale Creek | 225 | | 375 | | 150 | 750 |
| Trout Lake | | | | 2550 | | 2550 |
| Totals | 9804 | 560 | 6586 | 2550 | 1175 | 20675 |
| Class Totals | 9804 | 560 | 9136 | | 1175 | |

Unclassified Area 164683

# MAP SHEET 95G2

| Association | 3CA | 3M | 3D | 3I | 3ME | 4M | 4W | 4T | 4I | 5W | 5I | 5CH | 6W | 6T | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | | 17085 | | | 4035 | | 5022 | | | 5128 | | | | | 1555 | | 32825 |
| Bluebill | | 1430 | 10665 | | | | | | | 2130 | | 2275 | | | | | 16500 |
| Blackstone River | | | | | | | | | | 2150 | | | | | | | 2150 |
| Bulmer | | 1542 | | | | 735 | 60 | | | 15028 | | | | | 1835 | | 19200 |
| Bovie Lake | | 15291 | | | | | | | | 4492 | | | | | 467 | | 20250 |
| Grainger | | | | | | | | | | 1075 | | | | | 15350 | | 16425 |
| Hillwash | | | | | | | | | | | | | | 550 | | | 550 |
| Liard* | 1385 | | | 2655 | | | 65 | | 1795 | | | | | | | | 5900 |
| Netla | 3893 | | | | | | 1292 | | | | | | 415 | | | | 5600 |
| | | | | | | | | | | | | | | | | | |
| Poplar | | 7403 | | | | | 57 | | | 1440 | | | | | | | 8900 |
| Shale Creek | | 2453 | | | | | | | | 12302 | | | | | 3645 | | 18400 |
| Swan Point | 742 | | 2078 | | | | 705 | | | | | | | | | | 3525 |
| Trout Lake | | | | | | | | 1150 | | | | 375 | | | | | 1525 |
| Tributary Flood Plain | | | | | | | | 3705 | | 2470 | | | | | | | 6175 |
| Trail River | | | | | | | | | | | | | | | 1950 | | 1950 |
| Totals | 6020 | 45204 | 12743 | 2655 | 4035 | 735 | 7201 | 4855 | 1795 | 46215 | | 2650 | 415 | 550 | 24802 | | 159875 |
| Class Totals | 70657 | | | | | 14586 | | | | 48865 | | | 965 | | 24802 | | |

| | |
|---|---|
| Unclassified Area | 17083 |
| Sloughs | 200 |
| Liard River | 8200 |
| | 25483 |

MAP SHEET 95G3

| Association | 3CA | 3M | 3D | 3I | 4ME | 4W | 4T | 4I | 4DT | 4DE | 5W | 5I | 6W | 6T | 6I | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | | 7655 | | | | 80 | | | | | 1510 | | | | | 830 | | 10075 |
| Bluebill | | 130 | 195 | | | | | | | | | | | | | | | 325 |
| Bluefish | | 350 | | | | | | | | | | | | | | | | 350 |
| Blackstone River | 170 | | | | | | | | | | 680 | | | | | | | 850 |
| Bulmer | | 1155 | 1750 | | | 60 | | | | | 9163 | | | | | 1172 | | 13300 |
| Bovie Lake | | 3500 | 330 | | | | | | | | 910 | | | | | 910 | | 5650 |
| Colluvium | | | | | | | | | | | | | | 2475 | | | | 2475 |
| Exposure | | | | | | | | | | | | | | | | | 150 | 150 |
| Flett | | | | | | 870 | | | | | 2030 | | | | | | | 2900 |
| Grainger | | | | | | | | | | | 140 | | | | | 3310 | | 3450 |
| Liard | 2933 | | | 6095 | | 767 | 1690 | 9031 | | | 1402 | 2557 | | | | | | 24475 |
| Netla | 2573 | | | | | 672 | | | | | 55 | | 50 | | | | | 3350 |
| Poplar | 275 | 5641 | | | | 310 | | | | | 1147 | | | | | 202 | | 7575 |
| Rabbit Creek | | | | | 1043 | | | | 1367 | 2765 | 1625 | | | | | | | 6800 |
| Shale Creek | | 107 | | | | | | | | | 1631 | | | | | 112 | | 1850 |
| Swan Point | 2721 | | 7127 | | | 1897 | | | | | 1055 | | | | | | | 12800 |
| Tributary Flood Plain | | | | | | | | | | | | 1755 | | 1320 | 1100 | | | 4175 |
| Trail River | | | | | | | | | | | 22 | | 1210 | | | 1868 | | 3100 |
| Totals | 8672 | 18538 | 9402 | 6095 | 1043 | 4656 | 1690 | 9031 | 1367 | 2765 | 21370 | 4312 | 1260 | 3795 | 1100 | 8404 | 150 | 103650 |
| Class Totals | 42707 | | | | 20552 | | | | | | 25682 | | 6155 | | | 8554 | | |

| | |
|---|---|
| Unclassified Area | 71133 |
| Liard River | 8425 |
| South Nahanni River | 2150 |
| | 81708 |

