Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 30

CALSTOCK AREA

(NTS 42F/NE)

Districts of Algoma and Cochrane

by

D.F. McQuay

1980

Ontario

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CALSTOCK AREA

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by

D.F. McQuay[1]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Calstock area, Districts of Algoma and Cochrane. The area, which covers NTS block 42F/NE, lies between Latitudes 49°30'N and 50°00'N and Longitudes 84°00'W and 85°00'W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km^2 of northern Ontario.

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5083, accompanying this report). The Terrain Conditions for General Construction Map (OGS Map 5086, accompanying this report) is a derived map which illustrates the suitability of the terrain in the Calstock area for such activities as foundation, construction, excavation, and road construction.

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Interpretation of existing black and white aerial photographs, at scales of approximately 1:54 000, was the primary method of obtaining this terrain information. The interpretation was checked with published and unpublished literature which documented previous field visits and observations. During the summer of 1978, roads in the area were traversed and observed terrain conditions recorded as further verification of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common format for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of the terrain data is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed, in preparation), a companion publication to this series of maps, and reports.

2.0 GEOLOGICAL SETTING:

2.1 BEDROCK:

Except for a small expanse of Paleozoic sediments in the northeast corner, the entire map-area is underlain by Early Precambrian rocks. With the exception of comparatively small areas, the bedrock surface is covered by overburden materials of Quaternary age. Where the bedrock is exposed, mainly in the southwestern part of the area, the ground surface is undulating. Bedrock hills seldom reach more than 15 m in height.

Early Precambrian metasedimentary and metavolcanic migmatites underlie most of the map-area, except for the southeast and northwest corners where felsic intrusive rocks predominate. Minor bands of metasediments occur near the northern and southern margins of the area. Small bodies of mafic and ultramafic intrusive rocks are located in McCoig and Fintry Townships. In general, the bedrock in the area is extensively dissected by southeast-and east-northeast-trending Middle to Late Precambrian diabase dikes (Ayres *et al.* 1971; Innes and Ayres 1971).

Springer (1978) has assessed most of the area as having a low mineral potential. The granites and migmatites fall into this category. Small areas of moderate mineral potential are associated with the metasediments.

2.2 QUATERNARY:

Overburden materials occur extensively throughout the area and almost completely cover the bedrock. The drift is mainly composed of level to gently rolling till and glaciolacustrine sediments. As the Wisconsinan ice front retreated to the north, waters of Glacial Lake Barlow-Ojibway inundated the area, and thick sequences of silt, clay, and sand were deposited. Subsequently, a re-advance of the ice sheet covered most of the map-area; resulting in modification of the lacustrine sediments and deposition of ground moraine till. On the Data Base Map (OGS Map 5083, accompanying this report) the glaciolacustrine sediments are shown in blue and the ground moraine in green.

Two large interlobate moraines were deposited, probably during earlier stages of Wisconsinan glaciation. Large eskers are associated with these features, and together they represent significant resources of sand and gravel. Boissonneau (1965, 1966) identified these landforms during his work on the surficial geology of the area.

The level topography over large parts of the areas underlain by till and glaciolacustrine sediments is very poorly drained and has resulted in the formation of extensive but shallow deposits of organic terrain.

3.0 ENGINEERING TERRAIN UNITS:

3.1 BEDROCK LANDFORMS:

3.1.1 Description:

Rock knobs (RN) comprise most of the bedrock terrain units shown on the map (OGS Map 5083, accompanying this report). Bedrock terrain is limited to relatively small areas in the southwestern and eastern parts of the map-area. Relief is low, generally less than 15 m, and the topography is undulating to knobby.

A thin, discontinuous mantle of ground moraine or glaciolacustrine sediments overlies the bedrock. This layer of overburden ranges in thickness from 1 to 3 m and outcrops of bedrock are common. Overburden on sideslopes and in valleys between bedrock hills may reach thicknessess of 3 to 5 m.

A typical symbol depicting this terrain unit is:

$$\frac{\text{RN(smLP,tMG,pOT)}}{\text{Lunw-M}}$$

This indicates that the dominant landform in the area is rock knobs which form undulating terrain with less than 15 m of local relief. The rock and associated till have been modified by wave action in a former glacial lake. This has resulted in deposition of lake plain sediments, mainly silt and sand, which form a subordinate landform unit in association with a stony, silty, sand till ground moraine. Organic terrain, which is commonly found in low areas between bedrock outcrops, results in mixed wet and dry drainage conditions.

3.1.2 Significance:

RESOURCES: The bedrock areas, in general, may have potential for some commercial uses, such as providing sources of crushed stone for aggregate. Suitability for this purpose could only be determined by conducting feasibility studies and detailed quality evaluations of the rock. Ground water will be limited to fractures, fissures, and faults, in the rock. Thus, bedrock terrain is an unpredictable and generally poor source of ground water.

GENERAL CONSTRUCTION: The major constraint in terms of construction is the presence of near-surface bedrock. Poor surface drainage conditions and soft organic soils in the low areas will add futher complications. In most cases, below-ground excavations will require blasting. The rock can be utilized in fills, but grading operations for handling of the material will be expensive. Route alignments will probably require a certain amount of rock cut-and-fill operations; this can be assessed in the initial planning stages by studying topographic maps and aerial photographs. Because the local relief is low (less than 15 m) cut-and-fill for highway construction may be minimized within this terrain. The bearing strength of the rock should provide excellent foundation conditions.

Some of the bedrock areas have steep slope conditions. This, combined with shallow overburden, will generally make development activities more difficult and hence more expensive. Land management in these areas will require special consideration. For example, if the land is cleared of vegetation and not properly treated in a follow-up program, the shallow soils could be highly susceptible to erosion.

WASTE DISPOSAL: In general, the bedrock terrain in its natural state is not amenable to the disposal of waste, whether it be garbage, industrial liquid waste, or septic tank effluent. Construction of lagoons or tile fields may not be feasible in steeply sloping areas, since extensive grading and importation of fill would be required. Fractures in the bedrock could act as conduits for migration of effluents, and impact on surface drainage courses could be significant.

3.2 MORAINAL LANDFORMS:

3.2.1 Description:

Ground moraine (MG) occurs extensively throughout the area and consists mainly of a clay-rich, relatively stone-free till material. As previously discussed, the ground moraine overlying the bedrock in the southwestern part of the map-area is probably bouldery and sandy to silty in texture. Small patches of sandy till were also noted in the vicinity of the large kame moraines and as a shallow veneer overlying parts of the granular kame features. The sandy till surrounding the moraines is probably shallow and overlies glaciolacustrine silt and clay. A sample, collected on Highway 631, showed a grain-size distribution of 37% sand, 52% silt, and 11% clay.

Only occasional small areas of bedrock and shallow soils occur in the clay till unit, suggesting that the overburden may be quite thick. Natural river bank exposures, water well logs, and soil borings also indicate that the overburden is thick, often in excess of 15 m. The clay till itself appears to range in thickness from 1 to 5 m and, in general, is underlain by varved clay and silt. A sample of the till in the east-central part of the map-area consisted of 9% sand, 63% silt and 28% clay.

The surface of the ground moraine is generally level to undulating. In some places, the level topography results in poor drainage conditions which are reflected in surface wetness and shallow organic deposits.

A typical symbol depicting the ground moraine unit is:

$$\frac{\text{tcMG(RN,pOT)}}{\text{Lpu-D}}$$

This indicates that the surficial material is a clay till of ground moraine origin. Occasional rock knob features and areas of organic terrain occur as subordinate units. In areas of poor surface drainage, where the organic terrain may be as important as the till, the terrain is mapped as (tcMG, pOT). The letters (Lpu) indicate that the relief is low (less than 15 m) and the land surface is level to undulating. In general the landform has dry surface drainage conditions.

3.2.2 Significance:

RESOURCES: The ground moraine areas are not considered to have any potential as sources of sand and gravel. However, in a few locations, the mapping indicated the presence of eskers which are buried under 1 to 2 m of clay till. One such feature which is especially noteworthy trends in a southerly direction on the west side of Gull Lake in the northeast corner of the map-area. It probably has significant reserves of sand and gravel in a deposit which reaches a thickness of over 15 m.

