GEOTECHNICAL INVESTIGATION

PROPOSED BRIDGE SITE

CRISTINE CREEK

MILE 615.8

MACKENZIE HIGHWAY

E-2510 OCTOBER 15, 1973



HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERING & TESTING

R.M.HARDY & ASSOCIATES LTD.



# GEOTECHNICAL INVESTIGATION

PROPOSED BRIDGE SITE

CRISTINE CREEK

MILE 615.8

MACKENZIE HIGHWAY

E-2510 OCTOBER 15, 1973

**R.M.HARDY & ASSOCIATES LTD.**

CONSULTING ENGINEERING & TESTING • GEOTECHNICAL DIVISION

File No. E-2510

October 15, 1973

Mr. F. E. Kimball, P.Eng.,
Manager of Northern Roads Program,
Department of Public Works of Canada,
One Thornton Court,
Edmonton, Alberta.

Re: Geotechnical Investigations - Mackenzie Highway
<u>Proposed Bridge Site, Cristine Creek, Mile 615.8</u>

Dear Mr. Kimball:

We are pleased to submit our report on the proposed bridge site across Cristine Creek.

Should you wish for any explanation or amplification of any part of this report we will be pleased to be at your service.

Respectfully submitted,

R. M. HARDY & ASSOCIATES LTD.,

Per:

G. McCormick, P.Eng.

GM/jc

10214 - 112 STREET, EDMONTON, ALBERTA T5K 1M5 PHONE (403) 426-0405
CONSOLIDATING THE SERVICES OF: R. M. HARDY & ASSOCIATES LTD., MATERIALS TESTING LABORATORIES LTD. & NON DESTRUCTIVE INSPECTION LTD.
BURNABY CALGARY DAWSON CREEK EDMONTON LETHBRIDGE PRINCE GEORGE RED DEER WINNIPEG

INTRODUCTION

At the request of Mr. F. E. Kimball, P.Eng., Manager of Northern Roads Program, Department of Public Works of Canada, Western Region, R. M. Hardy & Associates Ltd. undertook a geotechnical investigation along part of the proposed location of the Mackenzie Highway. This report deals only with that part of the investigation appertaining to the proposed bridge at Cristine Creek.

The location of this bridge is shown on mosaic sheet No. 49 of a set of mosaics prepared by the Department of Public Works for the Mackenzie Highway Project. The site is covered by aerial photographs Nos. A22773 240 and 241 (scale 1" = 1000'). The site is located approximately 2200 feet downstream of the point where the creek is crossed by the Canadian National Telecommunications right-of-way.

In addition to these mosaics and aerial photographs R. M. Hardy & Associates Ltd. was provided with a sketch plan and profile showing the proposed crossing. This last drawing is entitled "Plan and Profile Showing Proposed Drainage Structure at Cristine Creek" and is not dated. It was used as the basis for Plate 1, Appendix A.

A report entiled "Geotechnical Investigations, Mackenzie Highway, Mile 544 to Mile 635" has been previously submitted to the Department. The geotechnical conditions are discussed in Volume I, while Volume II contains information on permafrost of a more general nature. We recommend that these volumes be read in conjunction with this report.

DRILLING AND TESTING

Two test holes were drilled at this site on March 11, 1973 using a Failing 1000 drill rig. Compressed air was used as the drilling fluid. Disturbed samples were obtained at frequent intervals for water content determinations, ice descriptions and material identification. All samples were tested in the field laboratory which formed part of the mobile camp accompanying the operation. Logs of these test holes are in Appendix A.

TOPOGRAPHY

The general direction of the drainage in the area is southwesterly towards the Mackenzie River. The banks of Cristine Creek are relatively low with the vertical distance from water level to the top of the valley wall on the south side being approximately 16 feet and the vertical distance from water level to the top of the valley wall on the northerly side being 8 feet. The width of the creek at the water line is less than 20 feet.

## SOIL PROFILE

The approaches to the bridge, on both sides of the creek, are at the lower edges of two alluvial fan deposits which consist of poorly sorted gravel, sand and silt overlying clay till. The depth from existing ground surface to the clay till is 8 feet on the southerly approach and 12 feet on the northerly approach. At both test holes unfrozen ground was encountered at a depth of 8 feet below existing grade. We believe that the frozen ground encountered in both these test holes was due to seasonal frost and that the soil profile would be in an unfrozen condition during the summer.

## DISCUSSION AND RECOMMENDATIONS

The effect of a stream on the permafrost profile is shown on Plate 2, Appendix A. This chart shows that the thaw bulb beneath a small creek can penetrate to considerable depths so that, for bridge building purposes, the presence of permafrost beneath the stream bed can be ignored. However it should be noted that the permafrost profile beneath the sides of the stream bed plunges at an extremely steep angle.

As is well known, the flow of water in northern streams varies tremdously throughout the year. Very large flows can be experienced during the spring runoff. The bed of this stream consists of rock and gravel fragments (according to the Surveyor's notes on the above mentioned drawing) so that only limited scour should be expected. The amount of scour that should be expected will depend on the flow of water during the height of the spring runoff and the constriction imposed upon the stream by the bridge structure.

