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Quaternary Stratigraphy of the Edmonton Map Area, NTS 83H

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Terrain Sciences Department, Natural Resources Division
Alberta Research Council

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I am very appreciative of the efforts of Joe Olic in performing the numerous and tedious laboratory analyses, and of Bonnie Blackwell's work in designing a computerized management system for the analytical data.

The excellent figures and maps are the products of the graphics staff at the Alberta Research Council.

Many of the ideas and concepts for the bedrock topography and drift thickness maps were derived from pre-existing work, in particular that of Richard Stein who evaluated the hydrogeology in parts of the study area. During numerous personal communications, Richard also provided critical comments on the information presented in a number of the figures.

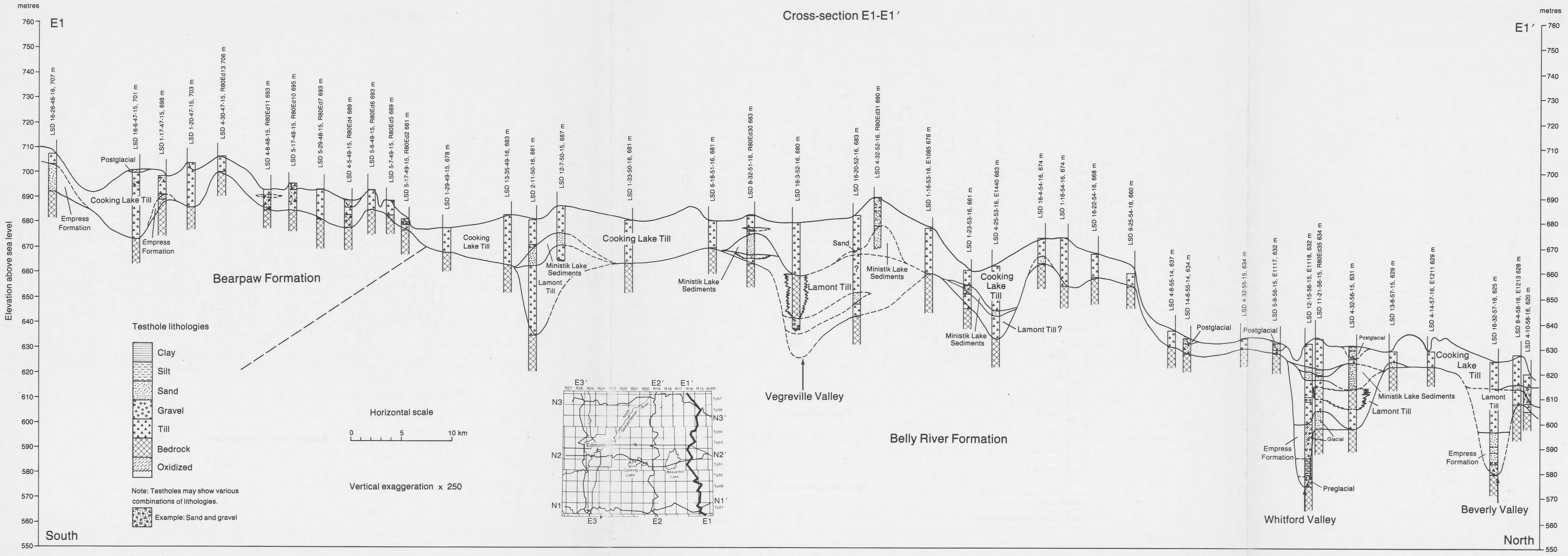
Steve Moran and Mark Fenton of the Terrain Sciences Department provided constructive critiques during the various phases of the project.

Introduction

This report summarizes in map form the results of a regional stratigraphic study of the Quaternary sequence in the Edmonton map area. The objective of the study was to define the three-dimensional distribution of the glacial and nón-glacial lithologic units to assist in the evaluation of the natural resources in the Edmonton region.

The study encompassed an area of about 5800 square miles (9200 square km), extending from Townships 46 to 58, and Ranges 14 to 28, west of the 4th meridian. Field investigations consisted primarily of drilling 84 exploratory dry-auger testholes during the summer periods of 1978 through 1981. Some outcrop sec- tions were examined, mainly in exposures along the North Saskatchewan River and within man-made excavations such as aggregate quarries. Samples of the different lithologic units were analysed for grain size distribution, carbonate content, and petrologic characteristics of the very-coarse-sand fraction. The results of these analyses, as well as the testhole lithologs, are not included in this report but are available at the Terrain Sciences Department of the Alberta Research Council. Other data such as previous geologic reports in the area, water-well drill logs, Alberta Environment exploratory drill logs, and oil ompany structure testhole logs were used to supplement the data collected in this study.

The report contains 27 figures depicting the distribution of the Quaternary geologic units that overlay the pre-glacial bedrock topography. These include: six geologic cross-sections; two 1:250 000 scale maps of the bedrock topography and drift thickness; and nineteen 1:500 000 scale structure contour and isopach maps of the stratigraphic units. Each figure is designed to stand alone and is accompanied by descriptive text and explanatory notes.



Description of Stratigraphic Units

Quaternary

Postglacial and Recent Stratified Sediments: clay, silt, sand, gravel of lacustrine, fluvial and aeolian origin.

Glacial Lake Edmonton Stratified Sediments: lacustrine sand, silt and clay, overlying silt and sand of deltaic origin.

Cooking Lake Till: glacial sediment characterized by a clayey texture; numerous local bedrock fragments and few carbonate fragments in very-coarse-sand fraction.

Elk Island Stratified Sediments: predominantly sand and gravel laying on the surface of the Chipman Till; overlain by the Cooking Lake Till; likely of fluvial origin.

Chipman Till: glacial sediment characterized by a sandy texture; abundant carbonate in the very-coarse-sand, and silt-clay fractions.

Ministik Lake Stratified Sediments: predominantly sand and gravel, minor silt and clay, laying on the surface of the Lamont Till; overlain by the Cooking Lake or Chipman Till.