The ground moraine is not usually considered a good target area for ground water supplies. An exception to this could occur where the till is thick and underlain by sand and gravel. Conditions of this nature are indicated by water well records near where the Nagagami River crosses Highway 11 in the central part of the map-area.

GENERAL CONSTRUCTION: Construction conditions in the clay till moraine, on average, are considered to be only fair. In wetter parts of this unit, where organic terrain is prevalent, conditions for general construction would be difficult or poor. Within the clay till, there should be few problems with excavations under dry conditions. However, wet weather handling of these materials could be very difficult because of high soil plasticity. Detailed geotechnical investigations are recommended prior to foundation construction because of possible low shear strengths in the till and in the underlying glaciolacustrine silt and clay.

In some locations, where the till forms only a shallow mantle over bedrock (tcMG/R), blasting for underground excavations might be necessary.

WASTE DISPOSAL: The dry and deeper ground moraine deposits represent potential areas for disposal of both solid and liquid wastes. However, as stated before, wet weather handling of the clay tills, when used as cover material, could be a problem. In areas where the water table is not a problem, the clay tills may be highly suitable for lagoon sites. On the other hand, the impermeable nature of the clays may not be suitable for proper operation of septic tile fields. In such a situation, a suitable fill material would have to be imported.

3.3 GLACIOFLUVIAL LANDFORMS:

3.3.1 Description:

Two large *kame moraines* (GK), located in the eastern and southern parts of the area, are prominent on the Data Base Map (OGS Map 5083, accompanying this report). These are considered to be interlobate in origin (Boissonneau 1966), the eastern moraine and part of the western one having been overridden by the last advance of the ice (Cochrane re-advance). The western landform in particular contains an abundance of conical shaped kame hills, while its eastern counterpart has an undulating to rolling surface. The sand and gravel materials of these landforms are deep and exhibit good to excessively good drainage conditions. Shallow pits in the area indicate surficial materials to be gravelly sand that may have some potential as a source of crushed stone. An operating pit on the lower north flank of the western moraine indicates the presence of an excellent crushing source for aggregate that could have extensive reserve possibilities.

A typical cross-section through these features would depict a shallow layer of sandy to gravelly till (1 to 3 m thick) overlying deep stratified gritty sand with some gravel layers. Lenses of silt and till could also be present. Supportive evidence for this is provided by Boissonneau (1966) in his description of a section as consisting of 0.5 m of sandy loam overlying 1 m of bouldery gravel till overlying slightly stony, coarse and medium sand. In some locations, well logs indicate the presence of more than 45 m of sand and gravel overlying bedrock. A typical symbol depicting these landforms is:

$$\frac{\text{sgGK(tMG/GK,pOT)}}{\text{Lupk-D}}$$

This indicates that the sand and gravel kames are the dominant landform and that a shallow layer of ground moraine till may overlie the kame material. Relatively small areas of organic terrain may occupy surface depressions. The landscape has low local relief and the surface is undulating to level and sometimes kettled. The moraines are well drained and dry.

Large *esker* features (>>>>>>>) are associated with the kame moraines. Observations were made in a pit (in use, summer, 1978) in the esker on the south side of Highway 11 at Hart Lake in the east-central part of the area. These observations indicated potentially large reserves of crushable granular material in a deposit which exceeds 25 m in thickness. This same esker feature extends north of the kame moraine where it is partially buried by till. A few small eskers, which reach heights of 5 to 10 m, occur elsewhere in the map-area.

3.3.2 Significance:

RESOURCES: The large eskers associated with the kame moraines possess the best potential for extraction of sand and gravel in the area. Large crushing reserves appear to be available in these features. There is probably good potential for sand and gravel within the kame moraines but, because of variability in materials, more detailed work is required to locate deposits that would be suitable for crushing. In general, the moraines appear to contain very large quantities of medium to coarse sand.

Glaciofluvial landforms possess fair to good ground water potential, based upon existing water well records in the area. As a general rule, the supply of ground water will depend upon the depth and permeability of the granular materials. In some locations, water wells may have to be sunk as much as 50 m before sufficient supplies are found.

GENERAL CONSTRUCTION: General construction activities should encounter few problems within the moraines. Foundation conditions should be adequate for any buildings common to the area, excavations should be easy, and soil materials should have good handling qualities. Earth construction materials are readily accessible.

WASTE DISPOSAL: The disposal of solid and liquid waste, in particular, should be approached with considerable caution. The main concerns regarding the disposal of such wastes are the permeable nature of the soils and the possibility of connection between surface and ground water. Septic systems, if properly designed, should function satisfactorily. Any planned waste disposal schemes in these areas should be preceeded by detailed hydrogeological investigations.

3.4 GLACIOLACUSTRINE LANDFORMS:

3.4.1 Description:

Glaciolacustrine plains (LP) of variable thickness occur mainly in the southwest quadrant and along the southern margin of the map-area. It is believed that these sediments were deposited in Glacial Lake Barlow-Ojibway during the last stages of Wisconsinan deglaciation. Remnant beach scarps marking the shoreline of this former lake are found along the margins of the kame moraine and further west, primarily bordering bedrock highs. The lake sediments are probably thinnest in the vicinity of the bedrock areas and become thicker further north. A gradual change probably occurs in soil texture, from sandy in the area of the beach scarps to varved silt and clay further north.

The flatness of the glaciolacustrine plains has resulted in poor surface drainage conditions. Consequently, extensive areas of shallow organic terrain (up to 1 m in thickness) mask the silt and clay. Spruce bog forests are the most common vegetation type in these areas. A map symbol typical of the lake plain is:

$$\frac{\text{cmsLP,pOT(RN)}}{\text{Lpu-M}}$$

This indicates a glaciolacustrine plain consisting mainly of clay and silt with some sand. These sediments are stratified in thin layers and often the surface is veneered with wet organic terrain. Rock knobs occur occasionally and the topography of the area is of low relief and level to undulating. The poor surface drainage conditions are generally classified as mixed wet and dry. The lake plain soils in the southeastern part of the area are generally well drained and have a dry surface.

3.4.2 Significance:

RESOURCES: The glaciolacustrine deposits have very little aggregate resource potential because of the fine-grained texture of the soils. Where the ancient shoreline features have been identified, there is the possibility of sand and gravel deposits. Most of these beach features are not presently accessible by road. In other map areas, where the beach deposits have been developed, the material tends to have a high sand content and aggregate reserves are small.

Ground water resources are not expected to be plentiful within the glaciolacustrine plains due to the impermeable nature of the sediments.

GENERAL CONSTRUCTION: Because the soils are mainly fine grained with high percentages of silt and clay, construction conditions on the glaciolacustrine plains will be far from ideal. The poor surface drainage conditions add further complications. The main problems for construction in these areas will be:

1) Difficulties in earth-moving operations and subsequent compaction of the silt and clay, especially during wet weather and where surface drainage conditions are poor.

2) Low bearing strengths for footings and foundations in the deep fine-grained soils.

3) Frost susceptible soils which will require special treatment for pavement design and backfill operations.

4) High erodibility of silt and clay on sloping land, that has been cleared.

5) Bank instabilities along rivers and deep man-made ditches.

WASTE DISPOSAL: The poorly drained, relatively impermeable clay soils, in their natural state, provide unsuitable locations for the placement of septic tile beds. In such cases, a suitable fill will have to be imported to construct a proper tile field. These same conditions can present serious problems for the siting of lagoons and sanitary landfills, particularly in terms of construction and possible contamination of surface and ground water resources.

3.5 ORGANIC TERRAIN LANDFORMS:

3.5.1 Description:

Organic terrain (OT) is commonly found on the flat glaciolacustrine and ground moraine landforms and is particularly prevalent on the poorly drained lands in the western half of the map-area. Only the larger deposits, which form dominant terrain units, are shown on the Data Base Map (OGS Map 5083, accompanying this report).