While we believe that it would be feasible to support the bridge piers and abutments on concrete spread footings, we are of the opinion, that due to difficulties of logistics, it would be desirable to reduce onsite work to the absolute minimum. We therefore recommend that the bridge be supported on driven steel H piles. It is extremely unlikely that any other type of pile would be feasible at this site.

Steel H piles which are to be placed on the banks where they will not be affected by scour should be driven a minimum of 30 feet below existing grade and designed on the basis of an allowable skin friction of 800 psf (on the gross perimeter) with the top 10 feet of pile being assumed to carry no load.

Steel H piles driven in the stream bed should be driven a minimum distance of 20 feet below the bottom of anticipated scour and should be designed on the basis of the "Table of Penetration Resistance" following. Design parameters are summarized on Plate 3, Appendix A.

In driving H piles the weight of the pile driving hammer should be at least twice the weight of the pile being driven except where a diesel hammer is to be used when the weight of the hammer should be at least equal to the weight of the pile. To prevent damage to the points of the piles they should be reinforced with flange plates for a distance equal to 1.5 times the size of the pile. Alternatively, the point can be reinforced with a driving shoe.

Piles should be driven to refusal or practical refusal according to the following table of penetration resistances assuming that the hammer delivers an energy of 15,000 ft-lbs. per blow.

TABLE OF PENETRATION RESISTANCE

| Description | Inches per Blow |
|---|---|
| refusal | .00-.05 |
| practical refusal | .05-.25 |
| high resistance | .25-.50 |
| medium resistance | .50-1.25 |

In order to ensure that refusal has been reached, driving should be continued for at least 100 blows after a state of high resistance is first recorded. Piles driven to refusal, as defined above, should be designed for the structural strength permitted for the pile as a structural column. Consideration should be given to using battered piles on the outside of the pile bents in order to provide increased lateral resistance should the structural designer consider this necessary.

If a drop hammer is used in driving the piles, care should be taken that the energy delivered to the pile is not greater than 50,000 ft. pounds per blow.

One of the problems facing bridges is the possibility of log jams occurring which can cause partial of complete failure of the bridge. In this case, it is almost certain that the entire width of the river at high flood can be spanned with one clear span. However, if such is not the case, we suggest that the height of trees growing adjacent to Cristine Creek upstream of the bridge site should be checked and, should it be observed that there is a possibility of large trees being washed downstrem, such facts should be borne in mind by the bridge designer.

If piles are used to support a vertical face of embankment fill, the lateral force against the pile can be computed by assuming the backfill to a fluid with a density of 60 pounds per cubic foot where the backfill is not compacted.

Embankments constructed below the highest expected flood level should be protected with riprap. As suitable rock may not be available, sandbags filled with concrete may have to be used.

Respectfully submitted,

R. M. HARDY & ASSOCIATES LTD.

Per:

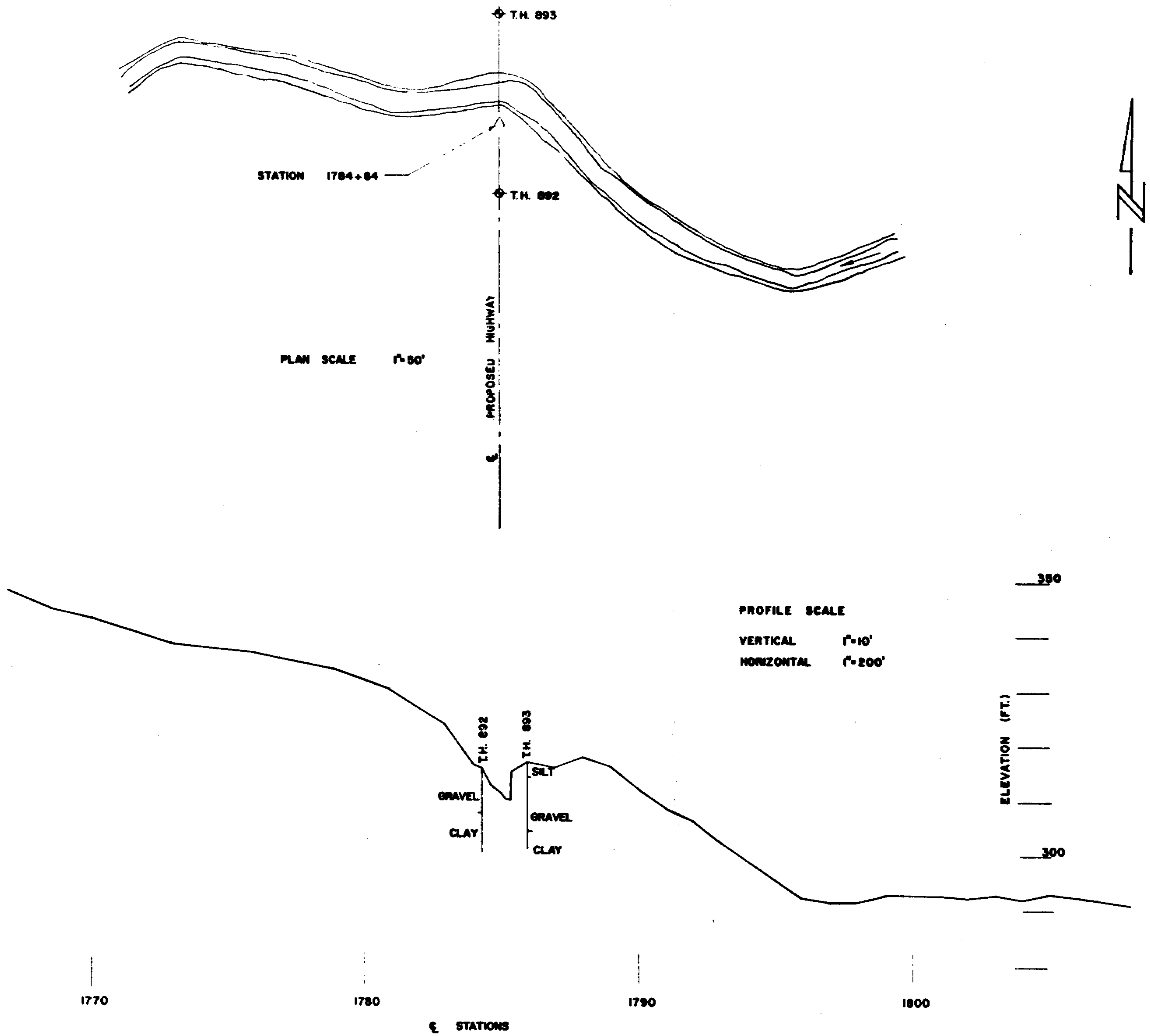
G. McCormick, P.Eng.