Lamont Till: glacial sediment characterized by a clayey texture; abundant crystalline and few carbonate fragments in the very-coarse-sand fraction.

Empress Formation: all stratified clay, silt, sand and gravel directly overlying bedrock, and directly overlain by glacial sediment; may include preglacial sand and gravel on the floors of buried valleys and glacial sand and gravel on the bedrock uplands.

Tertiary and Cretaceous

Paleocene and Upper Cretaceous

Paskapoo Formation: grey to greenish grey, thick-bedded, calcareous, cherty sandstone; grey and green siltstone and mudstone; minor conglomerate, thin limestone, coal and tuff beds; Scollard Member: grey, feldspathic sandstone, dark grey bentonitic mudstone; thick coal beds; nonmarine.

Cretaceous

Upper Cretaceous

- North Central Alberta

Wapiti Formation: grey, feldspathic, clayey sandstone; grey bentonitic mudstone and bentonite; scattered coal beds; nonmarine mudstone; thick coal beds; nonmarine.

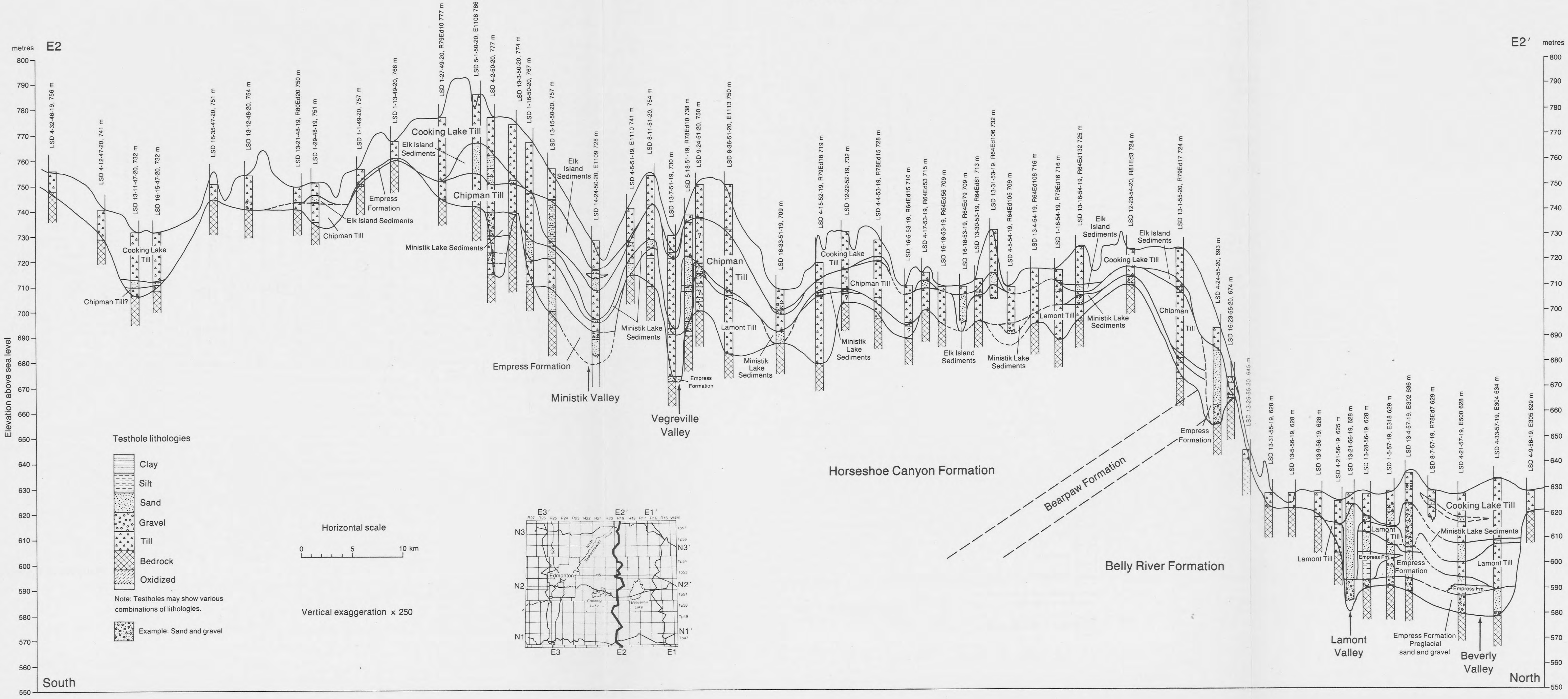
- Northeastern Alberta

Horseshoe Canyon Formation: grey, feldspathic, clayey sandstone; grey bentonitic mudstone and carbonaceous shale; concretionary ironstone beds; scattered coal and bentonite beds of variable thickness, minor limestone beds; mainly nonmarine.

Bearpaw Formation: dark grey blocky shale and silty shale; greenish glauconitic and grey clayey sandstone; thin concretionary ironstone and bentonite beds; marine.

Belly River Formation: grey to greenish grey, thick-bedded, feldspathic sandstone; grey clayey siltstone, grey and green mudstone; concretionary ironstone beds; nonmarine.