MAP SHEET 95G4

| Association | 3CA | 3M | 3D | 3I | 4M | 4W | 4T | 4I | 5M | 5W | 5I | 6W | 7W | 7T | 7I | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alluvium | | | | | | | | | | | | | | | 2350 | 2350 |
| Colluvium | | | | | | | | | | | | | | 2075 | | 2075 |
| Flett | | | | | 172 | 225 | | | | 928 | | | | | | 1325 |
| Grainger | | | | | | | | | | | | | 2050 | | | 2050 |
| Liard | 1005 | | | 1627 | | | | 3052 | | 3036 | 1705 | | | | 600 | 11025 |
| Netla | 378 | | | | | 85 | | | | 22 | | 15 | | | | 500 |
| Poplar | 45 | 495 | | | | | | | | 240 | | | 70 | | | 850 |
| Swan Point | 735 | | 980 | | | | | | | 735 | | | | | | 2450 |
| Yohin Lake | | 1190 | | | 825 | | | | 1438 | 1780 | | 862 | 205 | | | 6300 |
| Totals | 2163 | 1685 | 980 | 1627 | 997 | 310 | | 3052 | 1438 | 6741 | 1705 | 877 | 2325 | 2075 | 2950 | 28925 |
| Class Totals | 6455 | | | | 4359 | | | | 9884 | | | 877 | 7350 | | | |

Unclassified Area 154933
South Nahanni River 1500

156433

## MAP SHEET 95G7

| Association | 3CA | 3M | 3D | 4W | 4D | 5W | 5CH | 6TI | 6W | 7W | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | | 960 | | 240 | | | | | | | 1200 |
| Bluebill | | 390 | 585 | | | | | | | | 975 |
| Big Island | | | | | | 270 | | | 180 | | 450 |
| Blackstone River | | | | | | 225 | | | | | 225 |
| Bulmer | | 1890 | 1860 | 840 | 840 | 12720 | | | | 1700 | 19850 |
| Bovie Lake | | 13529 | 4130 | | 1073 | 4506 | | | | 812 | 24050 |
| Grainger | | | | | | 235 | | | | 13415 | 13650 |
| Liard* | 425 | | | | | | | | | | 425 |
| Netla | 840 | | | 360 | | | | | | | 1200 |
| Petitot | 7003 | | 1765 | | | 1507 | | | | | 10275 |
| Poplar | | 2930 | | 232 | | 248 | | | | 15 | 3425 |
| Rabbit Creek | | | 1880 | | 3933 | 5630 | 5925 | | | 3532 | 20900 |
| Tributary Flood Plain | | | | | | | | 1275 | | | 1275 |
| Trail River | | 350 | | | 1090 | 895 | | | 4590 | 10275 | 17200 |
| Totals | 8268 | 20049 | 10220 | 1672 | 6936 | 26236 | 5925 | 1275 | 4770 | 29749 | 115100 |
| Class Totals | 38537 | | | 8608 | | 32161 | | 6045 | | 29749 | |

