

P. MACHIBRODA ENGINEERING LTD.

QUATERNARY GEOLOGY OF THE
SOUTHEND AREA, REINDEER LAKE,
SASKATCHEWAN

Report 0052-002 November 4, 1980

E. A. Christiansen Consulting Ltd.

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November 4, 1980

P. Machibroda Engineering Ltd.
2331 Millar Avenue
Saskatoon, Saskatchewan

Attention: Mr. P. Machibroda

Dear Mr. Machibroda:

Enclosed are eight copies of Report 0052-002 on the "Quaternary geology of the Southend area, Reindeer Lake, Saskatchewan".

Sincerely yours,

E. A. Christiansen

E.A. Christiansen



Old Settlement (left) and New Settlement (right), Southend separated by channel draining Reindeer Lake.



New Settlement of Southend on shores of Numabin Bay, Reindeer Lake. Photographs by P. Machibroda.

SUMMARY

The Southend area is underlain in ascending order by:

- (1) metamorphic, volcanic, and intrusive rocks which crop out in the Old Settlement and in the ridges west and east of the channel.
- (2) Lower Gravel, the base of which was not penetrated and which may be an excellent aquifer.
- (3) Lower Sand, more than 8.5 m thick which is highly susceptible to fluvial erosion and which may be an aquifer if thick enough.
- (4) 0 to 4 m of impervious Silt and Clay deposited in glacial Lake Agassiz.
- (5) 0 to 1 m of silty Till deposited during the glacial re-advance to the Cree Lake Moraine about 10,000 years ago.
- (6) 0 to 4.3 m of Upper Gravel which was used as grade material in the road and causeway fills.
- (7) 0 to 8+ m of fine-grained sand deposited in glacial Reindeer Lake.

LIMITATION

Except at sample sites where geologic logs are available, the geologic contacts are inferred and represent geologic models that are believed to best fit the information. Bedrock, which is the base of exploration for this study, was believed to have been penetrated in only 4 of the 17 augerholes. To obtain a proper evaluation of the nature of the surficial deposits, 10 additional testholes, drilled about 3 m into bedrock, are proposed.

RESPONSIBILITY

The geologist is responsible for defining the geologic units, processes, origin, and history, whereas the geotechnical engineer is responsible for determining the engineering properties and defining the dimensions of the earth materials to the scale relevant to the engineering analyses required for the intended use.

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1. INTRODUCTION

1.1 Objective

The objective of this study was to provide a geologic framework of the Southend area for P. Machibroda Engineering Ltd. who commissioned this investigation.

1.2 Location

The Southend area, which is at the south end of Reindeer Lake, comprises the Old Settlement on Big Island and the New Settlement on the west side of the "channel" (Drawing 0052-002-01; Figs. 1,2). Southend is served from La Ronge by Highway 102.

1.3 Previous Work

The surficial deposits were studied by Schreiner *et al.* (1976) who dug 5 shallow holes into these deposits in the Southend area. The surficial deposits were also investigated by J.D. Mollard and Associates Limited (1978) who conducted an aerial photo-reconnaissance of the Southend Indian Reserve. The bedrock deposits were studied most recently by Johnston (1979).

1.4 Present Study

Between August 28 and 30, 1980, 14 augerholes were drilled (Fig. 3) and sampled in the Southend area under supervision of E.A. Christiansen and P. Machibroda (EAC - 1 to 14, Drawing 0052-002-01). Geologic logs from these augerholes and augerholes EAC - 15 and PM - 15 and 35 along with two exposures (EAC - 16,17) form the information base for this study (Appendix 1).



Figure 1. Old Settlement, Southend, Reindeer Lake. Notice bedrock outcrops in right foreground and between houses and Numabin Bay of Reindeer Lake slightly to the right of centre of the photograph. Notice also glacial deposits in road cut in left-centre of photograph.



Figure 2. New Settlement, Southend, nestled between a rock ridge to the west and the channel draining Reindeer Lake to the east. Houses are built on silty Till overlying varved Silt and Clay deposited in glacial Lake Agassiz. See Drawing 0052-002-01 for location of the New Settlement.

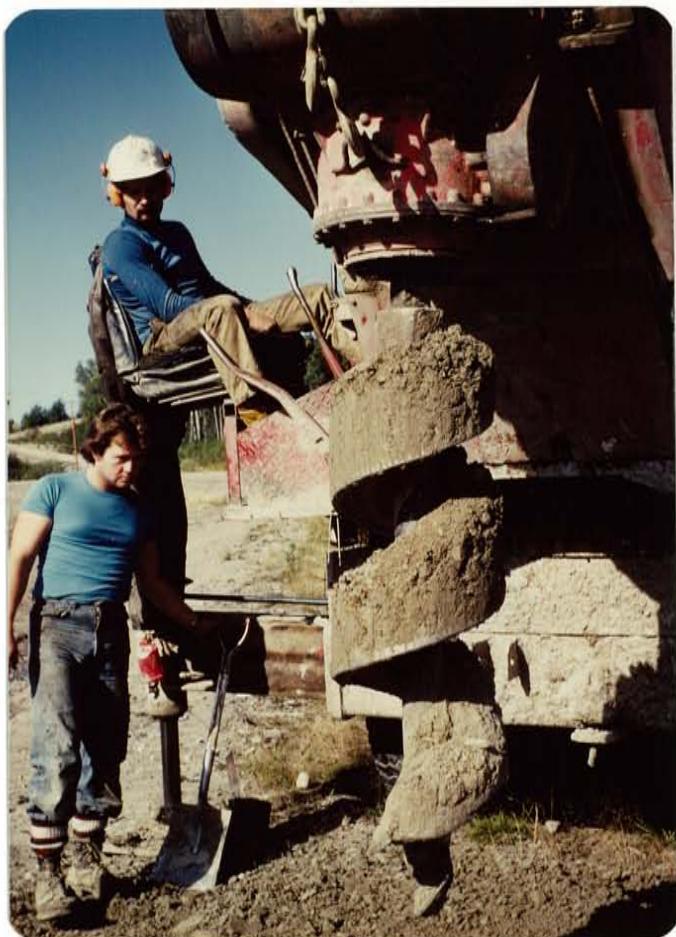


Figure 3. Williams MF power auger drilling EAC - 12 (Drawing 0052-002-01).
The augering equipment is owned and operated by P. Machibroda
Engineering Ltd. who supplied the samples and field logs.

To interpret the information provided by these augerholes and exposures, three cross sections were drawn (Drawing 0052-002-02-04).

2. BEDROCK GEOLOGY

The Southend area is in the La Ronge-Reindeer Lake folded belt. The bedrock in this area is composed of gneisses, schists, meta-sediments, and volcanic rocks cut by granitic and diabase intrusives (Johnston, 1979) and crops out in the Old Settlement (Fig. 1). The relief of the area (Drawing 0052-002-01) is believed to be related primarily to the differential resistance offered by these rocks to both fluvial and glacial erosion. According to Johnston (1979), a major fault underlies the channel between the two Settlements and, consequently, became a valley because of its susceptibility to erosion.

