AD/A-002 627

TERRAIN DATA OF MOUNT HAYES D-4 QUADRANGLE, FORT GREELY, ALASKA

T. R. Currin, et al

Army Engineer Topographic Laboratories
Fort Belvoir, Virginia

August 1974

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ETL-TR-74-7	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER AD/A - 00 2627
4. TITLE *(and Subtitle)* TERRAIN DATA OF MOUNT HAYES D-4 QUADRANGLE, FORT GREELY, ALASKA (REPORT NO. 4 IN THE ETL SERIES ON REMOTE SENSING)		5. TYPE OF REPORT & PERIOD COVERED Technical Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) T. R. Currin J. W. Ingram, Jr.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Technology Development Branch, Geographic Information Systems Division, Geographic Sciences Laboratory USAETL, Fort Belvoir, Virginia 22060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Project 4A762707A854 Work Unit 14854020003
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineer Topographic Laboratories Fort Belvoir, Virginia 22060		12. REPORT DATE August 1974 13. NUMBER OF PAGES 130
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Alaskan terrain
Multiband photography
Arctic environment
Military geographic information
Alaska physiographic provinces
Alaskan vegetation
Alaskan hydrology

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report discusses a field investigation at Fort Greely, Alaska, conducted by the Geographic Sciences Laboratory (GSL) of the U. S. Army Engineer Topographic Laboratories (USAETL) as part of the Test and Analyze Experimental Color and Multiband Photography project. Field teams were deployed to collect terrain information in the areas of soils, vegetation, hydrology, and cultural features; various types of aerial imagery missions were flown coincident with the acquisition of ground data. A discussion of each of the areas of terrain data is presented.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

SUMMARY

Much of the information presented in this report is of a quantitative nature and is intended by GSL to allow for the use of the Mount Hayes D-4 Quadrangle, Fort Greely, Alaska, as a calibrated, remote sensing test site for the study of aerial photography and remote sensor imagery by GSL and other users.

This report and those for five other GSL test sites are being published separately in the belief that the terrain information has inherent value quite aside from the remote sensor experiments in support of which the information was collected.

PREFACE

Authority for performing the research and for preparing this report is contained in Project 4A762707A854, "Military Geographic Analysis."

The research described in this report was conducted by: the Geographic Sciences Laboratory, Dr. Kenneth R. Kothe, Director; the Geographic Information Systems Division, Mr. Bernard B. Scheps, Chief; and the Technology Development Branch, Mr. John S. Odell, Chief.

Other personnel involved in the project were:

T. C. Vogel, Color and Multiband Team Leader
Earl Garland, Cultural Features
Michael Ledbetter, Hydrology and Climatology
J. Wes Ingram, Vegetation
T. R. Currin, Soils and Landforms

Detailed terrain information was acquired by the 334th Engineer Detachment (Terrain), U.S. Army Reserve, Nashville, Tennessee.

CONTENTS

ILLUSTRATIONS

TABLES

TERRAIN DATA OF MOUNT HAYES D-4 QUADRANGLE, FORT GREELY, ALASKA (REPORT NO. 4 IN THE ETL SERIES ON REMOTE SENSING)

1. INTRODUCTION

1. **Background.** The Geographic Sciences Laboratory (GSL) of the U.S. Army Engineer Topographic Laboratories (USAETL) has conducted and is continuing an extensive program designed to test and analyze the effective parameters of various imaging systems for application to military image interpretation for terrain information. Toward this effort, five test areas that are believed to be representative of the major military geographic regions of the world were selected. Terrain data obtained at these areas will be utilized with simultaneously obtained aerial imagery to develop an image interpreter test. The test has been designed to statistically indicate the relationship between sensor system, interpreter capability, geographical region, and accuracy of image-derived data.

Ground data taken at each site will be presented in a series of reports of which this is the first of five. Their purpose is to present terrain information to other users who need "calibrated test sites" for the evaluation of aerial imaging systems.

The GSL test sites are located at the following areas: Fort Belvoir, Virginia; Fort Carson, Colorado; Yuma, Arizona; Manati, Puerto Rico; and Fort Greely, Alaska. Aerial imagery missions were flown on contract over a selected quadrangle at each site with major emphasis placed on testing color, color-infrared multiband, and panchromatic imaging systems. Radar, thermal infrared, and multispectral scanner missions were also flown at some locations. Field teams were deployed at each site to collect ground-truth information needed (along with the assortment of aerial imagery obtained) to test various imaging systems.

The GSL image-evaluation program is an ongoing and continuing one. Future imaging missions over the test sites will provide seasonal coverage. At some sites, ground studies will be expanded to cover adjacent quadrangles where additional imagery has been or will be obtained.

2. **Purpose.** This series of reports on the ground data is one aspect of the multifaceted Color and Multiband Project. This report will concern itself with the data collection activities of USAETL at its Fort Greely, Alaska, test area; these activities were conducted in a manner similar to efforts at the other test areas. Terrain data gathered in the field will be presented in detail. It is intended that the information

contained herein will be useful not only for the GSL image-evaluation project but also for future projects of other users requiring calibrated terrain information in an arctic environment.

3. **Scope.** The principal area of investigation at Fort Greely was the Mount Hayes D-4 Map Quadrangle (Fig. 1). This report will involve a tabulation and discussion of terrain data gathered by GSL within that area. Field activities were largely limited to 11 preselected sites within the quadrangle in order that more intensive quantitative data could be gathered within a 1-month time frame. Significant aspects of the soils, vegetation, cultural features, and hydrology of the quadrangle will be discussed in the text on the basis of information gathered within those sites. Tabulations and quantitative information will be presented in the appendixes.

4. **Fort Greely Area Description.** Fort Greely is located in eastern interior Alaska at 63° 58'N., 145°45'W. and lies in the Tanana Lowland, a region underlain by discontinuous permafrost. Directly to the south is the Alaska Range, the foothills of which form the highest point within the Mount Hayes D-4 Quadrangle, 4,995 feet above sea level. Average elevation is approximately 1,650 feet above sea level.

Landforms in the quadrangle are primarily bedrock and glacial in origin and exhibit alluvial and aeolian reworkings. Two extensive morainal systems are evidenced by numerous kettle lakes, hillocks, and bogs; their associated outwash plains are characterized by gentle northward slopes. Floodplains and silt-covered terraces are associated with the two major braided alluvial systems in the quadrangle: Jarvis Creek and Delta River. In general, soils in the quadrangle consist of surficial deposits of sandy-silt underlain by coarse gravel. There are essentially two kinds of bedrock mountains in the quadrangle: the rugged granodiorite mountains of Granite Mountain and Ober Dome and the smoother schist of Donnelly Dome.[1]

Vegetation in the quadrangle includes forests representative of the North American boreal forests and of tundra found both at higher latitudes and in alpine situations. Forest stands consist of varying compositions of black spruce and white spruce, aspen, balsam, poplar, paper birch, and willow. Many of these stands have been modified by an extensive history of forest fire. In certain areas, some of these same species occur as scrub or shrub vegetation. Where permafrost occurs near the surface, drainage is poor and trees are stunted. Shrub tundra occurs in the foothills and is characterized by a dense thicket of 1- to 3-foot-tall shrubs underlain by a spongy mat of moss and sedge. On Donnelly Dome and Granite Mountain, an alpine rock desert occurs, consisting of an incomplete cover of low-growing plants in mats, tufts,

[1] G. W. Holmes and W. S. Benninghoff, *Terrain Study of the Army Test Area, Fort Greely, Alaska*, Volumes I and II, Waterways Experiment Station, Vicksburg, Mississippi, 1957.

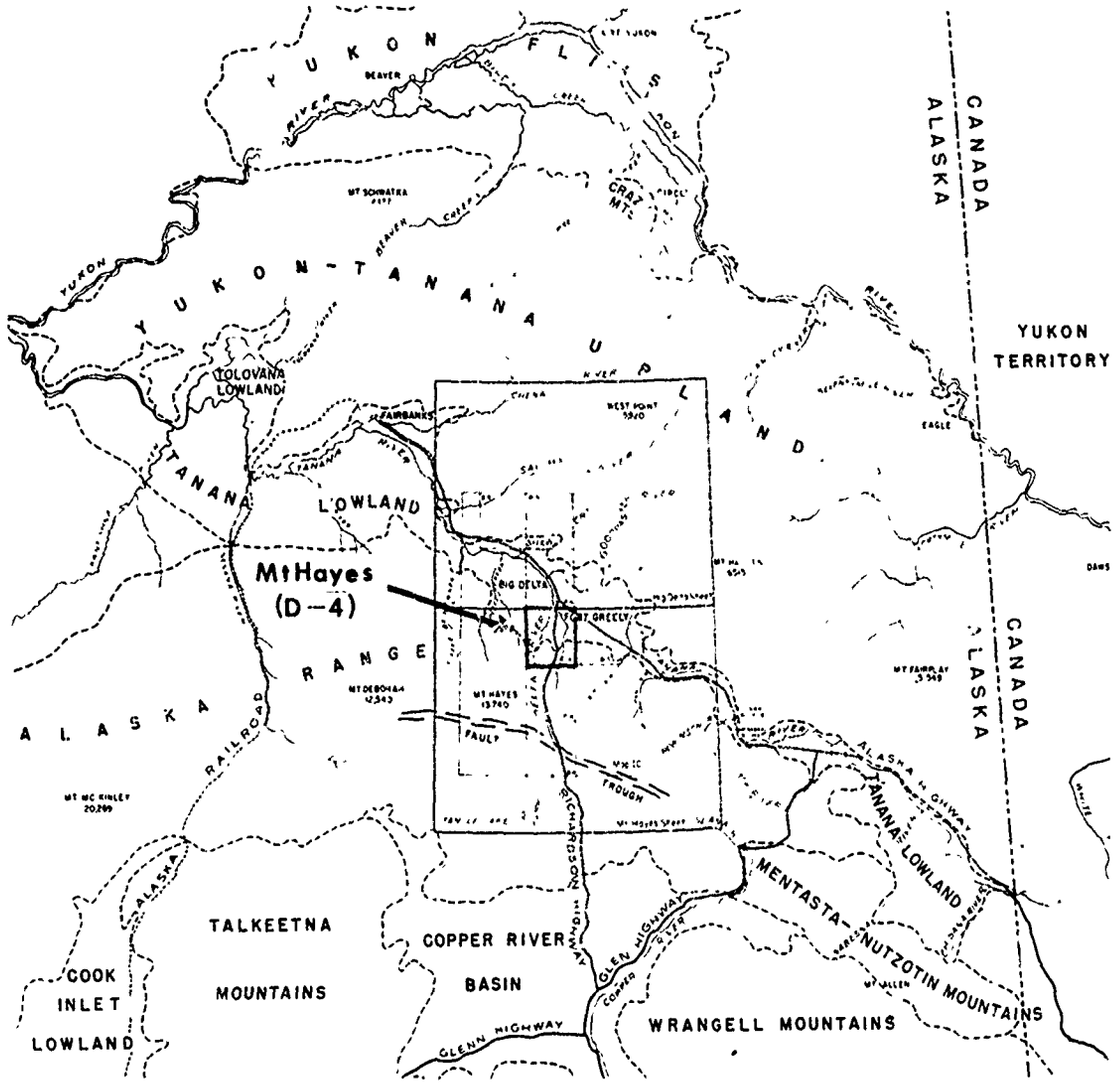

Fig. 1. Physiographic provinces of interior Alaska and index to maps of Fort Greely and vicinity (scale: 1 inch equals 55 miles).

rosettes, and cushions. Large areas of lichen barrens occur on windswept sites near the foothills and are sometimes mixed with spruce.

Weather at Fort Greely exhibits great seasonal variation with temperatures ranging from brief periods of -60°F in the winter to the upper 80's in the summer. Polar continental air from Siberia brings intensely dry, cold weather in winter, and maritime air from the Pacific brings moisture and warmth in the summer. Temperatures below -30°F generally occur less than 20 percent of the time from December through parts of February. More common are temperatures in the range of 0°F to -25°F during the winter months. The mean temperature in January is -5°F and in July is 59°F. A complex wind pattern and local variations in terrain cause significant local differences in temperature ranges. Average annual snowfall is 34 inches, and the snow is unevenly distributed due to topographic and wind anomalies.

Fort Greely, Alaska, is headquarters for the U.S. Army Arctic Test Center, a Class II activity of the U.S. Army Materiel Command. The Arctic Test Center is under the command of the U.S. Army Test and Evaluation Command at Aberdeen Proving Ground, Maryland. The Arctic Test Center's more than 500,000 acres is used in tests of performance of Army equipment and personnel in an arctic environment. Numerous firing ranges allow for testing of mortar, artillery, small arms, helicopter armament systems, direct or indirect air weapons, tank weapons, and air defense systems. Other test facilities are available for testing explosives, individual equipment, and rations. The terrain is ideal for testing winter mobility of vehicles and is used extensively for that purpose. Facilities at Fort Greely are entirely adequate to support an extensive testing program. An all-weather airfield, equipped with a large hangar, accommodates heavy cargo aircraft; an instrumentation section provides technology and expertise on test and mensuration equipment; and an adequate motor pool makes military vehicles and commercial cargo trucks available. A calibration section is available for insuring accuracy of instruments; a modern laboratory stands ready to provide chemical analysis for tests; a technical library is well equipped to provide all relevant information. A meteorological section provides complete weather data, and a computer facility equipped with an IBM 360/20 is able to process programs in FORTRAN IV or ANS CORDA. Temporary, World War II-type buildings were erected in 1955 and provide for billeting, quarters, administration, shops, and offices. As a site for controlled testing and support of a test program, Fort Greely leaves little to be desired.

5. Selection of Ground Data Collection Sites. A preliminary air photo analysis of the D-4 Quadrangle was performed, prior to field work, during which 12 sites were selected which were representative of the quadrangle. Subsequently, one site was eliminated since it was inaccessible for sampling. Photography for this site selection was within the selected sites; data would be collected in the field in four main categories: vegetation, soils, hydrology, and culture.

Five major criteria were involved in the selection of sites. Considerations were:

a. All anticipated variations in each category of data to be gathered would be sampled.

b. Sites would be located so as to allow for sampling of many features within one site.

c. Sites could be located over solitary (but important) features.

d. Most sites should be accessible by road and, if possible, be distributed so as to make rapid sampling possible by an available ground party at the exact time of overflight.

e. The size of each site could vary, but the total area of all sites was limited by the amount of multiband film allotted for the mission. (See Fig. 2 for location of the sites.)

6. Ground Data Collection. Ground data collection by a five-man GSL team began on 3 July 1973 and lasted the duration of the month. After an initial ground surveillance of the quadrangle, the team made a final selection of locations within each site at which detailed terrain information would be collected. Information was collected by three teams of the unit: soils, vegetation, and cultural. With the guidance of a GSL team member, the vegetation team studied vegetation plots, the soils team sampled soils transects, and the cultural team described and measured various cultural features. A GSL hydrology team took stream profile information at one location on each of the two main fluvial systems running through the quadrangle.

In the following sections of this report, data will be presented and discussed according to category of collection. A detailed description of methodologies employed and work performed during the collection of the data appearing in each category will be found in the section dealing with that category. Ground-truth data are presented in the appendixes in four sections according to category and site. Numbered positions where ground data were taken may be located on the aerial photographs of each site. (See Figs. 3 through 14.)

Different numbering systems were used by each team in locating specific points within the sites. Using Fig. 5 as an example, each soils datum is represented by two numerals preceded by the site designation, such as B33 and B45. The first numeral represents the soils transect while the second names the sampling station along that transect. Those points having an arrow between them (e.g., B51 and B54) represent

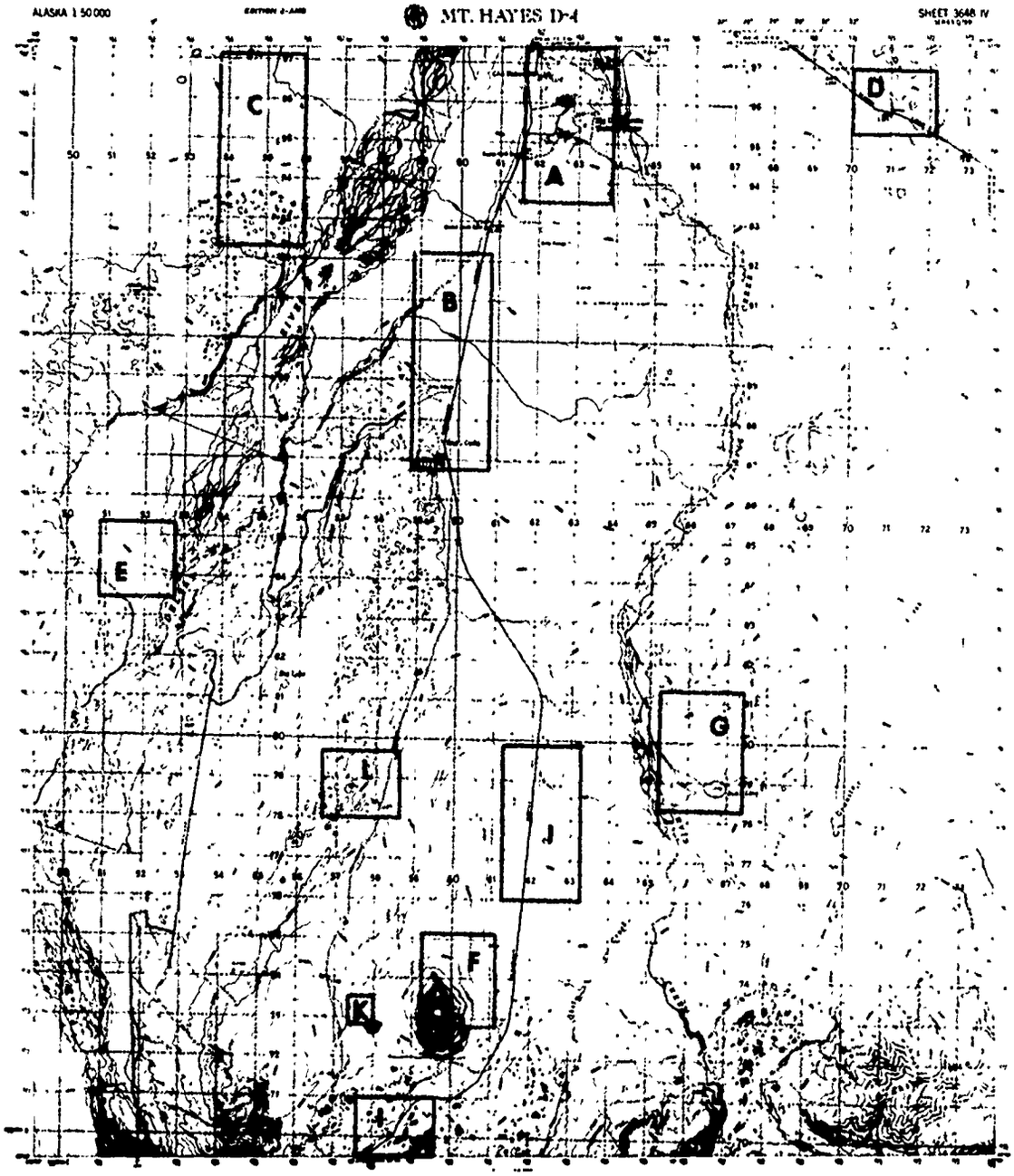

Fig. 2. Location of study sites within quadrangle.

Fig. 3. Site V (approximate scale, 1:17,000).


DVZ
VZ
UZ

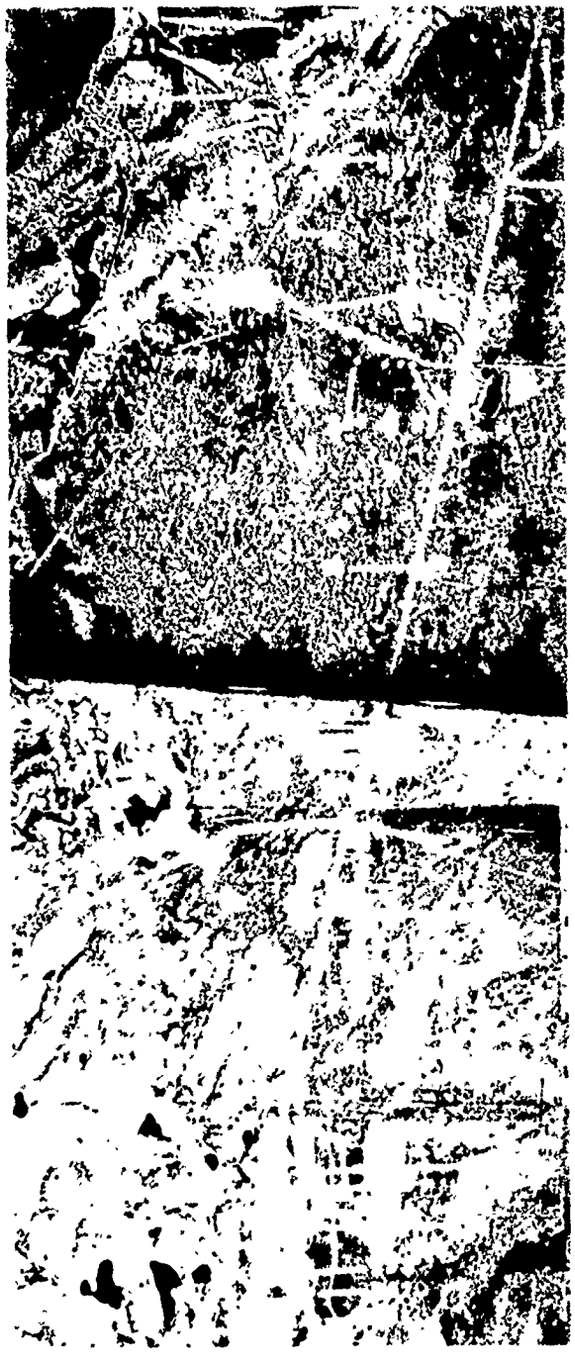

Fig. 5. Site B (approximate scale 1:18,500).

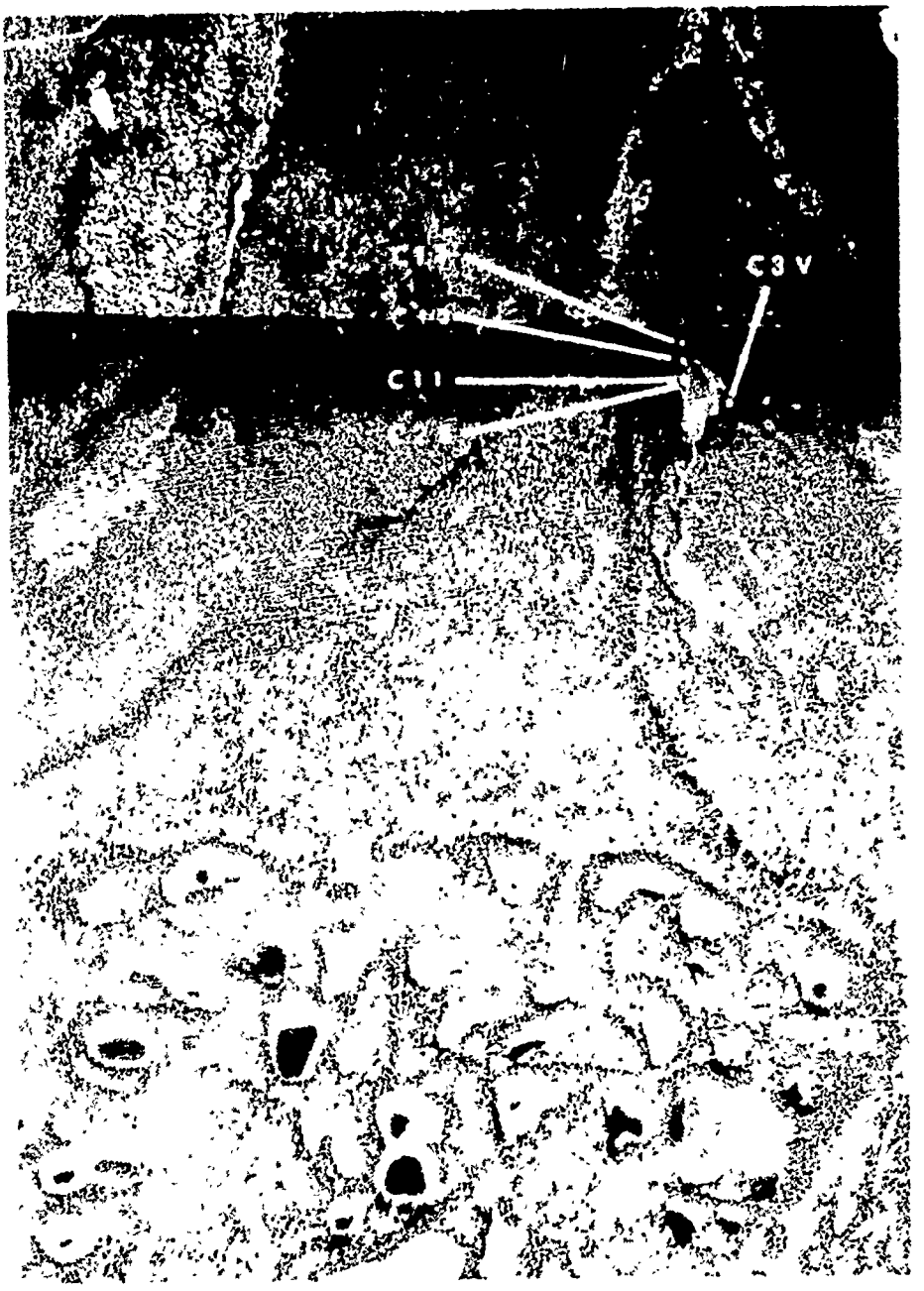

Fig. 6. Site C (approximate scale: 1:14,000).

