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SASKATCHEWAN CULTURE AND YOUTH

GEOLOGY OF THE SJOVOLD SITE

Report 0050-001 January 26, 1981

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January 26, 1980

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Attention: Dr. I.G. Dyck

Dear Dr. Dyck:

Enclosed is one copy of Report 0050-001 on the "Geology of the Sjovold Site". If you have any queries, please contact me.

Sincerely yours,

E.A. Christiansen

SUMMARY

The tributary valley, in which the Sjovold Site is located, was eroded mainly by postglacial runoff. As Lake Saskatchewan and Lake Agassiz fell, the South Saskatchewan Spillway and River and, in turn, the tributary creek at the Sjovold Site, eroded into their valley bottoms. This process continued from about 13,000 to 10,000 years at the Sjovold Site. Between about 10,000 and 4,500 years ago, the tributary valley was either being eroded, or sediments were not being deposited on the valley floor.

The Alluvium resting on an eroded till surface in the tributary valley bottom was deposited between about 4,500 and 4000 years ago. The overlying, interbedded Alluvial and Eolian sediments were deposited from about 4000 to 2,500 years ago when the Sjovold Site was periodically flooded. Humans occupied this site periodically during this interval. The upper Eolian deposits were laid down during the last 2,500 years when the site periodically received blankets of wind-blown deposits followed by periods of soil development and human inhabitation.

LIMITATION

This report is based mainly on the information from eight augerholes and a brief reconnaissance of the Sjovold Site and immediate vicinity. The archeological exposure was not measured, described, or sampled because this was done by other investigators who will submit their findings to the Saskatchewan Museum of Natural History for incorporation in the museum's final report. The topographic map with a one-metre contour interval was not available at the time of writing, and consequently, the vertical control for the cross section was taken from a hand level survey.

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1. INTRODUCTION

1.1 Objective

The objective of this geologic investigation is to provide a geologic framework for the Sjovold Site including: (1) stratigraphy as it pertains primarily to a cross section across the valley in which the site is located, (2) geomorphology, (3) geologic processes which were operative during and since the formation of the site, and (4) the geologic history of the Sjovold Site.

1.2 Location

The Sjovold Site is near the mouth of a tributary valley of the South Saskatchewan River (Figs. 1,2,3,4). It is about 6 km south of Outlook, Saskatchewan or about 19 km downstream from Gardiner Dam (Fig. 1).

1.3 Previous Work

The bedrock and glacial deposits were studied by Christiansen and Meneley (1971) and Scott (1971). Christiansen and Meneley (1971) investigated these deposits by test drilling as part of their study of the geology and groundwater resources of the Rosetown map-area (72-O). Scott's (1971) study of this same area emphasized the surficial deposits and the history of deglaciation. The history of the last deglaciation of the Sjovold Site is included in the Wisconsinan deglaciation of southern Saskatachewan and adjacent areas (Christiansen, 1979). The soils of the Rosetown area were mapped by Ellis *et al.* (1968).

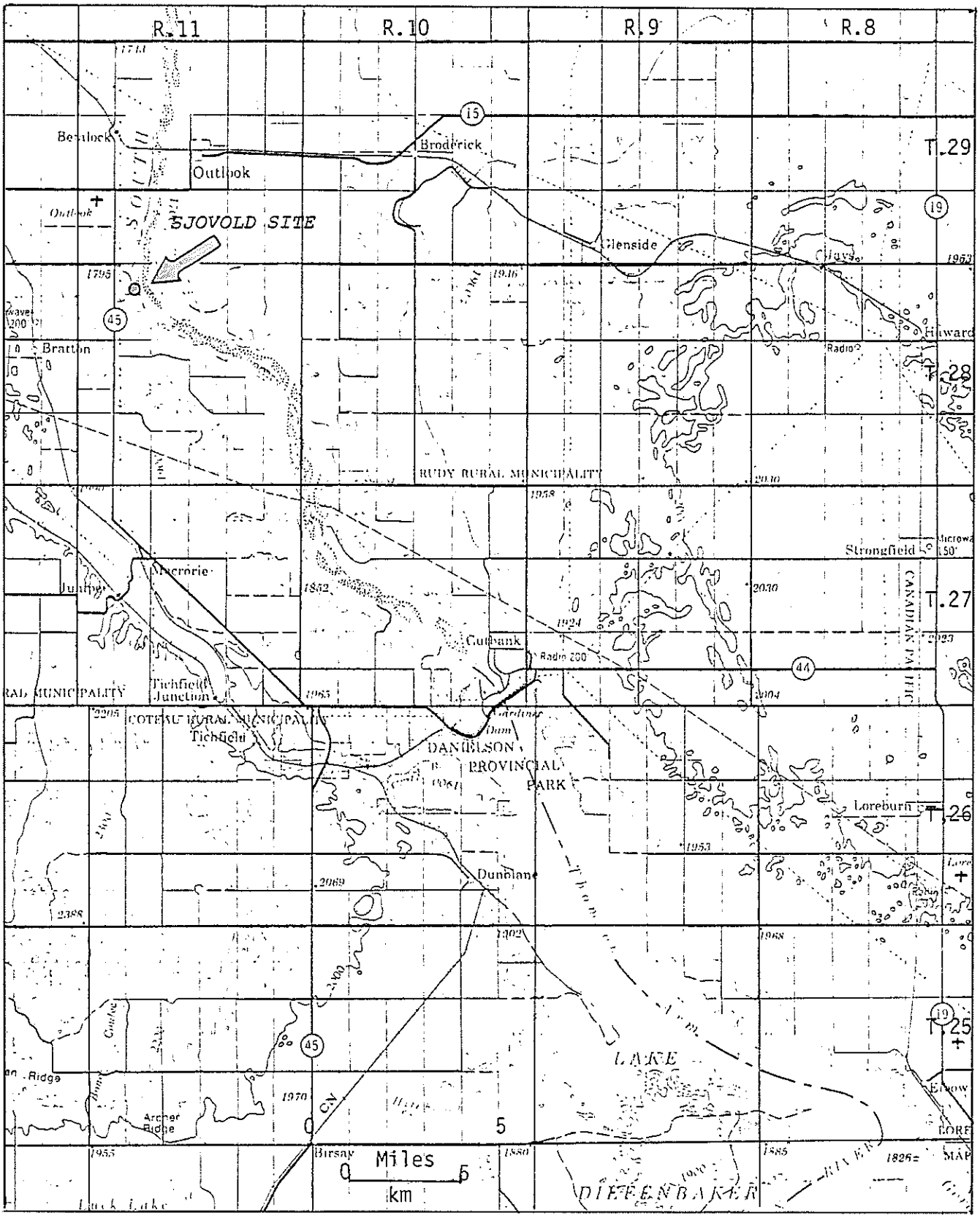


Figure 1. Location of the Sjovold Site. Map from Energy, Mines and Resources, Ottawa.

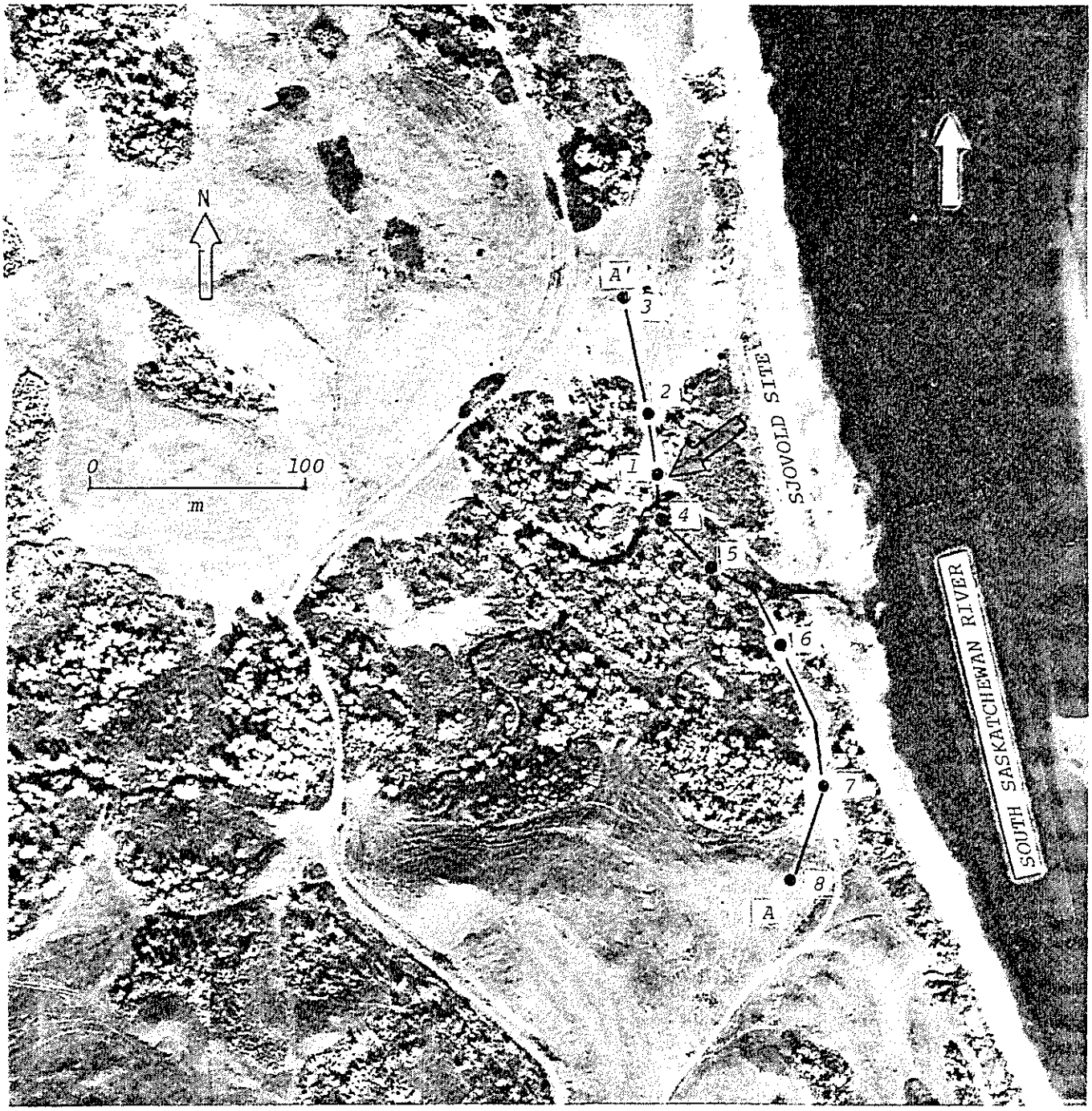


Figure 2. Aerial photograph of the Sjovold Site showing the location augerholes and Cross section A-A'.

A

B

Figure 3. Ground photographs of Sjovold Site. (A) Sjovold Site in tributary valley with South Saskatchewan River and duned terraces in right background and (B) Sjovold Site with South Saskatchewan River and town of Outlook in right background.