Unclassified Area 67199
Liard River 1575

68774

MAP SHEET 95G8

| Association | 3CH | 3CA | 3M | 3D | 4M | 4W | 4T | 4D | 5W | 5CS | 6TI | 6W | 6T | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | | | 2855 | | | | | | 810 | | | | | 385 | | 4050 |
| Bluebill | | | | 2580 | | | | | 645 | 225 | | | | | | 3450 |
| Babiche | | | 765 | | | | | | 1785 | | | | | | | 2550 |
| Bluefish | | | 700 | | | | | | 175 | | | | | | | 875 |
| Big Island | 535 | | | | | | | | 2600 | | | 565 | | 350 | | 4050 |
| Blackstone River | | | | | | | | | 2250 | | | | | | | 2250 |
| Bulmer | | | 1830 | | | 1070 | | 2610 | 11401 | | | | | 3014 | | 19925 |
| Bovie Lake | | | 22376 | 3627 | 3440 | | 465 | 4215 | 3977 | | | | | | | 38100 |
| Grainger | 505 | | | | | | | | 3559 | | | 2500 | | 33261 | | 39825 |
| Hillwash | | | | | | | | | | | | | 2700 | | 500 | 3200 |
| Netla | | 210 | | | | 90 | | | | | | | | | | 300 |
| Petitot | 14286 | | | 2370 | | | | | 3347 | | | | | 1047 | | 21050 |
| Poplar | | | 8595 | | | 405 | | | 1125 | | | | | 525 | | 10650 |
| Rabbit Creek | | | | | | | | | 308 | 615 | | | | 102 | | 1025 |
| Sibbeston | | | 1590 | | 7648 | | | | 2442 | | | | | 870 | | 12550 |
| Scotty Creek | | | | | 370 | | | | 1480 | | | | | | | 1850 |
| Shale Creek | | | 570 | | | | | | 950 | | | | | 380 | | 1900 |
| Trout Lake | | | | | | | | | | 200 | | | | | | 200 |
| Tributary Flood Plain | | | | | | | | | | | 2075 | | | | | 2075 |
| Trail River | | | | | | | | | | | | 5075 | | 800 | | 5875 |
| Totals | 15326 | 210 | 39281 | 8577 | 11458 | 1565 | 465 | 6825 | 36854 | 1040 | 2075 | 8140 | 2700 | 40734 | 500 | 175750 |
| Class Totals | 63394 | | | | 20313 | | | | 37894 | | 12915 | | | 41234 | | |

| | |
|---|---|
| Sloughs | 2199 |
| Liard River | 5925 |
| | 8124 |

**MAP SHEET 95G16**

| Association | 3ME | 4M | 5W | 5CH | 6T | 7W | Total |
|---|---|---|---|---|---|---|---|
| Bulmer | 2372 | | 29158 | 1445 | | | 32975 |
| Bovie Lake | | | 70 | 105 | | | 175 |
| Cormack Lake | | | 250 | | | | 250 |
| Hillwash | | | | | 975 | | 975 |
| Sibbeston | | 315 | 158 | | | 52 | 525 |
| Trout Lake | | | 3520 | 5280 | | | 8800 |
| Totals | 2372 | 315 | 33156 | 6830 | 975 | 52 | 43700 |
| Class Totals | 2372 | 315 | 39986 | | 975 | 52 | |

Unclassified Area 137292

137292

MAP SHEET 95H5

| Association | 3M | 3D | 4M | 4T | 5MF | 5T | 5W | 5CH | 6W | 6T | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bovie Lake | 6622 | | 1060 | 2363 | | | 2180 | | | | | | 12225 |
| Grainger | | | | | | | 2985 | | 620 | | 58495 | | 62100 |
| Hillwash | | | | | | | | | | 1300 | | 3675 | 4975 |
| Jean Marie | | | 1090 | | 3270 | | 1090 | | | | | | 5450 |
| Sibbeston | 2431 | 2123 | 27573 | 323 | | | 7978 | 300 | | | 4697 | | 45425 |
| Scotty Creek | | | 4283 | | | | 10419 | | | | 1073 | | 15775 |
| Trout Lake | | | | | | 1025 | | | | | | | 1025 |
| Trail River | | | 250 | | | | 1005 | | 1402 | | 1443 | | 4100 |
| Winter Road | | | 17430 | | | | 3795 | | | | | | 21225 |
| Totals | 9053 | 2123 | 51686 | 2686 | 3270 | 1025 | 29452 | 300 | 2022 | 1300 | 65708 | 3675 | 172300 |
| Class Totals | 11176 | | 54372 | | 34047 | | | | 3322 | | 69383 | | |

| | |
|---|---|
| Sloughs | 5525 |
| Unclassified Islands | 149 |
| Liard River | 5900 |
| | 11574 |