GM/jc

THE ASSOCIATION OF
PROFESSIONAL ENGINEERS
OF ALBERTA
PERMIT NUMBER
P [illegible]
R. M. HARDY AND
ASSOCIATES LTD.

# APPENDIX A

Section
Charts
Test Hole Logs




**NOTE**

**THIS DRAWING HAS BEEN REDUCED TO 50 % SIZE**

| No. | REVISION | DATE | BY |
|---|---|---|---|
| | | | |

D.P.W. DWG PROPOSED DRAINAGE STRUCTURE AT CHRISTINE CREEK

REFERENCES

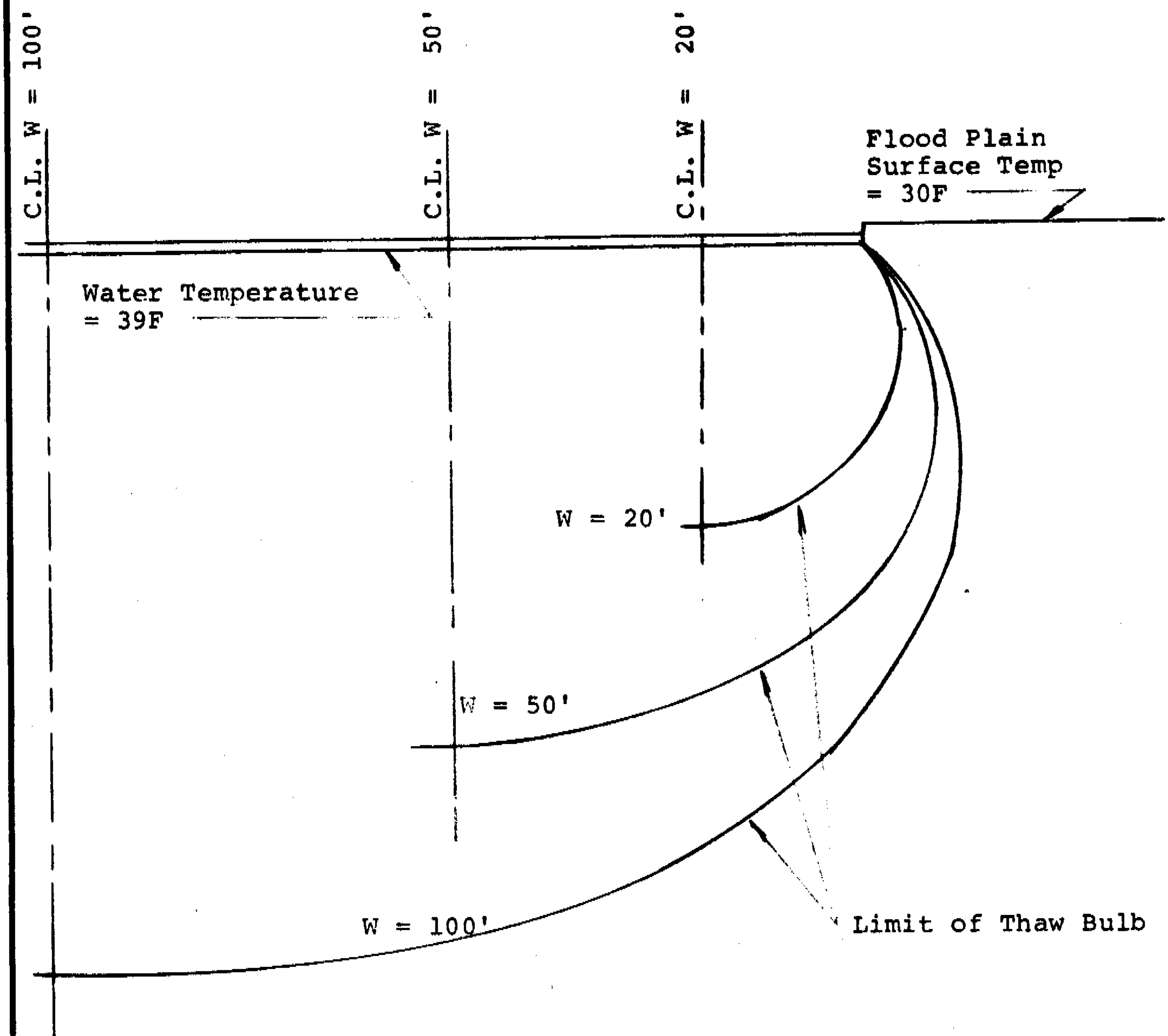
R.M.HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING & TESTING