Cross-section E2-E2′



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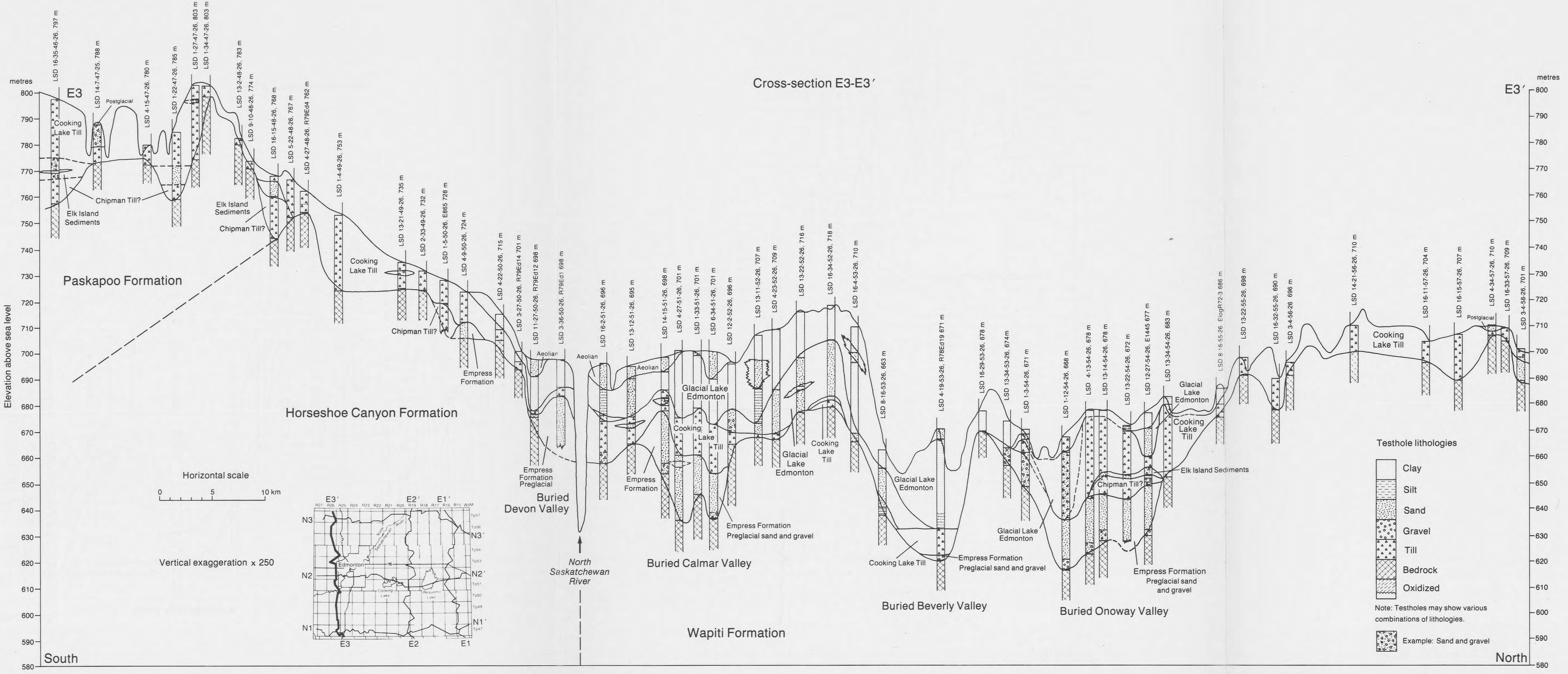

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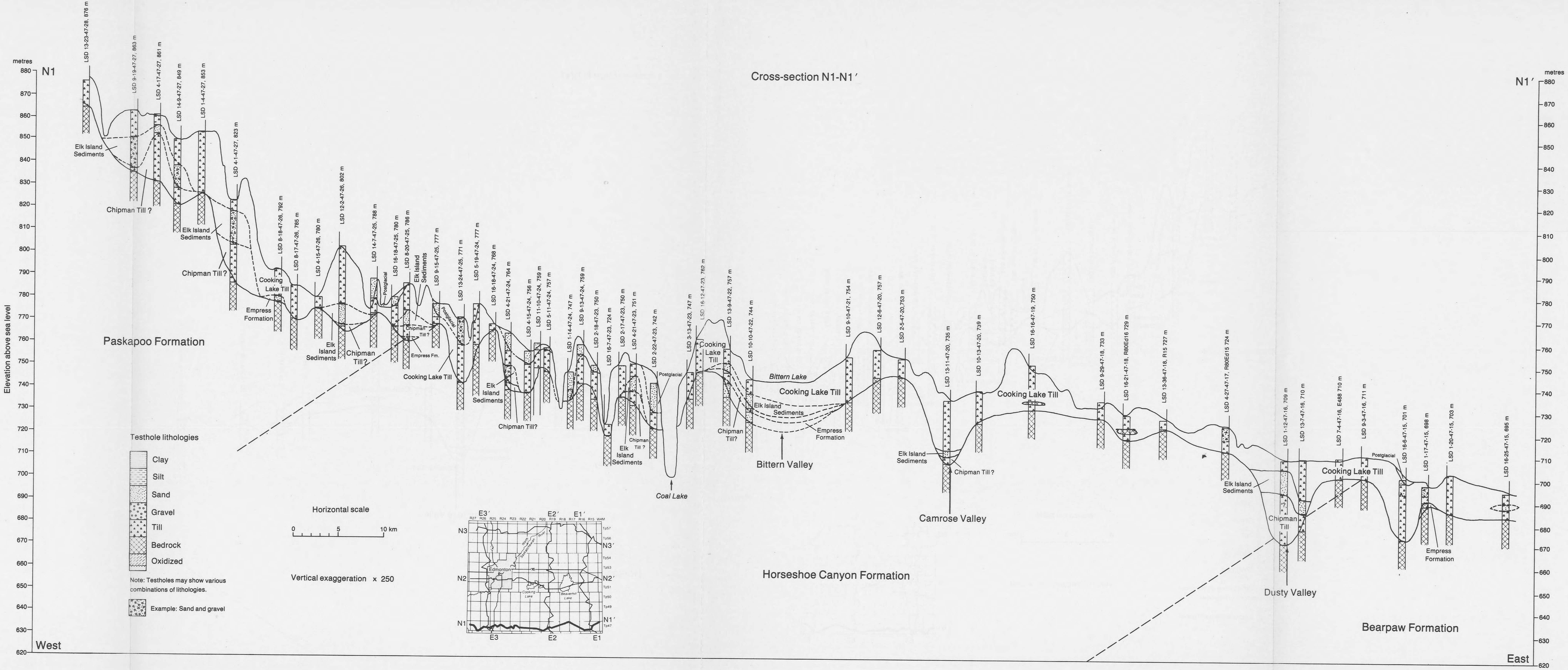