MAP SHEET 95H6

| Association | 3D | 4M | 4T | 5MF | 5T | 5W | 5CH | 6SE | 6T | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antoine | | | | 3110 | | 4665 | | | | | | 7775 |
| Grainger | | | | 2208 | | 6622 | | | | 30745 | | 39575 |
| Hillwash | | | | | | | | | | | 325 | 325 |
| Jean Marie | | | | 10900 | | | | | | | | 10900 |
| Martin River | | | | 1160 | | 110 | | 260 | | 45 | | 1575 |
| Sibbeston | 3091 | 22639 | | | | 6890 | 2600 | | | 80 | | 35300 |
| Scotty Creek | | 13031 | | 3245 | | 27999 | | | | | | 44275 |
| Tributary Flood Plain | | | 2170 | | | | | | 2430 | | | 4600 |
| Trout Lake | 1425 | 855 | | | | 570 | | | | | | 2850 |
| Trail River | | | | 3680 | | 6500 | | | | 24645 | | 34825 |
| Totals | 4516 | 36525 | 2170 | 24303 | | 53356 | 2600 | 260 | 2430 | 55515 | 325 | 182000 |
| Class Totals | 4516 | 38695 | | 80259 | | | | 2690 | | 55840 | | |

| | |
|---|---|
| Goose Lake | 674 |
| Liard River | 300 |
| Sloughs | 900 |
| | 1874 |

## MAP SHEET 95H11

| Association | 3CH | 3M | 3D | 4M | 4I | 5MF | 5W | 6SE | 6W | 6T | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anderson Mill* | | | | 562 | | | 63 | | | | | | 625 |
| Antoine | | | | | | 1250 | 4145 | | 60 | | 1970 | | 7425 |
| Bluefish | | 250 | | | | | | | | | | | 250 |
| Grainger | | | | | | | 263 | | | | 1712 | | 1975 |
| Gross Cap | | | 1700 | | | | | | | | | | 1700 |
| Hillwash | | | | | | | | | | 2725 | | 3075 | 5800 |
| Jean Marie | | | | | | 225 | | | | | | | 225 |
| Liard | 585 | 390 | | | | | | | | | | | 975 |
| Martin River | | | | 1260 | | 29577 | 14143 | 11690 | | | 16380 | | 73050 |
| Poplar | | 1822 | | | 110 | | 43 | | | | | | 1975 |
| Sibbeston | | | 1785 | 2975 | | | 1190 | | | | | | 5950 |
| Scotty Creek | | | | | | | 405 | | 270 | | | | 675 |
| Trail River | | | | | | 8928 | 9778 | | | | 46544 | | 65250 |
| Winter Road | | | | 6475 | | | 225 | | | | | | 6700 |
| Totals | 585 | 2462 | 3485 | 11272 | 110 | 39980 | 30255 | 11690 | 330 | 2725 | 66606 | 3075 | 172575 |
| Class Totals | 6532 | | | 11382 | | 70235 | | 14745 | | | 69681 | | |

Liard River. 6689
Sloughs 3200

9889

MAP SHEET 95H12

| ASSOCIATION | 4M | 5MF | 5T | 5W | 6SE | 6W | 7W | Total |
|---|---|---|---|---|---|---|---|---|
| Antoine | | 1178 | | 3902 | | 1085 | 185 | 6350 |
| Grainger | | | | 3170 | | 830 | 21050 | 25050 |
| Martin River | | 8150 | | 3720 | 5005 | | 2900 | 19775 |
| Sibbeston | 17097 | 1445 | | 7523 | | 1185 | | 27250 |
| Trail River | | 2315 | | 8051 | | 2400 | 34909 | 47675 |
| Tributary Flood Plain | 990 | | 1485 | | | 2475 | | 4950 |
| Scotty Creek | | 5395 | | 6857 | | | 1323 | 13575 |
| Winter Road | 4990 | | | 410 | | | | 5400 |
| Totals | 23077 | 18483 | 1485 | 33633 | 5005 | 7975 | 60367 | 150025 |
| Class Totals | 23077 | 53601 | | | 12980 | | 60367 | |

| | |
|---|---|
| Sloughs | 1600 |
| Antoine Lake | 5850 |
| Unclassified | 24989 |
| | 32439 |

MAP SHEET 95H13

| Association | 3M | 4M | 4T | 5MF | 5W | 6SE | 6W | 6T | 6P | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antoine | 493 | | | 3645 | 10982 | 1477 | | | | 1103 | | 17700 |
| Arrowhead | 3430 | | | | 340 | | | 1380 | | | | 5150 |
| Bulmer | 635 | 1485 | | | 7805 | | | | | | | 9925 |
| Grainger | | | | | | | | | | 6450 | | 6450 |
| Harris | | | | | | | | | 1905 | 1270 | | 3175 |
| Hillwash | | | | | | | | 5400 | | | 1925 | 7325 |
| Martin River | 1595 | | | 16046 | 4306 | 3237 | 88 | | | 1603 | | 26875 |
| Poplar | 1925 | | | | | | | | 1925 | | | 3850 |
| Sibbeston | | 1230 | | | 615 | | | | | 205 | | 2050 |
| Scotty Creek | | | | 835 | 3340 | | | | | | | 4175 |
| Tributary Flood Plain | | | 590 | | 1475 | | | 885 | | | | 2950 |
| Trail River | | | | 725 | 2518 | | 1130 | | 2280 | 30647 | | 37300 |
| Totals | 8078 | 2715 | 590 | 21251 | 31381 | 4714 | 1218 | 7665 | 6110 | 41278 | 1925 | 126925 |
| Class Totals | 8078 | 3305 | | 52632 | | 19707 | | | | 43203 | | |