DEPARTMENT OF PUBLIC WORKS
MAKENZIE HIGHWAY
CHRISTINE CREEK

SCALE SHOWN DATE OCT. 9 '73 MADE R.V.S. CHKD . APPD.

No. E 2510-101 REV. 0

PLATE 1




Scale: 1" = 10'

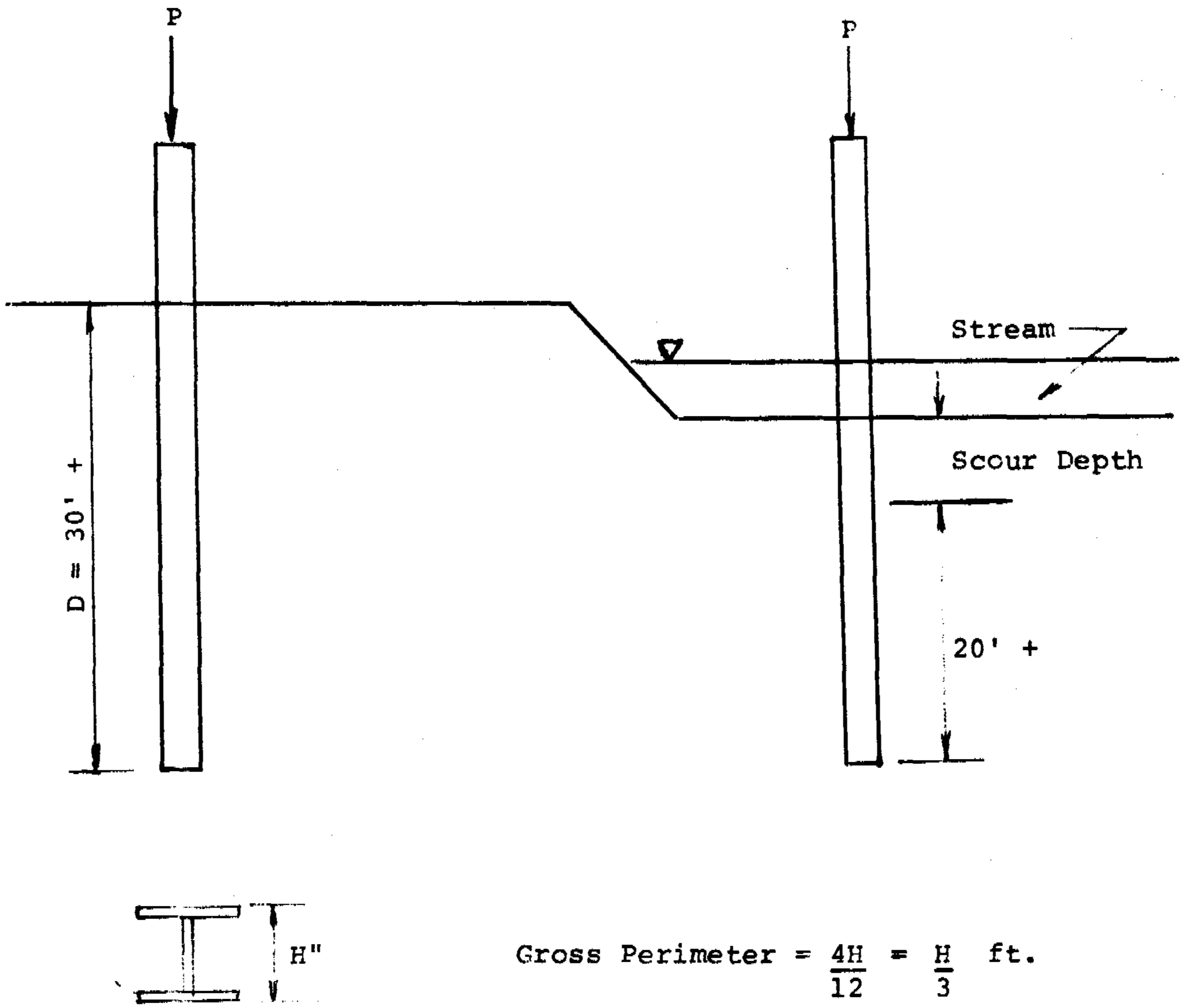
W = River Width
C.L. = Center Line

G.Mc September 14/73 E-2510

R.M.HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERING & TESTING

THAW BULBS BENEATH RIVERS
NORMAN WELLS AREA

PLATE 2




Gross Perimeter = $\frac{4H}{12} = \frac{H}{3}$ ft.

Piles on dry land to be designed on the basis of an allowable shaft friction over effective length of embedment of D-10 with D minimum = 30 ft.

Piles in stream bed to be driven to 20+ feet below scour depth and designed on the basis of penetration values (see text).

| | |
|---|---|
| R.M.HARDY & ASSOCIATES LTD. CONSULTING ENGINEERING & TESTING | MACKENZIE HIGHWAY<br>BRIDGE PILES<br>NORMAN WELLS AREA |

| SCALE | DATE | MADE G.Mc | CHKD. | JOB: E2510 | PLATE |
|---|---|---|---|---|---|

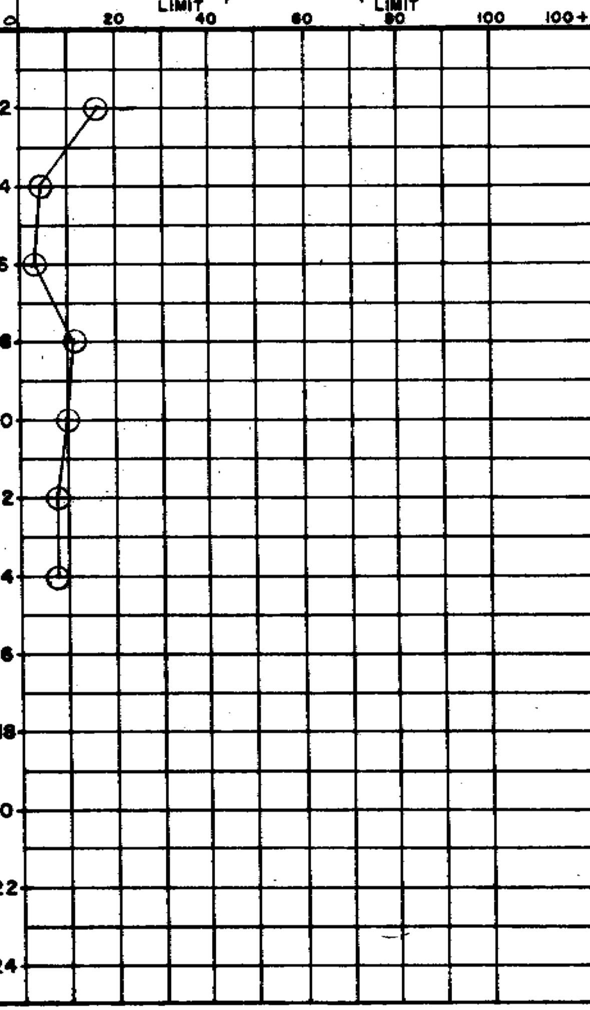