In general, organic terrain is composed of peat (p) and has a water table that is at or near surface. A typical symbol depicting this terrain unit is:

$$\frac{\text{pOT}}{\text{Lp-W}}$$

As indicated in the symbol, the topography is planar or flat with low relief and the ground is wet.

In some of the terrain unit symbols, the wetlands are indicated either as subordinate landforms or as having equal importance with other landforms. For example, the symbol

$$\frac{\text{cmsLP,pOT(RN)}}{\text{Lpu-M}}$$

indicates a poorly drained clay plain with an associated shallow surface layer of organic material. Thicknesses of organic deposits can vary considerably, from less than 1 m overlying glaciolacustrine or till plains to more than 5 m in the deep bogs.

3.5.2 Significance:

The organic landforms have very poor engineering properties for most types of construction activities. They are prone to flooding and contain soft and compressible peat. This could create serious problems for siting buildings, establishing route alignments, or excavation work.

In nature, they serve an important physical function by providing a balance for flow in adjoining streams, particularly between wet and dry seasons. Hence, during construction operations, every attempt should be made to minimize adverse effects on drainage regimes within the wetlands.

4.0 SUMMARY OF ENGINEERING SIGNIFICANCE:

The preceding section described the characteristics of the major landform types and the engineering and resource significance of these units. Table 1 is a summary of the general engineering significance of the more common terrain units found in the area. This table is intended only as a guide to help the reader in assessing the overall significance of the map-units. Site-specific work is necessary to better define actual ground conditions. Also, it must be realized that there are a number of conditions, such as drainage and slope, which are not considered in the table but which may affact the engineering significance of the various terrain units.

TABLE 1 SUMMARY OF ENGINEERING SIGNIFICANCE.

		BEDROCK	MORAINAL		GLACIOFLUVIAL	GLACIOLACUSTRINE		ORGANIC
		RN(tMG,pOT)	tcMG(RN,pOT)	tcMG/R	sgGK	cmsLP,pOT	smLP	pOT
RESOURCE POTENTIAL	Sand & Gravel	Poor	Poor	Poor	Fair to Good	Poor	Poor to Fair	Non-Existent
	Ground Water	Poor	Poor to Fair	Poor	Fair to Good	Poor to Fair	Poor to Fair	Poor
	Excavation	Blasting	Good to Fair	Fair	Good	Poor to Fair	Fair to Good	Poor
CONSTRUCTION CONDITIONS	Foundation	Excellent	Good	Good	Good	Poor	Fair	Poor
	Grading	Difficult	Fair to Good	Fair	Good	Poor	Fair	Very Poor
	Material Re-Use	Rock Fill	Fair	Fair	Excellent	Poor	Fair	Very Poor
WASTE DISPOSAL SUITABILITY	Septic Systems	Very Poor	Fair to Poor	Poor	Good	Poor	Fair	Very Poor
	Landfill	Poor	Fair	Poor	Fair	Poor	Fair	Very Poor
	Lagoons	Poor	Good	Poor	Fair	Poor	Fair	Very Poor

5.0 EXAMPLE OF DERIVED MAP: TERRAIN CONDITIONS FOR GENERAL CONSTRUCTION:

5.1 GENERAL COMMENTS:

The Data Base Map (OGS Map 5083, accompanying this report) contains a technical inventory of terrain conditions which, when analysed, can be used to prepare a variety of land capability maps. For example, this information can be used to derive maps which show areas having potential for sand and gravel deposits, general suitability for septic tank systems, or suitability for preliminary transportation route location. Various types of derived maps are discussed in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed, in preparation).

In this report, the Data Base Map has been analysed to produce a Terrain Conditions for General Construction Map (OGS Map 5086, accompanying this report) for the area. The scope of this type of evaluation should be treated in general terms, consistent with the 1:100 000 scale map base. Thus its purpose is to provide:

1) a framework for regional planning, and

2) a basis for formulating detailed follow-up studies.

5.2 SELECTION CRITERIA:

The main engineering concerns in the development of an area are those related to ground conditions for the siting of building foundations, the digging of excavations for servicing, and the construction of roads. Criteria that should be considered for general construction capability include (1) depth to water table and soil permeabilities as related to dewatering, (2) shallow bedrock that might require blasting in trenches and road cuts, (3) bearing strengths of soils, (4) handling properties of soils, (5) slope conditions, (6) drainage, and (7) availability of construction materials. These criteria have been interpreted from the terrain symbols on the Data Base Map to produce the derived Terrain Conditions for General Construction Map (OGS Map 5086, accompanying this report).

5.3 LAND CAPABILITY UNITS:

Based upon the above criteria, areas that share similar ground conditions have been grouped together. These are shown on the map as five separate units.

5.3.1 **UNIT I**: These areas are underlain by dry, deep granular materials which provide good foundation conditions. The materials can be easily excavated in trenches, and dewatering is not expected to be a problem. Parts of this unit have undulating to hummocky ground conditions, but in general, selection of transportation route alignments can be accomplished with few problems. The materials, with the exception of occasional bouldery areas, should handle easily in earth-moving operations, and abundant supplies of borrow for earth fill are available. Portions of this unit possess good potential for sand and gravel deposits, especially within the esker features. Such conditions exist within the large glaciofluvial kame deposits which are readily accessible from Highways 631 and 11, as well as by numerous connecting forestry roads.

5.3.2 **UNIT II**: The level to gently undulating till plain comprises the bulk of this unit. Although suitable conditions can be expected for normal foundation construction, the fine-grained soils (silt and clay) will be difficult to handle under wet weather conditions. The high plasticity of the soils when wet will create earth-moving and compaction problems. A shallow organic mat (approximately 1 m thick) overlies the clay in the flat, poorly drained parts of this unit. This may not create serious problems for construction, but should be investigated for drainage considerations. In general, excavations should have few difficulties and topography will not be a problem in the selection of route alignments. In some areas, the till unit forms only a thin mantle over the glaciolacustrine clay and silt. This condition may be of particular concern in the wet, low-lying areas. The glaciolacustrine soils, when they are wet, can be unstable in trenches and have low bearing strengths for foundations.

5.3.3 UNIT III: Construction operations in these areas will have to contend with predominantly poorly drained ground underlain by fine silt and clay soils. These conditions will result in low bearing strengths for normal foundations, and potential instability and dewatering problems in trenches. Frost susceptible soils may require special treatment for highway construction. High water table conditions and flooded land pose serious constraints for the location of waste disposal sites and construction of septic tile fields. The level nature of the terrain provides ideal conditions for route alignments. A thin organic mat (up to 1 or 2 m in thickness) commonly occurs as a surface covering in these areas. The organic materials, where they are sufficiently thick, provide poor conditions for most construction activities and should be investigated prior to development.

5.3.4 UNIT IV: This unit includes the larger areas of organic terrain and the alluvial plains. The very poor drainage and flood susceptibility of these lands, combined with the soft, compressible nature of the organic materials, make conditions unsuitable for any type of construction. The materials have low bearing strengths for foundations. The high water table, which is at or near surface, may necessitate dewatering in excavations.

5.3.5 UNIT V: This unit includes areas of bedrock outcrop and those areas where shallow soils mantle the bedrock. The bedrock will create problems for excavations, and highway alignments may require blasting in rock cuts. Local areas may provide suitable sites for the shallow excavations required for septic systems, but detailed evaluations are necessary. The bedrock and associated ground moraine will provide adequate bearing strengths for building structures. However, bedrock outcrops and large boulders may present problems for grading operations.

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(accompanying report)

Map 5083 (coloured) - Northern Ontario Engineering Geology Terrain Study, Data Base Map, Calstock (NTS 42F/NE). Scale 1:100 000.

Map 5086 (coloured) - Northern Ontario Engineering Geology Terrain Study, Terrain Conditions for General Construction Map, Calstock (NTS 42F/NE). Scale 1:100 000.