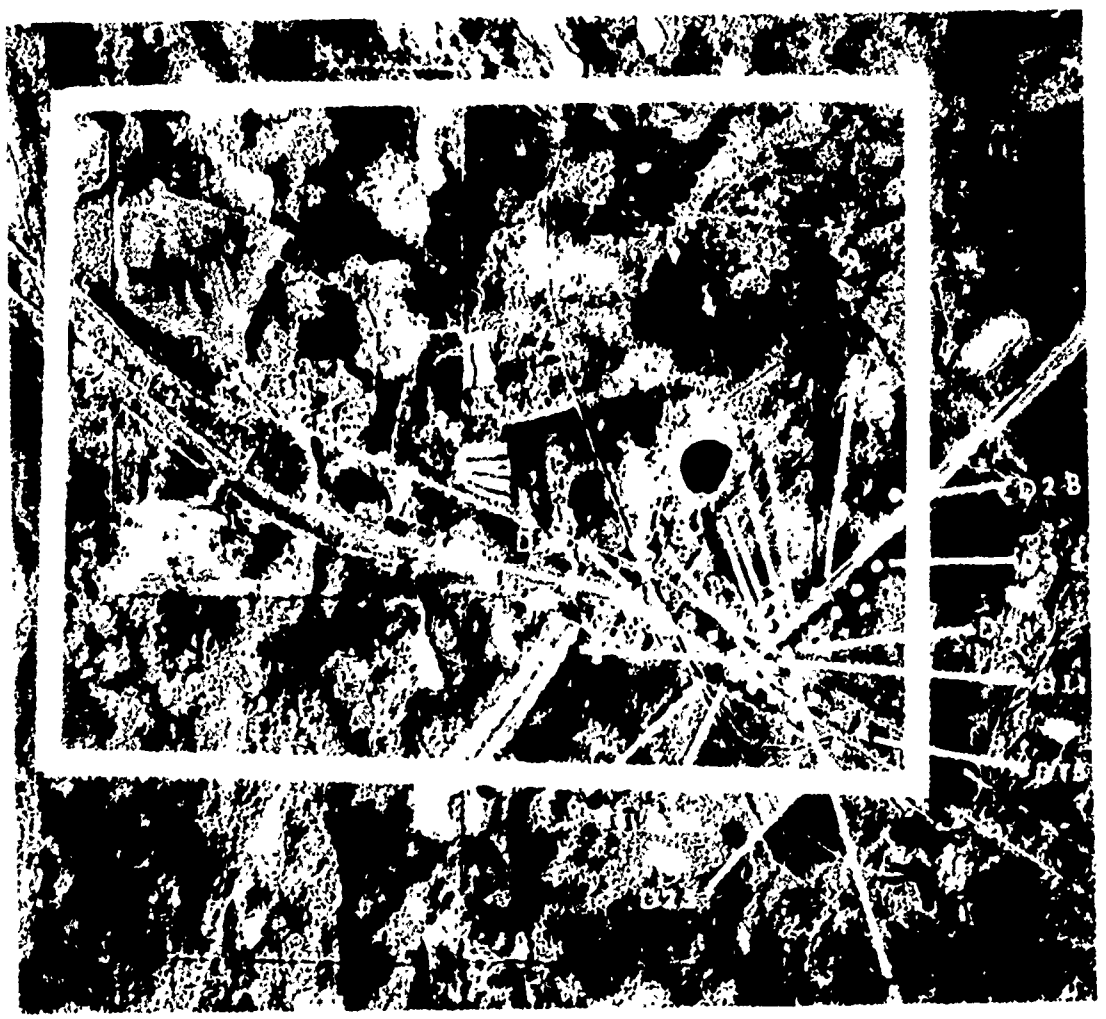

Fig. 7 Site D (approximate scale 1:16,000)

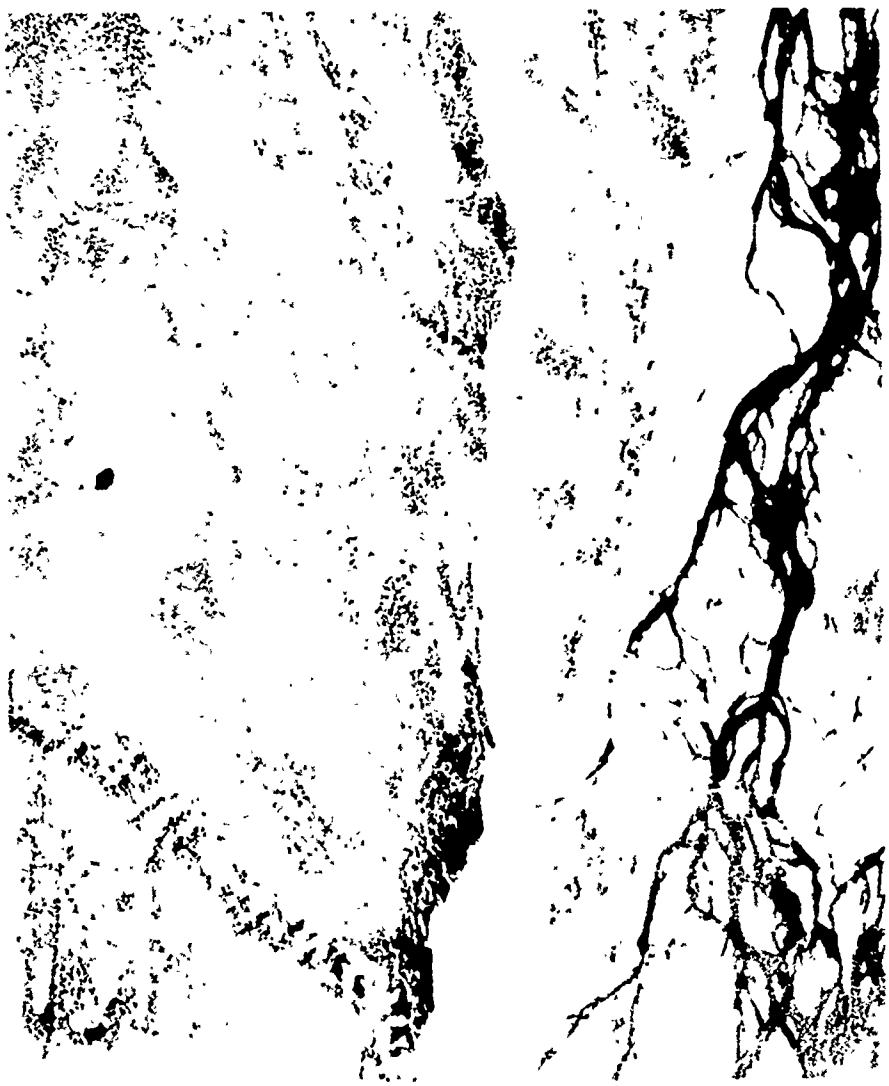

Fig. 8. Site E (approximate scale: 1:16,000).

Fig. 9. Site F (approximate scale: 1:16,000).

Fig. 10 Site 6 (approximate scale: 1:11,000).

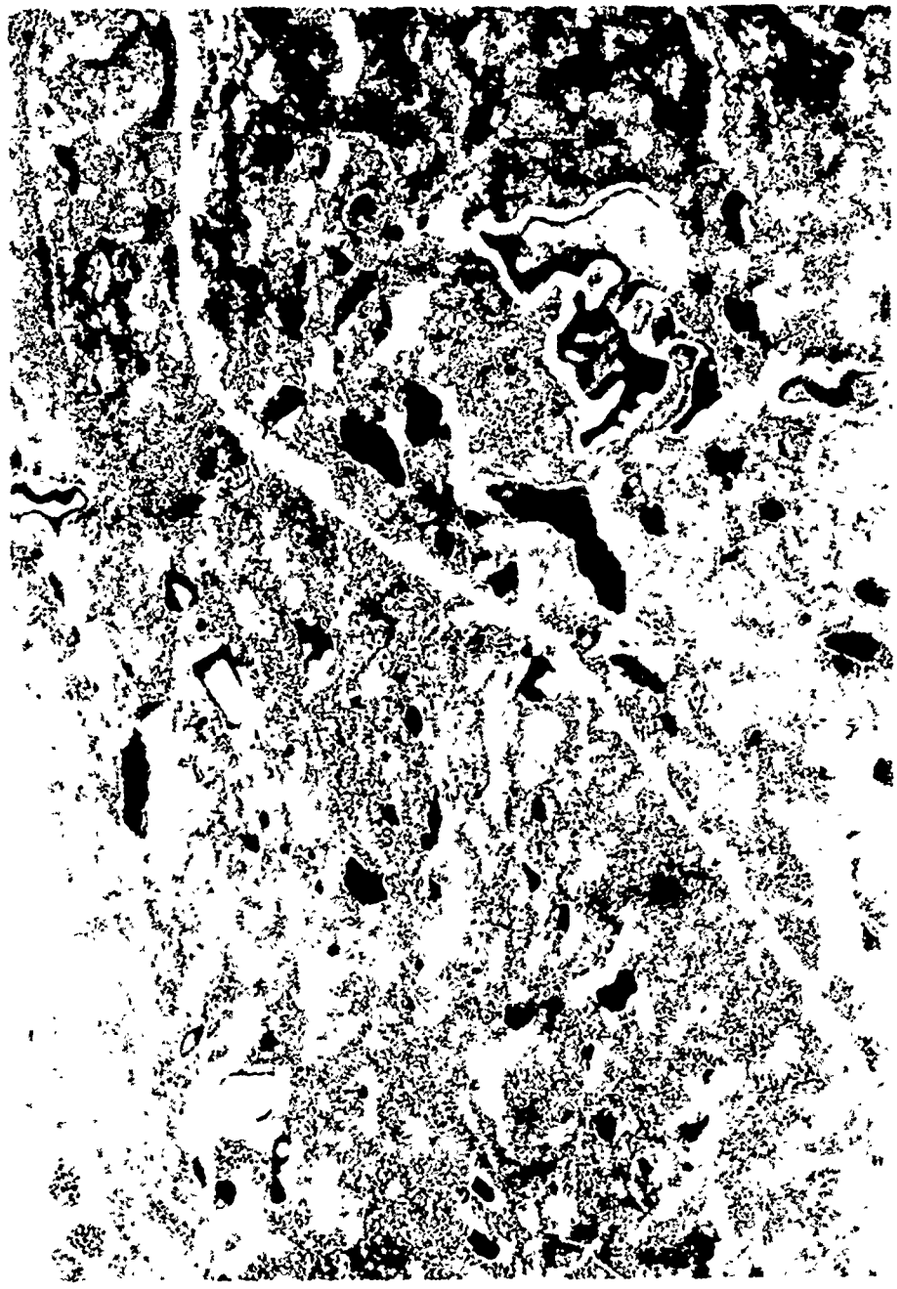

Fig. 11. Site I (approximate scale 1:13,000).

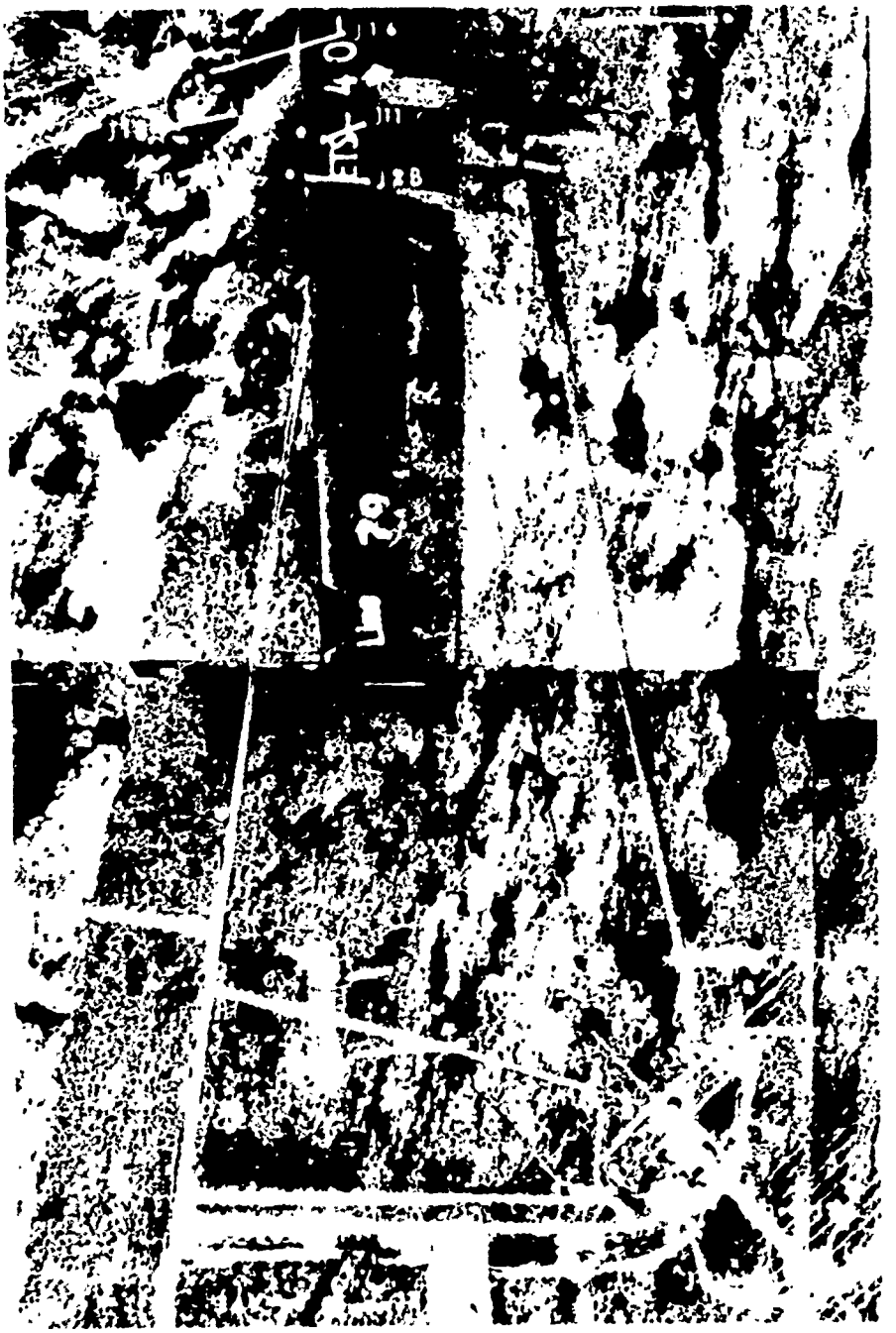

Fig. 12. Site 1 (approximate scale 1:13 000)

Fig. 13. Site K (approximate scale: 1:16,000).

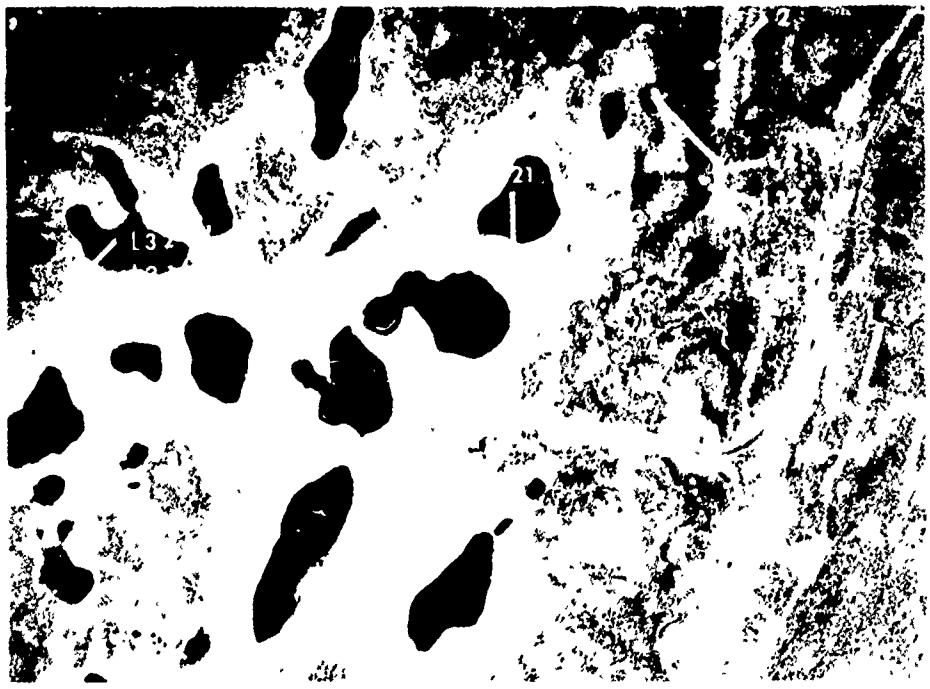

Fig. 14. Site L (approximate scale: 1:16,000).

the first and last sampling points of a transect, the intermittent points being unlabeled for the sake of neatness. Cultural data points are numbered 1, 2, 3, . . ., etc. in the order in which recorded. Vegetation data points are represented by one numeral preceded by the site designation as are the soils data.

II. SOILS AND LANDFORMS

7. Introduction. Contained within this section is an examination of the soil conditions present within the boundaries of the Mount Hayes D-4 Quadrangle, Fort Greely, Alaska. The presentation includes a discussion of sampling procedures utilized. distinctive results obtained, and extrapolation of data to cover each portion of the test area.

8. Investigations. Sites were chosen as outlined in Section I and were placed in order of priority according to the anticipated worth of the soils data to be obtained. The anticipated worth of a site evolved from a preliminary air-photo interpretation which gave special emphasis to photo-tonal boundaries. The worth of the site, therefore, was measured primarily by the number of theoretical soil-type boundaries it possessed and by its ability to clearly define difficult or doubtful interpretation of soils from imagery.

A program of sampling that provided the maximum amount of information with the least amount of effort was then required. After an investigation of methods employed by various researchers, it was deduced that a methodology utilizing transects would best suit the needs of the mission. The procedure employs the collection of data along a predetermined path at either specified or random intervals. Since these data are collected by transect rather than by individual points, any question as to the credibility of the data obtained at a particular location can be resolved through comparison with adjacent data. This method introduces the least sampling bias possible. Sampling method implications were thoroughly discussed with statisticians in advance in the concept of a formal test design in order to assure valid test data.

Two steps were involved in locating each transect. First, using the aerial photography available, transects were chosen which provided a sampling of each area appearing homogeneously within the site. These transects were considered of prime importance to the study. Second, upon arrival at the test area, each site was visited, and supplemental transects were chosen from field observations.

Sampling occurred at random intervals along a straight path usually three to four such intervals in length. Major landform divisions were crossed in order that changes in soil type, if any, could be noted. Areas thought to be homogeneous as a

result of preliminary work were investigated in order that the degree of homogeneity might be determined.

A soil sample information sheet (see Appendix A, Fig. A-10) was used to record those characteristics unique to each 400- to 500-gram sample. These data include structure, textural classification, and Munsell color designation. Five penetrometer readings, taken at the surface with a Soiltest pocket penetrometer calibrated in tons/ft^2, were also recorded on this data sheet. Any unusual conditions observed were reported under the "Remarks" section. Two numbering systems were devised to facilitate immediate recognition of samples and their respective data. Both systems are best illustrated through example. Designation A-1-3 indicates that the sample is from Site A, transect 1, the third sample along that transect. This system dominates the soils data. The second system for nonsampling, depth-to-permafrost transects is quite similar. Designation G-1-P denotes that this is the first measurement station along the permafrost transect located within Site G.

Field measurements of soil density were taken, where practical, at the first sampling station of the first transect at each site. The sand cone method of density determination was utilized. These measurements were made to provide the investigator with a general view of the soil density distribution over the Fort Greely test area. The data obtained are presented in chart form (Table A-12) in Appendix A of this report.

All useful soils data obtained at each site are presented in Appendix A (Tables A-1 through A-10). Bearing capacities which appear are the averages of the five readings taken in the field. Depth at which a sample was taken, Munsell color designation, and Unified Soil Classification System classification are also presented.

9. **Discussion.** The main categories of soil found within the quadrangle were those in paragraphs 9a through 9c following.

a. **Silt.** The major component of Site A, silt mixed with a large amount of organics, dominates most of the outwash areas of Fort Greely. Within Site A, the first three transects of data were recorded as pure silt varying in color from area to area primarily because of variations in organic content. At times, however, moisture was also an important factor.

Other outwash areas sampled also showed that silt was the dominant soil type. Sampling at Site J provided one complete transect of pure silt within the outwash portion of the site. Further reinforcement for the data obtained at Site A came from the fifth transect of Site B. This transect, like those previously mentioned, consisted of pure silt.

Anomalous situations did occur, however. The fourth transect of Site A proved to be totally comprised of silty gravel. It had been noted during sampling that there was a possibility that this transect had inadvertently been placed within an area of artificially introduced soil. After further investigations, however, it was surmised that the surface soil layer (comprised of silt) had been scraped away during construction of a nearby airfield, exposing underlying gravel deposits.

Outwashes were not the only places for silt to be found. To the west of the Delta River, sampling of the Donnelly Moraine at two different sites produced a dark, highly organic, silt causing permafrost at depths of approximately 25 centimeters. Permafrost is soil which remains frozen beneath the ground's surface year round, being insulated (from the heat of summer) by a thick blanket of vegetation. It should be noted that this was the only moraine to exhibit, wherever it was sampled, the characteristic of being comprised of silt. All the other moraines visited appeared to be entirely composed of the second major soil group of the Fort Greely area – silty gravel.

b. Silty Gravel. As just mentioned, the moraines visited by the field team at Sites B, K, L, and G gave evidence that they were comprised almost entirely of silty gravel rather than of the silt found in the Donnelly Moraine section west of the Delta River. This same condition could easily exist at all the moraine sections. It is possible that all are comprised of silty gravel overlain with a layer of silt varying in thickness from place to place. This is presently unconfirmed but seems highly probable.

Another area where silty gravel was present was in the floodplain of the Delta River. Sampling was not really necessary, since no vegetation was apparent thus leaving the soil bare to examination. Where this same floodplain was sampled in Site B, however, the third major group of soil existing within the quadrangle (silty sand) was found supporting a sparse vegetation cover.

c. Silty Sand. The section of the floodplain where silty sand was found supporting this sparse vegetation was at a slightly higher elevation than the rest of the floodplain. The difference in relief averaged approximately 4 to 5 feet and was probably caused by the gradual deposition of particles by varying meanders of the Delta River.

The terrace west of the Delta River within Site C was also found to contain silty sand as did the terrace of Site E.

10. Conclusions. From the data presented, it can be concluded that soil type within the Mount Hayes D-4 Quadrangle is, by and large, a function of landform unit. Anomalous situations do occur; but, in general, it can be said that moraines contain silty gravel overlain with varying amounts of silt, terraces are made up of silty sand and outwashes are comprised of silt.

Using these conclusions along with the soils data obtained, the soils map (Fig. 15) was constructed to illustrate the distribution of soil types within the quadrangle.

III. VEGETATION

11. Introduction. The major thrust of the vegetation aspect of data collection was to collect repetitive and quantitative information on all the vegetation types exhibited in the D-4 Quadrangle. A description of the approach and methodologies used in data collection and a discussion of vegetation types found in the quadrangle follow in paragraphs 12 and 13, respectively.

12. Investigations. The plan used for collection of vegetation data was to locate numerous plots in each vegetation type throughout the sites. In selecting site locations in the quadrangle, the vegetation team gave great consideration to inclusion of representative vegetation types of the quadrangle. Locations for the plots were determined before going into the field on the basis of a study of prior air photos of the sites. Modifications and additions to these locations were made in the field after a ground survey of vegetation.

An inventory of vegetation of each plot was conducted by a four-man, Army reserve unit team. Within a 20- by 40-foot area, trees over 5 feet tall were tabulated by 2-inch increments of stem diameter classes, the average height and the crown diameter for each class were measured, and the species was recorded. A 15- by 15-foot area arbitrarily located at one corner of the larger area was used for tabulating shrub data. Here, shrub characteristics were recorded to show species, average height, average crown diameter, and percent of ground covered by shrub. A 3- by 3-foot plot for herb data was located within a 900-ft^2 sample area where sampling would be representative of the herbal situation of the larger area. Information acquired in these plots included percent of ground covered by species and average height. All vegetation plots of this type can be located on the photomosaics of the sites and are distinguished from other points by a V which follows the name of the site and the plot number. For example, point A-1-V indicates vegatation plot 1 at Site A.

Another series of vegetation plots was sampled, but the information obtained is more qualitative than quantitative. In these plots, tree height was measured; but, instead of number of trees per plot being taken, an average spacing was approximated for each diameter class. From these data, the approximate number of trees per plot in each diameter class was calculated using the method described in Appendix B. This series of vegetation sample sites is distinguished from the vegetation plots in the annotation systems by a B instead of a V, i.e., point A-1-B.