A

B

Figure 4. Ground photographs of Sjovold Site. (A) looking upcreek and (B) looking downcreek toward South Saskatchewan River.

1.4 Present Study

This investigation is based on brief examinations of the Sjovold Site on June 26, 1980 with I.G. Dyck, Saskatchewan Museum of Natural History and on October 1, 1980 with D.W. Anderson and J.G. Ellis Saskatchewan Institute of Pedology; H.E. Hendry, Department of Geological Sciences, University of Saskatchewan; and I.G. Dyck. In addition to these brief field examinations, eight augerholes were drilled into the underlying till (Appendix 1) on October 23 and 24 and on November 8, 1980.

Samples were taken off the continuous auger flights at about one-metre intervals (Fig. 5) and placed in muffing tins, dried, and described with the aid of dilute hydrochloric acid, a hand lens, and a Munsell Color Chart. Based on these descriptions of the samples and the field logs, geologic logs were compiled (Appendix 1).

The augerhole locations were taken from the aerial photograph (Fig. 2) and the elevations were obtained by hand level surveys with the top of the Sjovold Site as the datum of 100 feet (30 m). The distance between augerholes was measured by tape.

2. BEDROCK SEDIMENTS

The Sjovold Site is underlain by the Bearpaw Formation (Christiansen and Meneley 1971; Fig. 6). According to Christiansen and Meneley (1971) the bedrock surface is about 40 feet (12.2 m) below the top of the Sjovold Site. An augerhole drilled at this site, however, indicates that at least 50 feet of glacial and postglacial deposits overly bedrock at the Sjovold Site. Bedrock crops out along the South Saskatchewan River about 5 km downstream and about 1 km upstream from the Sjovold Site (Christiansen and Meneley, 1971).

A

B

Figure 5. Augering rig. (A) Augering rig at Augerhole 6 showing continuous flight augers and (B) auger flight from which samples were taken.

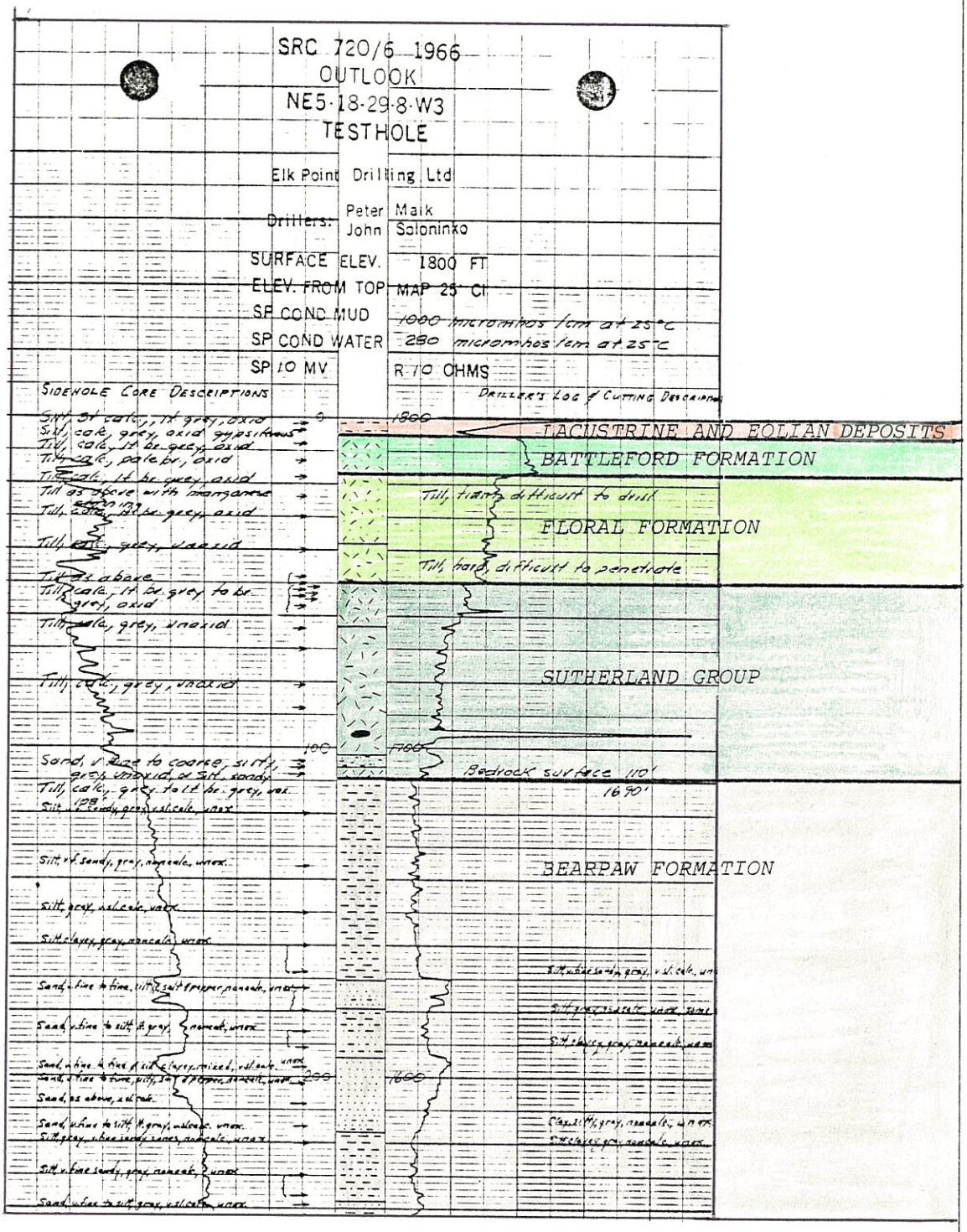


Figure 6. SRC Outlook testhole 5.5 km north of Sjovold Site showing geologic units of bedrock and drift. See Figure 7 for location. Nomenclature of till is from Christiansen(1968a,b).

3. GLACIAL TILLS IN THE SJOVOLD-OUTLOOK AREA

According to the SRC Outlook testhole (Fig. 6), tills named the Sutherland Group and Floral and Battleford Formations by Christiansen (1968a,b) occur about 5.5 km north of the Sjovold Site. The clayey nature of the till beneath the site (Drawing 0050-001-01) and the olive-brown weathering suggest that this till belongs to the Sutherland Group. The younger tills of this site were removed by fluvial erosion when the valley, in which the site was located, was formed.

4. GEOMORPHOLOGY OF THE SJOVOLD - OUTLOOK AREA

4.1 Introduction

Landforms in the Sjovold - Outlook area include: (1) moraine, (2)outwash plains, (3) dunes, (4) channels, (5) terraces, (6) lacustrine and eolian plains, undifferentiated, (7) flood plains, (8) landslides, (9) eroded areas,and (10) South Saskatchewan River (Fig. 7). Figure 7 is based mainly on Ellis *et al.* (1968) and Scott (1971).

4.2 Moraine

Most of the surface till (Figs. 6,7), where erosion has not occurred, is composed of soft, unjointed and unstained till of the Battleford Formation (Christiansen, 1968a).

4.3 Outwash Plains

Outwash sands and gravels occur south of Outlook (Fig. 7). Although they were deposited during the last deglaciation,the exact nature of their origin has not been investigated.

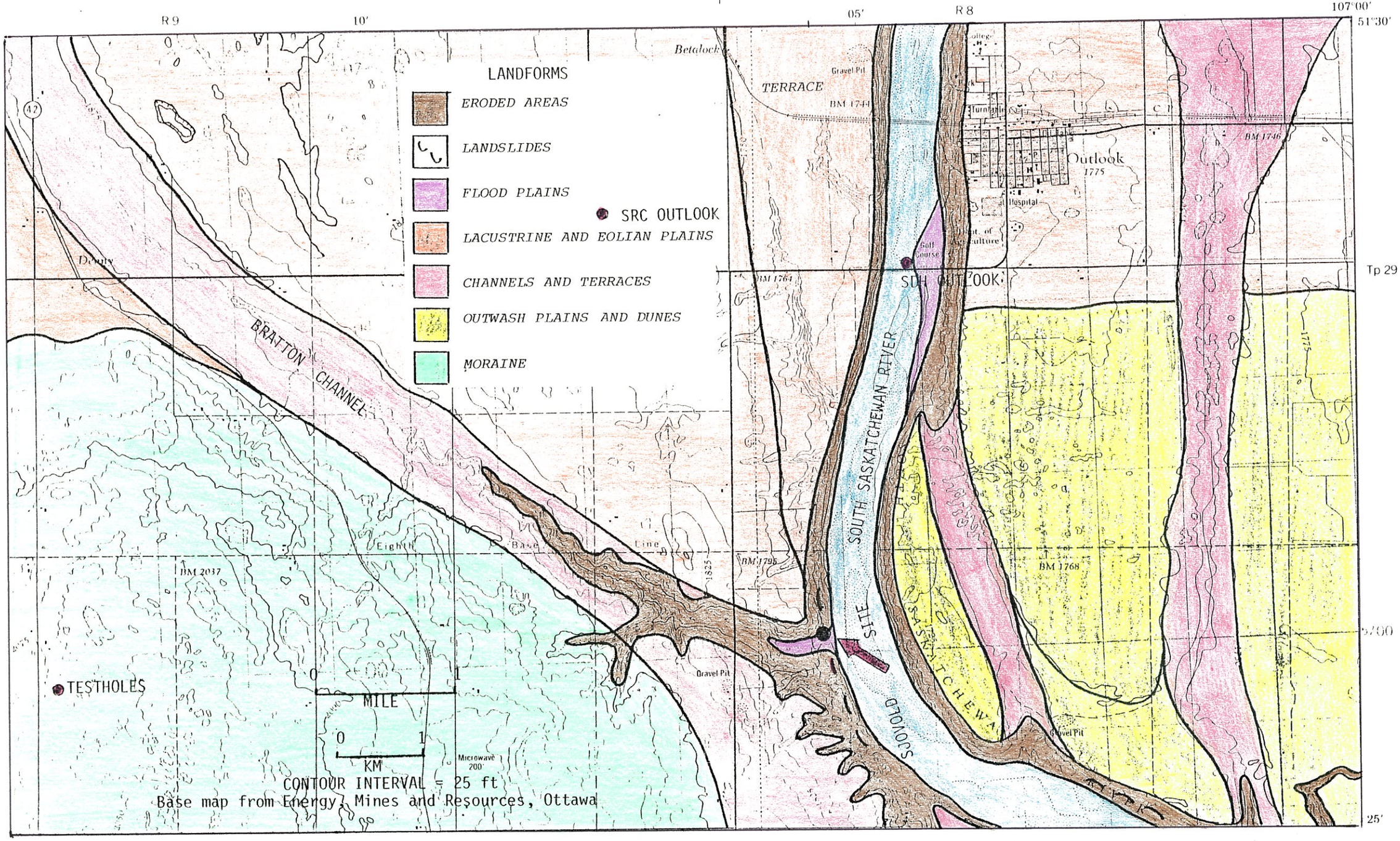


Figure 7. Surficial deposits of the Sjovold Site - Outlook area and locations of the Sjovold Site and SRC Outlook and SDH Outlook testholes. Map based mainly on Ellis *et al.*(1968) and Scott (1971).