3. QUATERNARY GEOLOGY

3.1 Introduction

Quaternary deposits include those sediments laid down during glacial and recent time. The Quaternary sediments penetrated during the augering program at Southend were almost exclusively glacial deposits which included in ascending order: Lower Gravel, Lower Sand, Silt and Clay, Till, Upper Gravel, and Upper Sand.

3.2 Lower Gravel

During the augering program, up to 5 m of Lower Gravel were penetrated. This unit is believed to be much thicker at EAC - 15 (Drawing 0052-002-03) and under the channel in Cross Section A-A' (Drawing 0052-002-02). The gravel is gray where unoxidized and brown where oxidized with coarse- to very coarse- grained sand. The lower part of the gravel pit in Figure 4 may be in this unit.



Figure 4. Gravel pit southeast of EAC - 3 (Drawing 0052-002-01) in Lower Sand and probably Lower Gravel.

3.3 Lower Sand

The Lower Sand (Figs. 4,5) is at least 8.5 m thick EAC - 12 (Drawings 0052-002-01,02) and ranges from coarse grained sand at the base to fine - and very fine - grained sand at the top of the unit. Locally, pebbles and silt occur in the lower and upper part, respectively. Both the lower and upper contacts are conformable as suggested by the gradual changes in texture across these contacts.

3.4 Silt and Clay

The Silt and Clay unit is composed of up to 4 m of varved, white and light gray silt and brownish gray clay (Fig. 6). The clay bipartite layer near EAC - 14 (Drawing 0052-002-01,02) is composed of 83% clay, 15% silt, and 2% sand. The main clay minerals present include illite, chlorite, and montmorillonite (Fig. 7). Illites and chlorites were derived locally, whereas the montmorillonite must have come from the Cretaceous sediments to the south through Lake Agassiz which, according to Christiansen (1979), extended to Southend (Fig. 8).

3.5 Till

In both the Old Settlement and the New Settlement (Drawings 0052-002-02, 03,04) the varved Silt and Clay unit is overlain by silty Till which appears to be derived from this underlying unit. Near EAC -14 (Fig. 9), this till is composed of pebbles and cobbles, 51% silt, 28% clay, and 21% sand. The silty Till unit is less than 1 m thick.

3.6 Upper Gravel

The upper Gravel is up to 4.3 m thick on the ridge north of the gravel pit (Fig. 5) west of the New Settlement and up to 1.5 m thick on the upland south of the Old Settlement (Fig. 10; EAC - 6,



Figure 5. Lower Sand beneath Silt and Clay unit in roadcut at EAC - 16 (Drawing 0052-002-01). Dark zone in roadcut is the Silt and Clay Unit, and the white patch in the foreground is bedrock.



Figure 6. Varved Silt and Clay unit about 1300 m west of Drawing 0052-002-01. The folding of the varves is believed to be caused by penecontemporaneous sliding of the sediments.

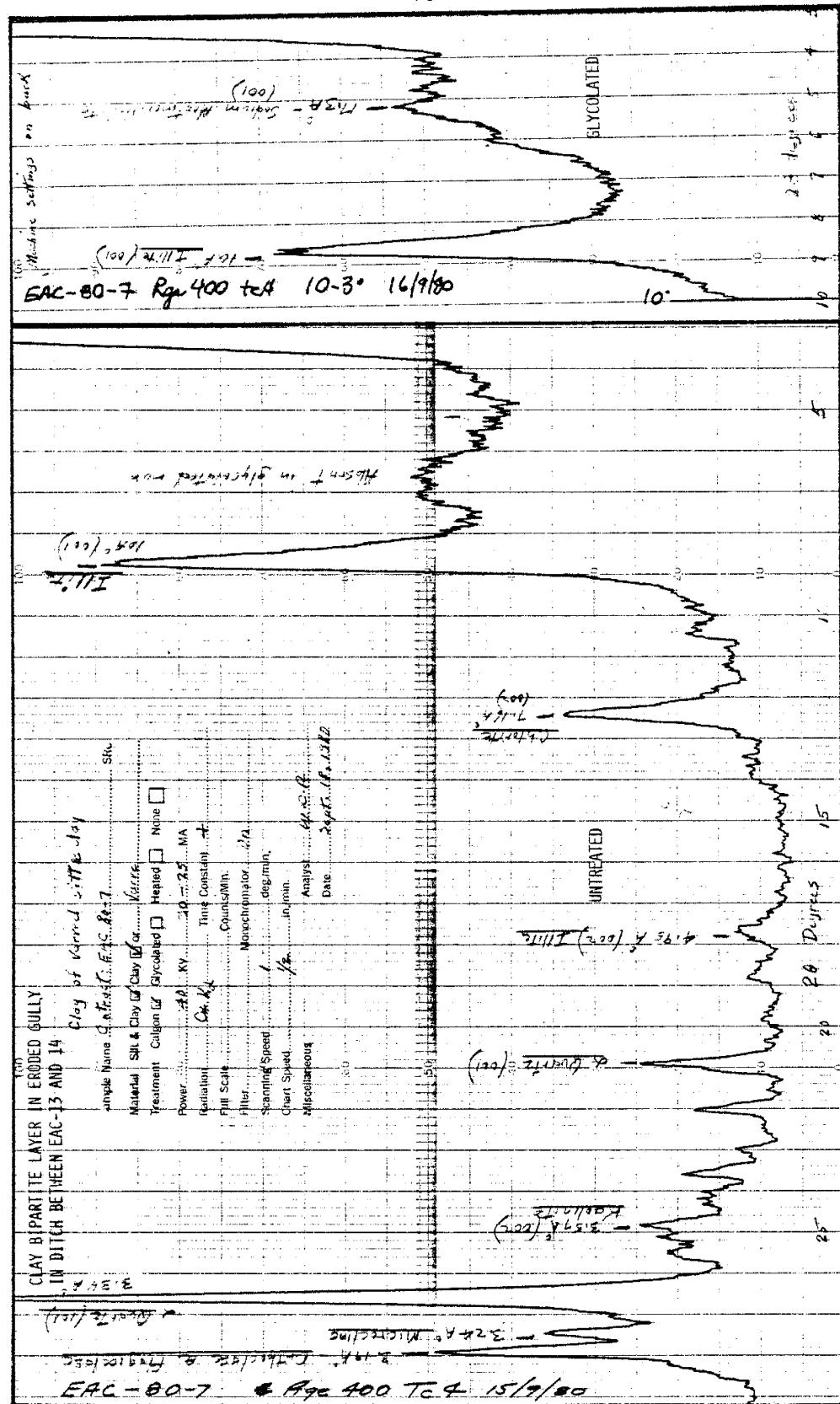


Figure 7. X-ray diffractogram of clay bipartite layer from varved Silt and Clay unit in gully in ditch along Highway 102 between EAC - 13 and 14 (Drawing 0052-002-01). The dominant clay minerals are illite, montmorillonite, and chlorite.