R.M. HARDY AND ASSOCIATES LTD. | DRILL HOLE REPORT | DEPARTMENT OF PUBLIC WORKS, CANADA MACKENZIE HIGHWAY

| | | | | | |
|---|---|---|---|---|---|
| DWN: CLA | FIELD ENG: BD | DATE DRILLED: 11/3/73 | AIRPHOTO NO: A22934-145 | CHAINAGE: 1784+20 | OFFSET: |
| CKD: [illegible] | TECH: MD & MB | RIG: MAYHEW 1000 | SURFACE DRAINAGE: GOOD | VEGETATION: SEE REMARKS | ELEV: |

| TEST HOLE | | |
|---|---|---|
| MILE | B,C,S | NUMBER |
| 615 | S | 892 |

| DEPTH (FEET) | SAMPLE NUMBER | SAMPLE TYPE | % RECOVERY | PENETRATION RESISTANCE | UNIFIED SOIL SYMBOL | SOIL DESCRIPTION | LIMITS OF FROZEN GROUND | ICE DESCRIPTION (EST.) |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | Moss Cover | | |
| 0–8 | | | | | G.C | GRAVEL; SILTY, SANDY CLAYEY, LOW PLASTIC. BROWN, CALCAREOUS ROOTLETS | F | Vx 10% |
| 4 | | | | | | — — — — — 4' COARSE SAND, LESS FINES | | |
| 8–15 | | | | | CL | CLAY (TILL); GRAVELLY SILTY, SANDY, LOW PLASTIC LIGHT BROWN RUST SPOTS | UF | |
| 12 | | | | | | — — — GREY HIGHER PLASTIC. | | |
| 15 | | | | | | END OF HOLE 15' | | |