Northern Ontario
Engineering Geology Terrain Study 30

CALSTOCK AREA

(NTS 42F/NE)

Districts of Algoma and Cochrane

by

D.F. McQuay[1]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Calstock area, Districts of Algoma and Cochrane. The area, which covers NTS block 42F/NE, lies between Latitudes 49°30'N and 50°00'N and Longitudes 84°00'W and 85°00'W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km^2 of northern Ontario.

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5083, accompanying this report). The Terrain Conditions for General Construction Map (OGS Map 5086, accompanying this report) is a derived map which illustrates the suitability of the terrain in the Calstock area for such activities as foundation, construction, excavation, and road construction.

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Interpretation of existing black and white aerial photographs, at scales of approximately 1:54 000, was the primary method of obtaining this terrain information. The interpretation was checked with published and unpublished literature which documented previous field visits and observations. During the summer of 1978, roads in the area were traversed and observed terrain conditions recorded as further verification of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common format for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of the terrain data is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed, in preparation), a companion publication to this series of maps, and reports.

2.0 GEOLOGICAL SETTING:

2.1 BEDROCK:

Except for a small expanse of Paleozoic sediments in the northeast corner, the entire map-area is underlain by Early Precambrian rocks. With the exception of comparatively small areas, the bedrock surface is covered by overburden materials of Quaternary age. Where the bedrock is exposed, mainly in the southwestern part of the area, the ground surface is undulating. Bedrock hills seldom reach more than 15 m in height.

Early Precambrian metasedimentary and metavolcanic migmatites underlie most of the map-area, except for the southeast and northwest corners where felsic intrusive rocks predominate. Minor bands of metasediments occur near the northern and southern margins of the area. Small bodies of mafic and ultramafic intrusive rocks are located in McCoig and Fintry Townships. In general, the bedrock in the area is extensively dissected by southeast-and east-northeast-trending Middle to Late Precambrian diabase dikes (Ayres *et al.* 1971; Innes and Ayres 1971).

Springer (1978) has assessed most of the area as having a low mineral potential. The granites and migmatites fall into this category. Small areas of moderate mineral potential are associated with the metasediments.

2.2 QUATERNARY:

Overburden materials occur extensively throughout the area and almost completely cover the bedrock. The drift is mainly composed of level to gently rolling till and glaciolacustrine sediments. As the Wisconsinan ice front retreated to the north, waters of Glacial Lake Barlow-Ojibway inundated the area, and thick sequences of silt, clay, and sand were deposited. Subsequently, a re-advance of the ice sheet covered most of the map-area; resulting in modification of the lacustrine sediments and deposition of ground moraine till. On the Data Base Map (OGS Map 5083, accompanying this report) the glaciolacustrine sediments are shown in blue and the ground moraine in green.

Two large interlobate moraines were deposited, probably during earlier stages of Wisconsinan glaciation. Large eskers are associated with these features, and together they represent significant resources of sand and gravel. Boissonneau (1965, 1966) identified these landforms during his work on the surficial geology of the area.

The level topography over large parts of the areas underlain by till and glaciolacustrine sediments is very poorly drained and has resulted in the formation of extensive but shallow deposits of organic terrain.

3.0 ENGINEERING TERRAIN UNITS:

3.1 BEDROCK LANDFORMS:

3.1.1 Description:

Rock knobs (RN) comprise most of the bedrock terrain units shown on the map (OGS Map 5083, accompanying this report). Bedrock terrain is limited to relatively small areas in the southwestern and eastern parts of the map-area. Relief is low, generally less than 15 m, and the topography is undulating to knobby.

A thin, discontinuous mantle of ground moraine or glaciolacustrine sediments overlies the bedrock. This layer of overburden ranges in thickness from 1 to 3 m and outcrops of bedrock are common. Overburden on sideslopes and in valleys between bedrock hills may reach thicknessess of 3 to 5 m.

A typical symbol depicting this terrain unit is:

$$\frac{\text{RN(smLP,tMG,pOT)}}{\text{Lunw-M}}$$

This indicates that the dominant landform in the area is rock knobs which form undulating terrain with less than 15 m of local relief. The rock and associated till have been modified by wave action in a former glacial lake. This has resulted in deposition of lake plain sediments, mainly silt and sand, which form a subordinate landform unit in association with a stony, silty, sand till ground moraine. Organic terrain, which is commonly found in low areas between bedrock outcrops, results in mixed wet and dry drainage conditions.

3.1.2 Significance:

RESOURCES: The bedrock areas, in general, may have potential for some commercial uses, such as providing sources of crushed stone for aggregate. Suitability for this purpose could only be determined by conducting feasibility studies and detailed quality evaluations of the rock. Ground water will be limited to fractures, fissures, and faults, in the rock. Thus, bedrock terrain is an unpredictable and generally poor source of ground water.

GENERAL CONSTRUCTION: The major constraint in terms of construction is the presence of near-surface bedrock. Poor surface drainage conditions and soft organic soils in the low areas will add futher complications. In most cases, below-ground excavations will require blasting. The rock can be utilized in fills, but grading operations for handling of the material will be expensive. Route alignments will probably require a certain amount of rock cut-and-fill operations; this can be assessed in the initial planning stages by studying topographic maps and aerial photographs. Because the local relief is low (less than 15 m) cut-and-fill for highway construction may be minimized within this terrain. The bearing strength of the rock should provide excellent foundation conditions.

Some of the bedrock areas have steep slope conditions. This, combined with shallow overburden, will generally make development activities more difficult and hence more expensive. Land management in these areas will require special consideration. For example, if the land is cleared of vegetation and not properly treated in a follow-up program, the shallow soils could be highly susceptible to erosion.

WASTE DISPOSAL: In general, the bedrock terrain in its natural state is not amenable to the disposal of waste, whether it be garbage, industrial liquid waste, or septic tank effluent. Construction of lagoons or tile fields may not be feasible in steeply sloping areas, since extensive grading and importation of fill would be required. Fractures in the bedrock could act as conduits for migration of effluents, and impact on surface drainage courses could be significant.

3.2 MORAINAL LANDFORMS:

3.2.1 Description:

Ground moraine (MG) occurs extensively throughout the area and consists mainly of a clay-rich, relatively stone-free till material. As previously discussed, the ground moraine overlying the bedrock in the southwestern part of the map-area is probably bouldery and sandy to silty in texture. Small patches of sandy till were also noted in the vicinity of the large kame moraines and as a shallow veneer overlying parts of the granular kame features. The sandy till surrounding the moraines is probably shallow and overlies glaciolacustrine silt and clay. A sample, collected on Highway 631, showed a grain-size distribution of 37% sand, 52% silt, and 11% clay.

Only occasional small areas of bedrock and shallow soils occur in the clay till unit, suggesting that the overburden may be quite thick. Natural river bank exposures, water well logs, and soil borings also indicate that the overburden is thick, often in excess of 15 m. The clay till itself appears to range in thickness from 1 to 5 m and, in general, is underlain by varved clay and silt. A sample of the till in the east-central part of the map-area consisted of 9% sand, 63% silt and 28% clay.

The surface of the ground moraine is generally level to undulating. In some places, the level topography results in poor drainage conditions which are reflected in surface wetness and shallow organic deposits.

A typical symbol depicting the ground moraine unit is:

$$\frac{\text{tcMG(RN,pOT)}}{\text{Lpu-D}}$$

This indicates that the surficial material is a clay till of ground moraine origin. Occasional rock knob features and areas of organic terrain occur as subordinate units. In areas of poor surface drainage, where the organic terrain may be as important as the till, the terrain is mapped as (tcMG, pOT). The letters (Lpu) indicate that the relief is low (less than 15 m) and the land surface is level to undulating. In general the landform has dry surface drainage conditions.

3.2.2 Significance:

RESOURCES: The ground moraine areas are not considered to have any potential as sources of sand and gravel. However, in a few locations, the mapping indicated the presence of eskers which are buried under 1 to 2 m of clay till. One such feature which is especially noteworthy trends in a southerly direction on the west side of Gull Lake in the northeast corner of the map-area. It probably has significant reserves of sand and gravel in a deposit which reaches a thickness of over 15 m.