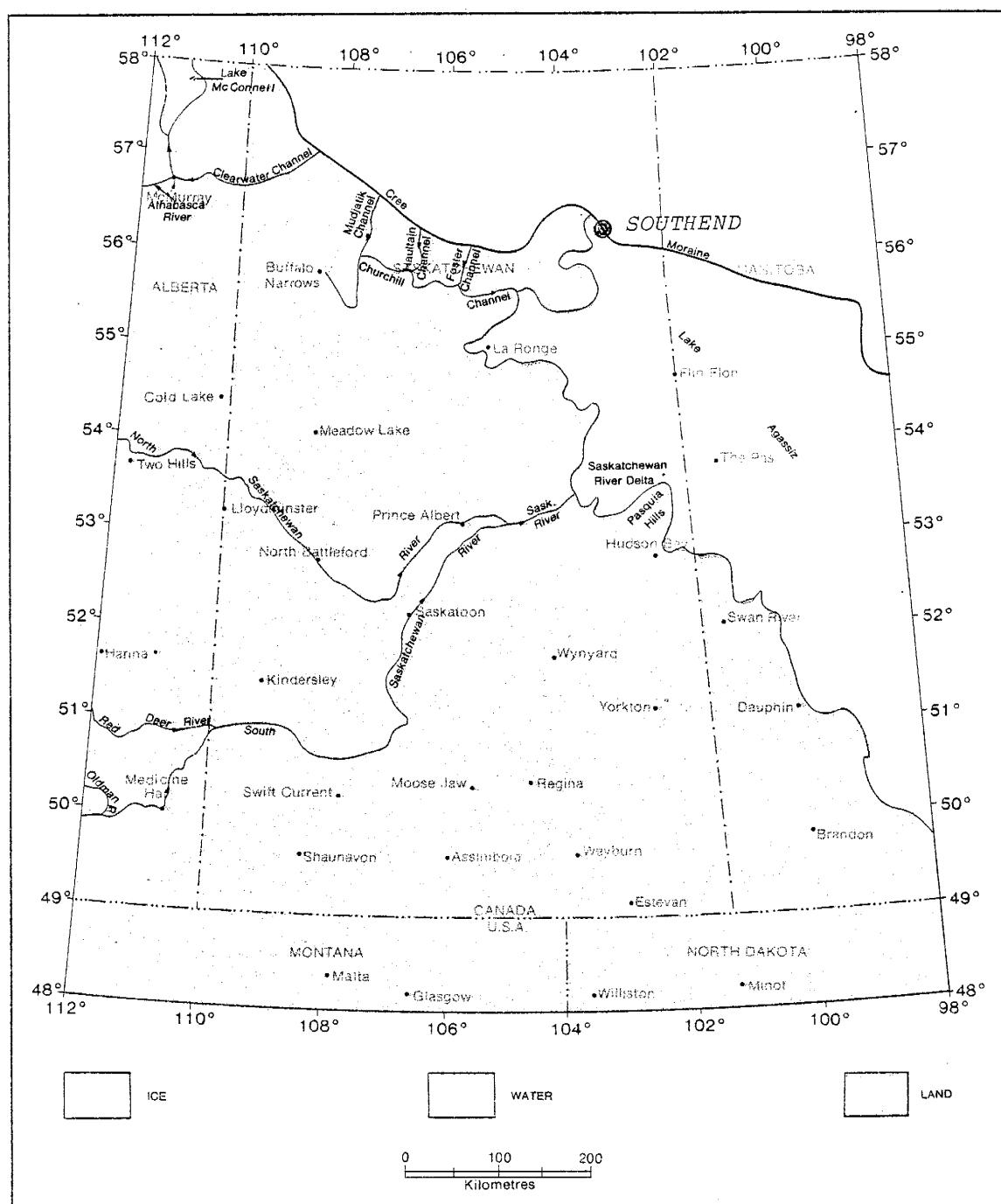


Figure 8. Phase 9 of the history of deglaciation about 10,000 years ago.
From Christiansen (1979).



Figure 9. Silty Till with stones overlying the Silt and Clay unit in exposure EAC-17 along ditch of Highway 102 near EAC-14 (Drawing 0052-002-01).



Figure 10. Upper Gravel in garbage pit at EAC - 6 (Drawing 0052-002-01).
Base of pit is in the Silt and Clay unit (Drawing 0052-002-04).

16, (Drawing 0052-002-01,02,04). This gravel appears to be restricted to these uplands west and south of the two Settlements.

3.7 Upper Sand

The Upper Sand unit, which is restricted for the most part to the low-lying areas (Fig. 11), is composed of 0 to more than 8 m of sand (EAC - 10, Drawing 0052-002-03). The sand ranges in texture from medium to very coarse grained at the base to fine to very fine in the upper part of the unit.

4. GEOLOGIC PROCESSES

4.1 Introduction

Glacial, fluvial, and wave erosion are the main geological processes that were or are operative in the Southend area. Although frozen ground occurs between 2.0 and 2.8 m in EAC - 7, permafrost is not considered to be an important geologic process in this area of discontinuous permafrost as defined by Brown and Pewe (1973).

4.2 Glacial Erosion

Glacial erosion is accomplished by quarrying and abrasion. The jagged downstream or lee end of roche moutonnee attests to glacial quarrying and the smooth striated upstream or stoss end to glacial abrasion. Glacial erosion is accentuated in the more erodible rocks, particularly those made more susceptible to erosion by faulting. In the Southend area the north-south trending valleys such as the "channel" lowland and the lowland at EAC - 1 (Drawings 0052-002-01,02) are believed to have formed largely by glacial erosion. The upward-facing concave surfaces of the bedrock surface shown in Drawings 0052-002-02 and 04 are based on this glacial erosion model. If this is the case, these glacially eroded valleys may be much deeper than shown in Drawing 0052-002-02.



Figure 11. Sandy beach derived from the Upper Sand unit near EAC - 10 (Drawing 0052-002-01) along Numabin Bay north of the New Settlement. Notice beach gravel derived from Lower Gravel in foreground and bedrock cliff in the background.

4.3 Fluvial Erosion

Fluvial erosion in the Southend area is caused primarily by the construction on Highway 102 which was recently built. The soft Silt and Clay unit and the Upper Sand are highly susceptible to fluvial erosion (Fig. 12). Not only is such erosion undesirable from an environmental impact point of view, but the integrity of the road may be in doubt.

4.4 Wave Erosion

The shores in the Southend area are developed in bedrock, Lower Gravel, Lower Sand, Upper Sand, and in the varved Silt and Clay and silty Till units. The shore north of EAC - 10 is developed in the Upper Sand unit (Drawing 0052-002-01,03) and displays beaches excellent for swimming (Fig. 11). North of here, the shoreline is in bedrock and no shore area is present. The shore east of EAC - 10 in the point jutting into Numabin Bay (Drawing 0052-002-01, Fig. 11) is developed in the Lower Gravel. Where the shoreline is in the Silt and Clay and silty Till units, the shore is gently sloping and muddy (Fig. 13).