4.4 Dunes

Parabolic, blowout dunes occur in the outwash deposits and channels south of Outlook. The sand for the dunes was derived from the outwash sand. According to Scott (1971), the dunes, for the most part, are stabilized and were formed by northwest winds.

4.5 Channels

The Bratton Channel and the two channels south of Outlook are the main channels in the area. The age and origin of these channels is shown in the chapter on "Geologic History". The nature of the sediments in these channels was not studied.

4.6 Terraces

A well - developed terrace occurs west of the South Saskatchewan River west of Outlook (Fig. 7). This terrace is covered with sand and gravel (gravel pit, Fig. 7) and silt (Ellis *et al.*, 1968) which is probably eolian in origin.

4.7 Lacustrine and Eolian Plains, Undifferentiated

According to Ellis *et al.*(1968), these plains (Fig. 7) are covered with lacustrine silts and clays. Reconnaissance work in the Sjovold Site area suggests that some of these lacustrine beds of Ellis *et al.* (1968) are either covered with wind - blown silt and sand blankets or are entirely eolian.

4.8 Flood Plains

Flood plains occur at the mouth of the tributary valley at the Sjovold Site and under the Outlook Golf Course (Fig. 7). The sediments in

the flood plain at the Sjovold Site are composed of up to 21 feet (6.5 m) of interbedded gravel, sand, silt, clay and organic material (Drawing 0050-001-01).

4.9 Landslides

Elongated, arcuate, slumped ridges occur in the valley slopes along the South Saskatchewan River (Fig. 7). They will be discussed in more detail in the chapter on "Geologic Processes".

4.10 Eroded Areas

Eroded areas occur in the banks of the South Saskatchewan River Valley and its tributaries (Fig. 7). The sediments are composed of colluvium including slumped material and alluvium at the base of slopes where river ice has also pushed up material from the river bed.

4.11 South Saskatchewan River

Beneath the South Saskatchewan River, more than 30 m of sand occurs (Fig. 8; Scott, 1971, p. 27). The top of this fill exhibits a braided pattern with sand bars emerging during low stages of the river (Fig. 3B,4B). Although the upper part of the fill is alluvial, it is conceivable that the lower, older part of the fill may be glacial or proglacial when the valley functioned as a spillway draining southward.

5. STRATIGRAPHY OF THE SJOVOLD SITE

5.1 Introduction

In ascending order the Sjovold Site is underlain by till, Alluvium, Alluvial and Eolian sediments, and Eolian deposits.

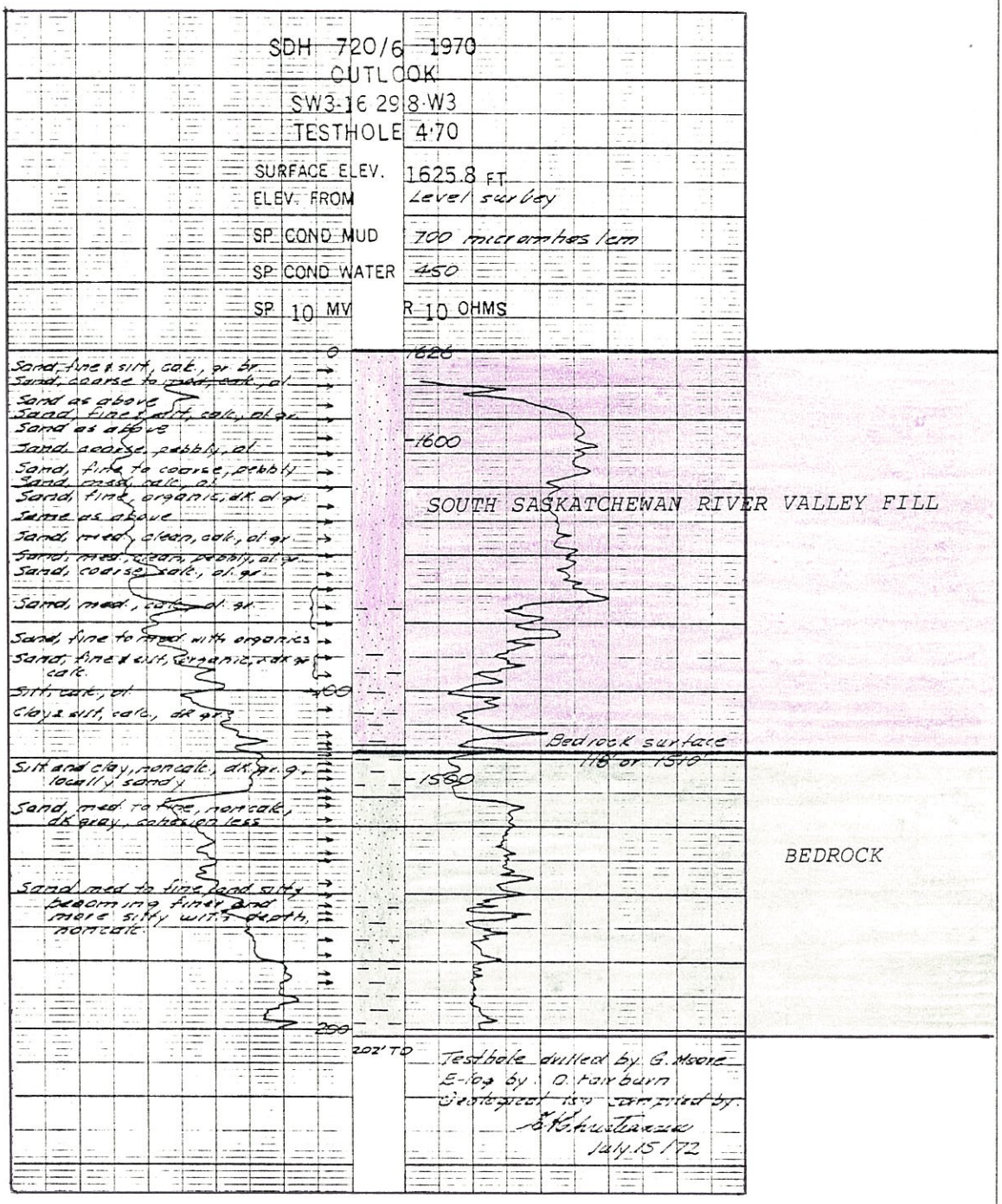


Figure 8. SDH Outlook testhole showing alluvial fill in the South Saskatchewan River Valley. See Figure 7 for location of testhole.

5.2 Till

The Sjovold Site is underlain by more than 26 feet (8 m) of dark gray, clayey, slightly calcareous Till, the upper part of which is jointed and stained to a light - olive brown color. The clayey nature and low carbonate content of this Till along with the olive color of the weathered zone suggest it belongs to the Sutherland Group (Drawing 0050-001-01) as defined by Christiansen (1968b). This Till was taken as the base of exploration for this study.

5.3 Alluvium

The Alluvium lies in the flood plain of the tributary (Fig. 3) between Till and the overlying interbedded Alluvial and Eolian sediments (Drawing 0050-001-01). The upper contact of the Alluvium is taken at the base of the lowest, massive, well-sorted, fine-grained sand which is interpreted as eolian. The Alluvium is composed of up to 17 feet (5 m) of poorly sorted gravels and sands, silts, and clays which is locally carbonaceous and wood bearing (Appendix 1, Augerhole 1).

5.4 Alluvium and Eolian Sediments

Between the basal Alluvium and the surficial Eolian deposits is a zone which is interpreted as interbedded Alluvial and Eolian sediments. The lower contact is marked by the base of the lowermost massive, well-sorted, fine-grained sand, and the upper contact is marked by the top of the uppermost clayey silt bed (Figs. 9,10). These sediments are composed of silty, fine-grained, massive sand interbedded with sandy and clayey silt beds. It is possible that some of the sandy silt is also eolian. The uppermost silt bed in the Sjovold excavation (Fig.10), however, is too clayey to be eolian. At the Sjovold Site most of Alluvial and Eolian zone is eolian and becomes more so toward the top of the exposure.

Figure 9. Sjovold Site. H.E. Hendry investigating Alluvium and interbedded Alluvial and Eolian sediments. D.W. Anderson (right) and J.G. Ellis studying the Eolian deposits, and I.G. Dyck, Archeologist in-charge looking on from top of site.

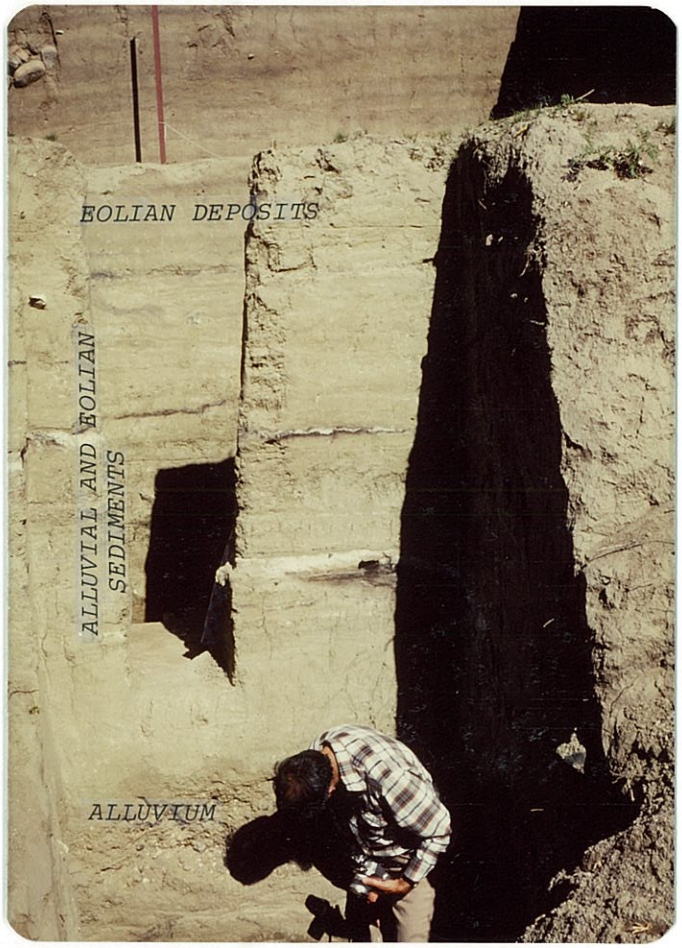


Figure 10. Sjovold Site. H.E. Hendry investigating alluvial sands and gravels (Alluvium). Notice clayey silt bed separating Alluvial and Eolian sediments from overlying Eolian deposits.