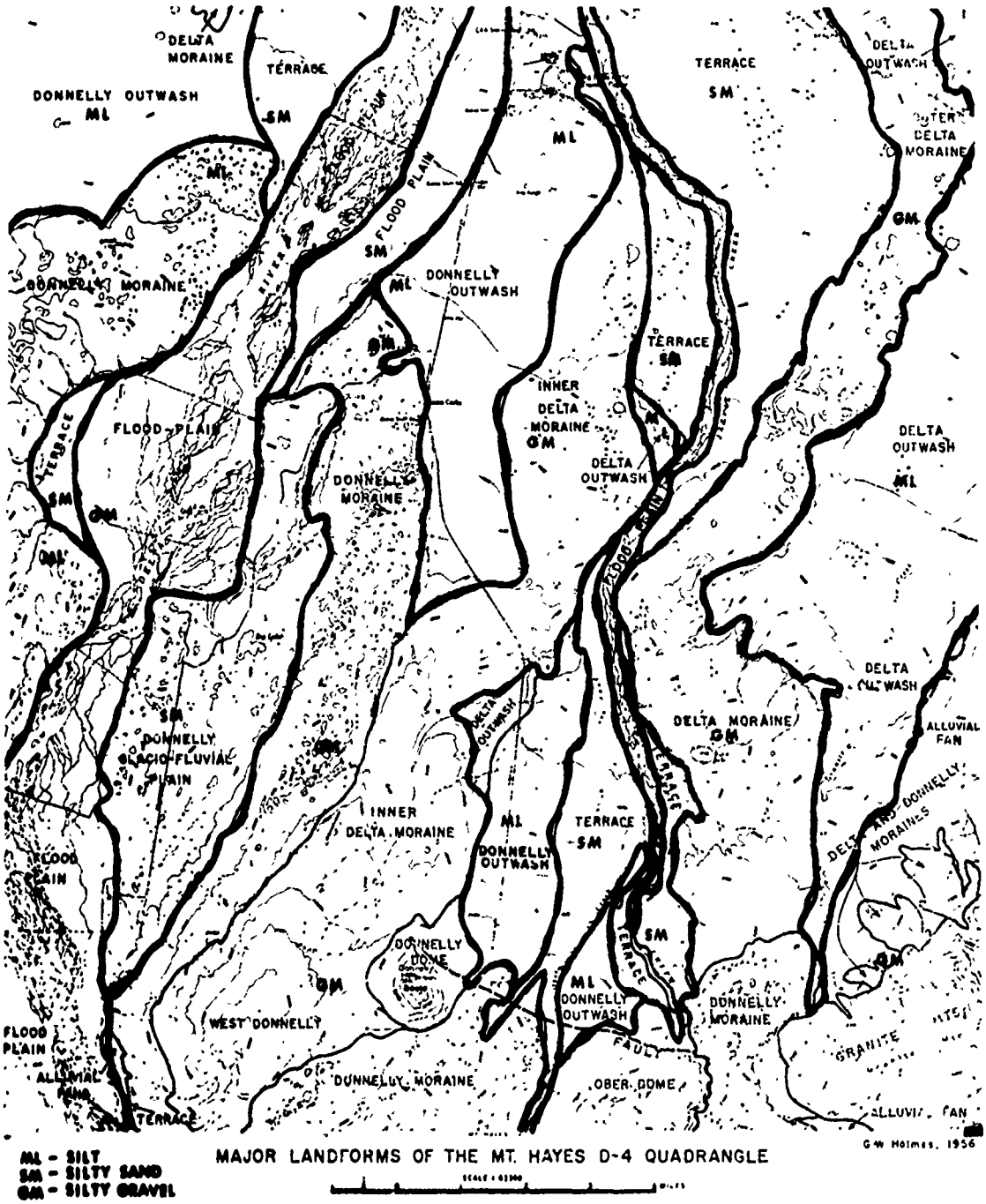

Fig. 15. Distribution of soil type.

At many locations of vegetation sampling, photographs of the canopy were taken from the ground using a Nikon F camera equipped with fisheye lens. These photographs provide a 180° hemispherical representation of the canopy. Canopy volume in the cone-shaped projection was measured and is termed Canopy Closure Index (CCI), expressed in percent.[2] The ETL-developed Automated Image Data Extraction System-I (AIDES-I) was used to determine the percent of sky represented on the 35mm, panchromatic-X negatives. This number was subtracted from 100 to give the Canopy Closure Index, or the percent of canopy volume in a conical projection. A knowledge of CCI's of differing forest types allows an evaluation of concealment factors offered by the canopy. A comparison of CCI's of different vegetation types will be presented later.

There are 59 points at which vegetation information was collected on the ground. Of these, 37 are vegetation sample plots (the V series) and the rest are the B series. Appendix B, Table B-2 presents charts giving all information gathered. There is one chart per sample point, and charts are grouped numerically by site. Using the sample site photomosaics and vegetation charts, the reader will be able to extract ground-truth vegetation information for any point sampled.

Thirteen vegetation types in the quadrangle are defined from the field information based on major species, height, and, in some cases, habit. In brief, these vegetation types are: white spruce forest, black spruce forest, black-and-white spruce forest, lichen barrens, spruce forest with lichen barrens, black spruce muskeg, mixed spruce and deciduous forest, deciduous forest, deciduous shrub, mixed spruce shrub/deciduous shrub, dryas tundra, sedge tussock bog, and marsh. These vegetation units will be described, variations within types will be discussed, and differences between types will be pointed out. Table B-1, "Plot Data by Vegetation Type," found in Appendix B, is arranged by vegetation type and is useful in making comparison between and among vegetation types.

It should be noted that much of the existing vegetation at Fort Greely is the result of extremely frequent reworkings by forest fire. However, one area that appears to have been untouched by fire is the Donnelly Moraine area west of Delta River.

13. Observations.

a. White Spruce Forest. White spruce, or *Picea glauca*, forests occur in stands 25 to 55 feet tall. Stem diameters at breast height (d.b.h.) range from 2 to 14 inches, although this range is not usually encountered within one stand. In dense

[2] P. L. Johnson and T. C. Vogel, *Evaluation of Forest Canopies by Photography*, Research Report #253, U.S. Army Materiel Command, Hanover, New Hampshire, October 1968.

stands, the average spacing between trees ranges from 3 to 20 feet, but this is a spacing which allows a person to walk through the trees without much difficulty. In most cases, these forests exhibit a marked absence of tall shrubs. The ground is almost entirely covered with a 6- to 12-inch layer of moss which is usually spongy. Shrubby species of medium height (1 to 1½ feet) are wild rose, cinquefoil, willow, and alder; low shrubs (under 1 foot tall) are cranberry, bog blueberry, mountain cranberry, Labrador-tea, alpine bearberry, and Viburnum. These shrubby species occur only in small amounts and grow on top of the moss. Herbaceous species include grass, *Equicetum, Epilobium, Astragalus, Hanunculus,* and others.

White spruce forests were found to grow on terraces, moraine ridges and slopes, and old floodplains. Since each of these landforms has different soil types, it can be concluded that white spruce forests are not selective as to soil type. However, some differences were found to exist between the forests growing on floodplain and those growing on moraine. Floodplain stands, as at point B-1-B, exhibited a higher density than other equally tall stands; whereas, stands growing on a moraine exhibited a much lower density (a density of 13/800 ft^2 as compared with 36/800 ft^2). One constant feature seemed to be that the taller the forest, the more widely spaced were the trees. The exception was the floodplain stand. A good expression of this height/spacing relationship can be found in a comparison of a young, white stand, J-1-V, with a density of 71 trees/plot. Not surprisingly, cross-country movement on foot is generally easier through the taller stands because of the decreased density, unless it is counterbalanced, as in a few instances, by a dense understory of 8-foot-tall alder bushes. This type of dense understory was encountered only on the Donnelly Moraine in Plot E-4-V. Plot C-2-V (Fig. 16) is an excellent example of white spruce forests at Fort Greely. Finally, from the CCI data, it can be seen that the white spruce forest offers approximately 50 percent canopy coverage -- usually more for the taller stands and less for the shorter ones.

Open stands of white spruce (Fig. 17) occur on gently sloping moraines and are similar to the so-called forested tundra of boreal Eurasia. Trees are from 10 to 32 feet tall and are spread 15 to 30 feet apart. Dwarf birch occupies 20 to 40 percent of the ground area, and a spongy carpet of moss occupies the rest. A considerable amount of bog blueberry grows on the moss along with varying amounts of the same low shrubs that grow in the denser white spruce forests. At an altitude of over 2,400 feet, these trees are approaching the tree line. This is the probable cause for their open habit. Very little canopy closure is afforded in these areas, although ground movement through them is easy.

b. Black Spruce Forest. Another major forest type is the black spruce, or *Picea mariana*, forest. Generally, the black spruce forests sampled were not as tall as the white spruce forests, with only one stand attaining the height of 15 feet. Average

Fig. 16. Plot C-2-V, white spruce forest.

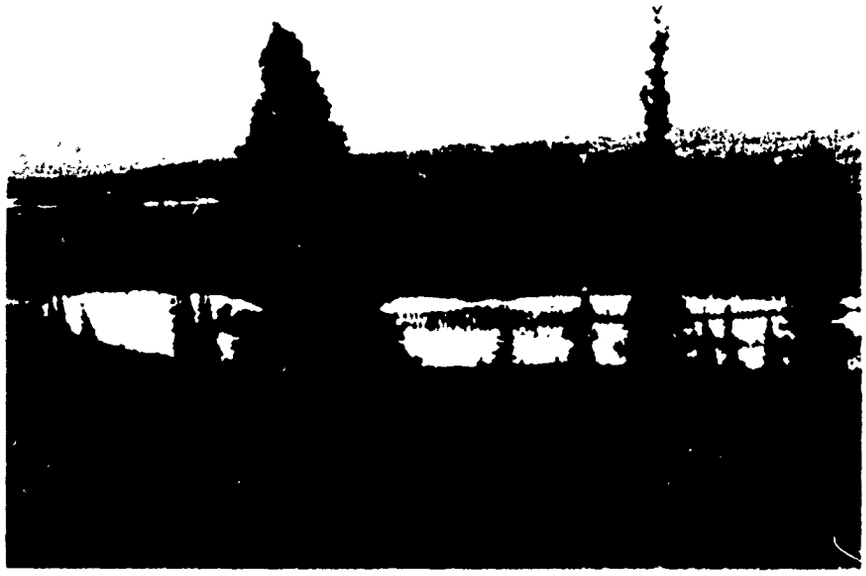

Fig. 17. Plot I-2-V, open spruce stand.

heights are 4 to 24 feet. Densities are generally greater in black spruce stands than in the white spruce stands. Average spacings are from 2½-3 feet to 6 feet, and densities are from 20 stems/plot to a more representative 110 stems/plot. Stem diameters more commonly fall in the 0- to 2-inch and 2- to 4-inch range, but in taller stands diameters may approach the 6- to 8-inch class.

In the medium shrub stratum of black spruce forests, dwarf birch is common along with occasional 2- to 3-foot-tall aspen bushes. Common, low-growing shrubs are mountain cranberry, bog blueberry, and Labrador-tea. Moss is a dominating ground cover, covering 30 to 85 percent of the ground at points sampled. Common herbs are grasses, sedge, *Linnaea,* and *Pellia,* a leathery liverwort.

Black spruce forests (Fig. 18) sampled grew on terrace, moraine, and outwash landforms. Generally, black spruce forests will grow in locations unsuitable for white spruce forests; i.e., sites where drainage is poor and where, due to permafrost, the active soil layer is thin. It is usually the case, however, that the better drained and nonpermafrost sites support taller stands of black spruce as well. Plot C-3-V growing on terrace was able to support tall trees even though depth to permafrost was only 14 inches. This could possibly be due to better drainage afforded by the sandy composition of the soil.

c. **Black Spruce Muskeg.** One peculiar form of black spruce forest occurs as "black spruce muskeg," a dense stand of short, stunted trees with a boggy ground cover of moss and low shrubs also found in other black spruce stands. Site C-3-V (Fig. 19) is an excellent example of muskeg. Here, the trees are only 4 feet tall and are spaced about 3 feet apart. Diameters are under 2 inches. It is difficult to draw the line between the black spruce forest and the muskeg, particularly since after about 30 years of growth muskeg stands on well-drained sites can assume almost full stature. Such seems to be the case with the forest at Plot C-3-V. Benninghoff, in his 1955 study of the area, had classified this stand as black spruce muskeg, but in 1973 the stand was approaching maturity.[3] The problem here may be in determining which stands are simply young stands and which are actually old muskeg stands stunted by poor conditions. At any rate, the concealment factor for the muskeg stands is much lower than that of the taller upland stands because of tree height differential.

d. **Black Spruce/White Spruce Forests.** Black spruce and white spruce are occasionally found growing in association with one another. In these forests (Fig. 20), trees range from 12 to 36 feet tall and are spaced quite closely at 2¼ to 3 feet. The density of the stands is generally greater than that of white spruce forests but less than

[3] Benninghoff et al, *Terrain Study of the Army Test Area, Fort Greely, Alaska,* Volumes I and II, Waterways Experiment Station, Vicksburg, Mississippi, 1957.

Fig. 18. Plot G-2-V, black spruce forest.

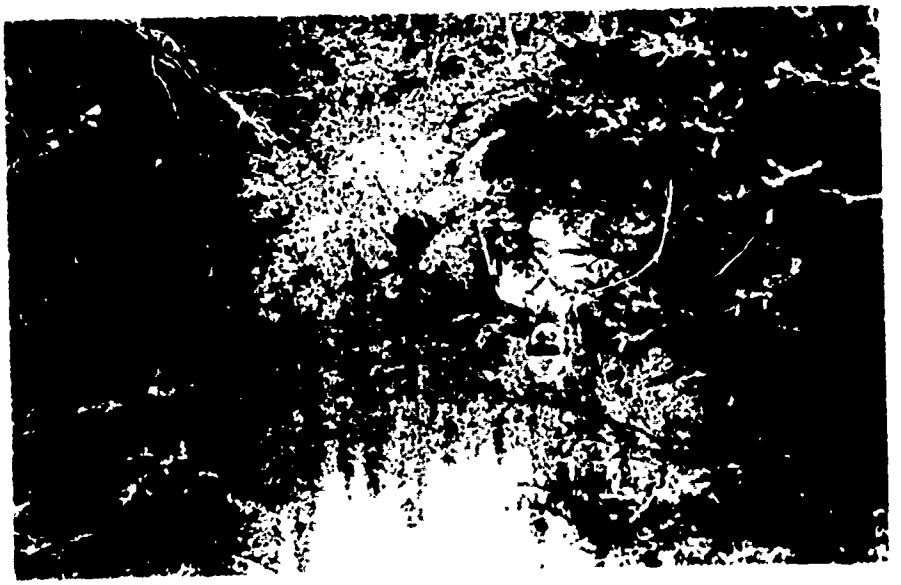

Fig. 19. Plot G-3-V, black spruce muskeg.

Fig. 20. Plot A-1-V, black spruce–white spruce forest.

that of black spruce forests. Likewise, stem diameters of this forest type reflect the diameters of its components: black spruce diameters huddle in the 2- to 4-inch range, while the white spruce diameters range from 10 to 12 inches. No tall shrubs are to be found in these stands, but occasional 2-foot-tall reproductive shoots form a medium-tall shrub layer. Common low shrubs are mountain cranberry, Labrador-tea, bearberry, and wild rose. The ground is almost completely covered with a 1-foot-thick layer of moss that depresses up to 1 foot when walked upon.

Black/white spruce stands were found to grow on outwash, moraine, and terrace landforms, all of which were very nearly flat. Canopy Closure Indexes ranged from 35 to 63 indicating great variability in concealment potential. This range in CCI is likely due to variations in percentages of black versus white spruce.

e. Deciduous Forest. In the deciduous forest, paper birch, balsam, poplar, and aspen usually appear in mixed stands and are only rarely found in pure stands. Trees range from 3 to 42 feet tall and have diameters up to 8 inches; stands are usually fairly dense, having 30 to 80 stems/plot.

In the tall shrub stratum, alder growths from 7 to 12 feet tall are common. At some sites, occasional young spruce trees occur. In such cases the forests will not remain solely deciduous but will likely become mixed spruce/deciduous forests. In the low shrub stratum, mountain cranberry predominates covering up to 70 percent of the

ground at one site. Other low shrubs were rare but include bog blueberry, bearberry, and cranberry. Moss cover is sparse in most cases, and leaf litter is prevalent on the ground. Herbs are plentiful here, with grass being the most common.

Deciduous forests sampled grew in floodplain and outwash, while locally pure stands of aspen (Fig. 21) grew on moraine. Pure stands are rare and tend to be strongly localized. No pure stands of balsam poplar were located, although Benninghoff reported them occurring only on floodplains and adjacent terraces.[4] Pure stands of paper birch are rare. While there are many deciduous trees in the area, very few of them occur in purely deciduous formations, most having been invaded by white or black spruce. At several locations, evidence of burned spruce stumps was found, indicating that a deciduous forest has replaced a spruce stand. Such was the case of Plot B-1-V (Fig. 22). Also found at B-1-V were young spruce shoots indicating that a mixed forest will likely develop. The possibility exists that a pure spruce forest might someday return. It can be said that within the quadrangle the purely deciduous forest is usually ephemeral, being soon invaded by spruces and started on its way toward becoming a mixed forest.

Canopies of deciduous forests offer the best concealment of any forest type in the quadrangle. CCI's were the highest of any tested, with values from 42 to 85 percent.

f. **Spruce/Deciduous Forest.** A widely represented forest in the quadrangle is the mixed spruce/deciduous forest composed of white and/or black spruce and any mixture of aspen, balsam poplar, and paper birch. Because of all the possible combinations of the deciduous trees with white spruce and black spruce, this vegetation type is probably the most diverse in the quadrangle. Because of this diversity, there is a tremendous range in tree heights – usually from 10 to 65 feet. Likewise, stem diameters range from 2 up to 20 inches; densities are as equally diverse, from 10 to 111 stems/plot. Eight-foot-tall alder is a frequent tall shrub in the understory and often makes passage difficult. Young 2-foot-tall, black-and-white spruce trees often occupy the medium shrub layer as their invasion into previous deciduous strongholds is continued. Buffaloberry and wild rose are the only other occasional medium shrubs occurring. Striking for its frequency and regularity of appearance is a low shrub, mountain cranberry, which composes over 30 percent of the ground cover in many plots. Occasionally, bog blueberry, Labrador-tea, and crowberry appear in these forests in varying amounts. Herbaceous species represented include grass, fireweed, *Equicetum*, *Linnaea*, and occasional lichens. The CCI's of mixed forests are from 29 to 77 percent, again reflecting the variation in concealment afforded by the mixed forests.

---

[4] Benninghoff, et al. *Terrain Study of the Army Test Area, Fort Greely, Alaska*, Volumes I and II, Waterways Experiment Station, Vicksburg, Mississippi, 1957.

Fig. 21. Plot D-1-B, aspen forest.

Fig. 22. Plot B-1-V: paper birch, balsam poplar, willow stand

Interestingly, the mixed forests sampled grew only on outwash plains and moraine landforms carrying ML and GL soils, respectively.

Plot A-3-V, Fig. 23, is a good example of a mixed forest containing all three major deciduous tree species. Trees are tall, with white spruce attaining a height of 65 feet and deciduous trees reaching 45 feet. The understory is generally open except for scattered alder bushes. In the mixed forest, aspen and balsam poplar are often found growing in association, both in moraine and outwash situations, as evidenced by Plots A-2-V, G-5-V, and B-2-V. Paper birch is often found growing with tall, mature stands of spruce, as at Plots A-3-V, C-1-V, and E-3-V. While on the airphotos these stands appear to be only spruce, paper birch is definitely a component of the forest. In these stands there is usually also a 12-foot-tall understory of alder making movement treacherous.

The CCF's here ranged from 45 to 60 percent, figures intermediary between those of spruce and deciduous forests.

Fig. 23 Plot A-3-V: aspen, balsam poplar, paper birch, and white spruce.

With the aid of past burns, we are able to see something of the stages of succession a forest undergoes from being a mixed forest to being a spruce forest. In Site A, sharp lines of past burns are visible on the photomosaic among the vegetation of Plots A-3-B through A-6-B. At Plot A-4-B (Fig. 24), spruces and aspen in mixed forests seem to be of equal height, although black spruce outnumbers aspen. At Plot A-6-B, the aspen is dying out. At Plot A-5-B (Fig. 25), the stand is older and is predominantly a white/black spruce forest. Only one live aspen appeared in the plot, and it appeared to be dying. In fact, many dead aspens were still standing here.

g. **Deciduous Shrub.** The deciduous shrub association consists largely of aspen and/or balsam poplar under 8 feet tall in association with other shrubs (namely: alder, willow, dwarf birch, and resin birch). Only in shrub tundra associations is aspen absent. In most cases, the shrubs form an almost complete cover. Some of the low-growing shrubs present in small amounts are mountain cranberry, wild rose, and Labrador-tea. The presence of moss as ground cover is only occasional, with a maximum of 40 percent ground cover. Herb presence is also minimal, with grasses and fireweed being somewhat predominant.

Shrubs were found to grow on outwash plains, floodplains, and moraine. In some cases, as at Plot B-5-V (Fig. 26), the shrub association of aspen and balsam poplar is probably only a step toward the establishment of a mature deciduous forest. In other cases, such as at Plot L-1-V, the forest growth may have reached its climax in the shrub condition due to high winds and/or colder conditions. This site is at 2,100 feet above sea level as compared with 1,470 feet at Plot B-5-V. Other deciduous shrub formations can occur as pioneer stands on recent floodplains, as evidenced at Plot E-1-B, an association of 2- to 7-foot-tall aspens and willows scattered along the Delta River floodplains.

A peculiar group of deciduous shrubs forms an association called shrub tundra. It occurs above the tree line and consists of three shrub species: willow, alder, and resin birch. Shrub height varies from 2 to 4 feet, and the shrubs again make a nearly complete cover over the ground. Low shrubs include mountain cranberry, bog blueberry, crowberry, and Lapland cornel. There is little moss present but grass is plentiful. Movement through the shrub tundra is tedious since vegetation is dense and springy.

Needless to say, deciduous shrub formations will not afford many concealment benefits, as evidenced by the CCI of 34 percent at Plot L-1-V. Taller, denser stands may offer good protection - but only for objects no taller than 6 feet. The CCI of 78 percent at Plot B-8-V would be misleading if this factor were not taken into consideration.

Fig. 24. Plot A-4-B.

Fig. 25. Plot A-5-B.

Fig. 26. Plot B-5-V; aspen, alder, balsam poplar shrub.

h. Mixed Spruce Shrub/Deciduous Shrub. Another vegetation type is 4- to 16-foot-tall black spruce in association with 6-foot-tall alder bushes. Plots were taken at two different stands, and densities were high: 128 stems/plot and 73 stems/plot. Medium-height shrubs are 2-foot-tall aspen, dwarf birch, and spruce shoots; low-growing shrubs include mountain cranberry, Labrador-tea, bog blueberry, and crowberry. Moss cover ranges from 10 to 65 percent.

This association is rather limited in distribution in the quadrangle, with these two stands occurring only on moraines. At 2,000 feet, these stands are near the tree line, and it is likely that this association represents a transition into shrub tundra. Concealment offered by these stands is variable because the CCI's varied from 15 to 66 percent.

i. Lichen Barrens. Lichen barrens occur in a few locations in the quadrangle. In this condition, the ground is covered up to 80 percent with lichens – both fruticose and foliose. Small amounts of medium-level shrubs, 2 to 2½ feet tall, are scattered over the lichens. These are aspen, willow, resin birch, and spruce seedlings. Even more sparsely scattered over the lichens are a few low-level shrubs, including bog blueberry, mountain cranberry, Labrador-tea, and bearberry. Very few herbs occur, and very little moss is present.

Fig. 27. Plot J-3-B, lichen barrens on polygon.

This formation occurs only on an outwash plain where high winds are frequent. At point J-3-B (Fig. 27), a lichen barren is growing on the surface of a large polygon, 40 feet in diameter. The polygons, caused by frost action and not easily discernible from the ground, have 1-foot-deep depressions at their perimeter. Twenty-foot-tall spruce trees often grow in these depressions as do 2-foot-tall aspens.

j. Spruce Forest/Lichen Barrens. Not far from these polygons, spruce trees are found growing in very open stands in association with lichen barrens. At these locations, lichens occupy 50 percent of the ground, with 2-foot-tall resin birch occupying up to 40 percent. The white spruce at Plot J-3-B are 6 feet tall; at J-4-B(b), the black spruce reach 16 feet in height.