5. GEOLOGIC HISTORY

The absence of till, except for the silty Till which overlies the Silt and Clay unit, suggests all of the glacial deposits in the Southend area can be related to the last deglaciation. It is conceivable that older tills may occur in the fault-valley under the channel. Only further test drilling, however, can confirm this.

The gradual decrease in grain size from the Lower Gravel through the Lower Sand into the Silt and Clay unit suggests that this sequence was deposited during deglaciation with the Lower Gravel



Figure 12. Gully erosion in ditch along Highway 102 between EAC - 13 and 14 (Drawing 0052-002-01). EAC - 13 is between bridge in causeway fill of channel and white truck.



Figure 13. Shoreline in silty Till and Silt and Clay units north of west end at causeway along west bank of channel.

being deposited as an outwash when the glacier was in the vicinity of Southend and the Lower Sand unit being deposited when the glacier was more remote. During this retreat of the glacier, Lake Agassiz inundated the Southend area and the varved Silt and Clay unit was deposited. The glacier then re-advanced to the Cree Lake Moraine (Fig. 8) and in doing so lobes of ice advanced into the "channel" lowland where the Settlements are located and into the lowland at EAC - 1 (Drawing 0052-002-01) and deposited the silty Till unit which was derived primarily from the underlying Silt and Clay. As the glacier stood in this position, the Upper Gravel was deposited as outwash in the interlobate area at EAC - 2 and 16 (Drawing 0052-002-01,02) and in the vicinity of EAC - 6. Prior to the final glacial retreat, Lake Agassiz (Fig. 8), in which the Silt and Clay unit was deposited, drained from the Southend area and glacial Reindeer Lake came into existence at a level of about 55 m above the surface of the present Reindeer Lake (Drawings 0052-002-02,04). As glacial Reindeer Lake fell from this higher level, the Upper Sand was deposited in the Southend area.

6. GEOTECHNICAL CONSIDERATIONS

6.1 Introduction

This chapter is restricted to geotechnical consideration from a geologic view point only and are presented as suggestions for the consideration of the geotechnical engineer who is responsible for applying the geologic framework in solving the geotechnical problems. The following geotechnical considerations are discussed: groundwater, runoff, and gullying.

6.2 Groundwater

Excellent possibilities for induced infiltration from the Lower Gravel and Lower Sand units exist adjacent to the channel between

the two Settlements, particularly if the Lower Gravel and Lower Sand are thicker than that penetrated in EAC-13 and 12, respectively (Drawing 0052-002-02). The fact that the channel is underlain by a fault (Johnston, 1979) suggests the sand and gravel may be much thicker than that shown in Cross section A-A' (Drawing 0052-002-02). Groundwater was encountered in augerhole EAC-7 (Drawing 0052-002-04, Fig. 14), and a piezometer was installed (P. Machibroda Engineering Ltd., Consulting Report).

6.3 Runoff

The impervious nature of the varved Silt and Clay and the silty Till units is conducive to runoff because there is little groundwater recharge (Fig. 15). Where the Upper Sand and Upper Gravel overlies these impervious beds, delayed runoff occurs as the water discharges along the base of these overlying pervious units.

6.4 Gullying

The Lower Sand, Silt and Clay, and Upper Sand units are very susceptible to fluvial erosion. The Silt and Clay and Upper Sand units in the east bank of the channel along Highway 102 east of the causeway are presently being severely eroded (Fig. 12).

7. LITERATURE CITED

Brown, R.J.E. and Pewe, T.L. 1973. Distribution of permafrost in North America and its relationship to the environment: A review 1963-1973, in Permafrost; North American Contribution, Second International Permafrost Conference, Yakutsk, USSR, National Academy of Science Publication 2115, pp. 71-100.

Christiansen, E.A. 1979. The Wisconsinan deglaciation of southern



Figure 14. Augerhole site EAC-7 in which groundwater was encountered in the Lower Sand at a depth of 6.4 m.



Figure 15. Runoff from surficial Silt and Clay and silty Till units and delayed runoff from the more permeable overlying Upper Gravel and Upper Sand units at EAC - 1 (Drawing 0052-002-01). Notice the upturned culvert caused by grade settlement in the boggy soils.

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- J.D.Mollard and Associates Limited, 1978. Air-photo interpretation, terrain assessment study of the Southend Indian Reserve 200, Northern Saskatchewan for the Department of Indian and Northern Affairs. *In* Report by James F. MacLearn Limited.
- Johnston, W.G.Q. 1979. Compilation Bedrock Geology, Reindeer Lake South (NTS Area 64D): *In* Summary of Investigations, 1979. Edited by J.E. Christopher and R. Macdonald. Saskatchewan Geological Survey, Miscellaneous Report 79-10, pp. 39-50.
- Schreiner, B.T., Alley, D.W. and Christiansen, E.A. 1976. Quaternary geology: 64D, 64E, 730, 74C, 74B, and 74H area. *In* Summary of Investigations, 1976. Edited by J.E. Christopher and R. Macdonald. Saskatchewan Geological Survey, pp. 58-62.

Appendix 1. Geologic logs

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PAGE 1 OF 1

GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.			
EAC		SOUTH END			0052			
N T S		UTM - ZONE		UTM-EASTING (M)		UTM-NORTHING (M)		
64D/06								
1/4	LSD	S	T	R	M	LATITUDE		
					W	°	'	
LONGITUDE		E,W		TYPE OF OBSERVATION		DAY	MO.	YEAR
0		1		AUGER HOLE		09	09	1980
ELEVATION (M)		SOURCE OF ELEVATION				AERIAL PHOTOGRAPH NO.		
<p>0 5 10 15 20 25 30 35 40 45 50</p> <p>FILL</p> <p>sand, fine to med., org., lt br. gray becoming grayish brown at base</p> <p>silt, clayey, non calc., lt gray with yellowish brown staining in upper part of unit, laminated</p> <p>unable to drill deeper because of sloughing conditions in auger hole</p> <p>Sample point</p>								
SIGNATURE								

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GEOLOGIST-SITE		NAME OF SITE				PROJECT NO.	
ERC	3	SOUTHENO				0052	
N T S		UTM - ZONE	UTM-EASTING (M)		UTM-NORTHING (M)		
64D	/ 06						
1/4	LSD	S	T	R	M	W	
LONGITUDE	°	' E,W	TYPE OF OBSERVATION		DAY	MO.	YEAR
			AOGER HOLE		09	09	19 80
ELEVATION (M)			SOURCE OF ELEVATION		AERIAL PHOTOGRAPH NO.		
 METRES		← Sand, pebbly, med. to coarse becoming s. fine ← silty at base, grayish br. to lt gray ← Silt, sandy with coarse sand float, lt gray-white ← Silt and clay, varved, mottled, white and ← lt br. gray ← Sand, v. fine, becoming, med to coarse ← pebbly at base, lt br. gray to ← grayish brown (10YR 6/2-5/2, dry)					
FEET		← Unable to drill deeper because of rocks.					
0 5 10 15 20 25 30 35 40 45 50		← Sample point					
SIGNATURE							

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GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.		
EAC	4	50 OUT HEND			0052		
N T S	UTM - ZONE		UTM-EASTING (M)		UTM-NORTHING (M)		
630/06							
1/4	LSD	S	T	R	M	W	
LONGITUDE °		E,W	TYPE OF OBSERVATION		DAY	MO.	YEAR
			AUGER HOLE		09	09	1980
ELEVATION (M)		SOURCE OF ELEVATION		AERIAL PHOTOGRAPH NO.			