The ground moraine is not usually considered a good target area for ground water supplies. An exception to this could occur where the till is thick and underlain by sand and gravel. Conditions of this nature are indicated by water well records near where the Nagagami River crosses Highway 11 in the central part of the map-area.

GENERAL CONSTRUCTION: Construction conditions in the clay till moraine, on average, are considered to be only fair. In wetter parts of this unit, where organic terrain is prevalent, conditions for general construction would be difficult or poor. Within the clay till, there should be few problems with excavations under dry conditions. However, wet weather handling of these materials could be very difficult because of high soil plasticity. Detailed geotechnical investigations are recommended prior to foundation construction because of possible low shear strengths in the till and in the underlying glaciolacustrine silt and clay.

In some locations, where the till forms only a shallow mantle over bedrock (tcMG/R), blasting for underground excavations might be necessary.

WASTE DISPOSAL: The dry and deeper ground moraine deposits represent potential areas for disposal of both solid and liquid wastes. However, as stated before, wet weather handling of the clay tills, when used as cover material, could be a problem. In areas where the water table is not a problem, the clay tills may be highly suitable for lagoon sites. On the other hand, the impermeable nature of the clays may not be suitable for proper operation of septic tile fields. In such a situation, a suitable fill material would have to be imported.

3.3 GLACIOFLUVIAL LANDFORMS:

3.3.1 Description:

Two large *kame moraines* (GK), located in the eastern and southern parts of the area, are prominent on the Data Base Map (OGS Map 5083, accompanying this report). These are considered to be interlobate in origin (Boissonneau 1966), the eastern moraine and part of the western one having been overridden by the last advance of the ice (Cochrane re-advance). The western landform in particular contains an abundance of conical shaped kame hills, while its eastern counterpart has an undulating to rolling surface. The sand and gravel materials of these landforms are deep and exhibit good to excessively good drainage conditions. Shallow pits in the area indicate surficial materials to be gravelly sand that may have some potential as a source of crushed stone. An operating pit on the lower north flank of the western moraine indicates the presence of an excellent crushing source for aggregate that could have extensive reserve possibilities.

A typical cross-section through these features would depict a shallow layer of sandy to gravelly till (1 to 3 m thick) overlying deep stratified gritty sand with some gravel layers. Lenses of silt and till could also be present. Supportive evidence for this is provided by Boissonneau (1966) in his description of a section as consisting of 0.5 m of sandy loam overlying 1 m of bouldery gravel till overlying slightly stony, coarse and medium sand. In some locations, well logs indicate the presence of more than 45 m of sand and gravel overlying bedrock. A typical symbol depicting these landforms is:

$$\frac{\text{sgGK(tMG/GK,pOT)}}{\text{Lupk-D}}$$

This indicates that the sand and gravel kames are the dominant landform and that a shallow layer of ground moraine till may overlie the kame material. Relatively small areas of organic terrain may occupy surface depressions. The landscape has low local relief and the surface is undulating to level and sometimes kettled. The moraines are well drained and dry.

Large *esker* features (>>>>>>>) are associated with the kame moraines. Observations were made in a pit (in use, summer, 1978) in the esker on the south side of Highway 11 at Hart Lake in the east-central part of the area. These observations indicated potentially large reserves of crushable granular material in a deposit which exceeds 25 m in thickness. This same esker feature extends north of the kame moraine where it is partially buried by till. A few small eskers, which reach heights of 5 to 10 m, occur elsewhere in the map-area.

3.3.2 Significance:

RESOURCES: The large eskers associated with the kame moraines possess the best potential for extraction of sand and gravel in the area. Large crushing reserves appear to be available in these features. There is probably good potential for sand and gravel within the kame moraines but, because of variability in materials, more detailed work is required to locate deposits that would be suitable for crushing. In general, the moraines appear to contain very large quantities of medium to coarse sand.

Glaciofluvial landforms possess fair to good ground water potential, based upon existing water well records in the area. As a general rule, the supply of ground water will depend upon the depth and permeability of the granular materials. In some locations, water wells may have to be sunk as much as 50 m before sufficient supplies are found.

GENERAL CONSTRUCTION: General construction activities should encounter few problems within the moraines. Foundation conditions should be adequate for any buildings common to the area, excavations should be easy, and soil materials should have good handling qualities. Earth construction materials are readily accessible.

WASTE DISPOSAL: The disposal of solid and liquid waste, in particular, should be approached with considerable caution. The main concerns regarding the disposal of such wastes are the permeable nature of the soils and the possibility of connection between surface and ground water. Septic systems, if properly designed, should function satisfactorily. Any planned waste disposal schemes in these areas should be preceeded by detailed hydrogeological investigations.

3.4 GLACIOLACUSTRINE LANDFORMS:

3.4.1 Description:

Glaciolacustrine plains (LP) of variable thickness occur mainly in the southwest quadrant and along the southern margin of the map-area. It is believed that these sediments were deposited in Glacial Lake Barlow-Ojibway during the last stages of Wisconsinan deglaciation. Remnant beach scarps marking the shoreline of this former lake are found along the margins of the kame moraine and further west, primarily bordering bedrock highs. The lake sediments are probably thinnest in the vicinity of the bedrock areas and become thicker further north. A gradual change probably occurs in soil texture, from sandy in the area of the beach scarps to varved silt and clay further north.

The flatness of the glaciolacustrine plains has resulted in poor surface drainage conditions. Consequently, extensive areas of shallow organic terrain (up to 1 m in thickness) mask the silt and clay. Spruce bog forests are the most common vegetation type in these areas. A map symbol typical of the lake plain is:

$$\frac{\text{cmsLP,pOT(RN)}}{\text{Lpu-M}}$$

This indicates a glaciolacustrine plain consisting mainly of clay and silt with some sand. These sediments are stratified in thin layers and often the surface is veneered with wet organic terrain. Rock knobs occur occasionally and the topography of the area is of low relief and level to undulating. The poor surface drainage conditions are generally classified as mixed wet and dry. The lake plain soils in the southeastern part of the area are generally well drained and have a dry surface.

3.4.2 Significance:

RESOURCES: The glaciolacustrine deposits have very little aggregate resource potential because of the fine-grained texture of the soils. Where the ancient shoreline features have been identified, there is the possibility of sand and gravel deposits. Most of these beach features are not presently accessible by road. In other map areas, where the beach deposits have been developed, the material tends to have a high sand content and aggregate reserves are small.

Ground water resources are not expected to be plentiful within the glaciolacustrine plains due to the impermeable nature of the sediments.

GENERAL CONSTRUCTION: Because the soils are mainly fine grained with high percentages of silt and clay, construction conditions on the glaciolacustrine plains will be far from ideal. The poor surface drainage conditions add further complications. The main problems for construction in these areas will be:

1) Difficulties in earth-moving operations and subsequent compaction of the silt and clay, especially during wet weather and where surface drainage conditions are poor.

2) Low bearing strengths for footings and foundations in the deep fine-grained soils.

3) Frost susceptible soils which will require special treatment for pavement design and backfill operations.

4) High erodibility of silt and clay on sloping land, that has been cleared.

5) Bank instabilities along rivers and deep man-made ditches.

WASTE DISPOSAL: The poorly drained, relatively impermeable clay soils, in their natural state, provide unsuitable locations for the placement of septic tile beds. In such cases, a suitable fill will have to be imported to construct a proper tile field. These same conditions can present serious problems for the siting of lagoons and sanitary landfills, particularly in terms of construction and possible contamination of surface and ground water resources.

3.5 ORGANIC TERRAIN LANDFORMS:

3.5.1 Description:

Organic terrain (OT) is commonly found on the flat glaciolacustrine and ground moraine landforms and is particularly prevalent on the poorly drained lands in the western half of the map-area. Only the larger deposits, which form dominant terrain units, are shown on the Data Base Map (OGS Map 5083, accompanying this report).

In general, organic terrain is composed of peat (p) and has a water table that is at or near surface. A typical symbol depicting this terrain unit is:

$$\frac{\text{pOT}}{\text{Lp-W}}$$

As indicated in the symbol, the topography is planar or flat with low relief and the ground is wet.