Concealment factors offered by lichen barrens are negligible; concealment is improved only by the presence of the scattered, low-growing spruce trees.

k. Marsh. Marsh vegetation occurs on wet sites. Herbaceous plants predominate, and vegetation never exceeds 2 feet in height. Common herbs are sedges, cotton-grass, grasses, Iris, horsetail, rushes, and yellow-cross. Visibility is not limited by vegetation, and no concealment is afforded. At Plot C-2-B, polygons are present in the marsh, with characteristic 1-foot depressions at the polygon edge.

l. **Sedge Tussock Bogs.** Sedge tussock bogs occur at edges of kettle lakes. Sedges, usually cotton-grass in 1-foot-tall tussocks, predominate. The ground between tussocks is often wet or damp, and movement by foot is difficult. Some resin birch, bog blueberry, and Labrador-tea occur at Plot G-4-V (Fig. 28).

m. **Dryas Tundra.** Dryas tundra is a desert-like form of vegetation with scattered, low-growing plants in high-altitude areas and at windswept summits. Low shrubs grow in tufts, mats, and rosettes, with some having a creeping habit. These low shrubs are blueberry, alpine, bearberry, moss campion, *Dryas*, *Diapensia*, and reticulate willow. Some moss in mats occurs along with scattered lichen. Scattered herbs include grass, sedges, saxifrage, and *Arnica*.

Plot F-1-V (Fig. 29), on the summit of Donnelly Dome, is rather characteristic of other rock desert tundra communities. Plot L-1-B, on a lower, windswept site, has characteristics of both the dryas tundra and deciduous shrub communities. This dual condition is undoubtedly due to the site's lower elevation of 2,150 feet: this elevation is just above the tree line but affords enough cold winds to allow for some aspects of the dryas tundra to appear.

The dryas tundra offers no concealment benefits.

IV. CULTURAL FEATURES

14. Introduction. Of prime importance in many remote-sensing investigations is the assessment of man's effect upon the environment. It is fitting, therefore, that a section of this report be devoted to those features which, by virtue of their presence, provide evidence that man is or was present and which allow examination of the extent to which he has modified and adapted to his surroundings.

15. Investigations. All buildings, roads, and similar features within each of the test sites were examined. Since size plays such an important role in the detection of any object, particular attention was paid to the dimensions of structures. Each building was measured using conventional steel taping procedures, the dimensions being recorded for comparison with future photographic coverage. Building height was determined using a HAGA Altimeter.

Construction materials and the utilization of cultural features were determined and recorded. Where necessary, the Post Engineer's Office was consulted in order that data, such as the current use being made of the building, could be obtained more easily.

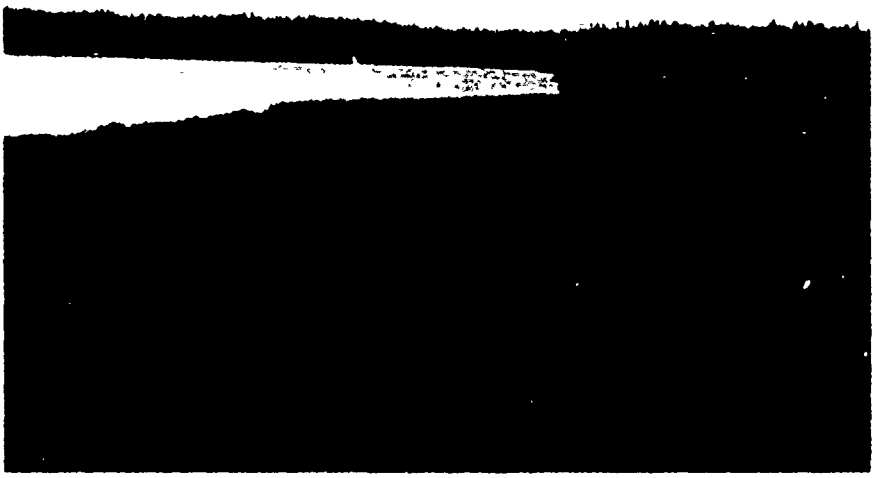

Fig. 28. Plot G-4-V, sedge tussock bog.

Fig. 29. Plot F-1-V, dryas tundra.

All data collected are presented in Appendix C. The point numbers listed correspond to the numbers shown on the accompanying aerial photographs, the only criterion for their order being the order in which they were collected at each test site.

16. Discussion. After full examination of the data, it can be readily observed that three major building types exist within the Fort Greely test area: concrete construction, metal construction, and wood-framed construction.

The first type, concrete block construction with reinforced concrete foundation, is the type used for all major facilities at the fort. Such facilities are the main barracks, mess halls, Post Headquarters, family housing units, and the like. This type of construction is illustrated in Fig. 30.

The second type of construction is used primarily for facilities that usually require only limited occupancy by personnel. Such facilities are constructed of sheet-type metal with similar type roofs. Metal construction units are exemplified by those located at Beales Range within Site B (see Fig. 31). These are used as field offices during the day, with the major portion of the buildings being used for storage of vehicles and other property not significantly affected by temperature changes.

The third type of structure is of wood-framed construction with either metal or wooden roofs. These buildings show signs of age and are used to a lesser degree than are either of the previous types (see Fig. 32).

Unique facilities were observed at Site J in the form of two radar domes of metal-framed construction (Fig. 33). This framing, very similar to that of a geodesic dome, was covered with a plastic-looking material of high flexibility.

Roads within the quadrangle consisted of three varieties categorized according to surface material and adequacy of drainage. Well-drained, asphalt paved roads (Fig. 34) dominated the higher density areas within the quadrangle. However, throughout the remaining portion of the test area, the major classification present was that of well-drained, gravel roads constructed with the gravel so abundant in this particular environment (Fig. 35). Running throughout the test area are many poorly drained dirt trails having varying widths (Fig. 36). These trails constitute the third and last category.

17. Conclusions. From the data obtained, it is apparent that the structures of Fort Greely are very good indicators of the climate to be found in this area. All high-use structures are of permanent design and have good insulation qualities. The location of the structures is such that little exposure to the elements is required in moving from one structure to another. Vehicle storage facilities are numerous also. In concluding

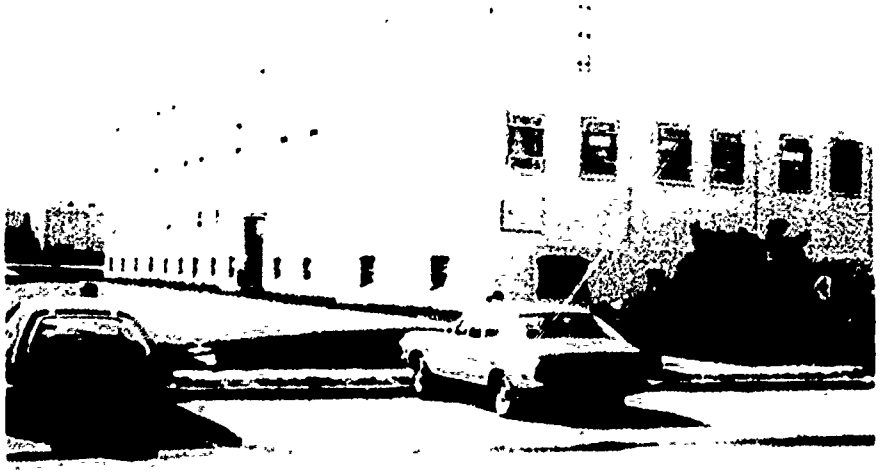

Fig. 30. Typical concrete construction.

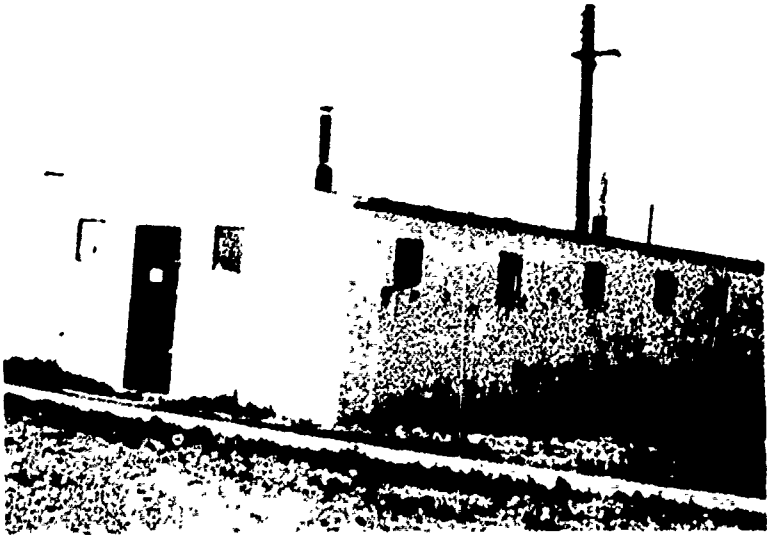

Fig. 31. Typical metal construction.

Fig. 32. Typical wood construction.

Fig. 33. Radar dome at Site J.

Fig. 34. Asphalt highway.

Fig. 35. Well-constructed gravel road.

Fig. 36. Poorly drained dirt trail.

this section, it may be stated that the cultural data of the Fort Greely Test Area exemplify its inhabitants' adaptation to the environment.

V. HYDROLOGY

18. Introduction. Two major glacial-fed, braided streams flow through the D-4 Quadrangle in a northerly direction. They are the Delta River to the west and Jarvis Creek to the east. The GSL team performed a partial transect across each of the rivers in order to produce a stream profile.

19. Investigations. Standard leveling procedures were used to measure absolute variations in elevation across each floodplain. Stadia rod and hand level were the primary tools, and data are accurate to 1 foot. Information collected was to include water depth, relative elevation, grain size and type, and surface velocity.

Transects were performed until channels became too deep to cross on foot. For this reason transect data are not complete, but the transects provide at least a partial picture of the structure of a braided stream.

Since there was a 4-day lapse between measurements of the two streams, comparisons of surface velocity data may lack accuracy.

20. Discussion. The transect at the Delta River was taken at Site E in a direction of S55°E. The Jarvis Creek transect was taken at Site A in a direction of N70°E. The photomosaics show precise locations of transects, and Appendix D contains stream profile charts for both transects.

It can be seen from the charts that the floodplains of both streams exhibit minor microrelief features. There is a steep dropoff from the banks of both rivers to the floodplain – 3 feet at Jarvis Creek and 8 feet at Delta River. Variations in surface elevation of the floodplain were 4 feet at Delta River and 2 feet at Jarvis Creek. Dropoffs into the channels were oftentimes extremely steep, and this condition can be dangerous to tank crossings. Numerous dry braids were evidenced on the Delta, whereas there were none at Jarvis. The main channel at Jarvis was only 2½ feet deep and 45 feet wide, and the main channel at Delta was too deep to be measured with the tools available but was 96 feet wide. Surface velocity of accessory channels of both systems was 4 feet/s. Surface velocities of the main channels were 6.7 feet/s at Delta and 4.8 feet/s at Jarvis. Comparison of these velocity figures is questionable due to a 4-day difference in sample dates. The actual velocities may comprise a reasonable range of values.

The stream floodplains are composed of various mixtures of sand and gravel, and the Delta River also has silt. Larger gravels are generally nearer to the banks and range in size from 2 to 6 inches at Delta River to 1 to 3 inches at Jarvis Creek. In various locations, gravels are only ¼ inch in diameter. Near the channels and dry beds, gravel size increases in both streams.

VI. AERIAL IMAGERY AND REMOTE SENSORS

21. Aerial Imagery. The initial aerial photographic coverage of the Alaskan Test Area was obtained with the three camera systems that were also employed for the four other test areas (see Appendix E). These camera systems included two cartographic cameras (KC-4A and KC-4B) and the USAETL Multiband Camera. In addition, area coverage was also obtained with the HMS-564X Multispectral Scanner and the Reconfax RA-35 Thermal Infrared Scanner.

The aerial photography was obtained at a scale of 1:10,000 on the following Eastman Kodak film emulsions: panchromatic, type 2402; color, type 2448; Eastman Kodak color negative, type 2445; and color infrared, type 2443. The experimental multiband photography was limited to the sample sites and was obtained, if not simultaneously, within an hour or two of the KC-4 photography. All photography was obtained with 25 percent side lap and 60 percent end lap to provide for stereo coverage of the sample sites.

22. **Remote Sensors.**

a. **KC-4A Aerial Camera.** The KC-4A is a cartographic aerial camera equipped with an f/5.6, 6-inch-focal-length, GEOCON I lens. It employs a Model B-2, Rapidyne shutter and Waterhouse stops in order to control exposure to within 1/3 of an f-stop on 9-inch film.

b. **KC-4B Aerial Camera.** The KC-4B was converted from a T-11 camera by the use of the following: (1) lens, GEOCON I, 6-inch focal length, f/5.6; (2) shutter, Model E-3-3, with remote station capability; (3) vacuum platen, reworked to a flatness of within 0.0002 inch over the entire format area; and (4) automatic exposure control (AEC), added to vary shutter speed with the changing integrated reflectivity of the terrain for each frame. When the camera is operated in the non-AEC mode, exposures can be controlled to within one f-stop.

c. **Multiband Camera.** This camera has been designed to record on 70mm panchromatic film four channels of information (red, green, blue, and infrared). The camera was developed with interchangeable 4- and 6-inch-focal-length lenses. A unique viewing system is required for reconstituting the four black-and-white images into a color or false-color image.

d. **HMS-564X Scanner.** This instrument is essentially a calibrated scanning radiometer capable of recording terrain data in five bands (0.5 to 13.0 micrometers). The scanner has a 2.0-milliradian instantaneous field of view and scans in a conical mode. This unique feature provides for constant scanner/terrain distance and for stereo viewing of the imagery when the fore and aft scan is employed. The five channels of information are recorded on magnetic tape in an analog mode and are then processed to a digital mode for hardcopy imagery.

e. **RA-35 Infrared Scanner.** This infrared scanner also has a 2.0-milliradian instantaneous field of view and records data on 70mm film. It is sensitive in the 8- to 14-micrometer portion of the electromagnetic spectrum. Imagery obtained from this scanner at 5,000 feet ASL will be used for evaluation and comparison with the thermal bands of the HMS-564X scanner.

BIBLIOGRAPHY

Church, Richard E., et al, *Origin and Environmental Significance of Large-Scale Patterned Ground, Donnelly Dome Area, Alaska,* Research Report 159, U.S. Army Materiel Command, Hanover, New Hampshire, June 1965.

Holmes, G. William, et al, *Terrain Study of the Army Test Area, Fort Greely, Alaska,* Volumes I and II, Waterways Experiment Station, Vicksburg, Mississippi, 1957.

Hulten, Eric, *Flora of Alaska and Neighboring Territories,* Stanford University Press, Stanford, California, 1968.

Johnson, Philip L., and Theodore C. Vogel, *Vegetation of the Yukon Flats Region, Alaska,* Research Report 209, November 1966.

Johnson, Philip L., and Theodore C. Vogel, *Evaluation of Forest Canopies by Photography,* Research Report 253, U.S. Army Materiel Command, Hanover, New Hampshire, October 1968.

Viereck, Leslie A., and Elbert L. Little, *Alaska Trees and Shrubs,* Agriculture Handbook No. 410, Forest Service, USDA, Washington, D.C., 1972.

APPENDIX A

SOILS AND LANDFORMS

Tables A-1 through A-10 below provide soil and landform data on Sites A, B, C, D, E, G, I, J, K, and L, respectively.

The abbreviations used in these tables for soil type are based on the Unified Soil Classification System:

Abbreviation	Soil Type
GW	Well-graded Gravel
GM	Silty Gravel
SM	Silty Sand
ML	Silt

Additional soil information is provided by Tables A-11 (nutrient analysis) and A-12 (density).

Figures A-1 through A-9 illustrate various unusual or outstanding characteristics of the D-4 Quadrangle.

The soil sample information sheet (Fig. A-10) was used in data collection at the various sites.

Permafrost transects were taken at Sites L and G and are shown in Figs. A-11 and A-12, respectively.

Table A-1. Site A

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
A-1-1	Outwash	24	1.75	4/3-5YR	ML
A-1-2	Outwash	20	0.84	6/4-5YR	ML
A-1-3	Outwash	20	2.03	4/4-5YR	ML
A-1-4	Outwash	22	1.31	4/5-5YR	ML
A-2-1	Outwash	21	1.58	5/2-7/5YR	ML
A-2-2	Outwash	22	1.03	4/3-5YR	ML
A-2-3	Outwash	28	0.98	6/6-5YR	ML
A-2-4	Outwash	21	1.80	6/6-5YR	GM
A-3-1	Outwash	20	0.99	6/6-5YR	ML
A-3-2	Outwash	20	1.39	5/4-5YR	ML
A-3-3	Outwash	20	1.72	5/3-5YR	ML
A-3-4	Outwash	21	1.61	6/4-5YR	ML
A-4-1	Outwash	18	2.37	3/3-10YR	GM
A-4-2	Outwash	22	–	3/3-10YR	GM
A-4-3	Outwash	21	–	4/2-7.5YR	GM
A-4-4	Outwash	22	3.03	3/3-10YR	GM

– Not taken

Table A-2. Site B

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
B-1-1	Floodplain	30	1.00	5/2-10YR	ML
B-2-1	Floodplain	20	2.11	5/4-5YR	SM
B-2-2	Floodplain	20	7.75	5/4-5YR	SM
B-2-3	Floodplain	22	2.08	5/3-5YR	SM
B-3-1	Moraine	20	1.22	3/3-5YR	SM
B-3-2	Moraine	21	0.86	3/3-5YR	SM
B-3-3	Moraine	22	0.98	4/4-7.5YR	GM
B-3-4	Moraine	21	0.93	4/3-5YR	GM
B-3-5	Moraine	22	0.99	4/4-5YR	GM
B-4-1	Moraine	21	0.99	4/4-5YR	GM
B-4-2	Moraine	22	1.04	4/4-7.5YR	GM
B-4-3	Moraine	20	0.80	4/3-5YR	GM
B-4-4	Moraine	19	0.82	4/4-5YR	GM
B-4-5	Moraine	19	0.96	4/3-5YR	GM
B-5-1	Outwash	21	1.25	4/3-5YR	ML
B-5-2	Outwash	25	0.99	4/4-5YR	ML
B-5-3	Outwash	22	1.30	4/3-5YR	ML
B-5-4	Outwash	21	1.50	4/3-5YR	ML

Table A-3. Site C

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
C-1-1	Terrace	21	1.69	4/2-10YR	SM
C-1-2	Terrace	22	1.57	4/2-10YR	SM
C-1-3	Terrace	22	–	4/2-10YR	SM
C-2-1	Moraine	21	–	2.5/1-5YR	ML
C-2-2	Moraine	20	–	4/2-10YR	SM
C-2-3	Moraine	25	–	4/2-10YR	SM

– Not taken

Table A-4. Site D

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
D-1-1	Moraine	22	1.52	4/2-7.5YR	SM
D-1-2	Moraine	28	1.07	5/4-5YR	SM
D-1-3	Moraine	24	1.65	5/4-5YR	SM
D-1-4	Moraine	20	1.85	5/4-5YR	SM
D-1-5	Moraine	20	1.70	5/4-5YR	ML
D-2-1	Moraine	30	2.00	2.5/0-7.5YR	SM
D-2-2	Moraine	20	1.46	2.5/0-7.5YR	ML
D-2-3	Moraine	20	0.88	3/2-7.5YR	ML
D-2-4	Moraine	22	1.50	3/2-5YR	ML
D-2-5	Moraine	22	0.95	5/6-5YR	ML
D-3-1	Moraine	21	0.93	3/2-7.5YR	SM
D-3-2	Moraine	21	1.16	3/0-7.5YR	ML
D-3-3	Moraine	20	1.45	4/2-7.5YR	SM
D-3-4	Moraine	22	0.90	4/2-7.5YR	ML
D-3-5	Moraine	20	1.65	4/4-7.5YR	ML
D-4-1	Moraine	22	2.41	5/6-5YR	SM
D-4-2	Moraine	20	2.09	5/6-5YR	ML
D-4-3	Moraine	21	1.22	4/4-5YR	SM
D-4-4	Moraine	25	1.30	4/3-5YR	ML
D-4-5	Moraine	20	1.45	4/4-5YR	SM

Table A-5. Site E

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
E-1-1	Floodplain	22	–	5/2-7.5YR	GM
E-1-2	Floodplain	55	–	5/2-7.5YR	SM
E-1-3	Floodplain	5	–	6/1-10YR	GW
E-1-4	Floodplain	Under Water	–	6/1-10YR	SM
E-2-1	Floodplain	16	–	5/1-5YR	GW
E-2-2	Floodplain	17	–	5/2-5YR	GM
E-2-3	Floodplain	22	–	6/1-5Y	GM
E-3-1	Terrace	13	–	5/2-5YR	SM
E-3-2	Moraine	40	–	2.5/0-7.5YR	ML
E-3-3	Moraine	40	–	2.5/0-7.5YR	ML
E-3-4	Moraine	40	–	2.5/0-7.5YR	ML

– Not taken

Table A-6. Site G

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
G-1-1	Inner Moraine	21	1.07	4/4-7.4YR	SM
G-1-2	Inner Moraine	20	0.66	5/8-10YR	SM
G-1-3	Inner Moraine	22	1.18	4/4-10YR	SM
G-1-4	Inner Moraine	21	1.57	5/6-10YR	GM
G-2-1	Inner Moraine	20	1.14	4/4-10YR	SM
G-2-2	Inner Moraine	20	1.09	3/2-7.5YR	GM
G-2-3	Inner Moraine	21	–	4/4-10YR	SM
G-2-4	Inner Moraine	19	1.39	4/4-10YR	GM
G-3-1	Inner Moraine	18	1.10	4/2-10YR	GM
G-3-2	Inner Moraine	20	–	4/3-10YR	GM
G-3-3	Inner Moraine	22	–	5/6-10YR	SM
G-3-4	Inner Moraine	20	0.79	4/4-10YR	GM

– Not taken

Table A-7. Site I

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
I-1-1	Moraine	20	2.22	5/4-2.5YR	ML
I-1-2	Moraine	21	1.40	4/3-10YR	ML
I-1-3	Moraine	22	–	3/2-10YR	ML
I-1-4	Moraine	20	1.10	4/4-10YR	ML
I-2-1	Moraine	21	0.90	3/2-10YR	ML
I-2-2	Moraine	20	1.04	3/3-10YR	GM
I-2-3	Moraine	21	1.44	4/4-10YR	GM

– Not taken

Table A-8. Site J

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
J-1-1	Outwash	21	1.44	4/3-5YR	ML
J-1-2	Outwash	25	1.15	4/6-5YR	GM
J-1-3	Outwash	20	2.00	4/6-5YR	GM
J-1-4	Outwash	21	1.24	5/4-5YR	SM
J-1-5	Outwash	22	–	6/6-5YR	SM
J-1-6	Outwash	20	–	2.5/0-7.5YR	SM
J-2-1	Outwash	20	0.76	4/2-5YR	ML
J-2-2	Outwash	21	0.81	4/2-5YR	GM
J-2-3	Outwash	19	1.15	4/6-5YR	GM
J-2-4	Outwash	19	1.00	4/6-5YR	GM
J-2-5	Outwash	23	1.44	4/6-5YR	GM
J-3-1	Outwash	20	1.19	5/4-5YR	ML
J-3-2	Outwash	19	0.75	5/3-5YR	ML
J-3-3	Outwash	22	1.00	5/4-5YR	ML
J-3-4	Outwash	20	0.61	5/4-5YR	ML
J-3-5	Outwash	18	0.90	5/3-5YR	ML

– Not taken

Table A-9. Site K

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
K-1-1	Moraine	20	–	2.5/0-7.5YR	ML
K-1-2	Moraine	22	–	3/2-10YR	ML
K-2-1	Moraine	20	–	4/2-10YR	GM
K-2-2	Moraine	20	–	3/3-10YR	GM

– Not taken

Table A-10. Site L

Sample	Landform Unit	Depth Taken (cm)	Bearing Capacity (kg/cm^2)	Munsell Color	Soil Type
L-1-1	Moraine	35	–	4/6-5YR	GM
L-1-2	Moraine	30	–	4/6-5YR	GM
L-1-3	Moraine	20	1.95	2.5/2-5YR	SM
L-2-1	Moraine	20	1.48	4/4-7.5YR	GM
L-2-2	Moraine	20	1.23	4/2-10YR	SM
L-2-3	Moraine	22	1.14	5/6-10YR	ML
L-3-1	Moraine	20	1.24	3/2-7.5YR	GM
L-3-2	Moraine	30	1.18	5/6-10YR	SM

– Not taken

Table A-11. Nutrient Analyses of Random Samples

Nutrient	Sample					
	B-1-1	B-3-1	D-1-1	D-3-1	J-1-1	J-3-1
pH	6.8	5.1	6.3	5.4	5.2	5.6
Phosphorus (lb/acre)	50	75	150	50	100	75
Nitrate Nitrogen (lb/acre)	20	20	40	60	20	20
Ammonia Nitrogen	Low	Very low	Low	Low	Very low	Low
Nitrite Nitrogen (p/m)	>1	>1	5	5	5	>1
Potassium (Potash) (lb/acre)	120	100	120	160	100	100
Calcium (p/m)	1,400	1,000	2,800	1,400	150	150
Magnesium	High	High	Very high	Medium	High	High
Manganese	Low	Low	Low	Medium low	Low	Low
Aluminum	High	Very high	Medium	High	Very high	Very high
Sulfate (p/m)	50	50	50	100	50	50
Chloride (p/m)	100	100	100	200	100	100
Ferric Iron	Medium	Low	Medium	High	High	Low

NOTE: All samples analyzed using the LaMotte nutrient testing procedures and materials.