5.5 Eolian Deposits

Eolian deposits extend northward from the Sjovold Site and in a ridge extending into the flood plain from between Augerholes 8 and 7 to between Augerhole 6 and 5 (Drawing 0050-001-01;Figs. 2,11). The deposits are composed of fine-to very fine-grained massive, silty, well-sorted, grayish brown and dark-grayish brown sand (Fig.10). The lower contact is marked by the top of the uppermost clayey silt bed (Fig. 10).

6. GEOLOGIC PROCESSES

6.1 Introduction

Fluvial erosion and sedimentation, landslides, and eolian deposition are the main process that were or are operative in the vicinity of the Sjovold Site.

6.2 Fluvial Erosion and Sedimentation

Glacial meltwater and postglacial runoff eroded the tributary valley in which the Sjovold Site is located. The South Saskatchewan River changed its direction of flow from south to north when is stood at about 1750 feet (534 m) at the Sjovold Site. Erosion of the valley to this depth was accomplished by the south flowing South Saskatchewan Spillway, whereas erosion below this elevation at the Sjovold Site was accomplished by the north flowing South Saskatchewan River.

According to Figure 8 and Scott (1971), more than 100 feet (30 m) of sand fills the South Saskatchewan River Valley at Outlook and Gardiner Dam. Although the origin of this deep erosion and thick fill in the South Saskatchewan valley is uncertain, it must have taken place prior to the erosion of the tributary valley in which the Sjovold Site is

A

B

Figure 11. Eolian deposits (A) sand dune ridge blocking mouth of tributary valley,(B) sand deflating from sand bars in South Saskatchewan River.

located because this tributary valley bottom is only a few metres below the top of sand fill in the South Saskatchewan River Valley. It is possible that this cut and till predates the last glaciation or that it represents a subglacial cut and fill which took place during the last deglaciation.

The alluvial fill in the tributary valley appears to be related to alluviation of the South Saskatchewan River which acted as a base level for the tributary valley. The alluvial deposits in the interbedded Alluvial and Eolian sediments are believed to have been laid down during ice jamming of the South Saskatchewan River causing flooding of the tributary valley. Such ice jamming along this stretch of the South Saskatchewan River was common prior to the construction of the Gardiner Dam (Don MacRae, personal communication, 1980).

6.3 Landslides

According to Scott (1971), the banks of the South Saskatchewan River exhibit extensive areas of landslides. These landslides form a series of elongated, arcuate ridges that parallel the river. The failure surfaces according to Scott (1971) invariably extend into the underlying bedrock of the Bearpaw Formation, and thus both bedrock and glacial deposits are included in the landslides.

To the north and south of the Sjovold Site, extensive landslide ridges parallel the South Saskatchewan River (Fig. 7). This figure also suggests the till and bedrock beneath the Sjovold Site were affected by landslides which may account fo the lower elevation of the bedrock surface than expected.

6.4 Eolian Activity

Massive, silty very fine - to fine grained sands with buried A-horizons are indicative of eolian deposits (Fig. 9). Where these deposits occur on top of cliffs along valleys, they are called cliff - top deposits by David (1970) who considers them to be wind - blown sediments derived from the cliff face. Such deposits occur in exposures along the cliff top of the South Saskatchewan River north of the Sjovold Site. These cliff - top deposits were traced to the Sjovold Site (Drawing 0050-001-01).

Eolian deposits form a well - defined ridge from between Augerholes 8 and 7 to between Augerholes 6 and 5 (Drawing 0050-001-01; Figs. 2,11A). At Augerhole 7 (Fig. 2), the tributary creek was blocked by the sand ridge. Although some of these wind - blown, eolian deposits may have been derived from the cliffs as David (1970) concluded, it is thought that most of these deposits at the Sjovold Site were derived from the braided South Saskatchewan River bottom during low water stages. During my visits to the site on October 1, 1980, sand was being deflated from the sand bars in the river (Fig. 11B). It is further thought that this well - developed sand ridge may be the result of the 5 - mile (8 km) sweep that southeast winds would have to deflate sand from the sand bars (Fig. 1) during low river stages. Such a direction of deflation would explain the northward growth of this ridge across the tributary valley (Drawing 0050-001-01, Fig. 2).

7. GEOLOGIC HISTORY

7.1 Introduction

The geologic history of the Sjovold Site will be considered for three intervals of time: (1) history of deglaciation of the site between about 13,000 and 10,000 years ago, (2) postglacial history between about 10,000 and 4,500 years ago, and (3) postglacial history, 4,500 years ago to present.

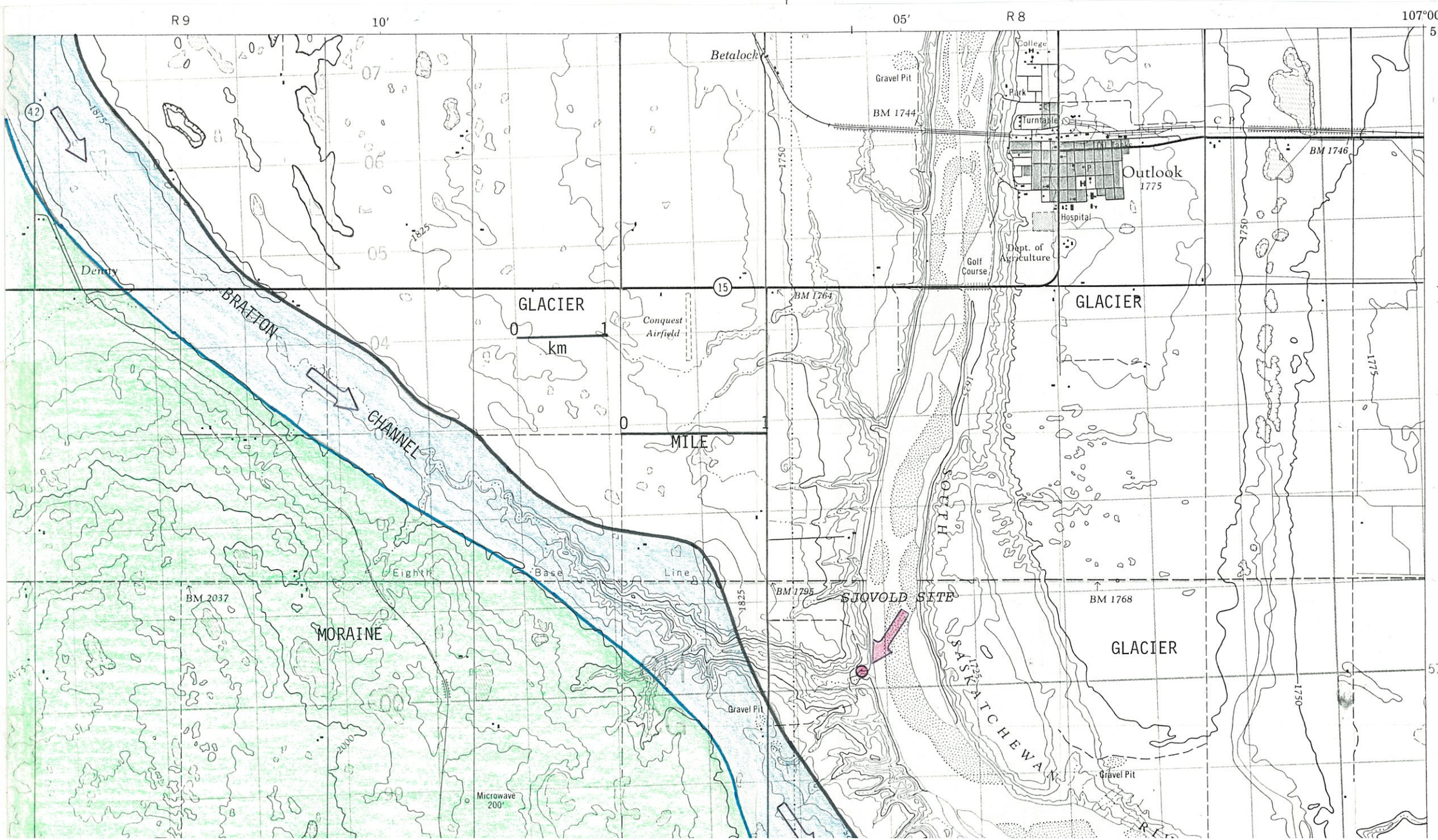
7.2 History of Deglaciation, 13,000 to 10,000 years ago

7.2.1 Introduction

The history of deglaciation of the Sjovold Site is shown in three phases (Figs. 12,13,14). The regional history of deglaciation, including the Sjovold Site was taken from Scott (1971) and Christiansen (1979).