In some of the terrain unit symbols, the wetlands are indicated either as subordinate landforms or as having equal importance with other landforms. For example, the symbol

$$\frac{\text{cmsLP,pOT(RN)}}{\text{Lpu-M}}$$

indicates a poorly drained clay plain with an associated shallow surface layer of organic material. Thicknesses of organic deposits can vary considerably, from less than 1 m overlying glaciolacustrine or till plains to more than 5 m in the deep bogs.

3.5.2 Significance:

The organic landforms have very poor engineering properties for most types of construction activities. They are prone to flooding and contain soft and compressible peat. This could create serious problems for siting buildings, establishing route alignments, or excavation work.

In nature, they serve an important physical function by providing a balance for flow in adjoining streams, particularly between wet and dry seasons. Hence, during construction operations, every attempt should be made to minimize adverse effects on drainage regimes within the wetlands.

4.0 SUMMARY OF ENGINEERING SIGNIFICANCE:

The preceding section described the characteristics of the major landform types and the engineering and resource significance of these units. Table 1 is a summary of the general engineering significance of the more common terrain units found in the area. This table is intended only as a guide to help the reader in assessing the overall significance of the map-units. Site-specific work is necessary to better define actual ground conditions. Also, it must be realized that there are a number of conditions, such as drainage and slope, which are not considered in the table but which may affact the engineering significance of the various terrain units.

TABLE 1 SUMMARY OF ENGINEERING SIGNIFICANCE.

		BEDROCK	MORAINAL		GLACIOFLUVIAL	GLACIOLACUSTRINE		ORGANIC
		RN(tMG,pOT)	tcMG(RN,pOT)	tcMG/R	sgGK	cmsLP,pOT	smLP	pOT
RESOURCE POTENTIAL	Sand & Gravel	Poor	Poor	Poor	Fair to Good	Poor	Poor to Fair	Non-Existent
	Ground Water	Poor	Poor to Fair	Poor	Fair to Good	Poor to Fair	Poor to Fair	Poor
	Excavation	Blasting	Good to Fair	Fair	Good	Poor to Fair	Fair to Good	Poor
CONSTRUCTION CONDITIONS	Foundation	Excellent	Good	Good	Good	Poor	Fair	Poor
	Grading	Difficult	Fair to Good	Fair	Good	Poor	Fair	Very Poor
	Material Re-Use	Rock Fill	Fair	Fair	Excellent	Poor	Fair	Very Poor
WASTE DISPOSAL SUITABILITY	Septic Systems	Very Poor	Fair to Poor	Poor	Good	Poor	Fair	Very Poor
	Landfill	Poor	Fair	Poor	Fair	Poor	Fair	Very Poor
	Lagoons	Poor	Good	Poor	Fair	Poor	Fair	Very Poor

5.0 EXAMPLE OF DERIVED MAP: TERRAIN CONDITIONS FOR GENERAL CONSTRUCTION:

5.1 GENERAL COMMENTS:

The Data Base Map (OGS Map 5083, accompanying this report) contains a technical inventory of terrain conditions which, when analysed, can be used to prepare a variety of land capability maps. For example, this information can be used to derive maps which show areas having potential for sand and gravel deposits, general suitability for septic tank systems, or suitability for preliminary transportation route location. Various types of derived maps are discussed in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed, in preparation).

In this report, the Data Base Map has been analysed to produce a Terrain Conditions for General Construction Map (OGS Map 5086, accompanying this report) for the area. The scope of this type of evaluation should be treated in general terms, consistent with the 1:100 000 scale map base. Thus its purpose is to provide:

1) a framework for regional planning, and

2) a basis for formulating detailed follow-up studies.

5.2 SELECTION CRITERIA:

The main engineering concerns in the development of an area are those related to ground conditions for the siting of building foundations, the digging of excavations for servicing, and the construction of roads. Criteria that should be considered for general construction capability include (1) depth to water table and soil permeabilities as related to dewatering, (2) shallow bedrock that might require blasting in trenches and road cuts, (3) bearing strengths of soils, (4) handling properties of soils, (5) slope conditions, (6) drainage, and (7) availability of construction materials. These criteria have been interpreted from the terrain symbols on the Data Base Map to produce the derived Terrain Conditions for General Construction Map (OGS Map 5086, accompanying this report).

5.3 LAND CAPABILITY UNITS:

Based upon the above criteria, areas that share similar ground conditions have been grouped together. These are shown on the map as five separate units.

5.3.1 UNIT I: These areas are underlain by dry, deep granular materials which provide good foundation conditions. The materials can be easily excavated in trenches, and dewatering is not expected to be a problem. Parts of this unit have undulating to hummocky ground conditions, but in general, selection of transportation route alignments can be accomplished with few problems. The materials, with the exception of occasional bouldery areas, should handle easily in earth-moving operations, and abundant supplies of borrow for earth fill are available. Portions of this unit possess good potential for sand and gravel deposits, especially within the esker features. Such conditions exist within the large glaciofluvial kame deposits which are readily accessible from Highways 631 and 11, as well as by numerous connecting forestry roads.

5.3.2 UNIT II: The level to gently undulating till plain comprises the bulk of this unit. Although suitable conditions can be expected for normal foundation construction, the fine-grained soils (silt and clay) will be difficult to handle under wet weather conditions. The high plasticity of the soils when wet will create earth-moving and compaction problems. A shallow organic mat (approximately 1 m thick) overlies the clay in the flat, poorly drained parts of this unit. This may not create serious problems for construction, but should be investigated for drainage considerations. In general, excavations should have few difficulties and topography will not be a problem in the selection of route alignments. In some areas, the till unit forms only a thin mantle over the glaciolacustrine clay and silt. This condition may be of particular concern in the wet, low-lying areas. The glaciolacustrine soils, when they are wet, can be unstable in trenches and have low bearing strengths for foundations.

5.3.3 UNIT III: Construction operations in these areas will have to contend with predominantly poorly drained ground underlain by fine silt and clay soils. These conditions will result in low bearing strengths for normal foundations, and potential instability and dewatering problems in trenches. Frost susceptible soils may require special treatment for highway construction. High water table conditions and flooded land pose serious constraints for the location of waste disposal sites and construction of septic tile fields. The level nature of the terrain provides ideal conditions for route alignments. A thin organic mat (up to 1 or 2 m in thickness) commonly occurs as a surface covering in these areas. The organic materials, where they are sufficiently thick, provide poor conditions for most construction activities and should be investigated prior to development.

5.3.4 UNIT IV: This unit includes the larger areas of organic terrain and the alluvial plains. The very poor drainage and flood susceptibility of these lands, combined with the soft, compressible nature of the organic materials, make conditions unsuitable for any type of construction. The materials have low bearing strengths for foundations. The high water table, which is at or near surface, may necessitate dewatering in excavations.

5.3.5 UNIT V: This unit includes areas of bedrock outcrop and those areas where shallow soils mantle the bedrock. The bedrock will create problems for excavations, and highway alignments may require blasting in rock cuts. Local areas may provide suitable sites for the shallow excavations required for septic systems, but detailed evaluations are necessary. The bedrock and associated ground moraine will provide adequate bearing strengths for building structures. However, bedrock outcrops and large boulders may present problems for grading operations.

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42F-4	Highway 11-Angelina Creek
42F-7	Near Highway 11-Nagagami River
42F-8	Near Highway 11-Nagagami River
42F-9	Highway 11-Shekak River

Strip Map Index, Materials and Testing Division, Contract No.