Table A-12. Field Density Measurements

Sample	Moisture Content (percent)	Wet Density (lb/ft^3)	Dry Density (lb/ft^3)	Voids Ratio
A-1-1	8.9	52.2	47.9	2.517
B-1-1	19.4	91.16	76.28	0.818
D-1-1	24.8	51.85	41.54	3.056
E-1-1	2.0	159.9	156.5	0.076
G-1-1	14.5	85.08	74.44	1.26
I-1-1	7.8	34.18	31.72	4.311
J-1-1	29.5	69.36	53.64	2.141
L-1-1	4.6	42.26	40.22	3.189

NOTE: Sand cone method utilized in all of the above determinations

Fig. A-1. Delta River as viewed from transect 3 located at the edge of the Donnelly Outwash.

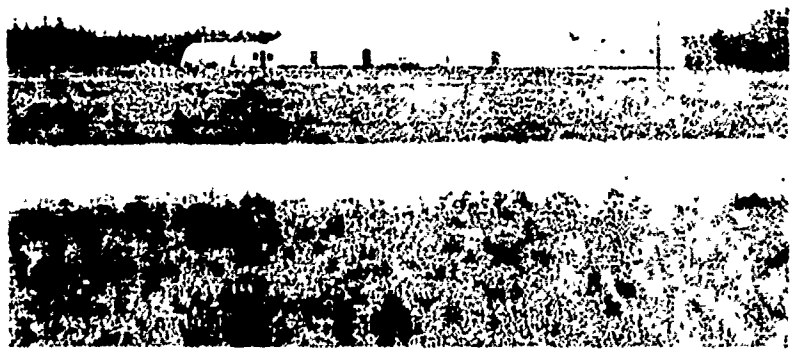

Fig. A-2. Evidence of underlying gravel deposits at transect 1

Fig. A-3. Deposition of fine sands along the banks of the Delta River.

Fig. A-4. Transect 3 evidence that outwash areas were covered with a silt surface layer.

Fig. V-5. Glacially formed dry lake located within the Donnelly Moraine.

Fig. V-6. Transect I demonstrates the variation of soils found in the Outer Delta Moraine.

Fig. A-7. Evidence of gravel deposits at Site G, transect 2.

Fig. A-8. Underlying gravel deposits were exposed by transect 2

Fig. A-9. Site L as viewed from Sample L-1-1 looking south.

SOIL SAMPLE INFORMATION SHEET

Date: **Sample No.:**

Location: (test area name)

Position and Slope of Site:

Apparent Source Material:

Natural Vegetation Cover:

Soil Structure:

Soil Texture:

Soil Horizons

Horizon No.	Color	Thickness	Sample Taken	Comments

Penetrometer Readings:

1.	2.	3	4.	5.

Remarks:

Collector:

Fig. A-10. Information sheet used in collecting soil sample data.

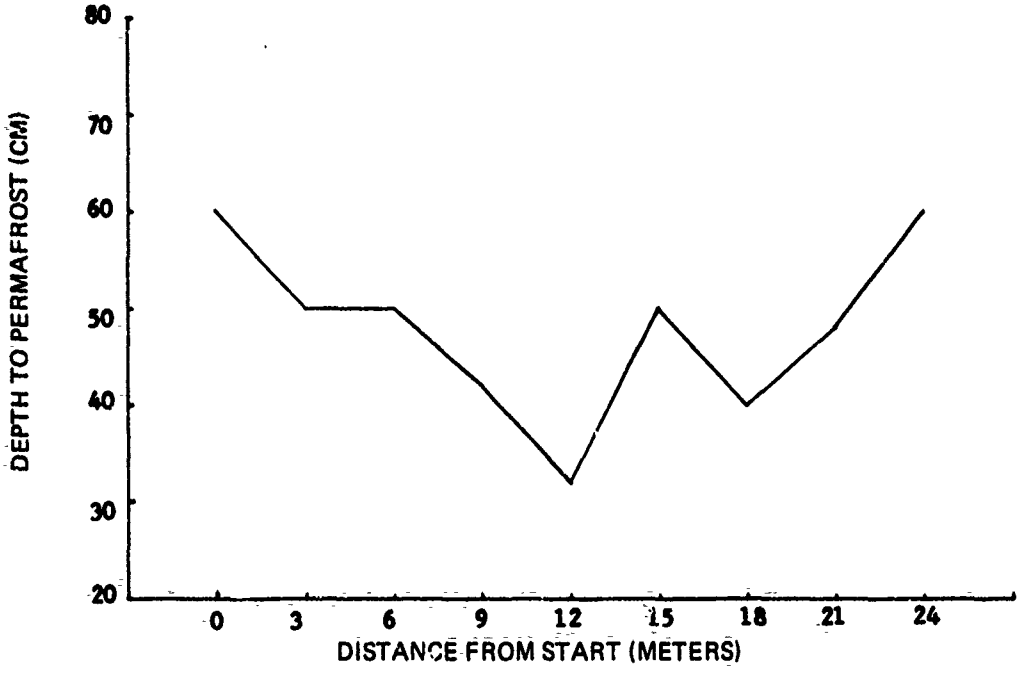

Fig. A-11. Permafrost transect, Site L.

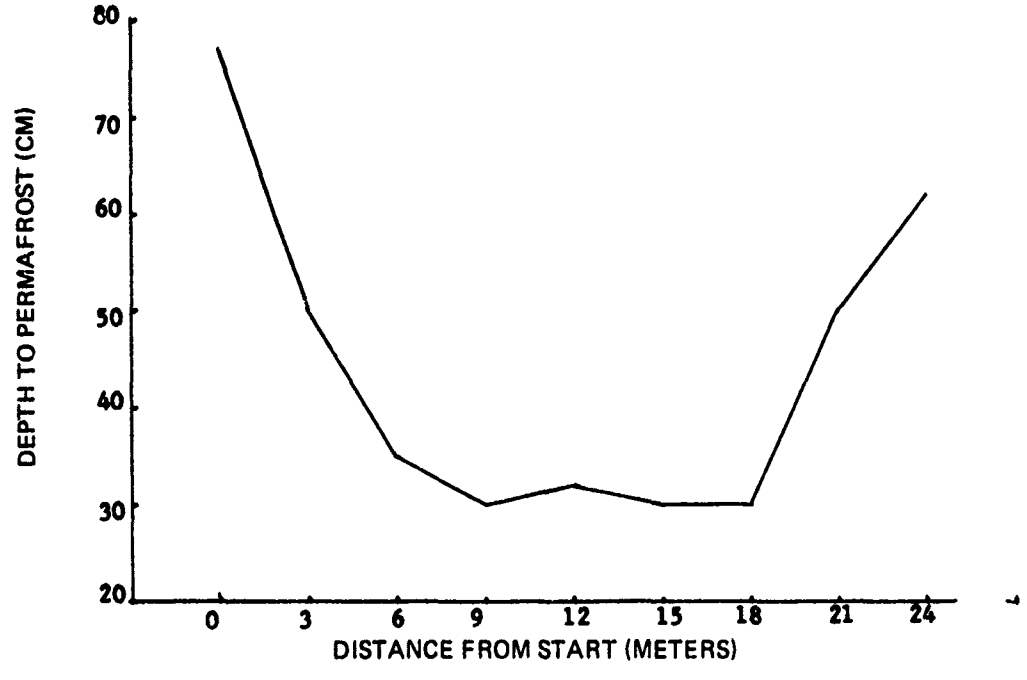

Fig. A-12. Permafrost transect, Site G.

APPENDIX B

VEGETATION

B-1. Density Calculation. The method for calculating the approximate number of trees for every 800 feet^2 from average spacing can be explained using Fig. B-1.

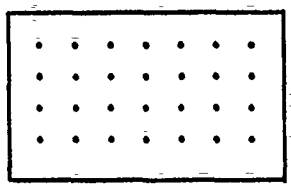

Fig. B-1. Vegetation Density Model

These dots represent a highly idealized forest with average spacing between trees at 5 feet. Dots are placed inside the square such that no dots fall on the square, thus rendering a more accurate picture of the forest than if some dots fell on the perimeter. From this representation, the following formula for calculation of the approximate number of trees per 800-foot^2 area, given the approximate average spacing between trees was deduced:

$$\text{Number of trees} = \frac{800 \text{ feet}^2}{\text{Average spacing}^2}$$

Example:

$$\text{Average spacing} = 5 \text{ feet}$$

$$\text{Let } x = \text{number of trees} = \frac{800 \text{ feet}^2}{(5)^2}$$

$$\therefore x = 32 \text{ trees}$$

B-2. Canopy Closure Index (CCI) Determination From AIDES. The Automated Image Data Extraction System–Phase 1 (AIDES-1) scans a square area and color codes each density. A digital readout, telling what percent of the total square is occupied by a certain color or density, is given. Figure B-2 is a representative fisheye photo from which CCI's were determined using the AIDES-1. AIDES-1 was used to find what percentage of the circular area was covered by sky. The AIDES-1 can only scan a square area and,

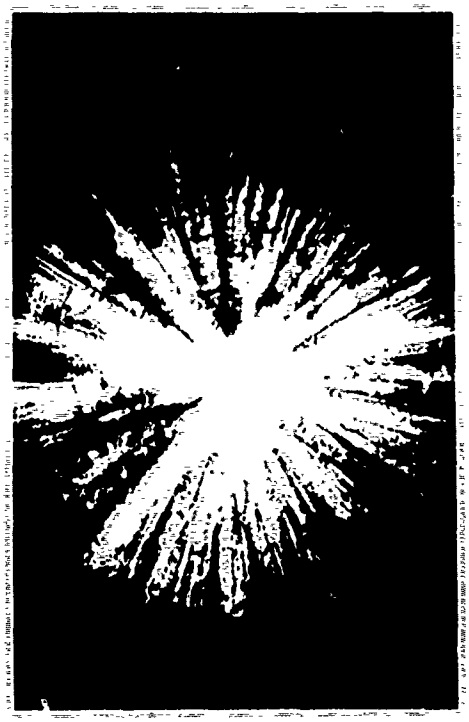

Fig. B-2. Sample canopy photo.

therefore, is only able to measure what percentage of sky is in the square area. It was determined that the canopy image, or circular area of the photo, is 78 percent of the square area. Since all sky falls within the circle, it follows that the amount of sky falling within the circle can be determined by a ratio of the amount of sky within the square to the area occupied within the square by the circle, or 78 percent.

$$\text{Area of sky within circle} = \frac{\text{area of sky in square}}{\text{area of circle in square}}$$

$$\text{Area of sky within circle} = \frac{\text{area of sky in square}}{78\%}$$

∴ The CC = 100% - area of sky.

B-3. **Additional Information.** Additional data for the various vegetation types are given in Table B-1.

Table B-2 provides data for each plot on the numerous species of vegetation found in the D-4 quadrangle area. (Note: In the table columns, "CD" is Crown Diameter.)

In Table B-2, species are identified by their scientific names. The common names for these species are as follows:

Scientific Name	Common Name
Trees	
Picea glauca	white spruce
Picea mariana	black spruce
Populus tremuloides	aspen
Populus balsamifera	Balsam poplar
Salix Spp.	willow
Betula papyrifera	Paper birch
Alnus crispa	alder
Shrubs	
Betula nana	–
Rosa acicularis	wild rose
Vaccinium uglinosum	bog blueberry
Vaccinium vitisidaea	mountain cranberry
Arctostophylos alpina	alpine bearberry
Arctostophylos rubra	–
Arctostophylos uvaursi	bearberry
Potentilla fruticosa	cinquefoil
Cornus canadensis	bunchberry
Ledum groenlandicum	Labrador-tea
Ledum decumbens	Narrow-leaf Labrador-tea
Betula glandulosa	resin birch
Salix Spp.	willow
Shepherdia canadensis	buffaloberry
Empetrum nigrum	crowberry
Ribes triste	American red currant
Silene acaulis	–
Dryas	mountain-avens
Diapensia lapponica	diapensia
Saxifrage bronchialis	–
Oxytropis Spp.	–
Viburnum edule	–
Herbs	
Potentilla Sp.	–
Equisetum	horsetail

Epilobium angustifolium	fireweed
Potentilla multifida	–
Linnaea borealis	twinflower
Campanula	bellflower
Lupinus	arctic lupine
Zygadenus elegans	death camas
Oxytropis Spp.	–
Ranunculus Sp.	crowfoot
Astragalus Sp.	milk vetch
Arnica frigida	–
Polygonum bistorta	–
Pellia	–
Delphinium	larkspur
Achillea	yarrow
Mertensia paniculata	bluebell
Galium	bedstraw
Iris	wild iris
Pedicularis labradoria	lousewort
Minuartia	–
Petastites hyperboverus	sweet coltsfoot
Boschniakia rossica	–

Table B-1. Plot Data by Vegetation Type

Plot	Vegetation Type	Canopy Height (ft)	Slope (percent)	Elevation (ft)	Aspect	Depth to Permafrost (in.)	Canopy Closure Index (percent)	Landform
B-1-B	Picea glauca	28-56	>1	1,260	–	–	–	Old floodplain
C-2-V	Picea glauca	26-45	~1	1,450	–	–	42	Moraine ridge
E-1-V	Picea glauca	10-30	1	1,410	–	36	42	Young terrace
E-4-V	Picea glauca; Alnus crispa	24-55	1	1,575	–	18	66	Moraine ridge
J-1-V	Picea glauca	8-14	–	1,850	–	–	–	Old terrace
J-2-V	Picea glauca	22-38	–	1,850	–	–	–	Old terrace
L-4-V	Picea glauca	12-22	15	2,150	W	20	53	Moraine slope
I-1-B	Picea glauca; Betula glandulosa shrub	13-21	~5	2,425	SE	24	–	Moraine slope
I-5-B	Picea glauca; Betula glandulosa shrub	22-32	~30	2,425	E	18	–	Moraine slope
K-1-V	Picea glauca; Betula glandulosa shrub	10-14	~3	2,675	S	–	–	Moraine slope
C-3-V	Picea mariana	10-45	–	1,285	–	14	59	Old terrace
G-3-V	Picea mariana (muskeg)	4	2	1,900	–	18	21	Moraine
J-1-B	Picea mariana	15-18	–	1,775	–	–	–	Outwash
J-2-B	Picea mariana	8-10	–	1,760	–	–	–	Outwash
J-3-B	Picea mariana	16-24	>1	1,780	–	–	–	Outwash polygon depression
J-5-V	Picea mariana (muskeg)	4-10	~1	1,725	–	–	–	Outwash
G-1-V	Picea mariana	10-22	16	1,975	NW	27	66	Moraine knob
J-3-B	Lichen barrens	0	>1	1,780	–	–	–	Outwash polygon

Table B-1. Plot Data by Vegetation Type (cont'd)

Plot	Vegetation Type	Canopy Height (ft)	Slope (percent)	Elevation (ft)	Aspect	Depth to Permafrost (in.)	Canopy Closure Index (percent)	Landform
J-3-V	Picea glauca; lichen barrens	6	–	1,875	–	–	–	Outwash
J-4-B (b)	Picea mariana; lichen barrens	14-16	>1	1,775	–	18	–	Outwash
A-1-V	Picea glauca; Picea mariana	16-30	>1	1,300	–	28	50	Outwash/Moraine
A-1-B	Picea glauca; Picea mariana	22-26	>1	1,275	–	18	63	Outwash
D-2-B	Picea glauca; Picea mariana; Betula papyrifera	28-35	~3	1,250	–	22	40	Moraine
E-2-V	Picea glauca; Picea mariana	12-36	1	1,430	–	10	35	Terrace
L-2-V	Picea mariana; Alnus crispa	6;16	15	1,950	E	18	66	Moraine
G-2-V	Picea mariana; Alnus crispa	4;6	1	2,000	–	–	15	Moraine knob
A-3-V	Picea glauca; Populus balsamifera; Populus tremuloides; Betula papyrifera	16-65	>1	1,280	–	18	54	Outwash
A-3-V	Populus tremuloides; Picea glauca	10-30	>1	1,285	–	18	31	Outwash
A-4-B	Picea mariana; Picea glauca; Populus tremuloides; Populus balsamifera	4-26	1	1,350	–	20	29	Outwash
A-5-B	Picea glauca; Picea mariana; Populus tremuloides	10-40	2	1,350	–	18	34	Moraine
A-6-B	Picea mariana; Populus tremuloides	7-14	1	1,375	–	18	30	Outwash

Table B-1. Plot Data by Vegetation Type (cont'd)

Plot	Vegetation Type	Canopy Height (ft)	Slope (percent)	Elevation (ft)	Aspect	Depth to Permafrost (in.)	Canopy Closure Index (percent)	Landform
B-2-V	Picea mariana; Populus tremuloides; Populus balsamifera	8-16	>1	1,570	–	12	36	Outwash
B-3-V	Picea mariana; Betula papyrifera	12-24	>1	1,590	–	18	40	Outwash
G-1-V	Picea glauca; Betula papyrifera; Alnus crispa	12-54	~2	1,350	–	18	65	Moraine
G-3-V	Picea glauca; Populus balsamifera; Betula papyrifera; Alnus crispa	12-40	83	1,500	NE	–	45	Moraine
G-5-V	Picea glauca; Populus tremuloides; Populus balsamifera	6-54	35	1,800	SW	<36	77	Moraine
L-3-V	Picea glauca; Salix; Alnus crispa	6-22	–	1,950	–	14	66	Moraine
V-2-V	Populus tremuloides; Populus balsamifera; Picea glauca; Picea mariana; Salix	8-34	>1	1,285	–	8	70	Outwash
B-4-V	Betula papyrifera; Picea glauca; Populus tremuloides; Alnus crispa	4-26	~10	1,630	E	24	62	Outwash/Moraine
B-1-V	Betula papyrifera; Populus balsamifera; Salix	10-26	>1	1,265	–	–	65	Floodplain

Table B-1. Plot Data by Vegetation Type (cont'd)

Plot	Vegetation Type	Canopy Height (ft)	Slope (percent)	Elevation (ft)	Aspect	Depth to Permafrost (in.)	Canopy Closure Index (percent)	Landform
B-6-V	Betula Papyrifera; Salix; Alnus crispa	12-40	~25	1,400	NW	–	85	Outwash slope
B-7-V	Populus tremuloides: Populus balsamifera: Alnus crispa	8-40	>1	1,425	–	–	42	Outwash
D-1-B	Populus tremuloides	15-35	1	1,275	–	18	56	Moraine
I-1-B	Populus tremuloides	14-28	~30	2,425	E	18	–	Moraine
B-5-V	Populus balsamifera: Populus tremuloides: Alnus crispa	8	>1	1,470	–	16	–	Outwash
B-8-V	Populus balsamifera: Populus tremuloides; Salix	6-8	>1	1,260	–	–	72	Floodplain
E-1-B	Salix: Populus tremuloides	2-7	1	–	–	<36	–	Floodplain
I-3-B	Salix: Betula glandulosa; Populus balsamifera; Alnus crispa	8	>1	2,450	–	–	–	Moraine ridgetop
J-4-V	Populus tremuloides: Betula nana: Betula glandulosa	2	–	1,875	–	–	–	Outwash
J-4-B(a)	Populus tremuloides	6	>1	1,775	–	18	–	Outwash
L-1-V	Alnus crispa; Populus tremuloides and balsamifera; Salix	6-8	–	2,100	–	–	34	Moraine
F-2-V	Salix; Betula glandulosa; Alnus crispa; Shrub tundra	2-4	–	3,250	NW	—	–	Schist bedrock

Table B-1. Plot Data by Vegetation Type (cont'd)

Plot	Vegetation Type	Canopy Height (ft)	Slope (percent)	Elevation (ft)	Aspect	Depth to Permafrost (in.)	Canopy Closure Index (percent)	Landform
F-3-V	Salix; Betula glandulosa; Alnus crispa; Shrul: tundra	3	–	3,200	NW	–	–	Schist bedrock
I-1-B	Dryas tundra/Populus tremuloides; Alnus crispa; Populus balsamifera	0-2	–	2,150	S	–	–	Moraine ridgetop
F-1-V	Dryas tundra	0	–	3,400	NW	–	–	Schist bedrock
G-4-V	Carex tussock bog	1	1	1,770	–	15	–	Moraine kettle
I-2-B	Carex tussock bog	1	>1	2,425	–	18	–	Moraine kettle
C-2-B	Marsh	1	1	1,275	–	–	–	Terrace

– Not taken

Table B-2. Vegetation Data Per Plot

VEGETATION TYPE Picea glauca, Picea mariana

PLOT A-1-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca			6/30/4				
Picea mariana	8/16/2	38/26/3			Average spacing 2½ - 3		
Populus tremuloides							
Populus balsamifera							
Salix spp.		2/24/6					
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	2	6	4	Moss/NOTE: Spongy, Thick	95	½
Vaccinium uglinosum	1	3	2	Pellia	5	1
Vaccinium vitisidaea	1	3	2	Equisetum	1	8
Arctostophylos alpina	1	3	2	Grass	10	8
Potentilla fruticosa	1	8				
Cornus canadensis	3	4	2			

VEGETATION TYPE Populus tremuloides, Populus balsamifera, Picea glauca, Picea mariana, Salix

PLOT A-2-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca			1/18/5				
Picea mariana	4/14/3						
Populus tremuloides	3/16/4	14/26/5	9/34/6				
Populus balsamifera	3/12/4						
Salix spp.	3/8						
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	50	3	1.5	Moss/NOTE: Not spongy	40	½
Arctostophylos alpina	1	2	2	Pellia	3	½
Potentilla fruticosa	1	8	2	Grass	15	8
Cornus canadensis	10	4	2	Epilobium angustifolium	3	6
				Potentilla multifida	1	6
				Linnaea borealis	1	2
				Campanula	1	8
				Lupinus	1	6
				Zygadenus elegans	1	8

Table B-2 (cont'd)

VEGETATION TYPE Picea glauca, Picea mariana, Populus tremuloides

PLOT A-5-B — Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca	4/10		2/30		1/40		
Picea mariana	4/10	8/22	8/15				
Populus tremuloides				6/8			
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	40	2	1	Moss/NOTE: Thick & Spongy	90	1
Arctostophylos uvaursi	20	4	2	Lichen	1	1
Cornus canadensis	1			Linnaea borealis	20	1
Picea glauca	3	24	12	Lupinas	3	5
Picea mariana	3	24	10	Grass	5	5
Shepherdia canadensis	1	4	3			
Empetrum nigrum	2	2	1			

VEGETATION TYPE Picea mariana, Populus tremuloides

PLOT A-6-B — Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana	13/7	4/13					
Populus tremuloides	4/14	(dying)					
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	5	3	1	Moss/NOTE: Thin	20	1
Vaccinium vitisidaea	80	2	1	Lichen	3	1
Ledum groenlandicum	40	4	2	Grass	5	18
Picea mariana	3	24	10	Lupinas	1	5
Betula glandulosa	5	1	20	Linnaea borealis	1	2

Table B-2 (cont'd)

VEGETATION TYPE Picea glauca, Betula papyrifera, Populus tremuloides, Populus balsamifera

PLOT A-3-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							2/65/16
Picea mariana							
Populus tremuloides				1/42/16			
Populus balsamifera	9/16/4			1/42/16			
Salix spp.							
Betula papyrifera			1/36/12	1/42/16		1/54/18	
Alnus crispa		24/20/1					

NOTE: Alnus crispa has 8 stems/bush, with a total CD of 8".

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	20	18	10	Moss	20	
Vaccinium uglinosum	5	5	3	Linnaea borealis	1	2
Ledum decumbens	1	2	1	Epiloblum angustifolium	5	6
Arctostophylos alpina	1	2	2	Equisetum	15	6
Potentilla fruticosa	2	8	3	Zygadenus elegans	1	6
Viburnum edule	15	14	10	Grass	30	10
Shepherdia canadensis	2	5	4			
Empetrum nigrum	1	3	2			

VEGETATION TYPE Picea mariana, Picea glauca

PLOT A-1-B — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca			/12/		/26/		
Picea mariana	/22/	/22/					
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	30	3	2	Moss/NOTE: Spongy, 6"-12"		
Cornus canadensis	5	2	1	Thick	100	1
				Linnaea borealis	1	2
				Grass	1	6
				Pellia	30	1

Table B-2 (cont'd)

VEGETATION TYPE Picea glauca

PLOT B-1-B — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	6/28/3	16/30/3	8/42/4	5/53/6		1/56/9	
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

NOTE: Largest tree in area is 86' tall (14-16").

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	1	6	4	Moss/NOTE: Spongy	95	½
				Lichen	25	1
				Grass	1	6
				Oxytropis spp.	2	6
				Unknown	12	6

VEGETATION TYPE Betula papyrifera, Populus balsamifera, Salix

PLOT B-1-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera	1/10/1	3/22/4					
Salix spp.	55/10/2	5/22/6					
Betula papyrifera	4/15/2	4/24/5	8/26/5				
Alnus crispa							

NOTE: Burned spruce stumps.