7.2.2 Phase 1

According to Scott (1971), the Bratton Channel, which initiated the formation of the tributary valley at the Sjovold Site, was formed when the glacier stood immediately north of the channel (Fig. 12). According to Christiansen (1979), Phase 1 (Fig. 12) took place before 12,500 years ago probably about 13,000 years ago. At the Sjovold Site, the Bratton Channel was eroded to an elevation of about 1850 feet (564 m) during Phase 1 (Fig. 12). As the glacier retreated northward and Lake Saskatchewan fell (Fig. 15), the Bratton Channel was abandoned as a glacial spillway, and erosion by postglacial runoff was initiated at the Sjovold Site.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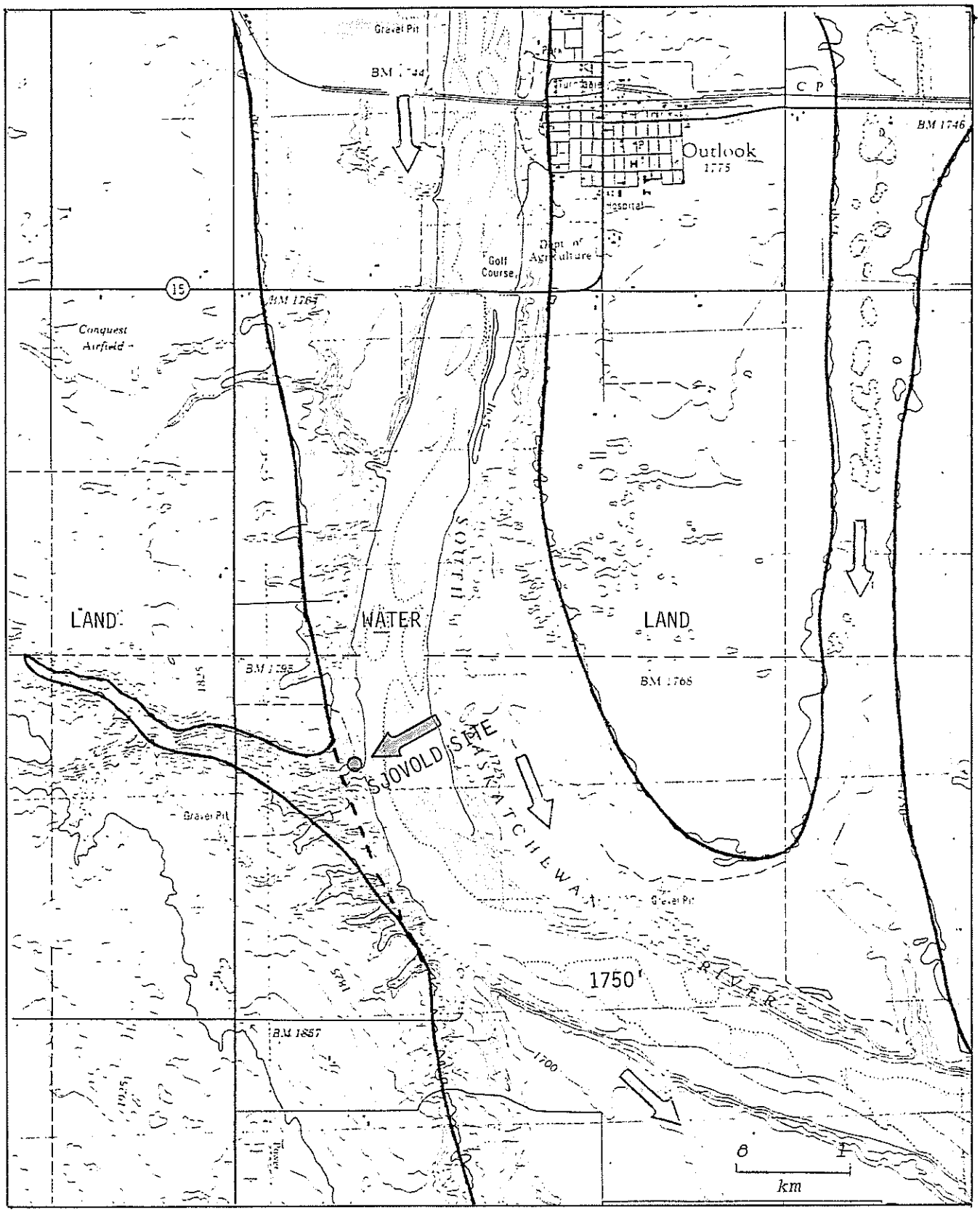

Figure 13. Phase 2 of the history of deglaciation of the Sjovold Site. South Saskatchewan Spillway is draining into the Qu'Appelle Spillway. Base map from Energy, Mines and Resources, Ottawa.

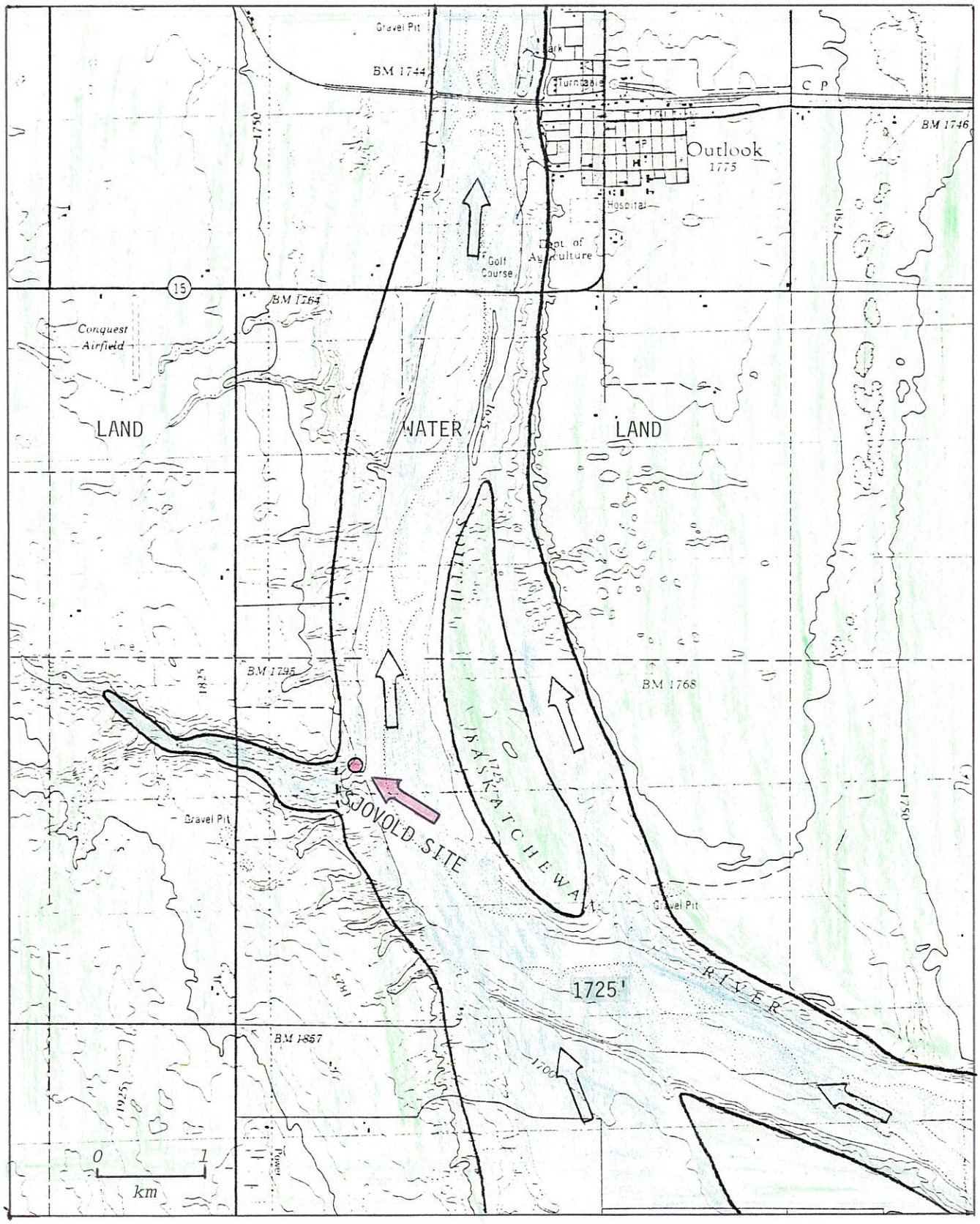

Figure 14. Phase 3 of the history of deglaciation of the Sjovold Site showing the South Saskatchewan River coming into existence. Base map from Energy, Mines and Resources, Ottawa.

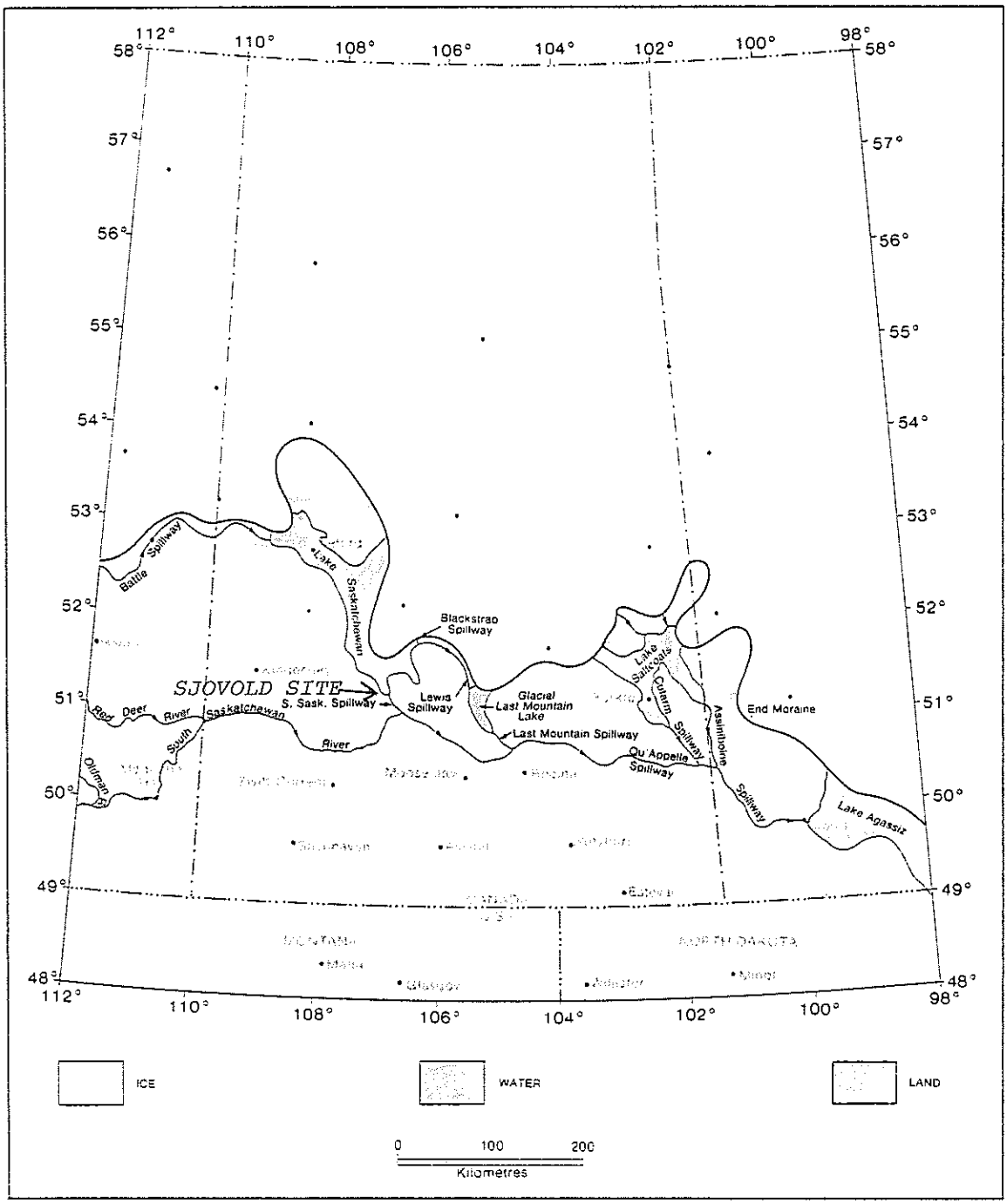

Figure 15. Phase 5 of the history of deglaciation about 12,500 years ago. From Christiansen (1979).

7.2.3 Phase 2

Between Phases 1 and 2(Figs. 12,13), the glacier stood at about the position shown in Figure 15. During this interval, the South Saskatchewan Spillway was eroded to an elevation of about 1750 feet (534 m) at the Sjovold Site (Fig. 13). At this time as was the case during Phase 1 (Fig. 12), Lake Saskatchewan drained southward through the South Saskatchewan Spillway into the Qu'Appelle Spillway (Fig. 15).