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT ├──┤ LIQUID LIMIT




| GRAIN-SIZE ANALYSIS CLAY % | SILT % | SAND % | GRAVEL % | WET DENSITY (P.C.F.) | DRY DENSITY (P.C.F.) |
|---|---|---|---|---|---|
| | | | | | |

REMARKS

SPARSE SPRUCE
10-20' HIGH
3"⌀ MAX
OCCASIONAL POPLAR
& WILLOWS

# R.M. HARDY AND ASSOCIATES LTD. — DRILL HOLE REPORT

## DEPARTMENT OF PUBLIC WORKS, CANADA — MACKENZIE HIGHWAY

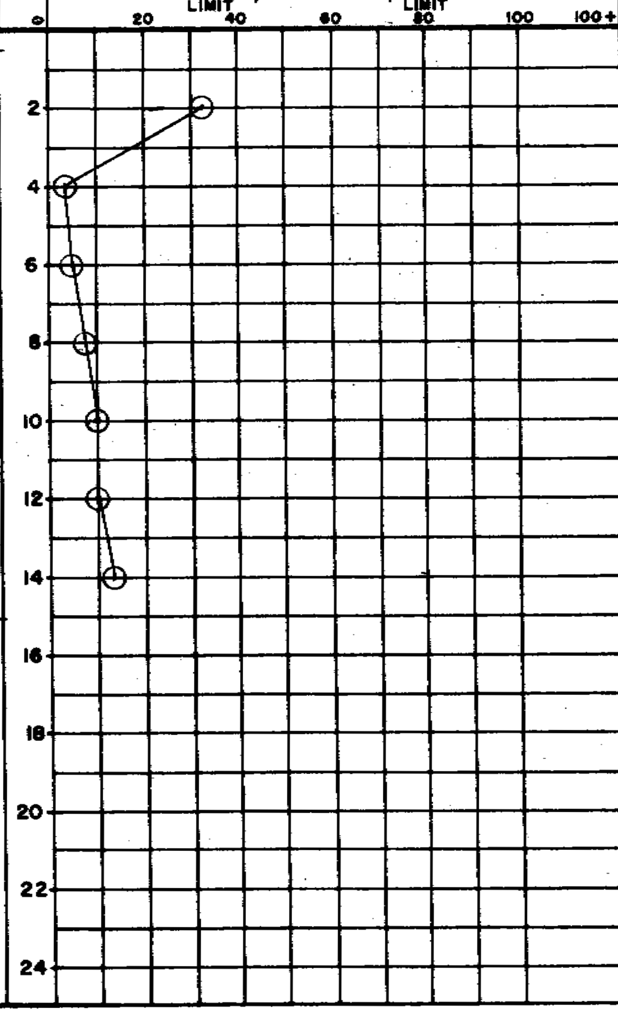
| | | | | | |
|---|---|---|---|---|---|
| DWN: [illegible] | FIELD ENG: BD | DATE DRILLED: 11/3/73 | AIRPHOTO NO: A22934 - 145 | CHAINAGE: 1785 + 80 | OFFSET: |
| CKD: [illegible] | TECH: MD, MB | RIG: MAYHEW 1000 | SURFACE DRAINAGE: FAIR | VEGETATION: SEE REMARKS | ELEV: |

**TEST HOLE**

| MILE | B,C,S | NUMBER |
|---|---|---|
| 615 | S | 893 |

| DEPTH (FEET) | SAMPLE NUMBER | SAMPLE TYPE | % RECOVERY | PENETRATION RESISTANCE | UNIFIED SOIL SYMBOL | SOIL DESCRIPTION | LIMITS OF FROZEN GROUND | ICE DESCRIPTION (EST %) |
|---|---|---|---|---|---|---|---|---|
| 0 – 1/2' | | | | | Pt | PEAT | F | Vx 70% |
| 1/2' – 2' | | | | | ML | SILT, LOW PLASTIC, BROWN | | Vx 30% |
| 2' – 12' | | | | | GM | GRAVEL (FINE); COARSE GRAINED SAND, SILTY, BROWN, RUST STAINS, TRACES OF ROOTLETS, CALCAREOUS; 8' SILTIER (SLUFFING) | UF (from 8') | Nbn |
| 12' – 15' | | | | | CI | CLAY (TILL); SANDY, SILTY, MED. PLASTIC, BROWN, PEBBLES, CALCAREOUS | | |

○ = WATER CONTENT (% OF DRY WEIGHT)
△ = ICE CONTENT (% OF SAMPLE VOLUME)
PLASTIC LIMIT ├──┤ LIQUID LIMIT




GRAIN-SIZE ANALYSIS: CLAY % | SILT % | SAND % | GRAVEL % — WET DENSITY (P.C.F.) — DRY DENSITY (P.C.F.)