| | |
|---|---|
| Sloughs | 1775 |
| Mackenzie River | 8125 |
| Unclassified Islands | 100 |
| Unclassified | 44067 |
| | 54067 |

MAP SHEET 95H14

| Association | 3CH | 3M | 3D | 4M | 4W | 4T | 5MF | 5T | 5W | 5CH | 6SE | 6W | 6T | 6P | 7W | 7T | 7I | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antoine | | | | | | | 944 | 456 | 2391 | | | | | | 1381 | | | 5172 |
| Bluefish | | 2272 | | | | | | | | | | | | | | | | 2272 |
| Grainger | | | | | | | | | | | | | | | 4696 | | | 4696 |
| Gros Cap | | | 2156 | | | | | | | | | | | | | | | 2156 |
| Harris | | | | | | | | | | | | | | 49845 | 5639 | | | 55484 |
| Hillwash | | | | | | | | | | | | | 2216 | | | 2560 | | 4776 |
| Liard | 1537 | | | | 279 | | | | | | | | | | | | | 1816 |
| Martin River | | | | 443 | | | 16920 | | 4350 | | 8412 | | | | 4915 | | | 35040 |
| Poplar | | 1300 | | | | | | | 96 | | | | | 376 | | | | 1772 |
| Rabbit Creek | | | | | | | | | | 3526 | | | | | 2350 | | | 5876 |
| Sibbeston | | | | 5239 | | | | | | | | | | | 3493 | | | 8732 |
| Tributary Flood Plain | | | | | | | | | | | | 1852 | | | | | | 1852 |
| Trail River | | | | | | | 1760 | | 1244 | | | 118 | | 2136 | 27070 | | | 32328 |
| Totals | 1537 | 3572 | 2156 | 5682 | 279 | | 19624 | 456 | 8081 | 3526 | 8412 | 1970 | 2216 | 52357 | 49544 | 2560 | | 161972 |
| Class Total | | 7265 | | | 5961 | | | | 31687 | | | | 64955 | | | 52104 | | |

| | |
|---|---|
| Islands | 292 |
| Rivers | 13724 |
| Slough | 5008 |
| | 19024 |

MAP SHEET 95I4

| Association | 3M | 3D | 3ME | 4E | 5MF | 5W | 6SE | 7W | 7T | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead | 2480 | | 995 | 1100 | | 1275 | | | | 5850 |
| Bulmer | | | | | | 10350 | | 6900 | | 17250 |
| Bovie Lake | 2455 | | | | | 1120 | | | | 3575 |
| Cormack Lake | | 440 | | | | 2405 | | 1530 | | 4375 |
| Grainger | | | | | | 1290 | | 21135 | | 22425 |
| Hillwash | | | | | | | | | 275 | 275 |
| Martin River | | | | | 1688 | 1427 | 2098 | 862 | | 6075 |
| Poplar | 425 | | | | | 170 | | 255 | | 850 |
| Trout Lake | | 920 | | | | 230 | | | | 1150 |
| Trail River | | | | | | | | 2550 | | 2550 |
| Totals | 5360 | 1360 | 995 | 1100 | 1688 | 18267 | 2098 | 33232 | 275 | 64375 |
| Class Totals | | 7715 | | 1100 | 19955 | | 2098 | 33507 | | |