Geological Column Log:

0	0
5	
10	3.0m
15	
20	
25	
30	
35	
40	
45	
50	

Bedrock

Metres Feet

0 to 10 m (30 ft) - Sand, fine to med., grayish brown silt, s. fine sand, 1t. gray with a fine sand interbed at 1.7m

10 to 15 m (33 ft) - Sand, med. to v. coarse, possibly at top and v. fine, silty at base, grayish brown to lt. gray

15 to 30 m (49 ft) - Bedrock exposures nearby

Sample point

[Handwritten Signature]

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GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.		
ERC	6	SOUTHEN D			COSZ		
N T S		UTM - ZONE	UTM-EASTING (M)		UTM-NORTHING (M)		
64D	/06						
1/4	LSD	S	T	R	M	W	
LONGITUDE	°	E,W	TYPE OF OBSERVATION		DAY	MO.	YEAR
			PIGGER HOLE		09	09	1980
ELEVATION (M)		SOURCE OF ELEVATION			AERIAL PHOTOGRAPH NO.		
METRES		Facies Description					
0		sand, coarse to v. coarse, pebbly, locally gravel (1cm pebbles)					
5		5-10ft, sandy becoming clayey at base, noncalcareous, lt. gray to white (JYR 711-811, dry).					
10		Sand, fine to med., lt. gray					
15		sharp change no color					
20		Sand, med. to coarse, grayish brown to lt. br. gray					
25		Gravel, coarse to v. coarse sandy, pebbles 1-2cm, pink granite color					
30		Unable to continue drilling no gravel					
35							
40							
45		Sample point					
50							


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GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.			
ERC	7				0052			
N T S	UTM - ZONE	UTM-EASTING (M)		UTM-NORTHING (M)				
64D / 06								
1/4	LSD	S	T	R	M	W	LATITUDE	N,S
							0	1
LONGITUDE	E,W	TYPE OF OBSERVATION			DAY	MO.	YEAR	
0°	1'	AUGER HOLE			09	09	1980	
ELEVATION (M)		SOURCE OF ELEVATION			AERIAL PHOTOGRAPH NO.			

Geological Log:

METRES	0	← Sand, v. fine, silty, lt. gray to lt. br. gray
	5	← Silt and clay, varved, lt. gray + pale br.
	10	← sand, fine dark brown
	15	← sand, v. fine and fine, lt. gray
	20	←
	25	← Sand, v. fine and fine, lt. gray with pale brown staining locally
	30	← sand, v. fine, pale brown to coarse, brown at base
	35	← gravel, fine to v. coarse sandy, brown
	40	← sand, v. fine to fine, lt. gray with pale br. staining
	45	← Sample point
	50	

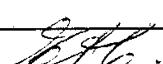
Note: Sediments frozen between 2.0 and 2.8m


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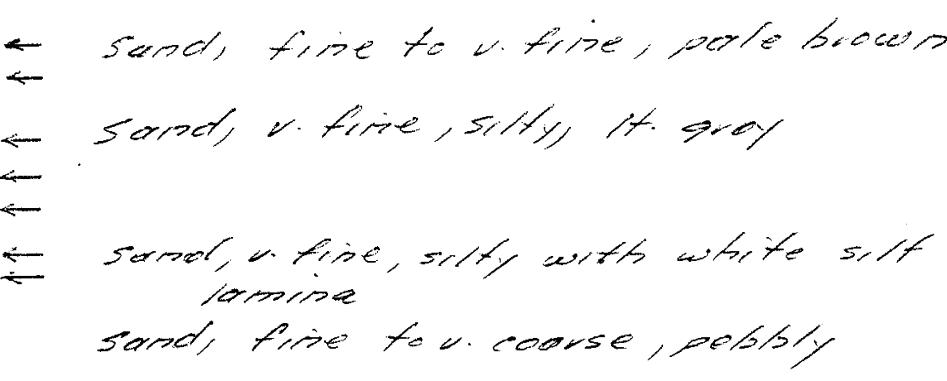
PAGE 1 OF 1

GEOLOGIST-SITE		NAME OF SITE				PROJECT NO.		
EAC		SOUTHERN				0052		
N T S		UTM - ZONE		UTM-EASTING (M)		UTM-NORTHING (M)		
64D / 06								
1/4	LSD	S	T	R	M	LATITUDE		
					W	°	'	N,S
LONGITUDE		E,W		TYPE OF OBSERVATION		DAY	MO.	YEAR
				AUGERHOLE		09	09	19 60
ELEVATION (M)		SOURCE OF ELEVATION				AERIAL PHOTOGRAPH NO.		
<p>0 ← Silt, noncalcareous, clayey, lt. gray and white 5 ← sand, fine to med., v. fine, fine 10 ← and fine to v. fine, lt. gray 15 ← sand, v. fine, silty, lt. gray 20 ← sand, v. fine to coarse, lt. br. gray 25 ← gravel, med. to v. coarse sandy, pebbles 1 to 2 cm, gray 30 ← Abandoned Augerhole because of caving hole. 35 ← Sample point 40 ← 45 ← 50 ←</p>								
<p>0 ← METRES 5 ← 10 ← 15 ← 20 ← 25 ← 30 ← 35 ← 40 ← 45 ← 50 ← 40m ← FEET 45 ← 50 ←</p>								
<p> SIGNATURE</p>								

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GEOLOGIST-SITE		NAME OF SITE				PROJECT NO.		
EAC	9	SOUTH END				0052		
N T S		UTM - ZONE		UTM-EASTING (M)		UTM-NORTHING (M)		
64	D / 06							
1/4	LSD	S	T	R	M	W		
LONGITUDE		E,W		TYPE OF OBSERVATION		DAY	MO.	YEAR
0		'		AUGER HOLE		09	09	19 80
ELEVATION (M)		SOURCE OF ELEVATION				AERIAL PHOTOGRAPH NO.		
METRES		FEET						
0		0						
5		5		Sand, fine to v. fine, pale brown				
10		10		Sand, v. fine, silty, H. gray				
15		15		Sand, v. fine, silty with white silt laminae				
20		20		Sand, fine to v. coarse, probably				
25		25						
30		30						
35		35						
40		40						
45		45		Sample point				
50		50						
								