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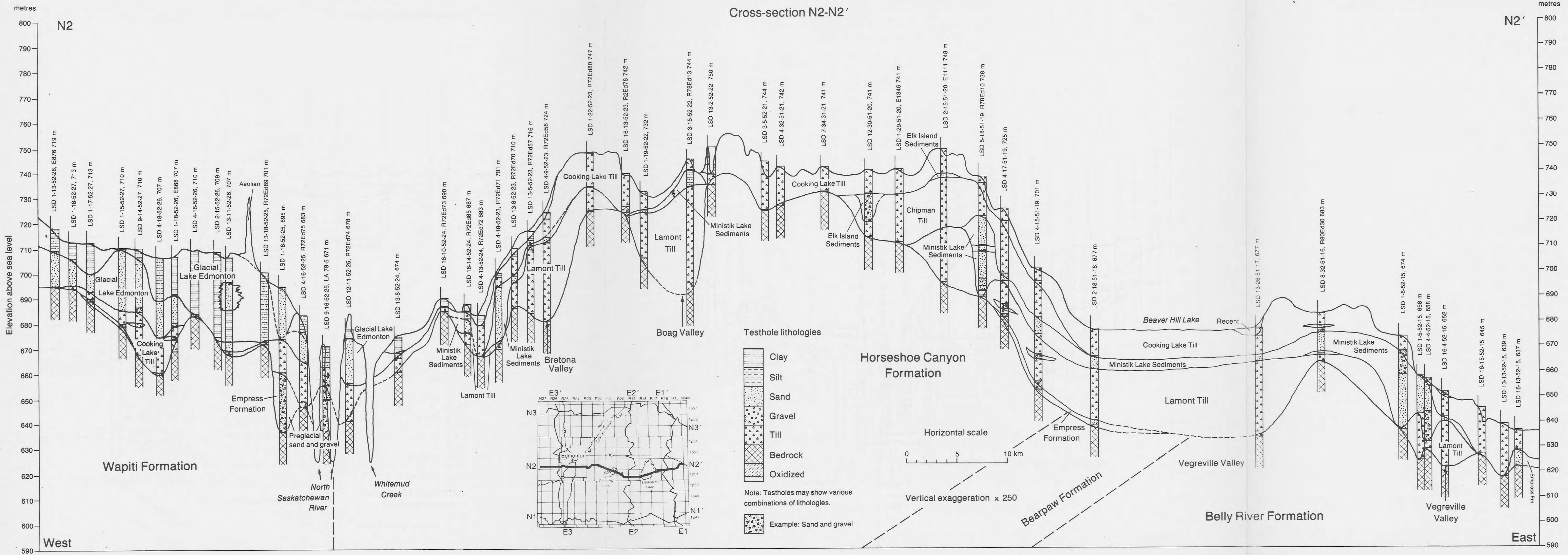

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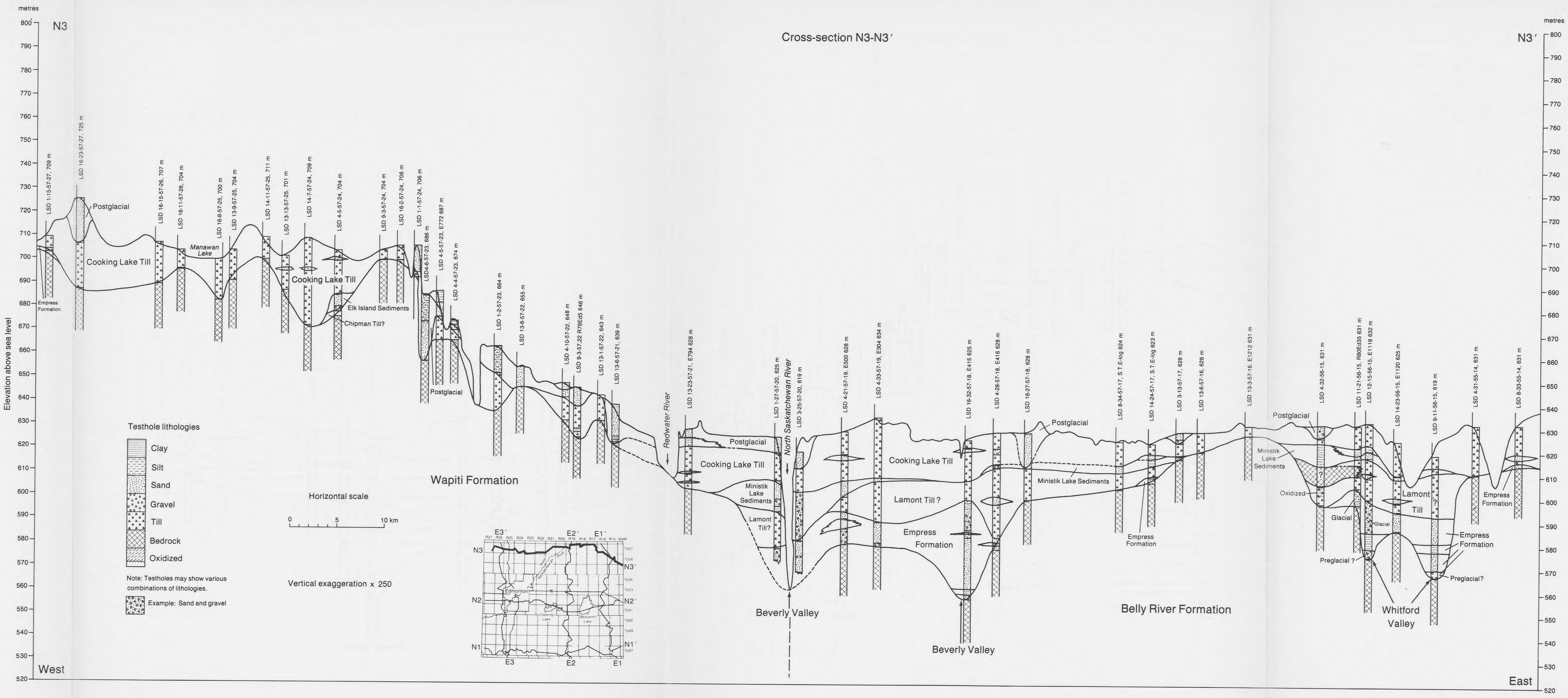
Cross-section N3-N3′