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	3	6	4	Moss	30	½
Vaccinium uglinosum	1	4	5	Lichen	4	½
Ledum groenlandicum	5	5	2	Grass	1	5
Ledum decumbens	1	2	1	Epilobium angustifolium	1	4
Arctostophylos alpina	2	6	3	Linnaea borealis	1	1
Picea glauca	3	24-72	12	Pellia	2	½
Empetrum nigrum	2	3	4	Leaf Litter	60	

Table B-2 (cont'd)

VEGETATION TYPE Picea mariana, Populus tremuloides, Populus balsamifera

PLOT B-2-V

Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana	12/8/3						
Populus tremuloides	3/10/4	5/16/7					
Populus balsamifera	3/12/5	3/16/7					
Salix spp.							
Betula papyrifera							
Alnus crispa	85/8/2						

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	85	2	1	Moss	5	½
Ledum groenlandicum	2	6	2	Lichen	10	½
Ledum decumbens	2	6	3	Grass	2	6
Picea glauca	10	24	10	Epilobium angustifalium	1	14
Empetrum nigrum	1	2	1	Campanula	1	6
				Pellia	2	1

VEGETATION TYPE Picea mariana, Betula papyrifera

PLOT B-3-V

Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana	25/12/4	16/16/6					
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera		9/18/6	3/24/8				
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	70	5	1	Moss/NOTE: Thin	65	½
Ledum groenlandicum	5	4	2	Lichen	1	1
				Pellia	3	1
				Leaf litter	10	-

Table B-2 (cont'd)

VEGETATION TYPE Betula papyrifera, Picea glauca, Alnus crispa, Populus tremuloides

PLOT B-4-V — Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca	4/4/2		1/25/6				
Picea mariana							
Populus tremuloides	4/26/6						
Populus balsamifera							
Salix spp.							
Betula papyrifera	2/12/4	8/24/6	1/26/7				
Alnus crispa	10/12/2						

NOTE: Tallest Picea glauca is 35' tall.

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	5	10	8	Epilobium angustifolium	10	10
Vaccinium vitisidaea	70	4	2	Grass	2	6
Picea glauca	10	36	2	Leaf litter	30	-

VEGETATION TYPE Populus balsamifera, Populus tremuloides, Alnus crispa

B-5-V — Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	10	3	2	Moss/NOTE: Hard, Dry	35	1
Salix spp.	2	8	4	Campanula	1	3
Populus tremuloides	20	72	36	Unknown	5	3
Alnus crispa	65	72	72			
Populus balsamifera	10	76	36			
Empetrum nigrum	3	2	2			

Table B-2 (cont'd)

VEGETATION TYPE Betula papyrifera, Salix

PLOT B-6-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.	2/20/4	5/32/6					
Betula papyrifera	4/30/3	9/36/5	8/40/8				
Alnus crispa	2/12/5						

NOTE: Many burned tree stumps.

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	1	3	10	Moss	60	½
Empetrum nigrum	5	4	½	Mertensia paniculata	10	14
Ribes triste	2	4	8	Epilobium angustifolium	2	8
				Linnaea borealis	1	2
				Pellia	1	½

VEGETATION TYPE Populus tremuloides, Populus balsamifera

PLOT B-7-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides	20/10/3	12/12/3	3/36/6	2/40/8			
Populus balsamifera	5/8/2						
Salix spp.							
Betula papyrifera							
Alnus crispa	8/8/2						

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	10	2	1	Moss	5	1
Vaccinium vitisidaea	40	2	1	Epilobium angustifalium	5	12
Picea glauca	10	24	12	Zygadenus elegans	2	18
Betula glandulosa	1	3	3	Grass	25	8
Salix spp.	5	8	12	Pedicularis labradorica	10	10
Empetrum nigrum	5	2	1	Linnaea borealis	1	2
				Lupinus	1	6

Table B-2 (cont'd)

VEGETATION TYPE Populus balsamifera, Populus tremuloides, Salix

PLOT B-8-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides	28/6/2						
Populus balsamifera	58/8/2						
Salix spp.	24/6/2						
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	2	3	2	Moss	40	½
Vaccinium vitisidaea	2	1	1	Epilobium angustifolium	10	12
Ledum groenlandicum	3	6	2	Grass	5	6
Picea glauca	5	12	1	Leaf Litter	60	-

VEGETATION TYPE Marsh

PLOT C-2-B — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
				Grass	50	6
				Sedge	20	5
				Irish	5	18
				Equisetum	5	5
NOTE: Dry marsh with 20 wide polygons.						

Table B-2 (cont'd)

VEGETATION TYPE Picea glauce, Betula papyrifera, Alnus crispa

PLOT C-1-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca					8/42/7	/-45/7	2/54/8
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera			1/30/12				
Alnus crispa	28/12/5						

NOTE: 4 stems/Alnus. NOTE: Many fallen trees.

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	7	10	5	Moss/NOTE: Spongy	85	½
Vaccinium vitisidaea	5	4	2	Grass	5	8
Ledum groenlandicum	10	5	3	Linnaea borealis	20	3
				Boschniakia rossica/NOTE:	1	8
				parasitic on Alnus crispa		
				root		

NOTE: Small 10' x 10' polygons.

VEGETATION TYPE Picea glauca

PLOT C-2-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	2/10/3	1/26/5	4/40/6				
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

NOTE: N. underbrush. NOTE: Spanish moss hangs from trees.

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	2	8	6	Moss/NOTE: Spongy	95	½
				Linnaea borealis	2	1
				Grass	5	14
				Pellia	2	½
				Mertensia paniculata	1	14

Table B-2 (cont'd)

VEGETATION TYPE Picea mariana muskeg

PLOT C-3-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	16/10/2	18/16/3	1/26/4	/45/6			
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	5	6	4	Moss/NOTE: Very spongy,	60	
Ledum groenlandicum	30	6	2	sinks 1-2' upon walking		
Arctostophylos alpina	2	3	2	Equicetum	20	8
Empetrum nigrum	2			Lupinus	10	9
				Pellia	5	½

NOTE: Plot is on a terrace hammock that rises 15' above adjacent marsh.

VEGETATION TYPE Populus tremuloides

PLOT D-1-B — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides	6/15	6/28	8/35				
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	1	12	4	Moss	20	
Vaccinium vitisidaea	70	2	1	Lichen	1	
Ledum groenlandicum	3	4	2	Epilobium anagustifolium	2	8
Arctostophylos alpina	5	2	2	Lupinus	1	5
Picea glauca	5	24	6	Galium	1	3
Empetrum nigrum	3	2	1	Pedicularis labradoria	2	4
Shepherdia canadensis	1	3	3	Zygadenus elegans	1	7
				Grass	20	6
				Leaf litter	20	-

Table B-2 (cont'd)

VEGETATION TYPE **Picea glauca, Picea mariana, Betula papyrifera**

PLOT **D-2-B** Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca		13/35					
Picea mariana	13/28						
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera			4/35				
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	10	2	1	Moss	80	2
Picea glauca	4	24	8	Lichen	10	1
Picea mariana	2	24	8	Pellia	30	1
				Leaf litter	20	-

VEGETATION TYPE **Salix/Populus tremuloides shrub**

PLOT **E-1-B** Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Salix spp.	3	24	12			
Populus tremuloides	3	42	24			
Salix spp.	8	84	36			

Table B-2 (cont'd)

VEGETATION TYPE **Picea glauca**

PLOT **E-1-V** Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	14/10/3	17/14/4	3/24/7	2/30/8			
Picea mariana							
Populus tremuloides							
Populus balsamifera	2/6/3						
Salix spp.	1/10/2						
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Arctostophylos alpina	15	5	3	Moss/NOTE: Not spongy or	85	1
Potentilla fruticosa	70	30	30	thick		
Picea glauca	10	72		Grass	5	4
Salix spp.	1	12	5	Aster	1	3
				Zygadenus elegans	2	12
				Ranunculus sp.	5	3
				Astragalus sp.	30	10

VEGETATION TYPE **Picea glauca, picea mariana**

PLOT **E-2-V** Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca		3/28/4		1/26/8		1/36/8	
Picea mariana	6/12/2	22/22/3					
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	2	5	4	Moss/NOTE: Very spongy,	95	
Vaccinium vitisidaea	3	2	1	depresses 1'		
Ledum groenlandicum	2	10	3	Sedge	30	8
Ledum decumbens	10	5	2	Lupinus	30	8
Arctostophylos alpina	5	4	2	Astragalus	2	4
Salix	2	4	2	Pellia	5	1
Empetrum nigrum	5	2	2			
Ribes triste	2	8	5			

Table B-2 (cont'd)

VEGETATION TYPE Picea glauca, Populus balsamifera, Betula papyrifera, Alnus crispa

PLOT E-3-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca					2/35/8		2/40/12
Picea mariana							
Populus tremuloides							
Populus balsamifera			1/30				
Salix spp.							
Betula papyrifera			1/35				
Alnus crispa	2/12/2						

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	2	5	4	Moss/NOTE: Locally thick	85	1
Ledum groenlandicum	15	5	3	& spongy		
				Grass	15	8

VEGETATION TYPE Picea glauca, Alnus crispa

PLOT E-4-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca		4/24/6	1/22/8	4/26/9	2/40/12		2/35/12
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa	48/8/2						

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	2	12	6	Moss/NOTE: Thick & spongy	8	1
Ledum groenlandicum	30	6	3	Grass	25	10
Ribes triste	5	10	6	Equicetum	2	6
				Pellia	5	1

Table B-2 (cont'd)

VEGETATION TYPE Dryas tundra

PLOT F-1-V

Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	2	2	2	Moss/NOTE: in matte	15	1
Arctostophylos alpina	10	2	2	Lichen	15	1
Salix spp.	2	2	2	Arnica frigida	2	2
Oxycropis	10	1	4	Grass	10	4
Silene acaulis	3	1	4	Sedge	1	4
Dryas	40	1	1	Lupinas sp.	1	5
Diapensia lapponica	2	3	1	Pellia	5	1

VEGETATION TYPE Salix, Betula glandulosa, Alnus crispa, Shrub tundra

PLOT F-2-V

Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	10	6	2			
Vaccinium vitisidaea	20	2	1			
Arctostophylos alpina	30	2	1			
Betula glandulosa	25	24	36			
Salix	20	24	36			
Alnus crispa	20	48	48			
Cassiope	10	4	1			
Empetrum nigrum	5	2	1			
Diapensia lapponica	5	1	1			

Table B-2 (cont'd)

VEGETATION TYPE Salix, Betula glandulosa, Alnus crispa, Shrub tundra (Cont'd)

PLOT F-2-V (Cont'd) Diameter Class (in inches)

	0-2	2-4	4-6	6-8	8-10	10-12	12-14
TREE SPECIES	No. Ht. CD	No. Ht. CD	No. Ht. CD	No. Ht. CD	No. Ht. CD	No. Ht. CD	No. Ht. CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Dryas	5	1	1	Moss	35	1
				Lichen	20	1
				Grass	35	1
				Epilobium angustifolium	1	1
				Polygonum bistorta	1	6
				Pellia	1	1

VEGETATION TYPE Salix, Betula glandulosa, Alnus crispa shrub

PLOT F-3-V Diameter Class (in inches)

	0-2	2-4	4-6	6-8	8-10	10-12	12-14
TREE SPECIES	No. Ht. CD	No. Ht. CD	No. Ht. CD	No. Ht. CD	No. Ht. CD	No. Ht. CD	No. Ht. CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	10	8	4	Grass	35	12
Betula glandulosa	5	36	36	Oxytropis	1	4
Salix	90	36	72	Mertensia paniculata	2	12
Alnus crispa	5	24	36	Delphinium	5	2
Cornus canadensis	15	4	2			
Empetrum nigrum	5	4	1			

Table B-2 (cont'd)

VEGETATION TYPE Picea mariana

PLOT G-1-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.	Ht.	CD	2-4 No.	Ht.	CD	4-6 No.	Ht.	CD	6-8 No.	Ht.	CD	8-10 No.	Ht.	CD	10-12 No.	Ht.	CD	12-14 No.	Ht.	CD
Picea glauca																					
Picea mariana	10	10	4	11	20	6	1	22	7												
Populus tremuloides																					
Populus balsamifera																					
Salix spp.																					
Betula papyrifera																					
Alnus crispa	16	4	4																		

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	25	5	3	Moss/NOTE: Semi-spongy	85	1
Vaccinium vitisidaea	15	5	3	Grass	2	6
Betula glandulosa	10	24	24	Pellia	3	1

VEGETATION TYPE Picea mariana, Alnus crispa

PLOT G-2-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.	Ht.	CD	2-4 No.	Ht.	CD	4-6 No.	Ht.	CD	6-8 No.	Ht.	CD	8-10 No.	Ht.	CD	10-12 No.	Ht.	CD	12-14 No.	Ht.	CD
Picea glauca																					
Picea mariana	8	4	2																		
Populus tremuloides																					
Populus balsamifera																					
Salix spp.																					
Betula papyrifera																					
Alnus crispa	120	6	10																		

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	1	3	1	Moss	10	1
Vaccinium vitisidaea	15	2	1	Lichen/NOTE:White & yellow	35	1
Ledum decumbeus	2	3	2	Campanula	1	6
Arctostophylos alpina	1	1	1	Grass	15	8
Arctostophylos avaursi	3	2	2	Pedicularis labradoria	1	5
Picea glauca	10	24	8	Pellia	10	1
Betula glandulosa	15	24				
Populus tremuloides	20	24	6			
Alnus crispa	5	1	1			

Table B-2 (cont'd)

VEGETATION TYPE **Populus tremuloides, Populus balsamifera, Picea glauca**

PLOT **G-5-V** Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	13/6/3						1/54/12
Picea marina							
Populus tremuloides	17/20/4	16/30/5	1/40/5				
Populus balsamifera	11/10/3	3/16/3					
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	5	6		Moss	1	1
Vaccinium vitisidaea	30			Grass	15	10
Ledum groenlandicum	3	7		Achillea	1	3
				Linnaea borealis	15	1
				Epilobium angustifolium	1	10
				Leaf litter	65	--

VEGETATION TYPE **Picea glauca, Betula glandulosa shrub**

PLOT **I-1-B** Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	8/5/	8/13/	2/21/				
Picea marina							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	80	12	2	Moss/NOTE: A spongy mat	80	6
Vaccinium vitisidaea	1	4	1	Lichen	1	1
Ledum groenlandicum	40	6	3	Equicetum	1	6
Betula glandulosa	20	24	24	Grass/NOTE: Clumped	10	10
Salix	2	24	12	Pellia	1	1
Cornus canadensis	1	2	1			
Empetrum nigrum	1	4	1			

Table B-2 (cont'd)

VEGETATION TYPE **Populus tremuloides**

PLOT I-4-B — Diameter Class (in inches)

TREE SPECIES	0-2 No.	0-2 Ht.	0-2 CD	2-4 No.	2-4 Ht.	2-4 CD	4-6 No.	4-6 Ht.	4-6 CD	6-8	8-10	10-12	12-14
Picea glauca													
Picea mariana													
Populus tremuloides	50	14		13	26		8	28					
Populus balsamifera													
Salix spp.													
Betula papyrifera													
Alnus crispa													

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
NO SHRUB OR HERB DATA						

VEGETATION TYPE **Picea glauca, Betula glandulosa**

PLOT I-5-B — Diameter Class (in inches)

TREE SPECIES	0-2 No.	0-2 Ht.	0-2 CD	2-4 No.	2-4 Ht.	2-4 CD	4-6 No.	4-6 Ht.	4-6 CD	6-8	8-10	10-12	12-14
Picea glauca	4	14		1	22		1	30					
Picea mariana													
Populus tremuloides													
Populus balsamifera													
Salix spp.													
Betula papyrifera													
Alnus crispa													

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	50	12	2	Moss/NOTE: Spongy	50	1
Vaccinium vitisidaea	1	4	1	Lichen	30	1
Ledum groenlandicum	25	6	3	Grass	10	10
Picea glauca	20	24	12			
Betula glandulosa	40	24	24			
Salix	1	12	12			
Cornus canadensis	1	2	1			
Empetrum nigrum	1	4	1			

Table B-2 (cont'd)

VEGETATION TYPE **Sedge tussock bog**

PLOT **I-2-B** Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
				Sedge/NOTE: Tussocks	**80**	**6**
				Grass	**10**	**8**

VEGETATION TYPE **Salix, Betula glandulosa, Populus balsamifera, Alnus crispa**

PLOT **I-3-B** Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Betula glandulosa	**20**	**96**	**48**			
Salix	**20**	**96**	**32**			
Alnus crispa	**30**	**96**	**48**			
Populus balsamifera	**20**	**72**	**48**			

Table B-2 (cont'd)

VEGETATION TYPE Picea mariana

PLOT J-1-B

Diameter Class (In inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana	45/15/3	45/18/4					
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	5	3	1	Moss	50	1
Vaccinium vitisidaea	30	2	1	Lichen	30	1
				Pellia	20	1
				Linnaea borealis	30	1

VEGETATION TYPE Picea mariana

PLOT J-2-B

Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana	50/10/3						
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	5	2	1	Lichen	2	1
Cornus canadensis	2	1	1	Lupinus	2	8
Betula glandulosa	20	24	24	Epilobium angustifolium	2	8
Populus tremuloides	30	36	30	Grass	2	8

Table B-2 (cont'd)

VEGETATION TYPE Lichen Barrens

PLOT J-3-B Diameter Class (in inches)

TREE SPECIES	0-2 No.	Ht.	CD	2-4 No.	Ht.	CD	4-6 No.	Ht.	CD	6-8 No.	Ht.	CD	8-10 No.	Ht.	CD	10-12 No.	Ht.	CD	12-14 No.	Ht.	CD
Picea glauca																					
Picea mariana																					
Populus tremuloides																					
Populus balsamifera																					
Salix spp.																					
Betula papyrifera																					
Alnus crispa																					

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	1	12	3	Lichen (white)	45	1
Vaccinium vitisidaea	1	4	3	Lichen (yellow)	35	1
Ledum decumbens	1	12	4	Pedicularis labradoria	1	8
Arctostophylos uvaursi	1	4	3			
Picea mariana	2	24	12			
Betula glandulosa	3	12	8			
Salix	3	24	8			
Populus tremuloides	5	30	10			

VEGETATION TYPE Picea mariana

PLOT J-3-B Diameter Class (in inches)

TREE SPECIES	0-2 No.	Ht.	CD	2-4 No.	Ht.	CD	4-6 No.	Ht.	CD	6-8 No.	Ht.	CD	8-10 No.	Ht.	CD	10-12 No.	Ht.	CD	12-14 No.	Ht.	CD
Picea glauca																					
Picea mariana	/15/			/24/																	
Populus tremuloides																					
Populus balsamifera																					
Salix spp.																					
Betula papyrifera																					
Alnus crispa																					

SHRUB SPECIES	%Ground Cover	Ht"	CD'	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	40					
Betula glandulosa	40	30	28			
Populus tremuloides	40	30	18			

Table B-2 (cont'd)

VEGETATION TYPE **Populus tremuloides**

PLOT **J-4-B (a)** Diameter Class (in inches)

TREE SPECIES	0-2 No.	Ht.	CD	2-4 No.	Ht.	CD	4-6 No.	Ht.	CD	6-8 No.	Ht.	CD	8-10 No.	Ht.	CD	10-12 No.	Ht.	CD	12-14 No.	Ht.	CD
Picea glauca																					
Picea mariana																					
Populus tremuloides	98/6/																				
Populus balsamifera																					
Salix spp.																					
Betula papyrifera																					
Alnus crispa																					

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"

VEGETATION TYPE **Picea mariana, Lichen barrens**

PLOT **J-4-B (b)** Diameter Class (in inches)

TREE SPECIES	0-2 No.	Ht.	CD	2-4 No.	Ht.	CD	4-6 No.	Ht.	CD	6-8 No.	Ht.	CD	8-10 No.	Ht.	CD	10-12 No.	Ht.	CD	12-14 No.	Ht.	CD
Picea glauca																					
Picea mariana				4/16/																	
Populus tremuloides																					
Populus balsamifera																					
Salix spp.																					
Betula papyrifera																					
Alnus crispa																					

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	20	4	2	Moss	20	1
Ledum decumbens	10	4	3	Lichen	50	1
Betula glandulosa	20	30				

Table B-2 (cont'd)

VEGETATION TYPE: **Picea glauca**

PLOT **J-1-V** — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	52/9/3	19/14/4					
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	15	4	2	**Moss/NOTE: Fairly spongy**	95	2
Vaccinium vitisidaea	20	2	1	**and thick**		
Ledum groenlandicum	15	6	2	**Lichen**	3	1
Salix spp.	10			**Pellia**	10	1
				Grass	1	8
				Equisetum	1	8
				Unknown	1	6

VEGETATION TYPE: **Picea glauca**

PLOT **J-2-V** — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca		4/22/3	5/24/3	5/28/4	3/30/6	1/38/8	
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	5	8	6			
Vaccinium uglinosum	5	4	4			
Vaccinium vitisidaea	2	2	1			
Ledum groenlandicum	1	6	2			
Potentilla fruticosa	5	12	3			
Cornus canadensis	1	2	1			
Picea glauca	10	10	8			
Salix spp.	20	18	5			
Alnus crispa	5	5	5			

Table B-2 (cont'd)

VEGETATION TYPE **Picea glauca (Cont'd)**

PLOT **J-2-V (Cont'd)** Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Viburnum	3	4		Moss/NOTE: Locally thick	90	1
Empetrum nigrum	2	2	2	Grass	3	6
				Mertensia	1	12
				Galium	1	2
				Equicetum	2	6
				Iris	1	8

VEGETATION TYPE **Picea glauca, Lichen barrens**

PLOT **J-3-V** Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca		1/6/8					
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Ledum decumbens	5	1	1	Lichen (white)	50	1
Cornus canadensis	1	2	1	Lichen (yellow)	5	1
Betula glandulosa	40	24	24	Grass	3	8
Betula nana	10	12	24	Potentilla sp.	1	6

Table B-2 (cont'd)

VEGETATION TYPE: **Alnus crispa, Populus tremuloides, Salix, Populus balsamifera**

PLOT **L-1-V** Diameter Class (In inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides	1/6/4						
Populus balsamifera	19/3/3						
Salix spp.	8/6/6						
Betula papyrifera							
Alnus crispa	10/8/10						

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	2	3	1	Moss	20	1
Ledum decumbens	2	5	3	Epilobium angustifolium	10	12
Arctostophylos alpina	1	2	1	Grass	3	
Betula glandulosa	1	6	4	Achillea	1	6
Empetrum nigrum	2	2	1	Minuartia	1	1

VEGETATION TYPE **Picea mariana, Alnus crispa**

PLOT **L-2-V** Diameter Class (In inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana	58/16/3						
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa	15/5/8						

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	40	8	4	Moss	95	1
Vaccinium vitisidaea	3	3	1	Lichen	1	1
Ledum groenlandicum	20	5	2	Petasites hyperboverus	1	6
Betula glandulosa	1	12	48	Pellia	2	1

Table B-2 (cont'd)

VEGETATION TYPE Picea glauca, Salix, Alnus crispa

PLOT L-3-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca		2/16/4	5/22/6	2/22/8	1/22/8		
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera	10/6/8						
Alnus crispa	5/6/8						

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Rosa acicularis	2	6	3	Moss	45	1
Vaccinium uglinosum	2			Epilobium angustifolium	10	8
Vaccinium vitisidaea	2	2	1	Linnaea borealis	1	2
Ledum decumbens	3	5	3	Pellia	3	1
Cornus canadensis	5	3	2	Grass	40	18

VEGETATION TYPE Picea glauca

PLOT L-4-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	5/6/2	2/12/4	1/18/6	2/22/7			
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinsoum	20	5	2	Moss	50	1
Vaccinium vitisidaea	3	2	1	Epilobium angustifolium	3	8
Ledum decumbens	2	6	2	Polygonum bistorta	1	12
Betula glandulosa	20	10	6	Grass	40	8
Salix	10	18	36			
Alnus crispa	20	48	72			

Table B-2 (cont'd)

VEGETATION TYPE **Populus tremuloides, Betula glandulosa**

PLOT **J-4-V** Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uliginosum	5	3	1	Lichen (white)	2	1
Vaccinium vitisidaea	10	1	1	Lichen (yellow)	1	1
Ledum decumbens	20	4	1			
Betula glandulosa	25	12	36			
Populus tremuloides	20	24	12			
Arctostaphylos rubra	7	1	2			

VEGETATION TYPE **Picea mariana muskeg**

PLOT **J-5-V** Diameter Class (in inches)

TREE SPECIES	0-2 No. Ht. CD	2-4 No. Ht. CD	4-6 No. Ht. CD	6-8 No. Ht. CD	8-10 No. Ht. CD	10-12 No. Ht. CD	12-14 No. Ht. CD
Picea glauca							
Picea mariana	13/6/3	7/10/4					
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium vitisidaea	50	2	1	Moss	30	1
Cornus canadensis	3	2	1	Lichen (white)	5	1
Betula glandulosa	15	18	38	Galium	1	4
Salix	10	18	36	Grass	10	8
Populus tremuloides	20	24	10			
Empetrum nigrum	2	2	1			

Table B-2 (cont'd)

VEGETATION TYPE Picea glauca, Betula glandulosa

PLOT K-1-V — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca	1/10/3	1/14/4					
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	25	5	2	Moss/MOTE: Thick, spongy	80	1
Vaccinium vitisidaea	1	2	1	Lichen (white)	35	1
Ledum decumbens	5	6	2	Grass	20	5
Arctostophylos alpina	10	2	2	Sedge	5	6
Betula glandulosa	20	18	24			
Salix	25	12	12			
Empetrum nigrum	5	2	1			
Dryas	2	1	2			

VEGETATION TYPE Dryas tundra, Populus tremuloides, Alnus crispa, Populus balsamifera, Betula glandulosa shrub

PLOT L-1-B — Diameter Class (in inches)

TREE SPECIES	0-2 No.Ht.CD	2-4 No.Ht.CD	4-6 No.Ht.CD	6-8 No.Ht.CD	8-10 No.Ht.CD	10-12 No.Ht.CD	12-14 No.Ht.CD
Picea glauca							
Picea mariana							
Populus tremuloides							
Populus balsamifera							
Salix spp.							
Betula papyrifera							
Alnus crispa							

SHRUB SPECIES	%Ground Cover	Ht"	CD"	HERB SPECIES	%Ground Cover	Ht"
Vaccinium uglinosum	20	4	2	Lichen	15	0
Vaccinium vitisidaea	10	2	1	Pedicularis	5	8
Arctostophylos alpina	4	2	1	Grass	5	8
Betula glandulosa	25	18	18			
Populus tremuloides	30	24	11			
Empetrum nigrum	20	4	1			
Dryas	40	1	1			
Saxifrage bronchialis	3	3	1			

APPENDIX C

CULTURAL FEATURES

The following cultural landmarks were noted in the Fort Greely area:

Point No.	Description
	Site A
1	Officers' Club: Concrete block structure with flat roof, 59 feet by 90 feet by 18 feet high.
2	Officers' Club Parking Lot: Concrete lot 140 by 62.8 feet excluding entrances; concrete curbing about perimeter measures 6.5 inches wide by 5.5 inches high; 4-foot-wide sidewalk along the west side of lot, 101 feet in length.
3	Cross section of road to south of Officer's Club (Fig. C-1).