								
								SIGNATURE

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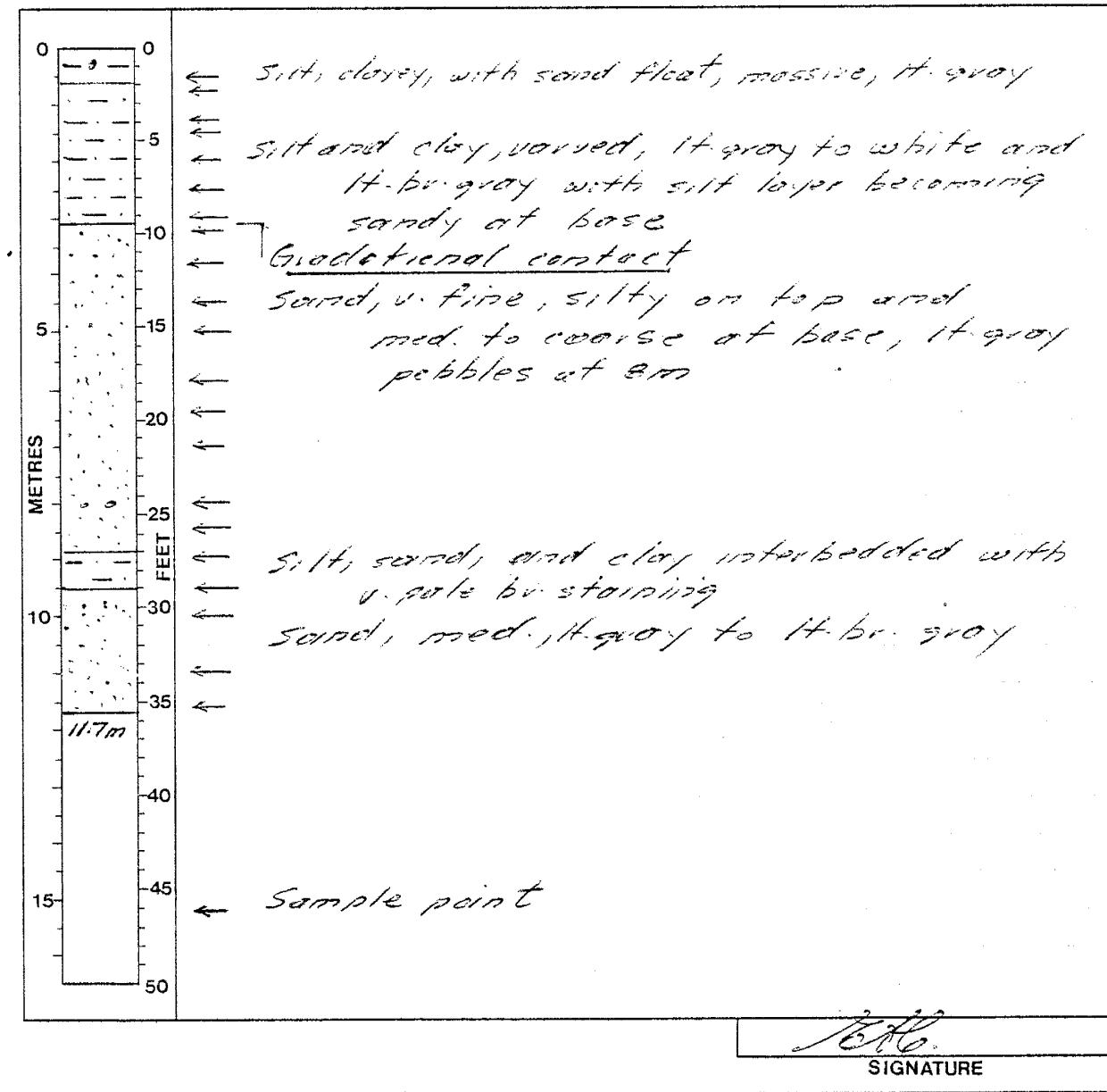
GEOLOGIST-SITE		NAME OF SITE				PROJECT NO.		
EPC		11		SOUTH END		6052		
N T S		UTM - ZONE		UTM-EASTING (M)		UTM-NORTHING (M)		
64D / 06								
1/4	LSD	S	T	R	M	LATITUDE		
					W	°	'	
LONGITUDE		E,W		TYPE OF OBSERVATION		DAY	MO.	YEAR
				AUGER HOLE		10	CE	19 EC
ELEVATION (M)		SOURCE OF ELEVATION				AERIAL PHOTOGRAPH NO.		

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GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.			
EAC		SOUTHERN			0052			
N T S		UTM - ZONE		UTM-EASTING (M)		UTM-NORTHING (M)		
1/4	LSD	S	T	R	M	W		
LONGITUDE ° °		E.W		TYPE OF OBSERVATION		DAY	MO.	YEAR
				AUGER HOLE		10	09	1980
ELEVATION (M)		SOURCE OF ELEVATION			AERIAL PHOTOGRAPH NO.			



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GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.			
EHC 13		SOUTHERN			0052			
N T S		UTM - ZONE		UTM-EASTING (M)		UTM-NORTHING (M)		
1/4	LSD	S	T	R	M	LATITUDE °		N,S
LONGITUDE °		E,W	TYPE OF OBSERVATION			DAY	MO.	YEAR
ELEVATION (M)		SOURCE OF ELEVATION			AERIAL PHOTOGRAPH NO.			
METRES		DESCRIPTION						
0		Silt, sandy, lt gray						
5		Sand, fine to med, pale brown to brown on top and lt gray and lt br gray below						
10		Silt, sandy, lt gray + lt yellowish brown						
15		sand, v. fine, silty, lt br gray						
20		Silt and clay varved, lt gray and gray						
25		Sand med. to coarse becoming fine to v. fine at base						
30		Gravel, coarse to v. coarse sandy, gray						
35								
40								
45								
50								
9.0m								
FEET								
10								
15								
20								
25								
30								
35								
40								
45								
50								
		← Sample point						
		J. H. [Signature]						
		SIGNATURE						

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GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.		
EFC	15	SOUTHEND			0052		
N T S		UTM - ZONE	UTM-EASTING (M)		UTM-NORTHING (M)		
64 10 / 06							
1/4	LSD	S	T	R	M	W	
LONGITUDE		E,W	TYPE OF OBSERVATION		DAY	MO.	YEAR
0° 0' 0"		1	AUGER HOLE		10	09	1980
ELEVATION (M)		SOURCE OF ELEVATION		AERIAL PHOTOGRAPH NO.			
<p>0 5 10 15 20 25 30 35 40 45 50</p> <p>0 5 10 15 20 25 30 35 40 45 50</p> <p>Sample point</p>		<p>Gravel, v. coarse sandy, v.pale brown becoming lt gray to lt br. gray at base</p> <p>Gravel, v. coarse sandy, lt gray + gray</p>					