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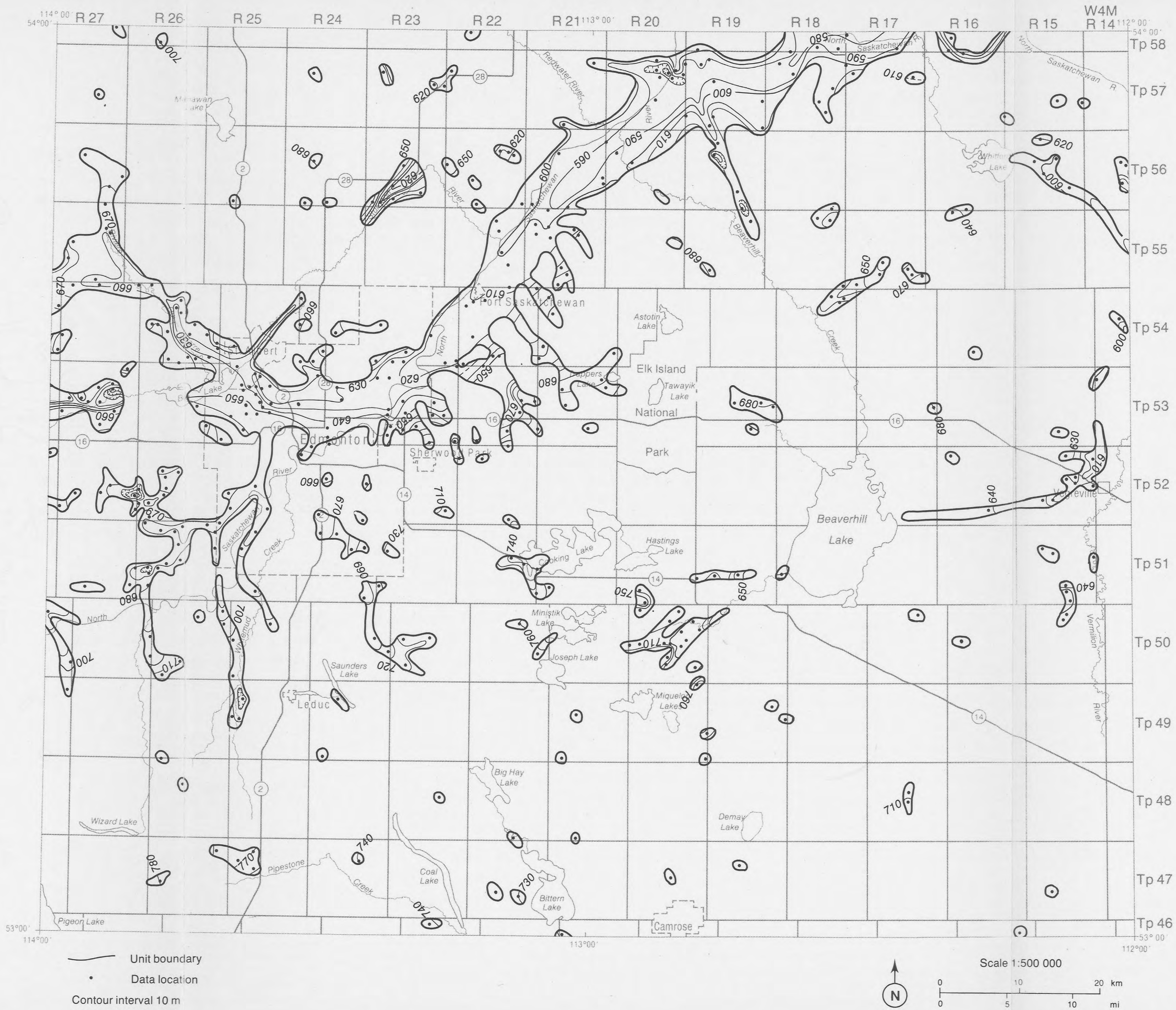


Structure Contours on the Surface of the Empress Formation, Edmonton Map Area, NTS 83H.

Description of Unit

The Empress Formation consists of all stratified sediment that lies on the bedrock surface and that is overlain by glacial sediment (till). In the Edmonton area this includes three lithologic units: a basal unit 1, preglacial sand and gravel; unit 2, silt and clay; unit 3, glacial sand and gravel. These units are not differentiated in the structure contour and thickness maps of the Empress Formation primarily because unit 2 has a limited extent, and because units 1 and 3 cannot be easily differentiated from the borehole data. The reader is directed to the Alberta Research Council open file report 1983-20, titled "Preliminary Report of the Surficial Geology and Quaternary Stratigraphy of Edmonton, map area NTS 83H, 1983" for additional information on the stratigraphic interpretation in the Edmonton map area.

All three units of the Empress Formation have been recognized in the Sand River area northeast of Edmonton, and detailed descriptions can be found in the stratigraphic report from that area (Quaternary Stratigraphy and Surficial Geology of the Sand River map area NTS 73L, by Andriashek and Fenton, 1986). In this study the Empress Formation was mapped primarily from borehole data, though some outcrops near the Edmonton area were also examined. Borehole data for this project was collected from dry-auger drill surveys conducted between 1978 and 1981. Requests for these data should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

Unit 1 of the Empress Formation is composed of sand, or sand and gravel, deposited by preglacial rivers that had their headwaters in the Rocky Mountains and plains region of Alberta. The dominant clasts include metaquartzites, chert, and volcanic rocks, though lesser amounts of carbonate rocks, ironstone, shale, sandstone are also present. Granitic rocks from the Canadian Shield are absent. Preglacial sand and gravel deposits are commonly referred to as 'Saskatchewan Sand and Gravel', though use of this term is discouraged because of the difficulty in differentiating preglacial and glacial sand and gravel in some areas.