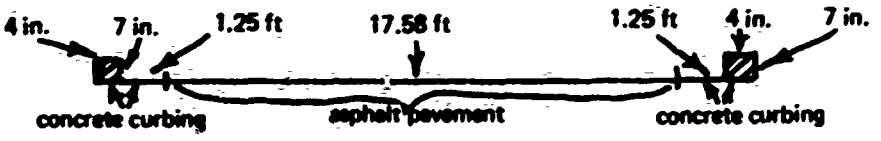

Fig. C-1. Roadway cross section.

4	Civilian Billeting Facility: Asbestos-sided, flat-roofed concrete structure measuring 153 feet by 37 feet by 34 feet in height; parking lot at west end of facility measures 81 by 148 feet, exclusive of entrances.
5	Bachelor Officers' Quarters: Asbestos-sided, flat-roofed concrete structure measuring 143 feet by 37 feet by 34 feet in height; concrete porches attached to each end measure 7 by 13 feet.
6	Wood-framed, asbestos-sided building having a concrete foundation and pitched roof and possessing dimensions of 174 feet by 28.5 feet by 25 feet in height. Gravel drive exists behind the structure.
7,8,9	See description for point 6.
10	Wood-framed building having roof of the pitched design with a measured size of 23 feet by 119 feet by 25 feet in height.
	Small wood-framed building measuring 21.5 feet by 22 feet by 13 feet in height lies between points 10 and 11.

11 Same as description for point 10.

12 Fort Greeley School: Concrete block construction having flat tar-roof which overhangs walls by 2 feet and is dimensioned according to Fig. C-2.

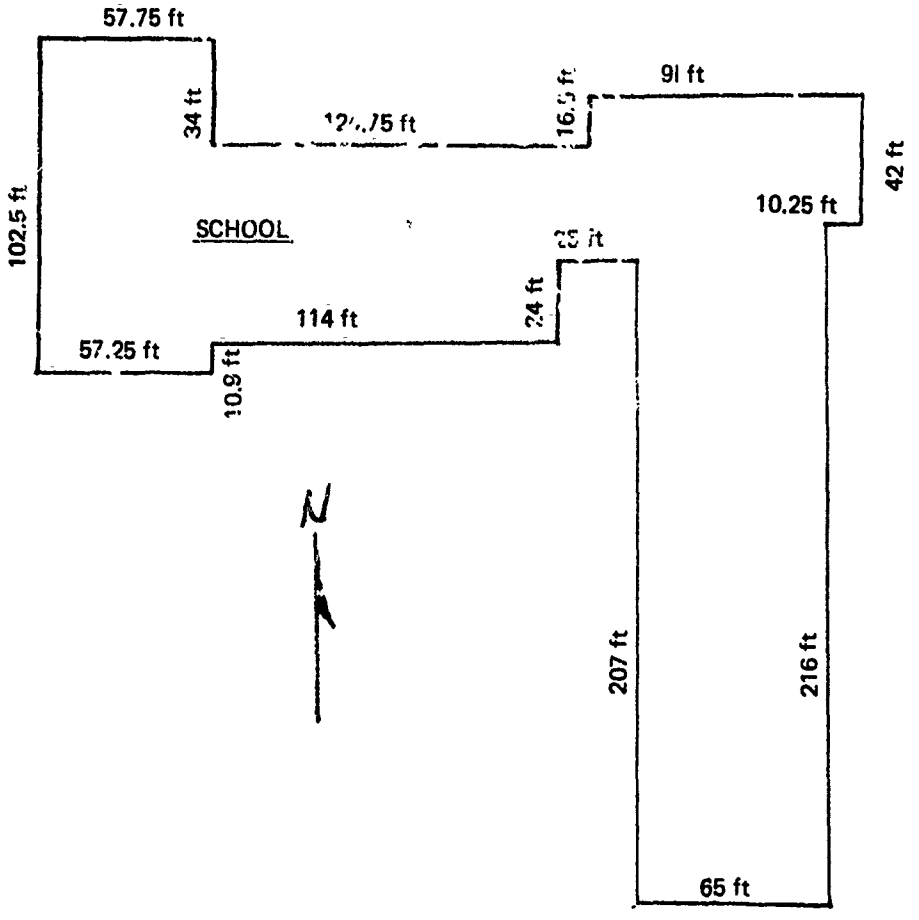

Fig. C-2. Fort Greely School, plan view.

13 Senior Officer Housing: Five buildings of wood frame and pitched roof construction measuring 36.5 by 104 feet. Concrete block building directly north of point 13 measures 14.67 by 17.5 feet.

14 Wooden framed housing units having pitched roofs with dimensons of 25 feet by 238 feet by 25 feet high and placed as illustrated in Fig. C-3.

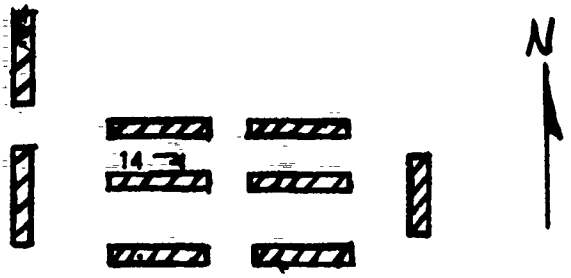

Fig. C-3. Layout of survey point 14.

15 Playground.

16 Wooden framed housing unit with pitched roof having dimensions of 238 feet by 23 feet by 25 feet high.

17 Similar housing units all of frame construction and having concrete foundations to point 17 are given below in Fig. C-4 with an illustration of their relationships to point 17.

17: 239.0 feet by 23.0 feet by 25 feet high.
A: 145.2 feet by 30.6 feet by 25 feet high.
B: 145.2 feet by 30.6 feet by 25 feet high.
C: 208.4 feet by 23.1 feet by 25 feet high.
D: 208.4 feet by 23.1 feet by 25 feet high.
E: 208.4 feet by 23.1 feet by 25 feet high.

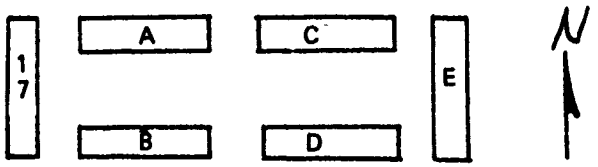

Fig. C-4. Housing units at point 17.

18 Housing units of frame construction with concrete foundations (Fig. C-5).

18, A, and B: 176.8 feet by 28.4 feet by 25 feet high;
C, D, and E: 176.8 feet by 26.1 feet by 25 feet high.

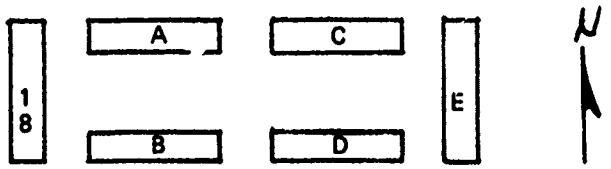

Fig. C-5. Housing units at point 18.

19 Housing units of frame construction with concrete foundations (Fig. C-6).
19, A, and B: 176 feet by 24.1 feet by 25 feet high;
C, D, and E: 176.8 feet by 26.1 feet by 25 feet high.

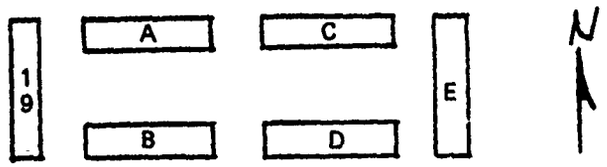

Fig. C-6. Housing units at point 19.

20 Wooden framed housing units with concrete foundations (Fig. C-7). Dimensions as follows:
17: 121.6 feet by 26.1 feet by 25 feet high.
A: 121.6 feet by 26.1 feet by 25 feet high.
B: 176 feet by 24.1 feet by 25 feet high.
C: 144.9 feet by 30.6 feet by 25 feet high.
D: 176.8 feet by 26.1 feet by 25 feet high.
E: 144.9 feet by 30.6 feet by 25 feet high.

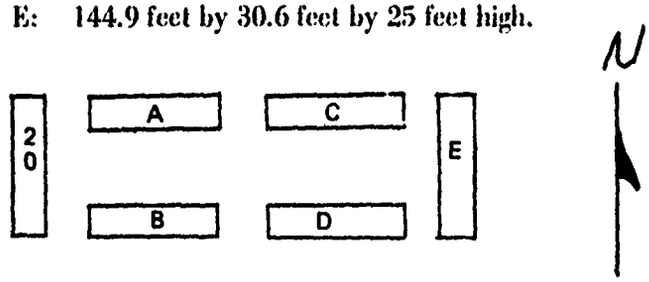

Fig. C-7. Housing units at point 20.

21 Post Chapel: An A-framed structure, the post chapel utilizes concrete blocks for external walls and reinforced concrete for the foundation. Its roof, standing 43 feet high, is made of aluminum.

22 Post Headquarters Building: Concrete block construction resting upon reinforced concrete foundation; structure stands 14 feet tall, while the flagpole in front of the building stands 76 feet tall.

23 Main Post Exchange and Theatre: Concrete block construction with reinforced concrete foundation. Entire complex stands 22 feet high.

24 Bowling Center: Reinforced concrete foundation with metal walls measuring 120 feet by 80 feet by 22 feet high.

25 Service Club: Concrete block construction with reinforced concrete foundation.

26 NCO Open Mess (NCO Club): Concrete block construction with reinforced concrete foundation. Overall height equals 17 feet.

27 Company HQ Building: Concrete block construction with reinforced concrete foundation and standing 22 feet at its tallest section.

28 Warehouse: Concrete block construction with reinforced concrete foundation; height of building equals 24 feet.

29 Motor Repair Shop: Concrete block construction with reinforced concrete foundation; dimensions are 68.4 feet by 360 feet by 20 feet tall.

30 Enlisted Men's Barracks and Mess Halls: Forty feet in height, this building along with two identical buildings due west from point 30 is constructed of concrete blocks with reinforced concrete foundation.

31 Post Commissary: Concrete block construction with reinforced concrete foundation.

32 Gymnasium: Concrete block construction with reinforced concrete foundation; stands 35 feet tall at highest point.

33 Fire Station: Twenty feet tall, constructed of concrete. Adjacent radio tower is 162 feet tall.

34 General Warehouse: Concrete block construction with reinforced concrete foundation measuring 201.33 by 451.33 feet.

35 Gas Station: Utilizes two pumps. Building measures 22.7 by 50 feet; pump island measures 3.7 by 19.7 feet.

36 Post Engineer's Building: Concrete construction measuring 181.2 feet by 50.4 feet by 22 feet tall.

37 Building, reinforced concrete foundation with corrugated metal walls and metal roof, measures 40.2 by 97.0 feet.

38 Maintenance Shop: Concrete construction measures 68.4 by 350.3 feet.

39 Motor Repair Shop: Concrete construction measures 182.3 feet by 68.3 feet by 26 feet tall.

40 Group HQ Building: Concrete construction measures 116 by 32.67 feet.

41 Communications Building: Concrete construction measuring 101 by 49.33 feet.

42 Tank Repair Shop: Concrete construction.

43 Maintenance Building. Concrete construction with corrugated metal roof; measures 68.3 feet by 25.0 feet by 32 feet tall.

44 Vehicle Storage Building: Concrete construction measuring 40 by 100 feet.

45 Chemical Test Center: Concrete foundation with prefabricated corrugated steel walls.

46 Sewage Lagoon: Four compartments measuring 269 by 514 feet.

47 General Purpose Warehouse and Adjacent Buildings: Warehouse has wooden foundation with metal roof and metal walls and measures 21 feet by 48 feet by 18 feet tall; adjacent buildings shown in Fig. C-8 are: A, wooden construction measuring 16.8 by 72.9 feet; B, C, and D, wooden construction with metal roof measuring 20.8 by 48.2 feet; E, wooden construction with metal roof formed by the joining of two modules each 20.8 by 48.2 feet with a corridor 20.2 feet long and 8 feet wide; and F, wooden building measuring 12.6 by 8.4 feet.

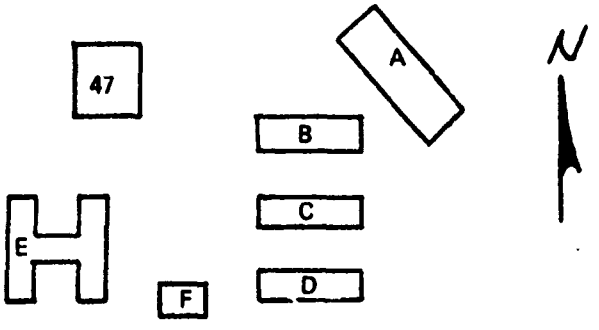

Fig. C-8. Warehouse and adjacent buildings.

48 Radio and Television Station: Wooden framed building with reinforced concrete foundation and aluminum roof standing 16 feet high; antenna nearby stands 112 feet tall.

49 Paint Shop: Reinforced concrete foundation with wooden walls and a metal roof having a height of 12 feet.

50 Instrumentation building and Adjacent Structures (Fig. C-9):
50: Metal walls and roof; 45.9 feet by 96.9 feet by 16 feet tall.
A: Identical to 50.
B: 40.25 feet by 57 feet by 12 feet tall; metal construction.
C: 31.3 by 19.0 feet; wooden construction; metal roof.
D: 6.7 by 12.2 feet; wooden construction.

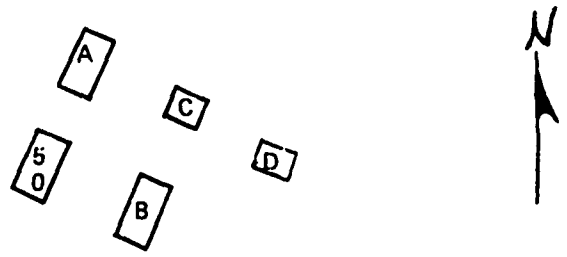

Fig. C-9. Instrumentation building and adjacent structures.

51 Boat Shop and Adjacent Building: Boat shop has concrete foundation, wooden walls, and an aluminum roof standing 22 feet tall; building immediately northwest of boat shop is a concrete structure having a metal roof and measuring 20.9 feet by 96.8 feet by 12 feet tall.

52 General Storehouse: Has a reinforced concrete foundation with metal walls and roof and measures 31.6 feet by 59.9 feet by 20 feet tall.

53 Water Well and Treatment Plant: This installation has a concrete foundation with wooden framed walls and a metal roof and measures 16.4 feet by 20.0 feet by 12 feet tall.

54 General Warehouse: This is of metal construction with a reinforced concrete foundation measuring 36 by 60 feet.

55 Radiosonde Tracking Station: The station has a wood-block foundation and steel walls and roof.

56 General Purpose Warehouse and Adjacent Structures: All are wooden framed with sheet metal roofs, dimensioned as follows (Fig. C-10):
56: 20.5 feet by 100.7 feet by 14 feet tall.
A: 20.5 feet by 100.6 feet by 14 feet tall.
B: 20.5 feet by 100.8 feet by 14 feet tall.
C: 20.5 feet by 120.7 feet by 14 feet tall.
D: 20.5 feet by 100.7 feet by 14 feet tall.
E: 20.0 feet by 48.0 feet by 14 feet tall.

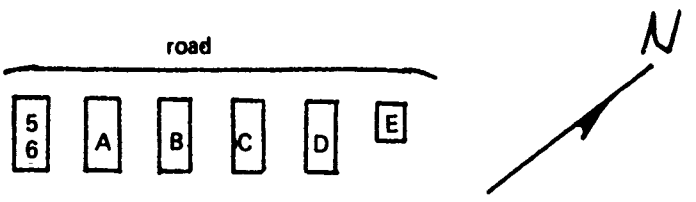

Fig. C-10. General purpose warehouse and adjacent structures.

57 General Storehouse: Metal walls and roof with reinforced concrete foundation, mea. ures 36 by 60 feet.

58 Barracks building without mess: concrete foundation with wooden walls and tin roof.

59 Barracks building as illustrated below (Fig. C-11) and constructed with metal walls and roofs; dimensions are as follows:
A: 20 feet by 26 feet by 10 feet high.
B: Eight each at 17 feet by 36 feet by 10 feet high.
C: Eight each at 17 feet by 73 feet high.
D: 7.2 feet by 311 feet by 10 feet high.

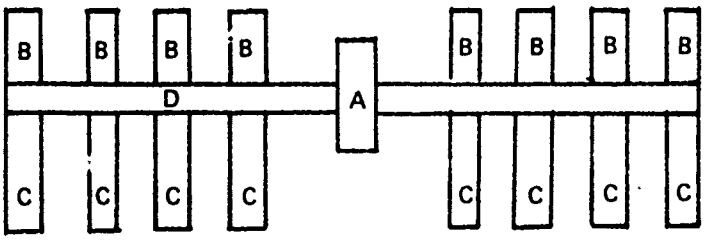

Fig. C-11. Barracks building.

60 Indoor target range having a reinforced concrete foundation, wooden walls, and a metal roof; dimensions as follows (Fig. C-12): A: 20.4 by 40.6 feet; B: 20.4 by 100 feet.

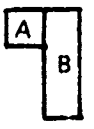

Fig. C-12. Indoor target range.

61 General Purpose Warehouse of wooden framed construction with a metal roof and standing 11 feet high.

62 Special Services Boat Shop: Constructed of wood with a metal roof and standing 20 feet high.

63 Teen Club: Complete wooden framed construction.

64 Mess Hall and bakery having a reinforced concrete foundation, wooden walls, and a metal roof and standing 16 feet high.

65 Water Storage tank having a concrete foundation with wooden walls and a metal roof.

66 Dormitory Building: Wooden framed building with metal roof: sections shown below (Fig. C-13) dimensioned as follows: A and B: 16 by 112.8 feet; C: 16 by 32 feet.

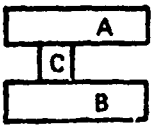

Fig. C-13. Dormitory building.

67 Parts building with steam plant due west; parts building is wooden framed with metal roof and stands 12 feet high; steam plant is concrete with metal roof and measures 31 by 56.8 feet.

68 Aircraft hangar having a reinforced concrete foundation and wooden walls and standing 50 feet high.

69 Diesel power plant having a concrete foundation and wooden roof and measuring 55.7 feet by 65.6 feet by 24 feet high.

70 Warehouse having a wooden foundation and walls and a metal roof.

71 Runway 6 running west to east, bearing S-82-55-35-E, having a length of 4675 feet.

72 Laundry building, which is composed of concrete walls and metal roof, standing 24 feet high.

73 Water Treatment: Concrete block construction with a wooden roof and measuring 16 by 16 feet.

74 Aircraft Diesel Fuel Facility: Concrete structure with metal roof measuring 16.7 by 18 feet; four gas pumps in front measure 4 by 6 feet each; four tanks southwest of main building have capacity of 324 bbl/tank, one tank for each pump.

75 Allen Army Airfield: Runway 18-36: 160 by 7,500 feet, bearing N-29-44-25-E: Runway 6-24: 158 by 4,675 feet, bearing S-82-55-35-E: Runway 9-27: 150 by 6,100 feet.

76 Range Offices: Four buildings running north from point 76, each of wood framed construction with reinforced concrete foundations and metal roofs and measuring 20.8 by 48.1 feet.

77 M-48 Tank on Display: 21.75 feet long, 12 feet wide, and 9.5 feet tall.

78 Two Wooden Buildings: Of these, the larger measures 20 feet by 8.33 feet by 14 feet tall at its highest point and 6 feet tall at its lowest point; the smaller building, a dugout, measures 23 feet by 6 feet by 5 feet tall.

79 Bleachers: These measure 60.5 feet by 11.33 feet by 8 feet tall.

80 Dugout: This measures 23 feet by 6 feet by 5 feet tall.

81 Two concrete block latrine buildings measuring 6.67 feet by 5.33 feet by 8 feet tall.

82 Concrete block building measuring 6 feet by 10 feet by 11 feet tall.

83 Main Gate Guard House: Length equals 14 feet; height equals 10 feet; island upon which it rests has an overall length of 34 feet and an overall breadth of 11 feet.

84 Dugout measuring 22.67 by 6 feet.

85 Quonset hut building measuring 20.67 by 48 feet with a 5- by 5-foot foyer attached and a tennis court on the south side of the building measuring 119 by 120 feet.

86 Wooden garage with pitched roof.

87 Quonset building measuring 18.5 by 8 feet with 5.5- by 8-foot entrances attached to opposite ends.

88 Two metal fuel tanks having a height of 34 feet.

89 Three wooden buildings running due north from point 89 and measuring 56.75 feet by 18.67 feet by 9.5 feet tall.

90 Two A-framed Wooden Sheds: The first measures 12.33 feet by 13 feet by 14 feet tall, housing motor and gear pulleys to operate ski tow; the second measures 12.33 feet by 21 feet by 16 feet tall, containing a stove and seats.

91 Tank crossing on Richardson Highway 22 feet long and 22 feet wide; pavement is 22 feet wide.

92 Exercise or Training Tower: Tower consists of three poles rising from the ground to a height of 42 feet, each pole having a diameter of 16 inches; the three poles form a triangle of 10.5 feet on a side. A board platform is at the 32-foot height with ropes suspended from it; ground around tower is outlined with sand bags and filled in with sand.

Site B

1 Metal Buildings: These are dimensioned as follows and located as illustrated in Fig. C-14:

A: Metal building with pitched roof measuring 56 feet by 24.5 feet by 13 feet tall.

B: Quonset hut 48.5 feet by 21 feet by 12.5 feet tall.

C: Same as B.

D: Building composed of two quonset huts of the dimensions of B and C and joined by a 24.5-foot-long corridor.

E: Wooden building measuring 46.5 feet by 18.5 feet by 14 feet tall.

F: Three-foot-wide concrete walk connecting A with the far side of D.

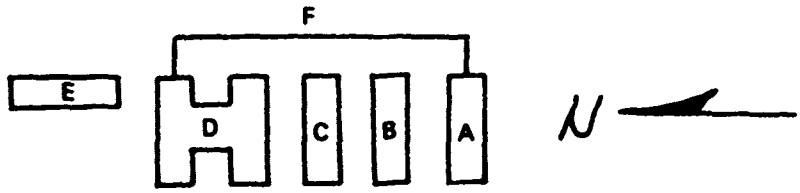

Fig. C-14. Metal buildings.

2 Concrete Block Shed with Adjoining Concrete Pad: Shed measures 13.5 feet by 10.8 feet by 9 feet tall; concrete pad measures 14 by 38 feet.

3 Metal house trailer 20 feet by 8 feet by 8 feet high.

4 Fuel tank being supported by three concrete supports. Tank is 17 feet long; overall height of tank and supports equals 11.5 feet.

5 Metal Quonset Huts: These are dimensioned and illustrated as follows (Fig. C-15):

A: 48.5 feet by 21 feet by 12.5 feet high.
B: 48.0 feet by 20 feet by 9.5 feet high.
C: 40.75 feet by 20.75 feet by 15 feet high.
D: Concrete sidewalk 3 feet in width.

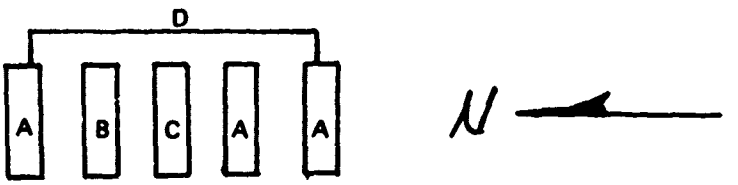

Fig. C-15. Metal quonset huts.