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Geologic Log

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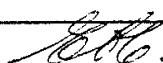
GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.			
PM / 15		SOUTH END			0052			
N T S		UTM - ZONE	UTM-EASTING (M)	UTM-NORTHING (M)				
1/4	LSD	S	T	R	M	W		
LONGITUDE		E,W	TYPE OF OBSERVATION			DAY	MO.	YEAR
ELEVATION (M)		SOURCE OF ELEVATION			AERIAL PHOTOGRAPH NO.			
<p>0 0 Fill ← — — — — ← Silt with floating sand grains, white — — — — ← 5 — — — — ← 10 — — — — ← 15 — — — — ← 20 Sand fine to v. fine becoming — — — — ← 25 fine to med at base — — — — ← 30 — — — — ← 35 — — — — ← 40 — — — — ← 45 — — — — ← 50 ← Sample point</p>								
<p>METRES FEET</p> <p>87m</p> <p>10 30 35 40 45</p> <p>BTG</p> <p>SIGNATURE</p>								

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GEOLOGIST-SITE		NAME OF SITE			PROJECT NO.				
PM	35	SOUTH END			0052				
N T S		UTM - ZONE	UTM-EASTING (M)		UTM-NORTHING (M)				
1/4	LSD	S	T	R	M	W	LATITUDE °		N,S
LONGITUDE °		E,W	TYPE OF OBSERVATION			DAY	MO.	YEAR	
ELEVATION (M)		SOURCE OF ELEVATION			AERIAL PHOTOGRAPH NO.				
METRES		0 5 10 15 20 25 30 35 40 45 50			← Gravel, sandy with white silt ← silt, clayey, lt. gray, massive, no float ← Silt and clay, varved, clay bi-partite layer up to 1cm thick ← sand, fine to med., lt. br. gray ← Sample point				
FEET									
10									
15									
20									
25									
30									
35									
40									
45									
50									


SIGNATURE

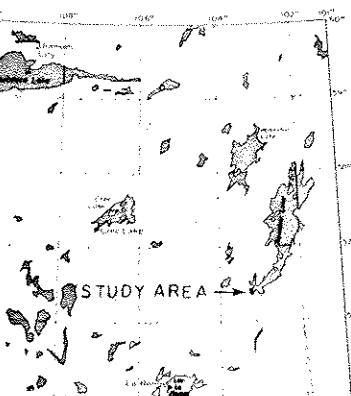


OUTHEND, REINDEER LAKE, SASKATCHEWAN

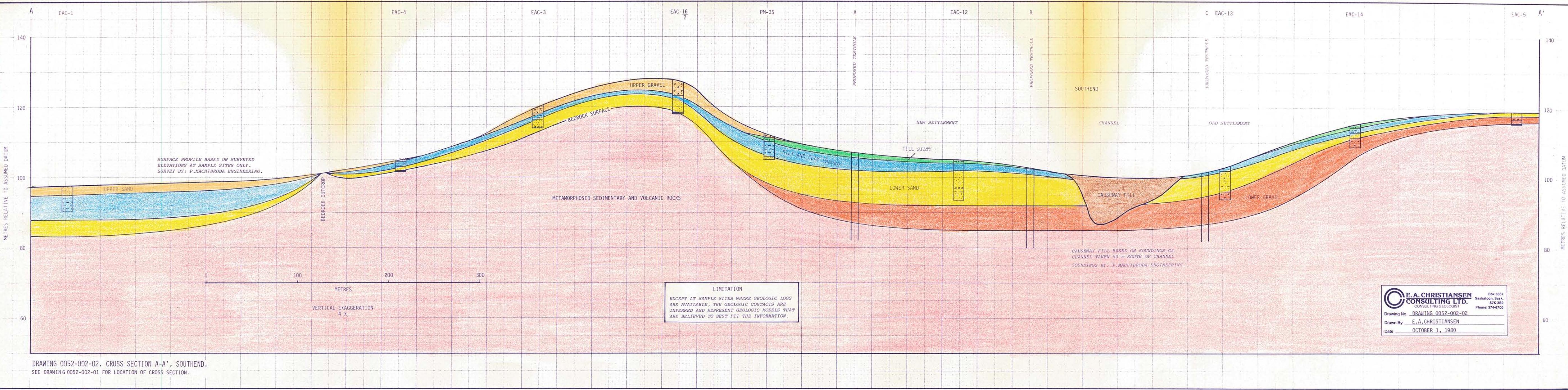
- Exposure
EAC I
PM 15 Augerholes

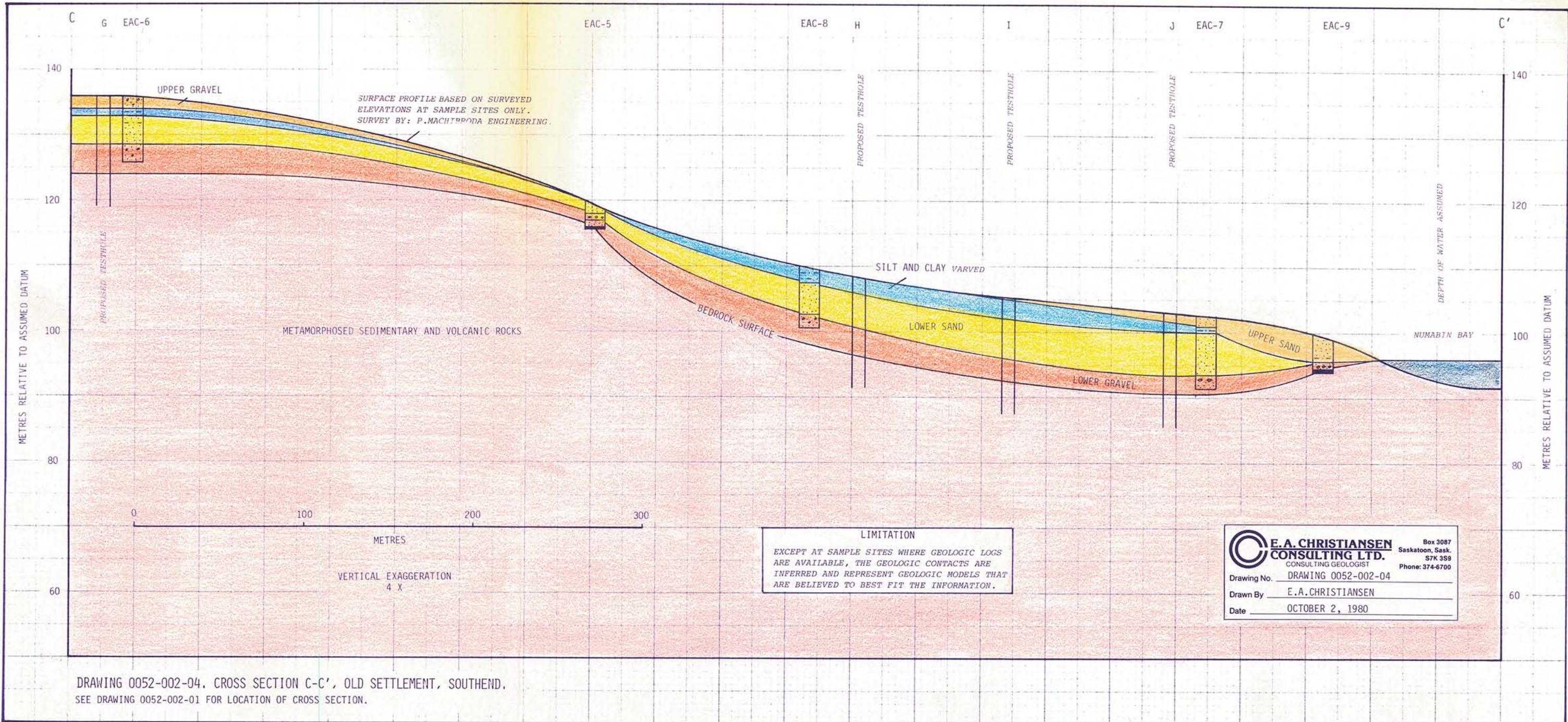
contour map by Energy, Mines and Resources, Ottawa