Unit 2 of the Empress Formation is composed of bedded silt and clay that overlies preglacial sand and gravel in a few places in the north part of the map area.

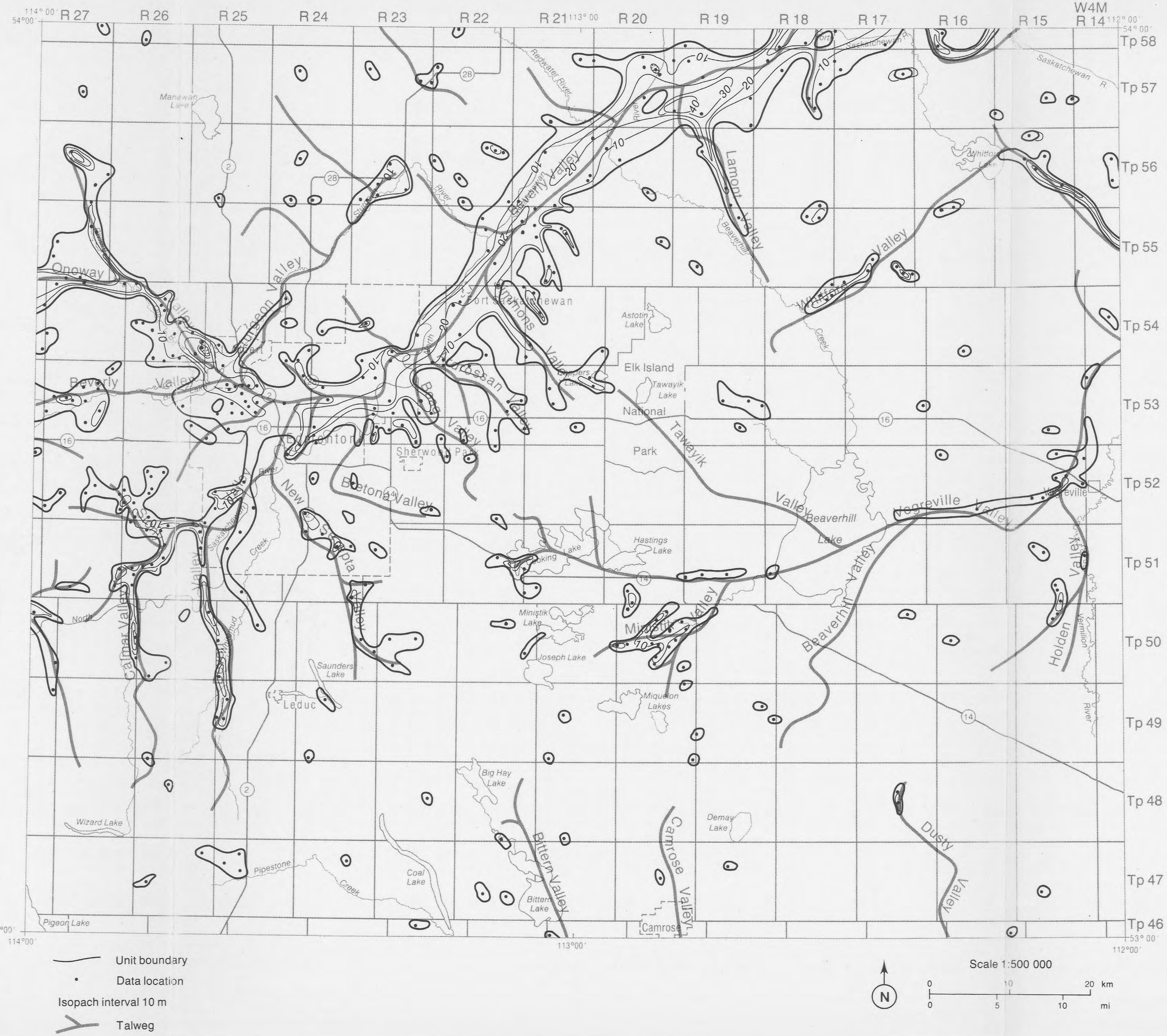
Unit 3 of the Empress Formation consists of sand and gravel deposited during, or since, glaciation. Granitic clasts frm the Canadian Shield are present in the gravel.

Sand and gravel deposits of units 1 and 3 cannot be easily differentiated unless they are separated by clay of unit 2. Even in outcrop it can be difficult to differentiate the units, because in places unit 3 consists almost entirely of preglacial gravel clasts that have been eroded and redeposited by glacial meltwater. Areas where this has occurred are found within buried, high-level terraces of the Onoway and Beverly Valleys west and east of Edmonton.

Distribution and Thickness

Extensive deposits of sand and gravel of the Empress Formation lie within the floors and along the flanks of the Onoway and Beverly valleys. Less extensive deposits are found along the floors of the tributary valleys, including the Stony Valley and its tributaries, the Devon Valley, the headwater of the New Sarepta Valley, the Ardrossan Valley, the Simmons Valley and the Lamont Valley. Discontinuous deposits are also mapped along the floors of the Vegreville and Whitford valleys. In his hydrogeological study of the Vegreville Valley aquifers, Stein (1976) comments that the sand and gravel deposits may have once been more continuous in the channel but that they were eroded during following glaciations. Unit 2 silt and clay deposits are mapped primarily in the northern segment of the Beverly Valley in Tps 56-58, Rgs 17-21. Isolated, thin deposits of the Empress Formation are scattered throughout the map area.

The Empress Formation ranges in thickness from a metre or less on flat-lying bedrock, to as much as 44 m along the talweg of the buried Beverly Valley. Extensive deposits in excess of 20 m thickness are mapped along the buried Beverly, Calmar, Stony and Devon valleys in the west, and Whitford Valley in the east.