**REMARKS**

SPARSE SPRUCE 10-30' HIGH 8"φ MAX

OCCASIONAL POPLAR & WILLOWS

# APPENDIX B

## Explanation Sheets

## EXPLANATION OF TERMS AND SYMBOLS

## USED ON TEST HOLE LOG SHEETS

### Depth

This column refers to the depth below the ground surface in feet.

### Sample Number

Tube and core samples were numbered consecutively from the surface. Grab samples were not numbered.

### Sample Type

This column indicates the depth interval and condition of each sample attempted. Undisturbed samples in this program were obtained with Shelby tubes of 18 inches length and 3 inches diameter, manufactured from 11 gauge steel, or by core drilling. Cores were of 2.85 inch diameter and up to 36 inches long.

Disturbed samples were obtained from the returned cuttings.

T indicates tube sample

C indicates core sample

indicates large grab sample

Note: Grab samples taken for water content and visual examination are not indicated in this column.

### Percent Recovery

This column shows the length of sample recovered as a percentage of the length attempted. 100% recovery is not indicated and may be assumed where no value is shown.

Penetration Resistance

No standard penetration tests were performed during this program.

Soil Symbol

The soil symbols used are explained in full on page 5 of this appendix.

Soil Description

Soils of different engineering classification are grouped generically for ease of reference. The system used is the Modified Unified Classification System for Soils.

Frozen Ground

The depth intervals over which frozen and unfrozen ground were encountered are indicated by F and UF respectively. No attempt was made to differentiate between seasonal frost and permafrost.

Ice Description

The ice content of permafrost soils has been classified according to the National Research Council System for describing permafrost. A brief review of the NRC System is contained on page 9 of this appendix. Where no entry is made, the type was not recorded in the field.

The amount of ice contained in a soil sample was estimated in the field laboratory by inspection. The value arrived at by the laboratory technician has been left unchanged.

Water Content

The natural water content of the soil at the time of drilling is plotted against depth on the chart at the right hand side of the log. The water content, which is indicated by a circle, is expressed as a percentage of the dry weight of the soil. It will be observed that water contents in excess of 100% are indicated in the column at the right of the chart by figures.

Volume of Ice

The total volume of ice in undisturbed samples is indicated on the same chart as water contents. The value is indicated by a triangle. This volume is the total volume of ice in an undisturbed sample and includes intersticial ice, as well as excess ice, and is expressed as a percentage of the total volume of the sample.

Grain Size Analysis

The proportions of clay, silt, sand and gravel in a sample are summarized. Grain size curves for each sample so analyzed are on separate sheets.

Wet Density

The wet in situ density of undisturbed samples is the total weight of the sample in pounds (including ice and water) divided by the volume of the sample in cubic feet.

## Dry Density

The dry in situ density of undisturbed samples is the weight of dry soil divided by the volume of the sample in cubic feet.

## Atterberg Limits

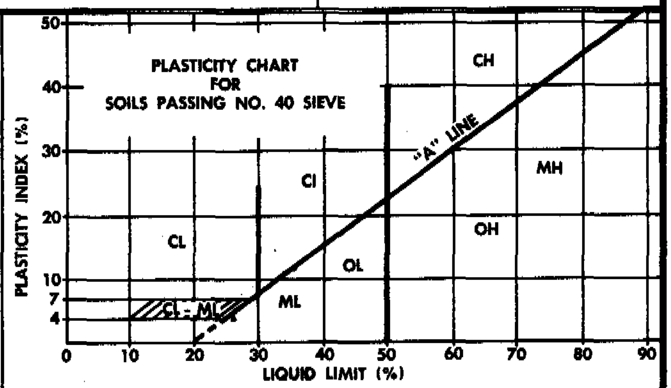
The plastic and liquid limits are shown on the water content chart by a horizontal bar. The Atterberg system is discussed in the following section.

## NOTES ON ATTERBERG LIMITS

Soils which possess a significant fraction of clay can exist in liquid, plastic or solid states according to the water content. Where the water content is very high, so that the soil is in the form of a slurry, the soil behaves as a liquid. If the water content is reduced, for example through evaporation, the clay will enter into a plastic state. If the water content is reduced yet further, the clay will become a solid. The transition from one state to another occurs gradually over a range of water content. Atterberg, a Swedish agronomist, developed a method for delineating the boundaries between the three states. If his method is used, the water content which marks the dividing line between the plastic and liquid state is known as the Liquid Limit. These water contents are all expressed as percentages of the dry weight of soil. The range of water content between the plastic

## MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

| MAJOR DIVISION | | | GROUP SYMBOL | GRAPH SYMBOL | COLOR CODE | TYPICAL DESCRIPTION | LABORATORY CLASSIFICATION CRITERIA | |
|---|---|---|---|---|---|---|---|---|
| COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 200 SIEVE) | GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE | CLEAN GRAVELS (LITTLE OR NO FINES) | GW | | RED | WELL GRADED GRAVELS, LITTLE OR NO FINES | $C_U = \frac{D_{60}}{D_{10}} > 6$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3 | |
| | | | GP | | RED | POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES | NOT MEETING ABOVE REQUIREMENTS | |
| | | DIRTY GRAVELS (WITH SOME FINES) | GM | | YELLOW | SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES | CONTENT OF FINES EXCEEDS 12% | ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4 |
| | | | GC | | YELLOW | CLAYEY GRAVELS, GRAVEL-SAND-(SILT) CLAY MIXTURES | | ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7 |
| | SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE | CLEAN SANDS (LITTLE OR NO FINES) | SW | | RED | WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES | $C_U = \frac{D_{60}}{D_{10}} > 4$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3 | |
| | | | SP | | RED | POORLY GRADED SANDS, LITTLE OR NO FINES | NOT MEETING ABOVE REQUIREMENTS | |
| | | DIRTY SANDS (WITH SOME FINES) | SM | | YELLOW | SILTY SANDS, SAND-SILT MIXTURES | CONTENT OF FINES EXCEEDS 12% | ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4 |
| | | | SC | | YELLOW | CLAYEY SANDS, SAND-(SILT) CLAY MIXTURES | | ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7 |
| FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES 200 SIEVE) | SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT | $W_L < 50\%$ | ML | | GREEN | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY | CLASSIFICATION IS BASED UPON PLASTICITY CHART (see below) | |
| | | $W_L > 50\%$ | MH | | BLUE | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS | | |
| | CLAYS ABOVE "A" LINE ON PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT | $W_L < 30\%$ | CL | | GREEN | INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS | | |
| | | $30\% < W_L < 50\%$ | CI | | GREEN-BLUE | INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS | | |
| | | $W_L > 50\%$ | CH | | BLUE | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS | | |
| | ORGANIC SILTS & CLAYS BELOW "A" LINE ON CHART | $W_L < 50\%$ | OL | | GREEN | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY | WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY | |
| | | $W_L > 50\%$ | OH | | BLUE | ORGANIC CLAYS OF HIGH PLASTICITY | | |
| HIGHLY ORGANIC SOILS | | | Pt | | ORANGE | PEAT AND OTHER HIGHLY ORGANIC SOILS | STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE | |




1. ALL SIEVE SIZES MENTIONED ON THIS CHART ARE U.S. STANDARD, A.S.T.M. E.11.
2. BOUNDARY CLASSIFICATIONS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE GIVEN COMBINED GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH CLAY BINDER BETWEEN 5% AND 12%.

and liquid limit is known as the plastic range and the numerical difference between the liquid and plastic limits is called the Plasticity Index.

It will be appreciated that where the natural water content is in excess of the liquid limit, the soil mass will be most unstable and will readily flow into excavations or trenches. Such considerations will not apply where the soil mass is kept frozen. However, in cases where the frozen soil is allowed to thaw, the relationship between the natural water content and liquid limit becomes critical.

On page 5 there is a chart showing the relationship between the Plasticity Index, the Liquid Limit and the group symbols of the Unified Classification System. The Atterberg Limit system is extremely useful for identifying and classifying soils.

## NOTES ON THE RADFORTH SYSTEM FOR CLASSIFYING PEAT

The Radforth classification system for describing muskeg (organic terrain) is a method for classifying the three elements of vegetation, topography and organic surface cover using letter and figure symbols. Height and type of vegetation is described by using capital letters (A through I). Topography is described by using lower case letters (a through p) Organic cover type if described by using figures (1 through 16).

Table I outlines these figure symbols and the peat structure and type represented by them. A complete description of the Radforth system is contained in "Guide to a Field Description of Muskeg" published by National Research Council, Ottawa, from which has been copied Table I.

TABLE I

SUBSURFACE CONSTITUTION

| Predominant Characteristic | Category | Name |
|---|---|---|
| | 1. | Amorphous-granular peat |
| | 2. | Non-woody, fine-fibrous peat |
| | 3. | Amorphous-granular peat containing woody fine fibres |
| | 4. | Amorphous-granular peat containing woody fine fibres |
| | 5. | Peat, predominantly amorphous-granular, containing non-woody fine fibres, held in a woody, fine fibrous framework. |
| | 6. | Peat, predominantly amorphous-granular containing woody fine fibres, held in a woody, coarse-fibrous framework. |
| | 7. | Alternate layering of non-woody, fine fibrous peat and amorphous-granular peat containing non-woody fine fibres. |
| | 8. | Non-woody, fine-fibrous peat containing a mound of coarse fibres. |
| | 9. | Wood, fine fibrous peat held in a woody, coarse-fibrous framework. |
| | 10. | Woody particles held in a non-woody, fine-fibrous peat. |
| | 11. | Woody and non-woody particles held in fine-fibrous peat. |
| | 12. | Woody, coarse-fibrous peat. |
| | 13. | Coarse fibres criss-crossing fine-fibrous peat. |
| | 14. | Non-woody and woody fine-fibrous peat held in a coarse-fibrous framework. |
| | 15. | Woody mesh of fibres and particles enclosing amorphous-granular peat containing fine fibres. |
| | 16. | Woody, coarse-fibrous peat containing scattered woody chunks. |