The outwash plain east of the South Saskatchewan River (Fig. 7) was formed between Phases 1 and 2 (Fig. 12,13),and dune activity was initiated at this time. As the glacier retreated, glacial lake silts and clays were laid down in Lake Saskatchewan. As Lake Saskatchewan fell to 1750 feet (534 m, Fig. 13), some of these lacustrine sediments were undoubtedly covered by wind-blown silts derived from the outwash deposits and sand bars which probably existed in the river at that time.

7.2.4 Phase 3

Between Phases 2 and 3 (Figs. 13,14), the south-flowing South Saskatchewan Spillway (Fig. 13) was abandoned,and the north-flowing South Saskatchewan River was initiated at the Sjovold Site (Fig. 14). This change in direction of the river took place between elevations of 1750 and 1725 feet (534, 526 m) at the Sjovold Site (Figs. 13,14). When the South Saskatchewan River started to erode below 1700 feet (518 m, Fig. 14), the channel east of the present river east of the Sjovold Site was abandoned, and its sand was reworked into dunes.

The South Saskatchewan River continued to downcut as Lake Saskatchewan and Lake Agassiz fell (Christiansen, 1979, Fig.16-18) until about

10,000 years ago (Fig. 16). As the South Saskatchewan River downcut, the tributary valley, in which the Sjovold Site is located, was eroded.

If the South Saskatachewan River Valley was eroded to the base of its present fill at this time such erosion and subsequent filling must have taken place before the tributary valley could be eroded. It seems more likely, however, that the alluvial fill in the South Saskatchewan River Valley predates the last deglaciation and that the base of the Alluvium in the tributary valley (Drawing 0050-001-01) marks the approximate depth to which the South Saskatchewan River Valley was eroded during the last deglaciation.

7.3 Postglacial History, 10,000 to 4,500 years ago

Sediments recording this interval of time were not identified at the Sjovold Site. It is thought that the tributary valley was either being continually eroded during this interval or that sediments were not being deposited on the tributary valley floor.

7.4 Postglacial History, 4,500 years ago to present

During this interval of time, most if not all of the Alluvium, the Alluvial and Eolian sediments, and the Eolian deposits were laid down at the Sjovold Site (Fig. 17). At the Sjovold Site (Fig. 17), the Alluvium was deposited from about 4,500 to 4,000 years ago, the Alluvial and Eolian sediments from about 4,000 to 2,500 years ago, and the Eolian deposits from 2,500 years ago to present.

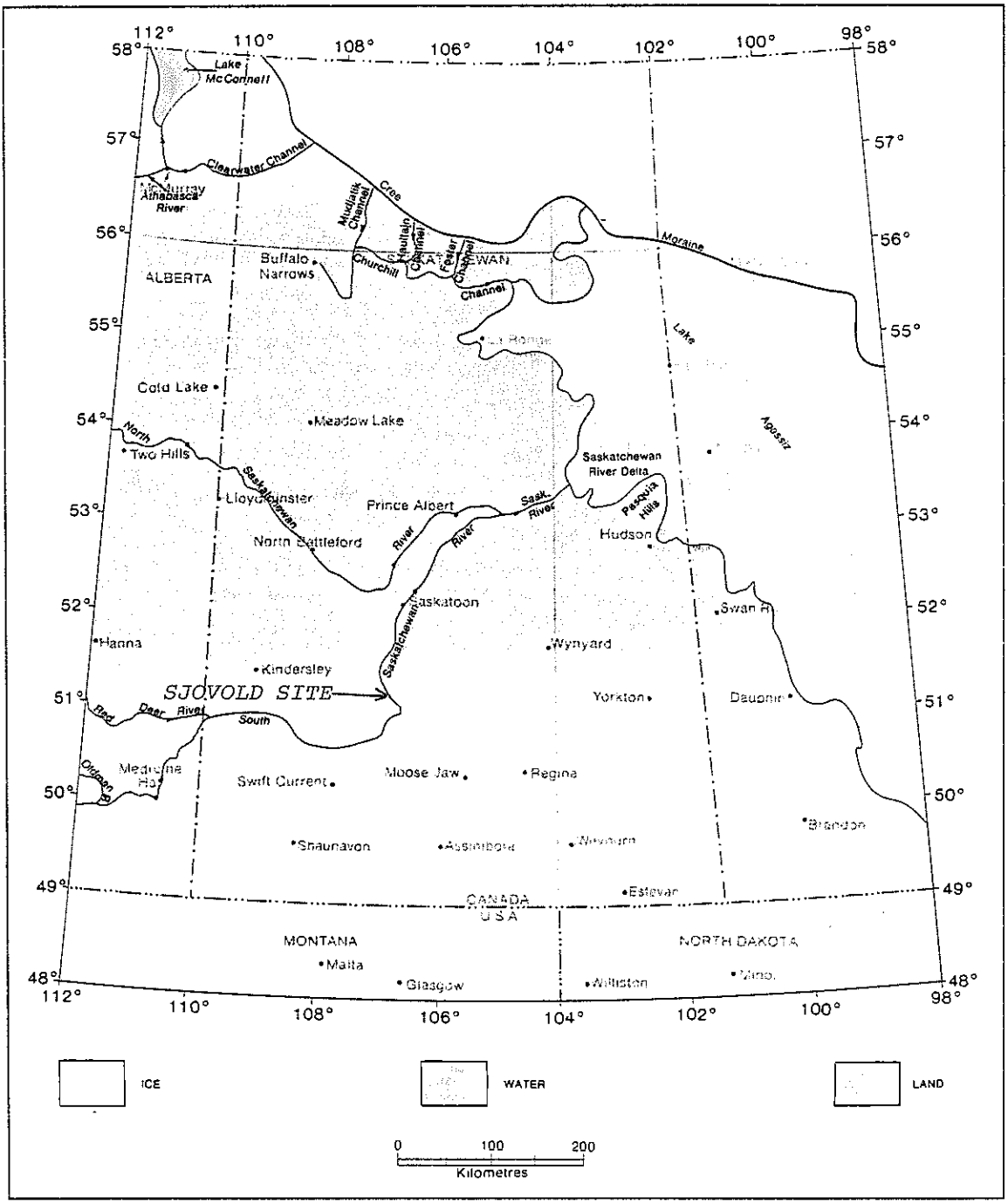

Figure 16. Phase 9 of the history of deglaciation about 10,000 years ago. From Christiansen (1979)

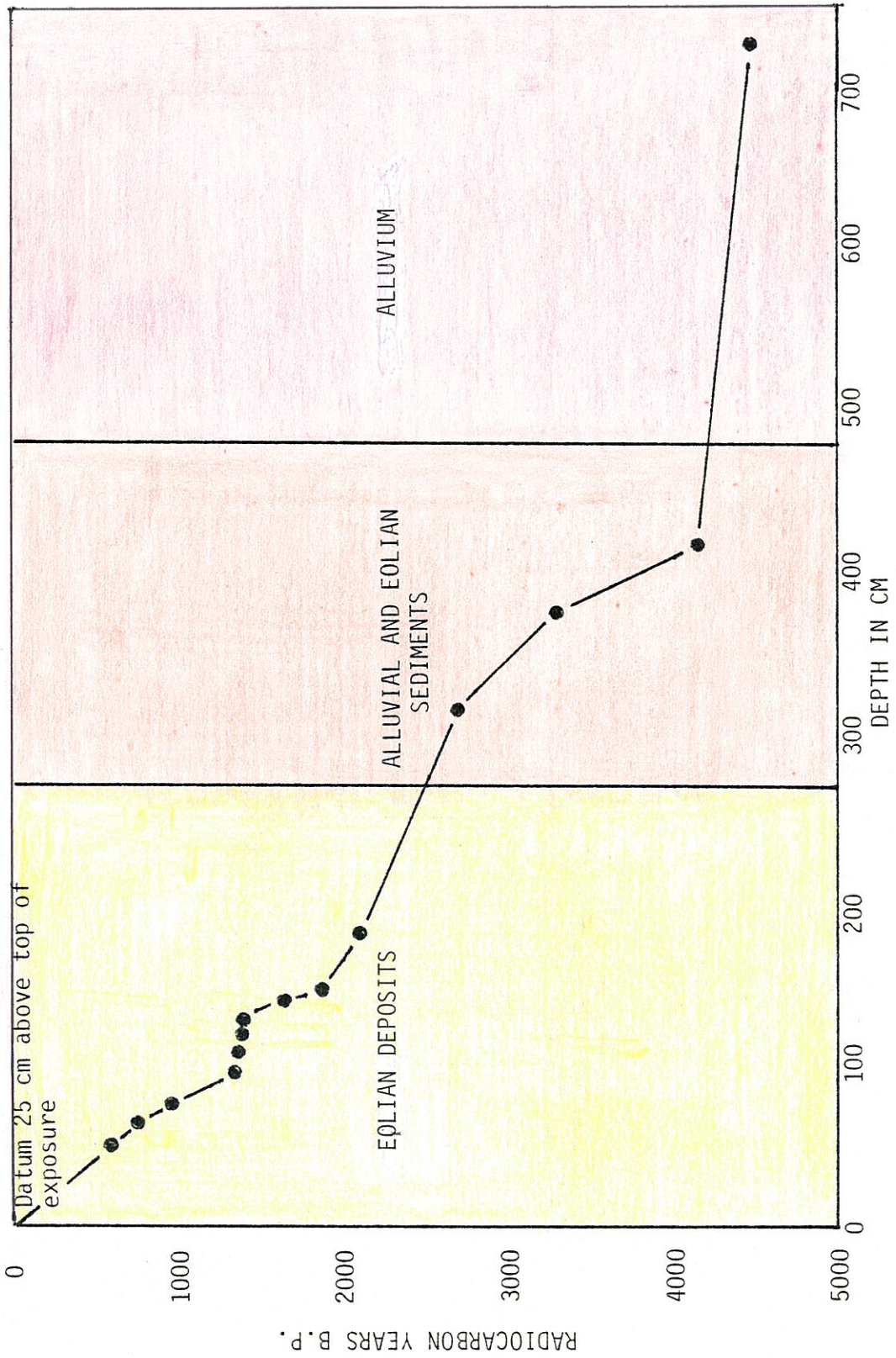

Figure 17. Graph showing relationship between age and depth of sediments at Sjovold Site. See Table 1 for information on radiocarbon dates.