68-508	Highway 11
69-505	Highway 11
69-621	Highway 11
70-591	Highway 11
74-68	Highways 11 and 583
75-310	Highway 631
78-352	Highway 583
78-529	Highway 631

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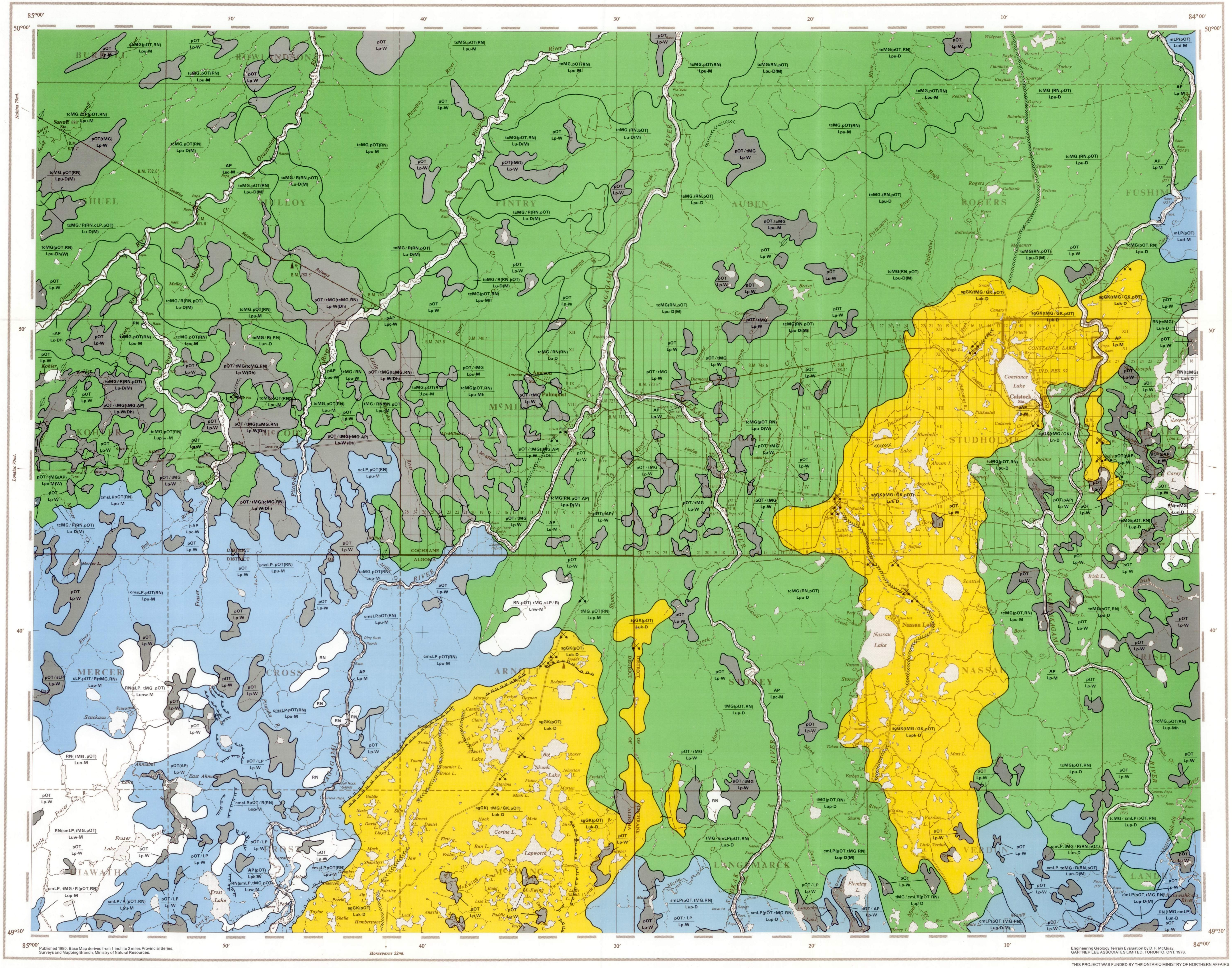

Published 1980. Base Map derived from 1 inch to 2 miles Provincial Series, Surveys and Mapping Branch, Ministry of Natural Resources.

Engineering Geology Terrain Evaluation by D. F. McQuay, GARTNER LEE ASSOCIATES LIMITED, TORONTO, ONT. 1978.

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Ministry of Natural Resources
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Hon. James A. C. Auld
Minister
Dr. J. K. Reynolds
Deputy Minister

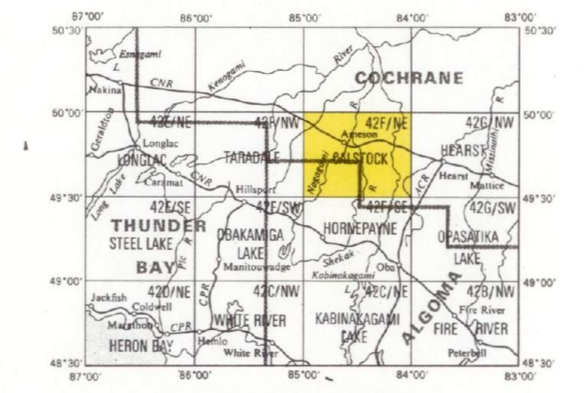
Ontario Geological Survey

Map 5083
CALSTOCK

NTS 42 F/NE

Data Base Map

Northern Ontario Engineering Geology Terrain Study



INDEX TO ADJOINING SHEETS

1:100 000

2 1 0 2 4 6

One centimetre represents one kilometre

LEGEND

LANDFORM

MORAINAL

- **ME** *End moraine*
- **MG** *Ground moraine*
- **MH** *Hummocky moraine*

GLACIOFLUVIAL

- **GD** *Ice contact delta, esker delta, kame delta, delta moraine*
- **GE** *Esker, esker complex, crevasse filling*
- **GK** *Kame, kame field, kame terrace, kame moraine*
- **GO** *Outwash plain, valley train*

GLACIOLACUSTRINE

- **LB** *Raised (abandoned) beach form*
- **LD** *Glaciolacustrine delta*
- **LP** *Glaciolacustrine plain*

ALLUVIAL

- **AP** *Alluvial plain*

COLLUVIAL

- **CS** *Slope failure*
- **CT** *Talus pile*
- **CW** *Slopewash and debris creep sheet; minor talus*

EOLIAN

- **ED** *Sand dunes*

ORGANIC

- **OT** *Organic terrain*

BEDROCK

- **RL** *Bedrock plateau*
- **RN** *Bedrock knob*
- **RP** *Bedrock plain*
- **RR** *Bedrock ridge*
- **/R** *Bedrock below a drift veneer*

MATERIAL

- **b** *boulders, bouldery*
- **c** *clay, clayey*
- **g** *gravel, gravelly*
- **p** *peat, muck*
- **r** *rubble*
- **s** *sand, sandy*
- **m** *silt, silty*
- **t** *till*

TOPOGRAPHY

LOCAL RELIEF

- **H** *Mainly high local relief*
- **M** *Mainly moderate local relief*
- **L** *Mainly low local relief*

VARIETY

- **c** *channelled*
- **d** *dissected, gullied*
- **j** *jagged, rugged, cliffed*
- **j*** *cliffed volcanic rock signature*
- **k** *kettled, pitted*
- **n** *knobby, hummocky*
- **p** *plain*
- **r** *ridged*
- **s** *sloping*
- **t** *terraced*
- **u** *undulating to rolling*
- **w** *washed, reworked*

DRAINAGE

SURFACE CONDITION

- **W** *Wet*
- **D** *Dry*
- **M** *Mixed wet and dry*
- **h** *Suspected high water table*

The letter codes describing the terrain units are made up of four components arranged as follows: –

MATERIAL	LANDFORM
TOPOGRAPHY	DRAINAGE

Examples:

1. **tMG(RN)** / **Mu(Hj)-D** — material; dominant landform; subordinate landform; drainage; relief of subordinate landform; topographic variety of dominant landform; local relief

2. **pOT/sGO** / **Lp-W** — slash indicates a veneer of one landform overlying a second landform

SYMBOLS

- *Significant end moraine or linear moraine-like feature*
- *Well expressed drumlins and drumlinoid ridges*
- *All other linear ice-flow features*
- *Esker ridge (continuous, discontinuous; the symbol does not indicate direction of flow)*
- *Abandoned shoreline (continuous, discontinuous)*
- *Local dune area (type and location of individual dunes not indicated)*
- *Abandoned river channel, spillway, or ice marginal channels*
- *Escarpment*
- ●10 *Sample location*
- *Small landslide scar*
- *Sand or gravel pit*
- *Quarry or mine workings evident from airphotos or field observation (crossed picks are shown in the area of open excavation)*
- *Other man-made features (rock dumps, tailings, lagoons, landfills, etc.: type of feature mentioned where identifiable)*
- *Steep-walled valleys, often bedrock-controlled features*
- *Talus (defined, inferred; base of talus triangle indicates downslope side of escarpment)*
- *Line joining the same terrain units*

NOTE 1:

This map is intended to be an inventory of regional engineering terrain conditions, as determined largely by airphoto interpretation. Its purpose is to provide a guide for engineering and resource planning functions. The boundaries of the terrain units shown on the map are approximate only, consistent with a 1:100 000 scale. Site specific investigations are required in order to obtain detailed information for a particular area. The map user should refer to the accompanying report for a fuller description of terrain in the study area.