Unclassified Area 109020
Mackenzie River 4625
Sloughs 1475

115120

MAP SHEET 95J1

| Association | 3M | 3D | 3ME | 4M | 4E | 5MF | 5W | 5CH | 6SE | 6T | 7W | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anderson Mill | | | | 270 | | | 30 | | | | | 300 |
| Antoine | | | | | | 200 | 3085 | | | | 2190 | 5475 |
| Bulmer | 1710 | | 1070 | | | | 33571 | 3490 | | | 11959 | 51800 |
| Bovie Lake | 6218 | | 6003 | | | | 6074 | 3455 | | | 450 | 22200 |
| Cormack Lake | | | | | | | 3850 | 1540 | | | 2310 | 7700 |
| Grainger | | | | | | | 1520 | | | | 6330 | 7850 |
| Gros Cap | | 700 | | | | | | | | | | 700 |
| Hillwash | | | | | | | | | | 1825 | | 1825 |
| Martin River | | | | | | 4853 | 1865 | | 2675 | | 1107 | 10500 |
| Poplar | 3315 | | | | | | 1140 | | | | 1245 | 5700 |
| Sibbeston | | | | 210 | | | 105 | | | | 35 | 350 |
| Shale Creek | | | 810 | | | | 4990 | | | | 600 | 6400 |
| Trail River | | | | | | | | | | | 625 | 625 |
| Arrowhead | | | 1275 | | 4000 | | 1850 | | | | | 7125 |
| Totals | 11243 | 700 | 9158 | 480 | 4000 | 5053 | 58080 | 8485 | 2675 | 1825 | 26851 | 128550 |
| Class Totals | | 21101 | | 4480 | | | 71618 | | 4500 | | 26851 | |

| | |
|---|---|
| Unclassified Area | 37470 |
| Mackenzie River | 12750 |
| Sloughs | 725 |
| | 50945 |

MAP SHEET 95J2

| Association | 3M | 3D | 3ME | 4M | 5MF | 5W | 5I | 6T | 7W | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Anderson Mill | | | | 428 | | 47 | | | | 475 |
| Antoine | | | | | | 975 | | | 650 | 1625 |
| Bulmer | 335 | | 2360 | | | 11060 | | | 3995 | 17750 |
| Bovie Lake | 4935 | | 2565 | | | 2425 | | | 2200 | 12125 |
| Grainger | | | | | | 190 | | | 285 | 475 |
| Gros Cap | | 1120 | | | | 280 | | | | 1400 |
| Liard | | | | | | | 4350 | | | 4350 |
| Martin River | | | | | 3698 | 1202 | | 800 | | 5700 |
| Poplar | 200 | | | | | | | | | 200 |
| Shale Creek | 1140 | | | | | 2660 | | | | 3800 |
| Trail River | | | | | | 310 | | | 3565 | 3875 |
| Totals | 6610 | 1120 | 4925 | 428 | 3698 | 19149 | 4350 | 800 | 10695 | 51775 |
| Class Totals | 12655 | | | 428 | 27197 | | | 800 | 10695 | |

Unclassified Area 114320
Mackenzie River 13400

127720

MAP SHEET 95J3

| Association | 3M | 5MF | 5W | 6SE | 6T | 7W | Total |
|---|---|---|---|---|---|---|---|
| Antoine | | | 435 | | | 290 | 725 |
| Bulmer | 412 | | 3613 | | | | 4025 |
| Bovie Lake | 3010 | | 830 | | | 310 | 4150 |
| Martin River | | 2460 | 1230 | 860 | 1975 | | 6525 |
| Shale Creek | 435 | | 1015 | | | | 1450 |
| Totals | 3857 | 2460 | 7123 | 860 | 1975 | 600 | 16875 |
| Class Totals | 3857 | 9583 | | 2835 | | 600 | |

| | |
|---|---|
| Unclassified Area | 149295 |
| Unclassified Islands | 2125 |
| Mackenzie River | 11200 |
| | 162620 |

MAP SHEET 95J6

| Association | 3M | 5MF | 5W | 5CH | 6SE | 6T | 7W | Total |
|---|---|---|---|---|---|---|---|---|
| Antoine | | | 795 | | 530 | | | 1325 |
| Bulmer | 1507 | | 6643 | 7725 | | | | 15875 |
| Bovie Lake | 2380 | | 2932 | 7488 | | | | 12800 |
| Grainger | | | | | | | 3375 | 3375 |
| Hillwash | | | | | | 625 | | 625 |
| Martin River | | 1665 | 1925 | | 2055 | | 405 | 6050 |
| Trail River | | | | | | | 1150 | 1150 |
| Totals | 3887 | 1665 | 12295 | 15213 | 2585 | 625 | 4930 | 41200 |
| Class Totals | 3887 | | 29173 | | 3210 | | 4930 | |

| | |
|---|---|
| Unclassified Area | 129016 |
| Unclassified Islands | 2900 |
| Mackenzie River | 4400 |
| Sloughs | 500 |
| | 136816 |