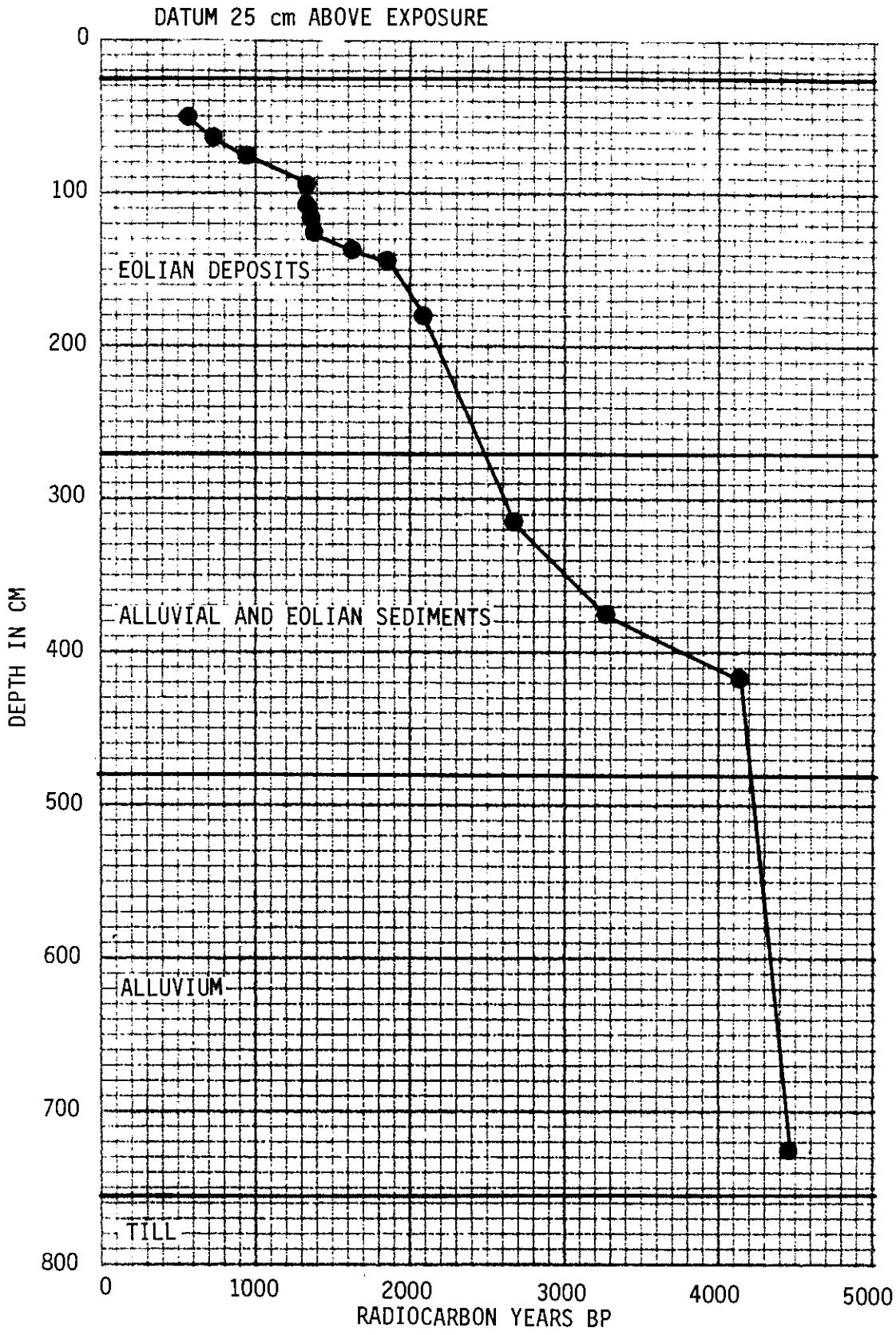

Figure 4.9. Graph showing relationship between age and depth of sediments at Sjovold site. See table 1 for information on radiocarbon dates.

Table 1. Radiocarbon Dates

Sample No.	Depth below Datum* in cm	Age Years B.P.
S - 1757	50	580 ± 190
S - 1758	62	725 ± 190
S - 1759	75	945 ± 190
S - 1760	94	1320 ± 190
S - 1761	102-115	1335 ± 190
S - 1762	117	1375 ± 195
S - 1763	125	1380 ± 190
S - 1764	138	1625 ± 195
S - 1765	144	1855 ± 195
S - 1767	180	2090 ± 165
S - 1768	315	2680 ± 165
S - 1769	375	3275 ± 160
S - 1770	418	4130 ± 205
S - 1979	725	4450 ± 240

* Datum is 25 cm above top of exposure

S - 1757 to 1770 on bone

S - 1979 on wood

Radiocarbon dates provided by I.G. Dyck, Saskatchewan Museum of Natural History

Habitation by humans of the Sjovold Site started when the site was sufficiently above the flood plain so that only occasional floods, probably caused by ice jamming, inundated the site. During these interflood intervals eolian sands were deposited at the site to form the interbedded Alluvial and Eolian sedimentary unit. Human activity continued at the site during the intervals between deposition of the upper Eolian deposits. During these intervals incipient soils developed in these wind-blown sediments.

8. LITERATURE CITED

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Appendix 1. Geologic logs.

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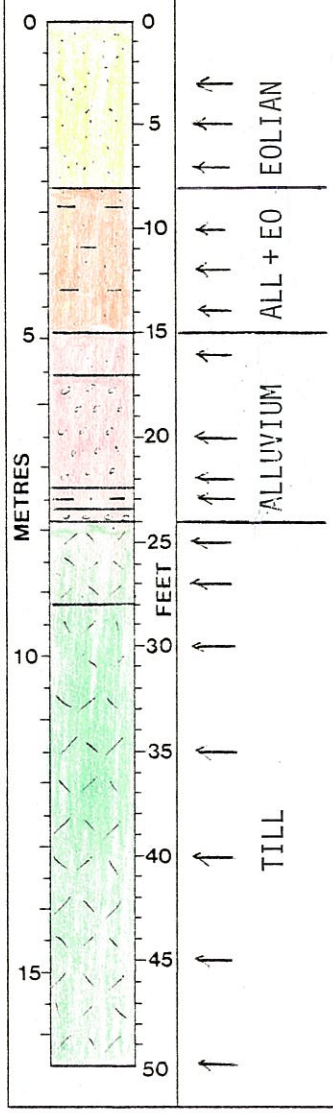
GEOLOGIST-SITE	NAME OF SITE	PROJECT NO.
EAC /	SJCV OLD	0050

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
			23	10	19 80

ELEVATION (M)	SOURCE OF ELEVATION	AERIAL PHOTOGRAPH NO.
	AUGERHOLE	



Sand, v. fine, locally silty, calc., grayish brown to dark grayish brown, massive with white specks

Sand as above but more silty with clayey silt beds

Sand, med to coarse, calc., grayish br.

Gravel, silty and sandy, poorly sorted, calc., lt brownish gray

Silt, v. fine sandy, dark gray (wood)*

Till, calc to s/calc, lt bn gray jointed with rt al br. staining

Till, s/calc to calc, dark gray

Note Tripped auger flight at 5' intervals to 30'

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* S-1979 — 4985 ± 125 years B.P.

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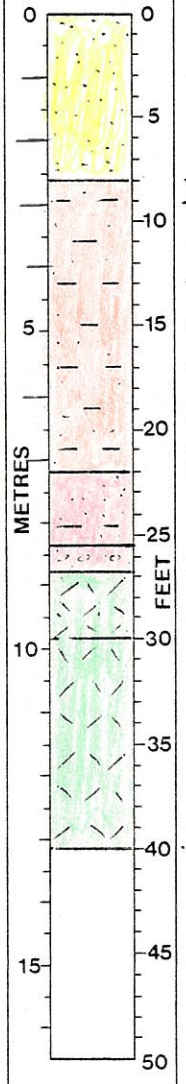
GEOLOGIST-SITE		NAME OF SITE	PROJECT NO.
EAC	Z	SJOVOLO	0050

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
		AUGERHOLE	25	10	19 80

ELEVATION (M)		SOURCE OF ELEVATION	AERIAL PHOTOGRAPH NO.	



EOLIAN

Sand, v. fine, locally silty, greyish br., massive, friable, sl. indurated where silty, with white specks

ALLUVIAL + EOLIAN

Silt, sandy, sl. calc., lt. br. gray interbedded with sand, v. fine, fine, med, and coarse at base, lt. br. gray, white calcite concretions are common in silt units

ALL.

Sand, fine to coarse, rded to well rded, mottled with silt interbed

Gravel, coarse to v. coarse sandy, stained at base

TILL

Till, calc. to sl. calc., gray and olive gray mottled

Till, sl. calc., dark gray

Note: Tripped auger flights every 5'

E. A. Christiansen
SIGNATURE

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PAGE 1 OF 1

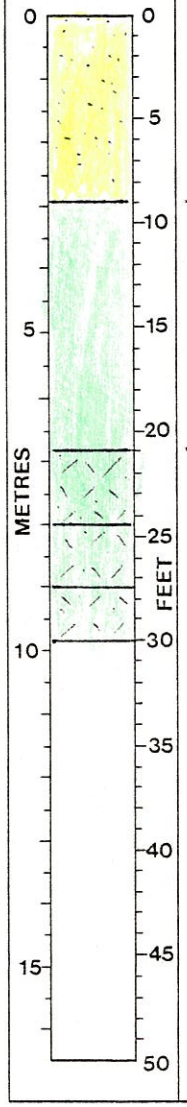
GEOLOGIST-SITE		NAME OF SITE	PROJECT NO.
EAC	3	SJOVOLD	0050

N T S		UTM - ZONE	UTM-EASTING (M)	UTM-NORTHING (M)

1/4	LSD	S	T	R	M	LATITUDE		N,S
					W	°	'	

LONGITUDE		E,W	TYPE OF OBSERVATION	DAY	MO.	YEAR
°	'		AUGERHOLE	25	10	19 80

ELEVATION (M)		SOURCE OF ELEVATION	AERIAL PHOTOGRAPH NO.	



Sand, v. fine, calc, with white specks of calcite at base, lt. br. gray, locally silty, brown staining at 6.5', massive, friable or sl. indurated

Sand, silty, with coarse sand float, poorly sorted, st. calc. with specks of white calcite, gray and yel. br. to dark yel. br., carbonaceous at top and bottom and at 19'

Till, calc. to st. calc., grayish brown, soft, unstained

Till, calc., lt. gray and lt. olive brown, harder than above

Till, sl. calc., clayey, gray and olive gray with lt. ol. br. staining

* Upper carbonaceous zone sample by Darwin Anderson, Sask. Envt. Fed.

Note: Tripped augerflights every 5'

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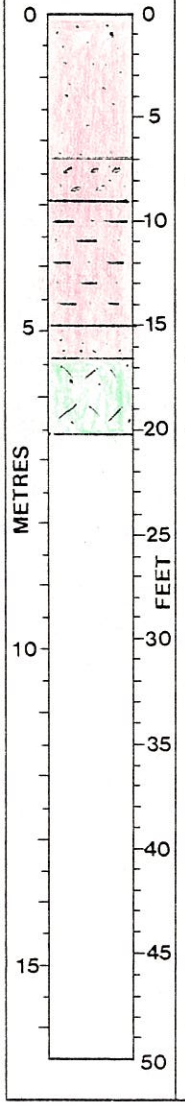
GEOLOGIST-SITE		NAME OF SITE	PROJECT NO.
EAC	4	SJOVOLD	0650

N T S		UTM - ZONE	UTM-EASTING (M)	UTM-NORTHING (M)

1/4	LSD	S	T	R	M	LATITUDE			N,S
					W	°	'		

LONGITUDE			E,W	TYPE OF OBSERVATION	DAY	MO.	YEAR
°	'			AUGERHOLE	25	10	19 80

ELEVATION (M)		SOURCE OF ELEVATION	AERIAL PHOTOGRAPH NO.	