6 Metal building with pitched roof measuring 97 feet by 40.5 feet by 19.5 feet tall. Concrete aprons are present at either end.

7 Wooden building, with metal roof, measuring 20.2 feet by 12.4 feet by 12.5 feet high.

8 Wooden building, with shingle roof, measuring 16.67 feet by 30.5 feet by 11 feet high.

9 Round building built upon a concrete pad having a service pit for performing maintenance upon vehicles. Building has circumference of 66.67 feet and a height of 9.33 feet. Concrete pad measures 21 by 64 feet.

10 Slope of roadway at this point equals 14 percent.

11 Display rocket mounted upon a concrete block measuring 4 feet by 4 feet by 3 feet high, located within a concrete block triangle, 29 feet per side. Rocket height equals 32 feet.

12 Concrete tank-crossing, 20 feet long and 23 feet wide. Road pavement at this point is 20 feet wide, dirt road heading east is 17 feet wide, and gravel road heading west is 28 feet wide.

13 Wooden footbridge 8.5 feet wide and 18 feet long crossing dry stream bed 2.5 feet below. Handrails of 2- by 6-inch wood are 3 feet from floor of bridge. Bridge leads to a wooden building 8 feet by 8 feet by 10 feet high.

14 Gravel road, 20 feet wide.

15 Radio tower, 117 feet high

16 Concrete tank-crossing, 24 feet wide and 20 feet long. Road pavement at this point is 20.5 feet wide. Meadows Road, leading west, is 28 feet wide. Gravel road east has no edge boundaries. Tank road that parallels Meadows Road is 10 feet wide and dirt surfaced.

17 At this point, Richardson Highway has a slope of 5 percent.

18 Field containing junked automobiles.

Site D

1 Wooden structure having a reinforced concrete foundation, a flat roof, and standing 10 feet tall. Other dimensions are as illustrated below (Fig. C-16). Flat roof overhangs 1.5 feet on all sides.

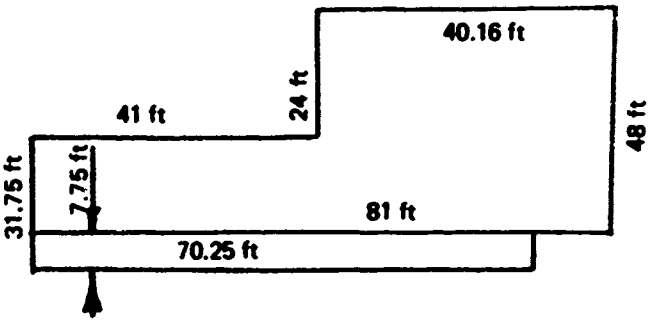

Fig. C-16. Wooden structure, Site D.

2 Flat roofed wooden shed, 22.6 feet by 51.5 feet by 10.5 feet tall.

3 Wooden shed, 19.16 feet by 32.16 feet by 10.5 feet high.

4 Wooden structure having a pitched roof and measuring 24.5 feet by 57 feet by 14 feet high.

5 Wooden housing unit with pitched roof 16 feet tall (Fig. C-17).

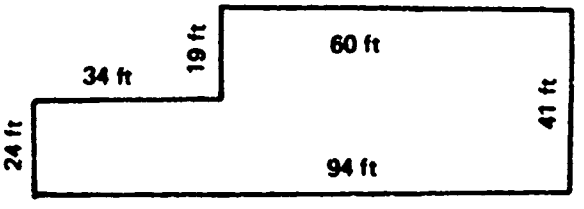

Fig. C-17. Wooden housing unit.

6	Gravel road leading northeast from paved road (the Alaska highway) slopes 4 percent towards the paved road Culverts, 24 inches in diameter on each side of gravel road.
7	Gravel road is approximately 36 feet wide at this point.

Site J

1	Metal roofed structure of concrete measuring 147.67 by 24 feet and having a height at either end of 20 feet with the central portion being 16 feet high.
2	Guard Shed: This is a wooden structure 6.5 by 8.67 feet and standing 11 feet tall; roof has 3-foot overhang on all sides. Fence encircling compound nearby is 8 feet high with three strands of barbed wire at the top. Chain link fence measures 280 by 178 feet.
3	Concrete building with metal roof measuring 25 by 75 feet and standing 20 feet at its tallest point, the southern rectangular section of roof, and 16 feet at its lowest point, the northern rectangular section of the roof. The entire building is encircled by a chain link fence 225 by 175 feet.
4	Metal building standing 24 feet in height and dimensioned as illustrated in Fig. C-18.

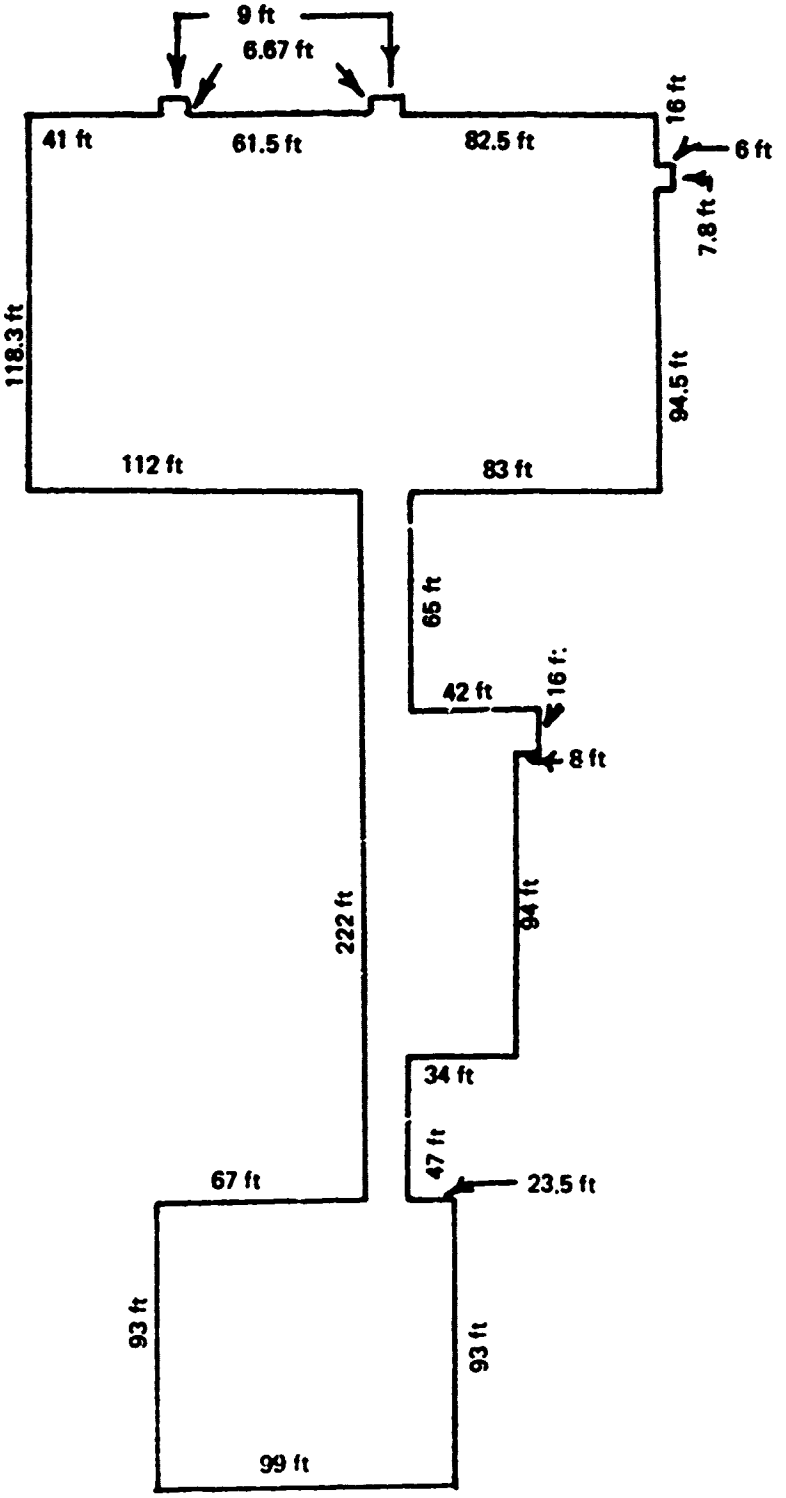

Fig. C-18. Irregularly shaped metal building, Site J.

5 Radar Dome Support with Adjoining Concrete Structure: Structure and support and adjoining corridor are 22 feet tall. Other dimensions are as illustrated in Fig. C-19.

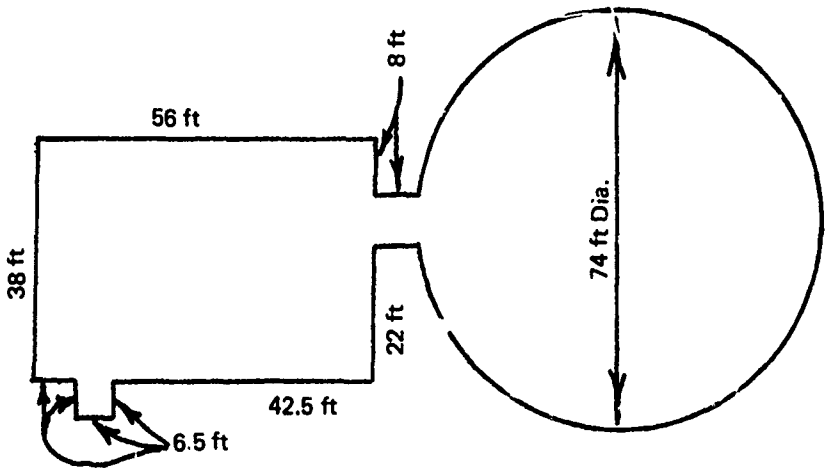

Fig. C-19. Radar dome.

6 Same as point 5 except radar dome (110 feet tall) is attached to concrete support.

7 Same as point 6 except dome is of smaller diameter, standing only 54 feet tall.

8 Metal building measuring 21 by 14.5 feet and standing 10 feet high.

Site L

1 Old Richardson Highway: This is a gravel road varying from 22 to 24 feet in width and having 4-foot drainage ditches on either side.

APPENDIX D

HYDROLOGY AND CLIMATOLOGY[5]

Climatology data for the Fort Greely area are shown in Tables D-1 through D-7 below.

Table D-1. Temperature

Month	Temperature (°F) Mean	Maximum	Minimum	Highest	Lowest	Years of Record
Jan.	-3.8	3.7	-11.2	48	-63	24
Feb.	2.7	11.7	-6.6	51	-60	24
Mar.	10.7	21.4	-2.5	52	-48	24
Apr.	28.6	38.5	18.4	71	-37	24
May	45.3	54.6	36.0	90	-1	25
Jun	56.6	66.3	46.5	88	32	23
Jul.	59.5	68.6	50.1	91	35	23
Aug.	53.0	64.3	45.6	86	22	24
Sep.	44.3	52.5	36.0	77	7	24
Oct.	24.9	31.9	17.8	62	-24	23
Nov.	5.2	13.3	-1.4	50	-46	23
Dec.	-5.3	2.8	-12.5	48	-62	23
Annual	27.0	35.8	18.0	91	-63	24

Table D-2. Ceiling/Visibility in Percent of Time

Month	Less than 500 ft and/or 1 mi	Less than 1000 ft and/or 3 mi	Less than 2000 ft and/or 7 mi	2000 ft and over 7 mi	Years of Record
Jan.	3.8	8.0	12.3	75.7	20
Feb.	2.5	6.9	9.6	81.0	20
Mar.	1.8	6.1	11.3	80.8	20
Apr.	0.4	3.4	6.3	89.8	20
May	0.3	1.4	4.2	94.0	20
Jun.	0.1	0.7	3.6	95.6	20
Jul.	0.2	2.1	6.1	91.6	20
Aug.	0.6	2.3	6.2	90.9	20
Sep.	1.8	6.0	9.9	82.3	20
Oct.	4.4	11.4	16.5	67.8	20
Nov.	2.4	8.2	13.5	76.0	20
Dec.	4.9	8.8	13.8	72.4	20
Annual	1.9	5.4	9.4	83.2	20

[5] NOTE: Data prepared by: U.S. Army Meteorological Team (RDT&E) Alaska, Fort Greely, Alaska. Charts prepared by: Weather Bureau Office, Fort Huachuca, Arizona, December 1963.

Table D-3. Wind (21 Years of Record)

Wind	Annual	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average Speed (mi/h)	9.3	12.7	11.6	8.7	8.5	9.0	7.8	7.1	7.8	8.6	9.2	10.5	9.9
Extreme Speed (mi/h)	104	75	104	96	67	82	63	79	93	75	86	82	98
Direction	S	ESE	S	E	SSW	SSE	SSW	S	S	NE	SE	SE	S

Table D-4. Sky Conditions (Percent of Time)

Month	Clear	Scattered	Broken	Overcast	Obscured	Years of Record
Jan.	26.0	17.3	17.0	31.6	8.1	20
Feb.	25.0	16.7	17.8	32.8	7.6	20
Mar.	25.1	18.5	19.5	32.9	4.0	20
Apr.	17.4	20.7	25.2	34.0	2.7	20
May	10.8	21.0	30.8	36.8	0.7	20
Jun.	5.7	21.1	35.8	37.4	NA	20
Jul.	6.6	18.8	31.0	43.0	0.4	20
Aug.	7.9	19.0	28.7	43.2	1.1	20
Sep.	10.5	15.5	23.0	48.0	2.8	20
Oct.	12.7	14.8	17.9	45.9	8.8	21
Nov.	22.6	16.6	17.0	35.4	8.4	20
Dec.	22.2	17.0	18.1	34.2	8.5	21
Annual	16.0	18.1	23.5	37.9	4.4	20

Table D-5. Obstruction of Vision

	Average Monthly Percentage												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Fog	3.2	3.6	3.4	2.5	1.3	0.7	1.4	1.5	3.8	7.3	4.9	4.4	3.2
Ground Fog	0.3	0.2	+	+	+	0.2	0.1	0.1	0.4	0.2	0.2	0.2	0.2
Ice Fog	5.3	3.9	0.3	+	0	0	0	0	0.1	+	1.1	6.0	1.4
Blowing Snow	1.2	0.3	0.1	0.1	+	+	0	0	0	0.1	0.5	0.7	0.3
Smoke	+	0.1	0	0	0	0.6	1.0	0.9	+	+	0.1	0.2	0.2
Years of Record	20	20	20	20	20	20	20	20	20	21	21	20	20

+ Less than 0.05%

Table D-6. Precipitation

	Average Precipitation (in.)											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Snowfall	6.2	1.6	5.5	3.0	0.5	T	0	T	0.9	7.1	6.4	5.9
Precipitation	0.37	0.50	0.37	0.31	0.90	2.3	2.7	2.0	1.2	0.55	0.43	0.48
Years of Record	24	24	24	24	24	24	24	24	23	23	24	24

Average Annual Snowfall = 37.1 in.; Average Annual Precipitation = 12.19 in.
T: Trace

Table D-7. Precipitation by Type

Type	Percentage											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rain	+	+	+	0.6	5.0	8.5	10.7	10.8	9.3	0.8	0.1	0.1
Rain Showers	0	0	0.2	0	1.4	2.4	2.7	1.3	0.3	0	0	0
Freezing Rain	0.1	0	0	0	0.1	0	0	+	+	+	+	+
Snow	17.0	19.0	16.9	10.5	2.3	0.1	0	+	3.9	19.6	20.5	19.3
Snow Showers	0.1	+	0.1	0.5	0.9	0	0	0	0.1	0.1	0.1	0.1
Snow Pellets	0	0	0	0.1	+	0	0	0	+	+	+	0.1
Snow Grains	0.1	0.1	0.1	+	+	0	0	0	0	0.1	0	0.1
Drizzle	+	0.1	0.1	+	0.3	0.3	0.6	0.6	1.7	0.3	0	+
Freezing Drizzle	0.1	+	0	+	0	0	0	0	+	0.6	0.3	0.1
Ice Crystals	1.1	0.7	0.2	+	0	0	0	0	0	0.1	0.5	1.5
Hail	0	0	0	0	+	+	+	+	0	0	0	0
Thunder	0	0	0	0	+	0.3	0.3	0.1	0	0	0	0
Years of Record	20	20	20	20	20	20	20	20	20	21	20	21

+ Less than 0.05%.

Hydrology of the Fort Greely area is represented by transects of Jarvis Creek and Delta River, shown in Figs. D-1 and D-2, respectively.

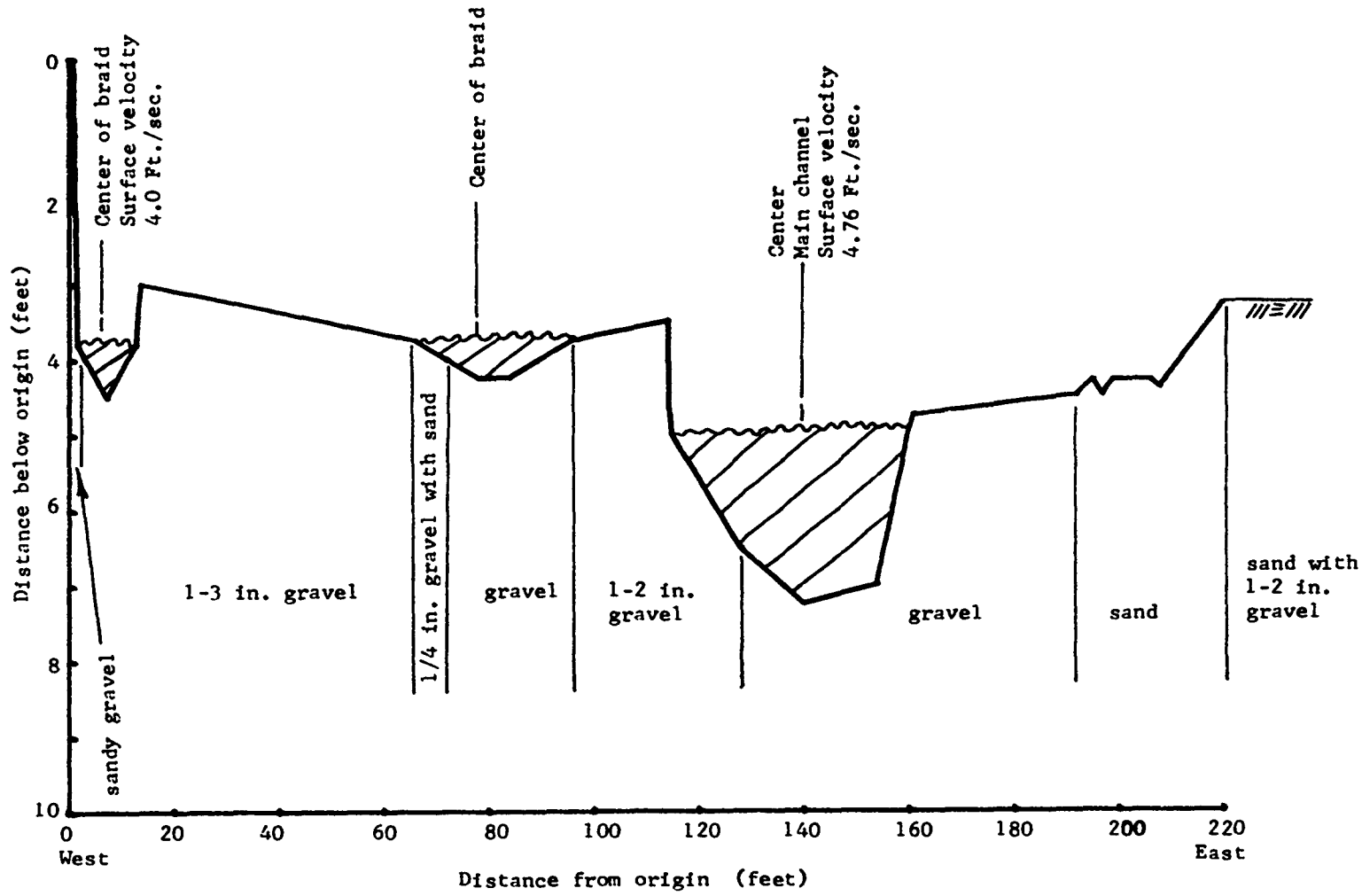

Fig. D-1. Typical cross section of Jarvis Creek.

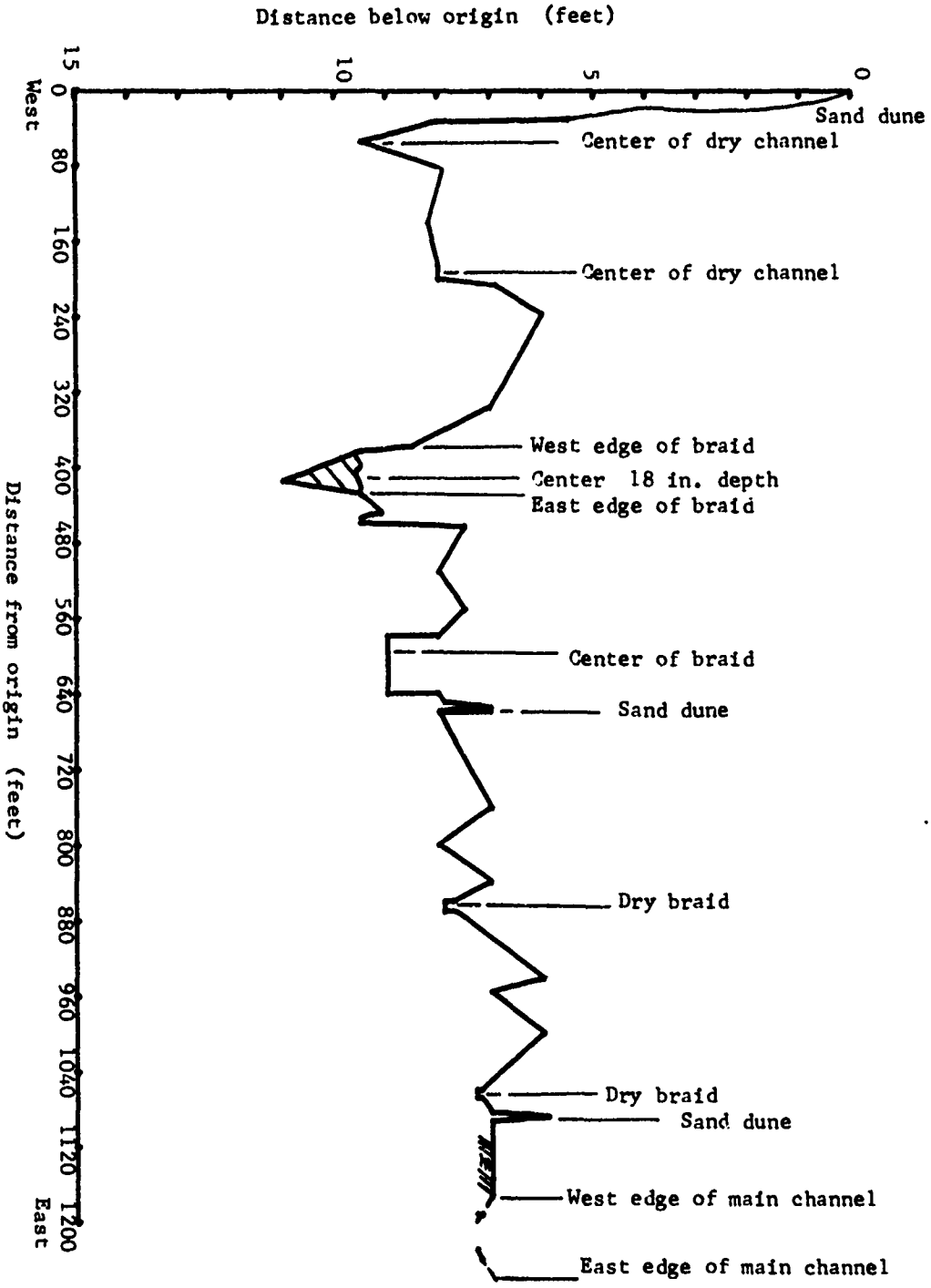

Fig. D-2. Typical cross section of Delta River.

APPENDIX E

AVAILABLE AERIAL PHOTOGRAPHY

Date Flown	Flown By	Project	Approximate Scale	Film Type	Agency Retaining Imagery
1950	USGS	NA	1:40,000	Panchromatic	USGS
March 1972	USAF	AF71-40A	1:40,000	Panchromatic	Defense Mapping Agency, Washington, DC
May 1972	USAF	AF71-40A	1:40,000	Panchromatic	Defense Mapping Agency, Washington, DC
September 1972	USAF	AF71-40B	1:60,000	Panchromatic	Defense Mapping Agency, Washington, DC
August 1973	U.S. Navy	Color, Multiband	1:5,000 1:10,000 1:15,000	Kodak Plus-X Aerographic #2402	USAETL, Fort Belvoir, VA
August 1973	Mark Hurd Aerial Surveys	Color, Multiband	1:5,000	Ektachrome MS Aerographic #2448	USAETL, Fort Belvoir, VA
			1:5,000	Aerochrome Infrared #2443	
			1:5,000	Multiband	