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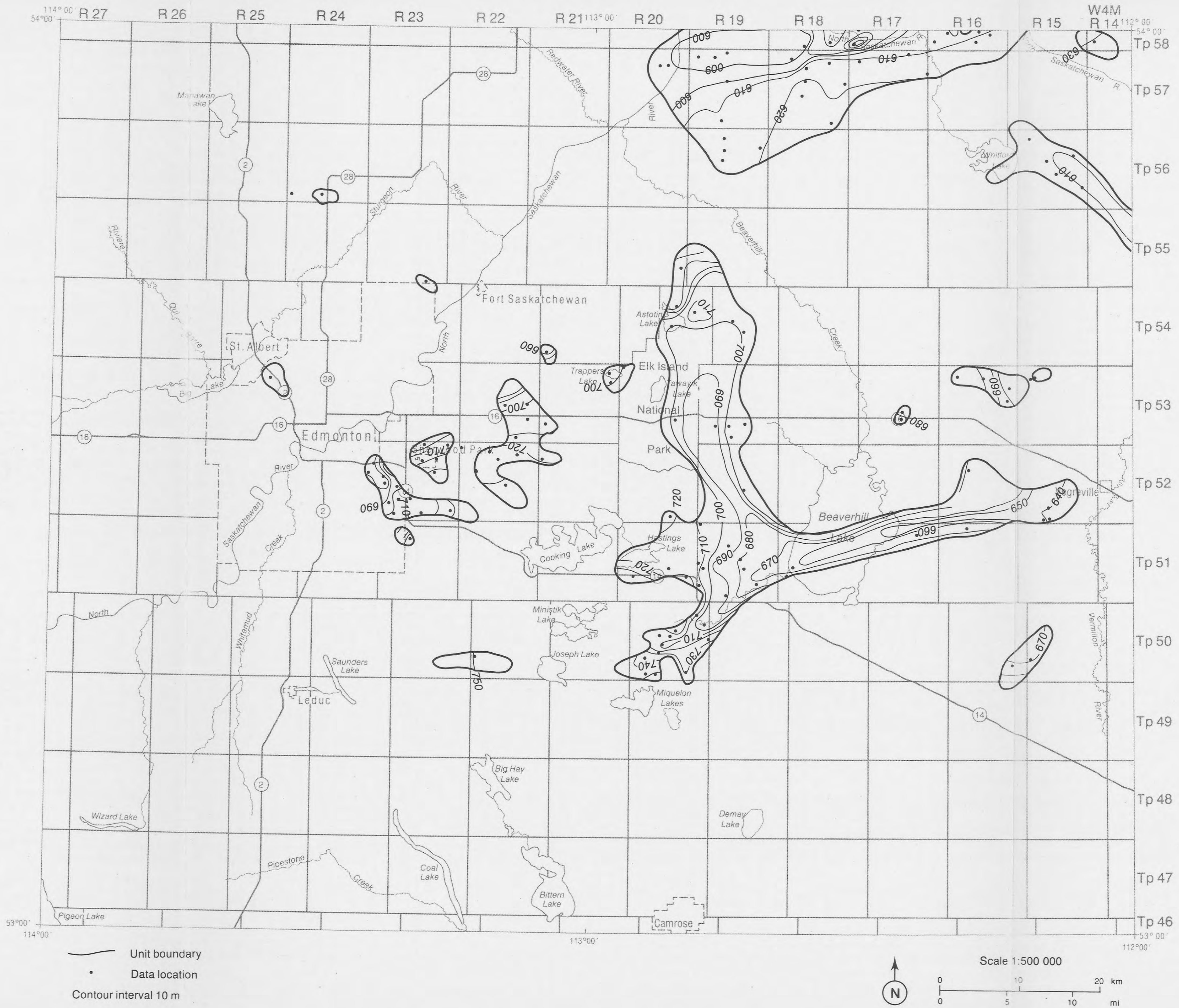

Structure Contours on the Surface of the Lamont Till, Edmonton Map Area, NTS 83H.

Description of Unit

The Lamont Till is the lowest till unit recognized in the stratigraphic sequence. It lies mainly within segments of buried bedrock valleys in the central, northern, and eastern parts of the map area. The till is recognized primarily from analytical data collected from dry-auger borehole surveys conducted between 1978 and 1981. These data include borehole litholog descriptions of the surface materials down to bedrock, as well as a series of laboratory analyses performed on the till units. Requests for these data should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

The properties of the Lamont Till differ within the map area. In the central part of the map area the till lies directly above either the Empress Formation in the buried valleys, or bedrock in the uplands. In this region the till is characterized by a clayey grain size ranging from about 27-38% sand, 22-25% silt, and 36-42% clay. The till becomes progressively more clayey with depth in those places where it lies directly on bedrock. In the eastern and northern part of the map area the Lamont Till is recognized in segments of the buried Beverly, Whitford and Vegreville valleys. Grain size analyses of a few samples from these areas indicate that the till appears to be more sandy, about 42-55% sand, though the clay content is about the same as in the central part of the map area. This sandiness possibly reflects incorporation of sand from underlying Empress Formation in these valleys.

The very-coarse-sand composition of the Lamont Till differs regionally as well. In many places in the central part of the map area where the till overlies bedrock, the composition ranges from about 52-64% Shield rock fragments, 27-36% quartz, 1% quartzite, 0.5-2% Athabasca sandstone, 2-4% limestone, 2-4% dolostone, and 3-6% local bedrock fragments. The amount of local bedrock fragments generally increases with depth. Within the buried valleys in the east, the composition of the very-coarse-sand fraction decreases by about 15% in Shield fragments, and increases by about 5% in quartz and about 4% in bedrock fragments.

Calcareous material makes up 14-22% of the silt-clay fraction of the till. The ratio of calcite to dolomite ranges from about 0.1-0.35, averaging about 0.25. Calcareous material in the till appears to be about 5-6% higher in the central part of the map area compared to the east and north. This may reflect incorporation of the underlying Horseshoe Canyon Formation which contains sandstone and siltstone cemented with calcite.

Resistivity-log responses of the till in the northeast show that the Lamont Till has a lower resistivity than that of the overlying tills. The top of the till is oxidized olive-brown in a few places within the Whitford, Boag and Ardrossan valleys east of Edmonton. Elsewhere, the till has an unoxidized dark gray color.