Sand, fine to coarse, mainly med., grayish br. with olive br. staining at 5'

Gravel, lt. br. gray

Silt, sl. calc., lt gray, gray, and dk. gray, carbonaceous, mottled with el. gray at 12'

Sand, silt, and pebble float, grayish br.

Till, sl. calc. grayish br. becoming gray and olive gray, mottled.

Note: Tripped augers flights every 5'

E.A. Christiansen
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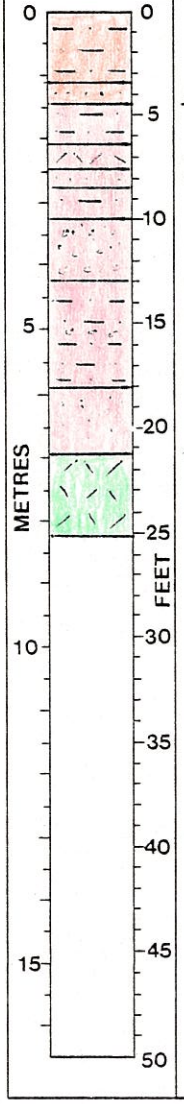
GEOLOGIST-SITE		NAME OF SITE	PROJECT NO.
EAC	S	SJOVOLD	0050

N T S		UTM - ZONE	UTM-EASTING (M)	UTM-NORTHING (M)

1/4	LSD	S	T	R	M	LATITUDE		N,S
					W	°	'	

LONGITUDE		E,W	TYPE OF OBSERVATION	DAY	MO.	YEAR
°	'		AUGERHOLE	23	10	19 80

ELEVATION (M)		SOURCE OF ELEVATION	AERIAL PHOTOGRAPH NO.	



Silt, sandy, calc., grayish brown
Sand, v. fine, sl. calc., grayish br., massive
Silt, sand, pebble float, grayish br. stained
Till, calc. to sl. calc., gray
Sand, silt, and pebbles, carb. underlain by silt, gray
Gravel, gray
Silt, calc., gray, locally with it'el. br. staining, gravel layer at 16', locally with pebble float, carbonaceous
Sand, silty, with pebble float, lt br. gray and lt yel. br., carbonaceous
Till, noncalc. to sl. calc., gray and dk gray

Note: Tripoded auger flights every 5'

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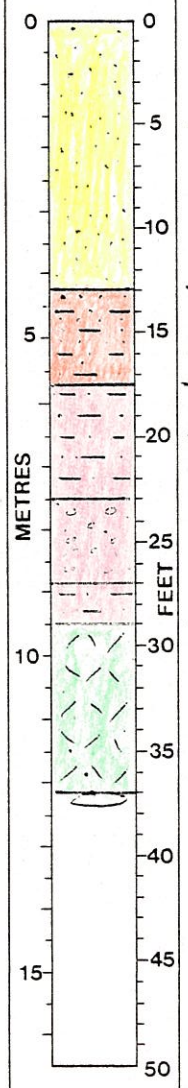
GEOLOGIST-SITE		NAME OF SITE	PROJECT NO.
EAC	6	SJOVOLD SITE	0050

N T S		UTM - ZONE	UTM-EASTING (M)	UTM-NORTHING (M)

1/4	LSD	S	T	R	M	LATITUDE		N,S
					W	°	'	

LONGITUDE		E,W	TYPE OF OBSERVATION	DAY	MO.	YEAR
°	'		AUGERHOLE	26	10	19 EC

ELEVATION (M)		SOURCE OF ELEVATION	AERIAL PHOTOGRAPH NO.	



sand, fine to v. fine with some coarse at base, calc., lt br. gray to grayish br., locally silty and dark grayish brown

sand and silt interbedded, calc., locally carbonaceous, lt br. gray to grayish br. with lt rd br. staining at 18 to 20', gray at base and more silty

Gravel, gray, clean

Silt, sandy, calc., gray

Till, sandy, calc., pale olive and gray with olive staining with poorly sorted, pebbly olive sand

Unable to drill deeper because of rocks

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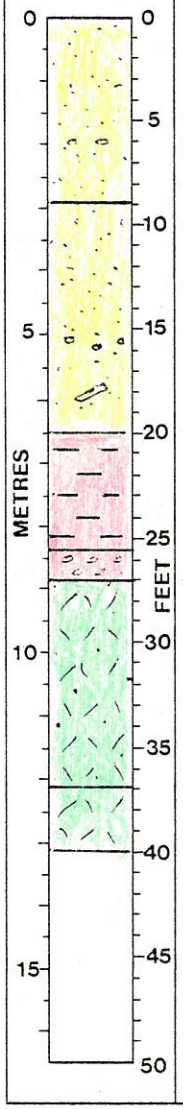
GEOLOGIST-SITE		NAME OF SITE	PROJECT NO.
EAC	7	SJOVOLD	0050

N T S		UTM - ZONE	UTM-EASTING (M)	UTM-NORTHING (M)

1/4	LSD	S	T	R	M	LATITUDE		N,S
					W	°	'	

LONGITUDE		E,W	TYPE OF OBSERVATION	DAY	MO.	YEAR
°	'		AUGERHOLE	9	11	19 80

ELEVATION (M)		SOURCE OF ELEVATION	AERIAL PHOTOGRAPH NO.	



EOLIAN

Sand, fine to v. fine, lt br. gray to grayish br.

Sand as above with calc. material + pebbles

Sand, fine to v. fine, grayish brown

Sand, v. fine, silty, sl. calc. with white specks, grayish brown

Sand to v. fine with coarse sand float

Bone

ALL.

Sand, v. fine, silty, lt. br. gray to grayish br.

Clay, silty, sl calc. with white calcite concretions and sand laminae

Gravel, coarse to v. coarse sandy, pale br.

TILL

Till, sl. calc., gray and olive, mottled

Till, sl. calc., gray to dark gray with lt. olive br. staining on joints

Till, sl. calc., dark gray

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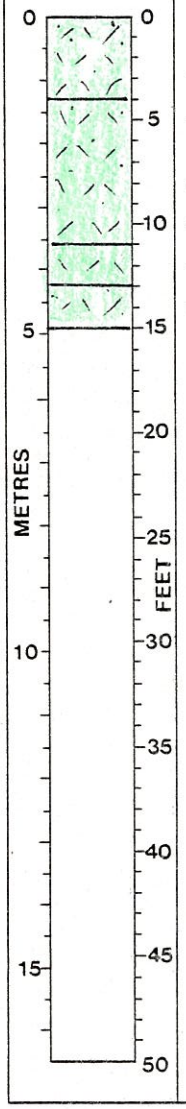
GEOLOGIST-SITE		NAME OF SITE	PROJECT NO.
EAC	E	SIOUOLD	0050

N T S		UTM - ZONE	UTM-EASTING (M)	UTM-NORTHING (M)

1/4	LSD	S	T	R	M	LATITUDE		N,S
					W	°	'	

LONGITUDE		E,W	TYPE OF OBSERVATION	DAY	MO.	YEAR
°	'		AUGERHOLE	09	11	19 80

ELEVATION (M)		SOURCE OF ELEVATION	AERIAL PHOTOGRAPH NO.	



TILL

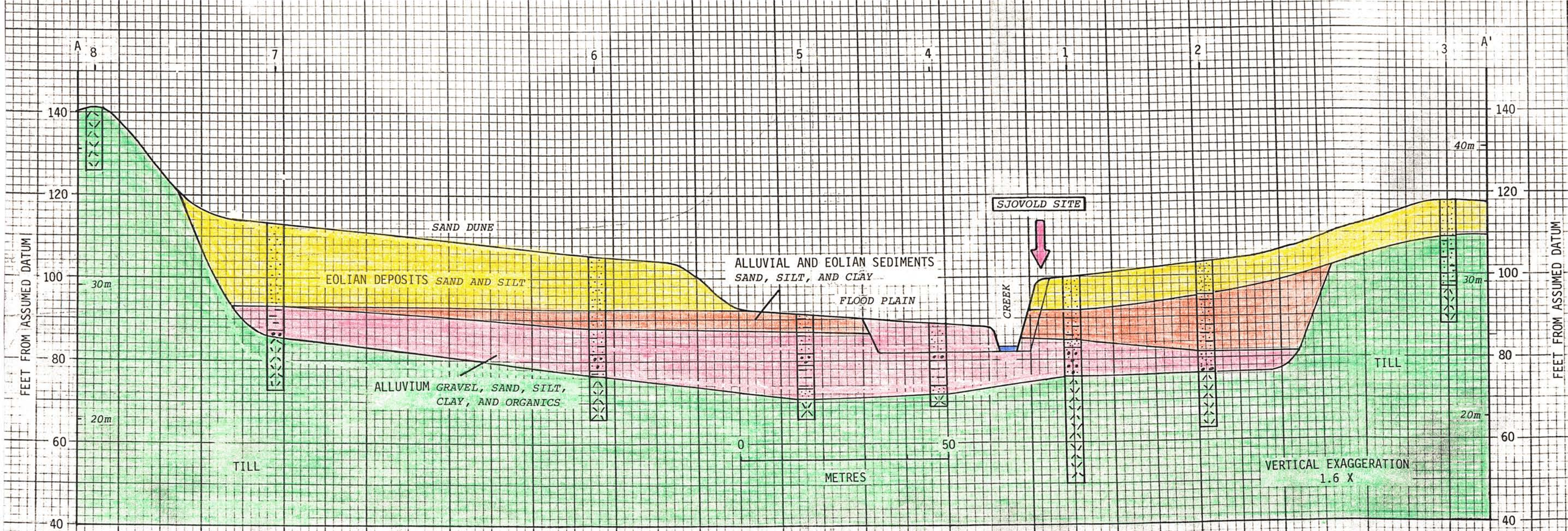
Till, st. calc., lt. br. gray, friable

Till, calc., gyp., grayish br. with disseminated yel. br. staining

Till, as above with less gypsum

Till, calc., olive gray with dark yel. br. staining on joint surfaces

SIGNATURE



SURVEY BY HAND LEVEL AND TAPE

CROSS SECTION A-A' ACROSS THE VALLEY IN WHICH THE SJOVOLD SITE IS LOCATED

SEE FIGURE 2 FOR LOCATION OF CROSS SECTION

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Date JANUARY 22, 1981