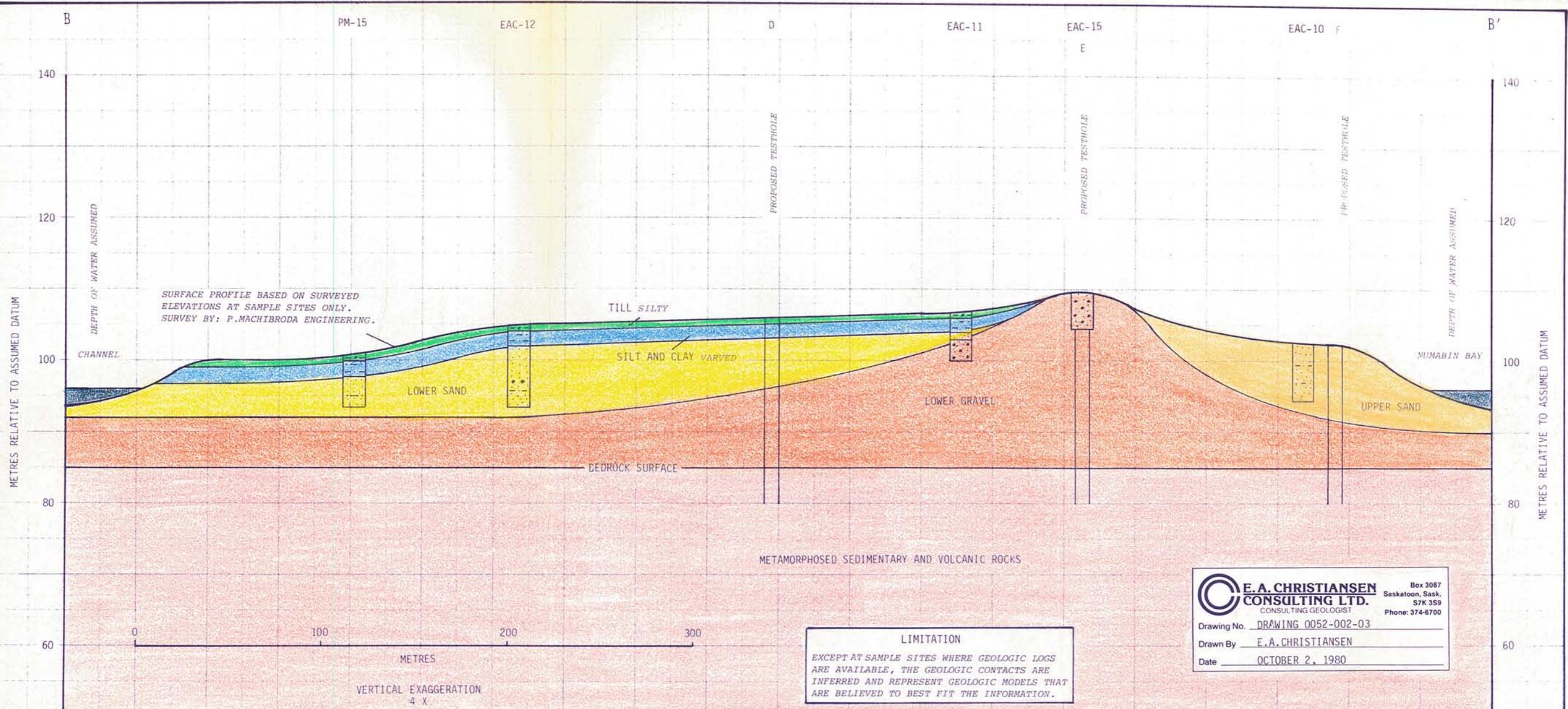
contour interval = 50 Feet



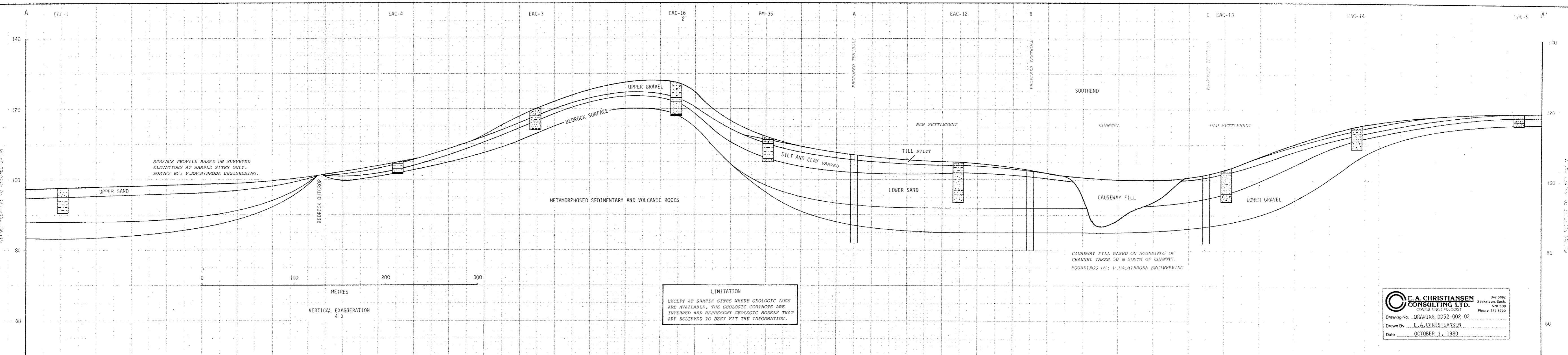
INDEX MAP







DRAWING 0052-002-03. CROSS SECTION B-B', NEW SETTLEMENT, SOUTHEND.
SEE DRAWING 0052-002-01 FOR LOCATION OF CROSS SECTION.



DRAWING 0052-002-02, CROSS SECTION A-A', SOUTHEND.
DRAWING 0052-002-01 FOR LOCATION OF CROSS SECTION.