NOTE 2:

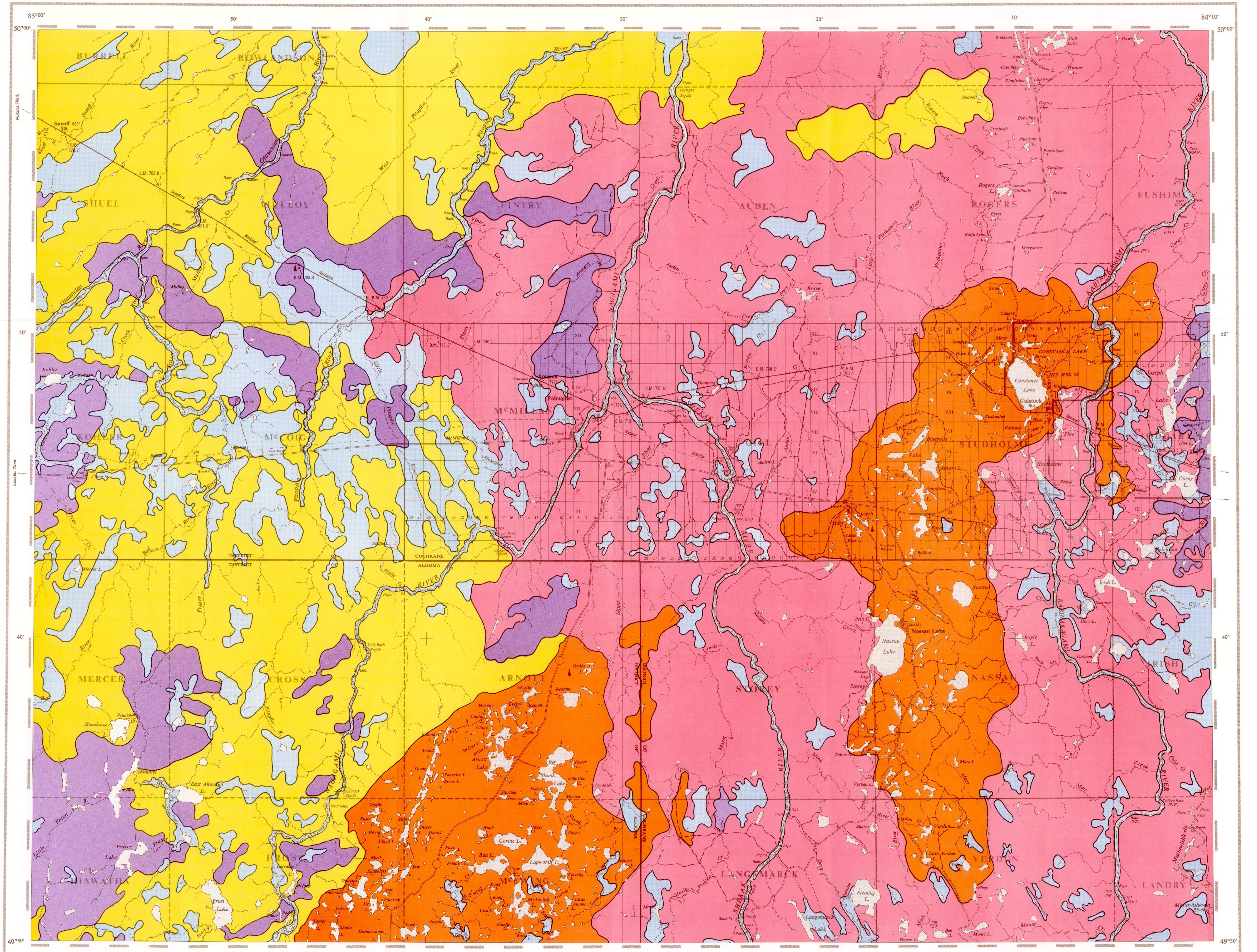
Colour is used to enhance what is considered to be the dominant engineering condition in simple, complex or layered terrain units.

NOTE 3:

Not all letter and graphic symbols shown in the legend necessarily appear on this map sheet.

Information from this publication may be quoted if appropriate credit is given.
Reference to this map is recommended as follows:

McQuay D. F.
1980: Northern Ontario Engineering Geology Terrain Study, Data Base Map, Calstock
Ontario Geological Survey, Map 5083, Scale 1:100 000



Published 1980. Base Map derived from 1 inch to 2 miles Provincial Series, Surveys and Mapping Branch, Ministry of Natural Resources.

Engineering Geology Terrain Evaluation by D. F. McQuay, GARTNER LEE ASSOCIATES LIMITED, TORONTO, ONT. 1978.

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Minister
Dr. J. K. Reynolds
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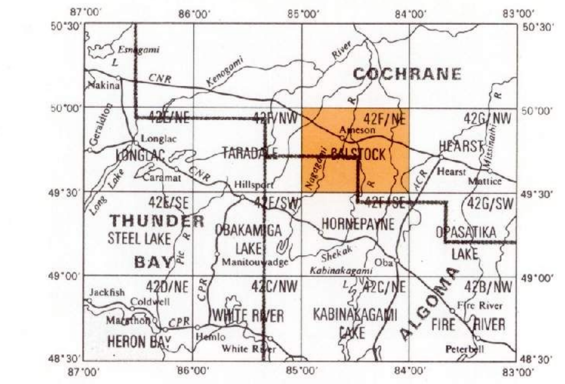
Ontario Geological Survey

Map 5086
CALSTOCK

NTS 42F/NE

Terrain Conditions for General Construction

Northern Ontario Engineering Geology Terrain Study



INDEX TO ADJOINING SHEETS

1:100 000

2 1 0 2 4 6

One centimetre represents one kilometre

LEGEND

(orange)	*Dry, deep, granular materials with a level to undulating surface. Should provide good conditions for foundations, excavations, highway alignment, and development of septic tile fields. Good potential sites for sand and gravel, and development of ground water supplies.*
(pink)	*Areas of generally dry, fine-grained soils with a level to undulating surface. Should provide adequate conditions for foundations and excavations. Wet weather handling and possible frost susceptibility of soils may create problems in highway construction and performance. Fair to good potential for waste disposal.*
(yellow)	*Areas of fine-grained soils interspersed with wet, peaty soils having level to undulating surface and poor surface drainage conditions. Will create problems for most construction practices. Materials may possess low strengths for foundations, are susceptible to frost action and have poor material handling in wet weather. Poor drainage and high water table conditions are potentially serious constraints for waste disposal and development of septic systems.*
(light blue)	*Areas of very poor drainage with soft, wet peaty materials, level surface, and water tables at or near ground surface. Represents poor conditions for all types of construction. Soils have low bearing strengths, are highly compressible and are not suitable for septic tile fields. These areas should be avoided wherever possible. Mainly includes organic terrain and alluvial plains.*
(purple)	*Areas of rock outcrop and shallow soils over rock with a knobby and undulating surface. Will present difficult conditions for excavations. Highway alignments may require blasting. Foundation conditions should be good, but large boulders and bedrock outcrops may create problems for grading works.*

NOTE: Refer to accompanying engineering terrain data map and text for details in specific areas.

McQuay, D. F.

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