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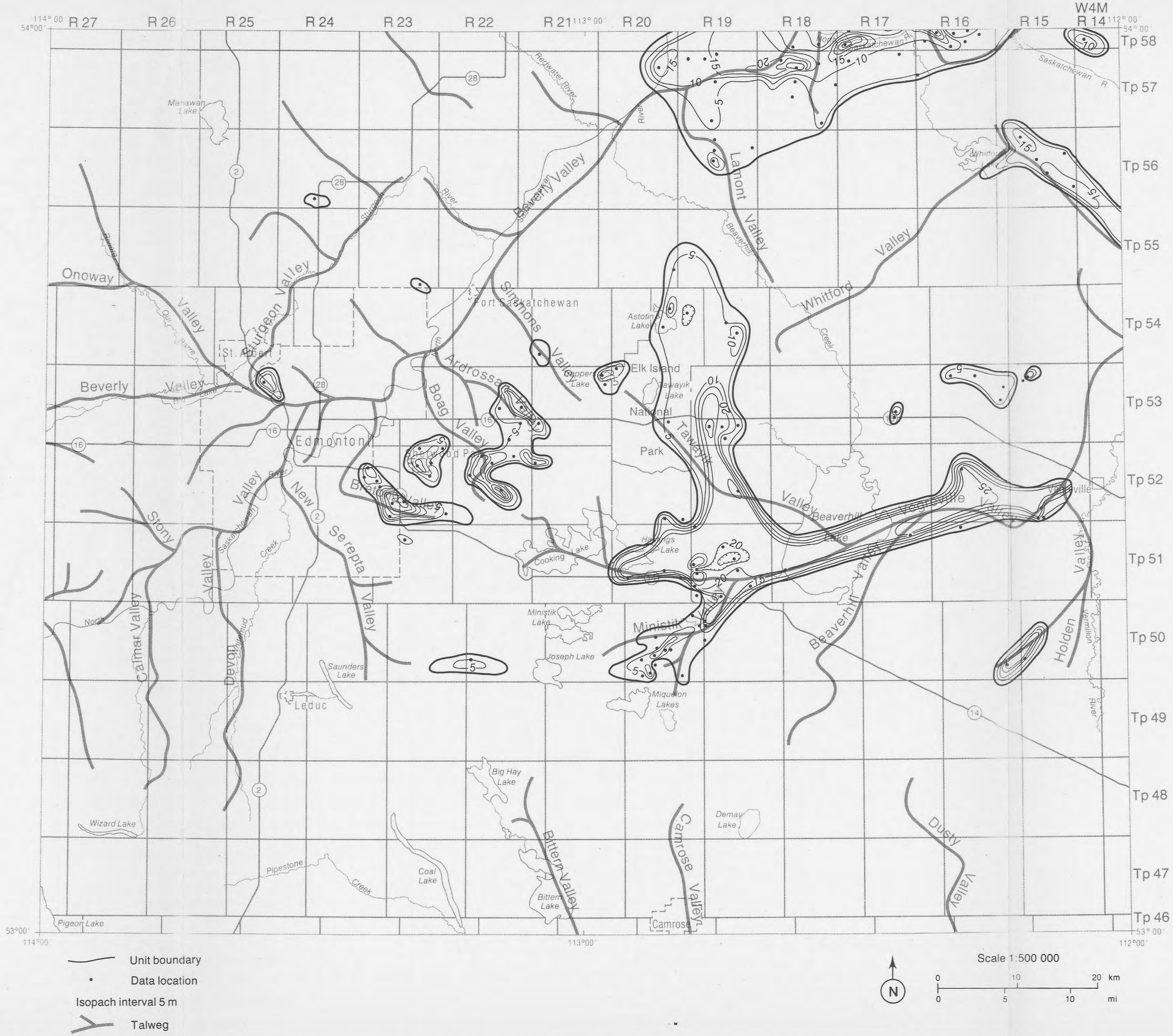
Distribution and Thickness

The Lamont Till lies primarily within segments of buried preglacial valleys. Widespread deposits of the till are found within the lower segments of the Ministik and Tawayik valleys, where they join the Vegreville Valley in the central part of the map area, and along the Beverly Valley and flanking uplands in the northeast part of the map area. Smaller areas of the Lamont Till are mapped in the eastern segment of the Whitford Valley in the map area, and within the Boag, Ardrossan, and Bretona valleys east of Edmonton.

The Lamont Till lies on bedrock uplands in the area around Elk Island National Park, defined by Tps 52 to 55, Rgs 19 to 20.

Deposits of the Lamont Till range in thickness from a few metres on the bedrock surface adjacent to the Beverly Valley, to as much as 26 m within the buried Boag, Tawayik, Vegreville and Beverly valleys.



Thickness of the Lamont Till, Edmonton Map Area, NTS 83H.

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The very-coarse-sand composition of the Lamont Till differs regionally as well. In many places in the central part of the map area where the till overlies bedrock, the composition ranges from about 52-64% Shield rock fragments, 27-36% quartz, 1% quartzite, 0.5-2% Athabasca sandstone, 2-4% limestone, 2-4% dolostone, and 3-6% local bedrock fragments. The amount of local bedrock fragments generally increases with depth. Within the buried valleys in the east, the composition of the very-coarse-sand fraction decreases by about 15% in Shield fragments, and increases by about 5% in quartz and about 4% in bedrock fragments.

Calcareous material makes up 14-22% of the silt-clay fraction of the till. The ratio of calcite to dolomite ranges from about 0.1-0.35, averaging about 0.25. Calcareous material in the till appears to be about 5-6% higher in the central part of the map area compared to the east and north. This may reflect incorporation of the underlying Horseshoe Canyon Formation which contains sandstone and siltstone cemented with calcite.

Resistivity-log responses of the till in the northeast show that the Lamont Till has a lower resistivity than that of the overlying tills. The top of the till is oxidized olive-brown in a few places within the Whitford, Boag and Ardrossan valleys east of Edmonton. Elsewhere, the till has an unoxidized dark gray color.

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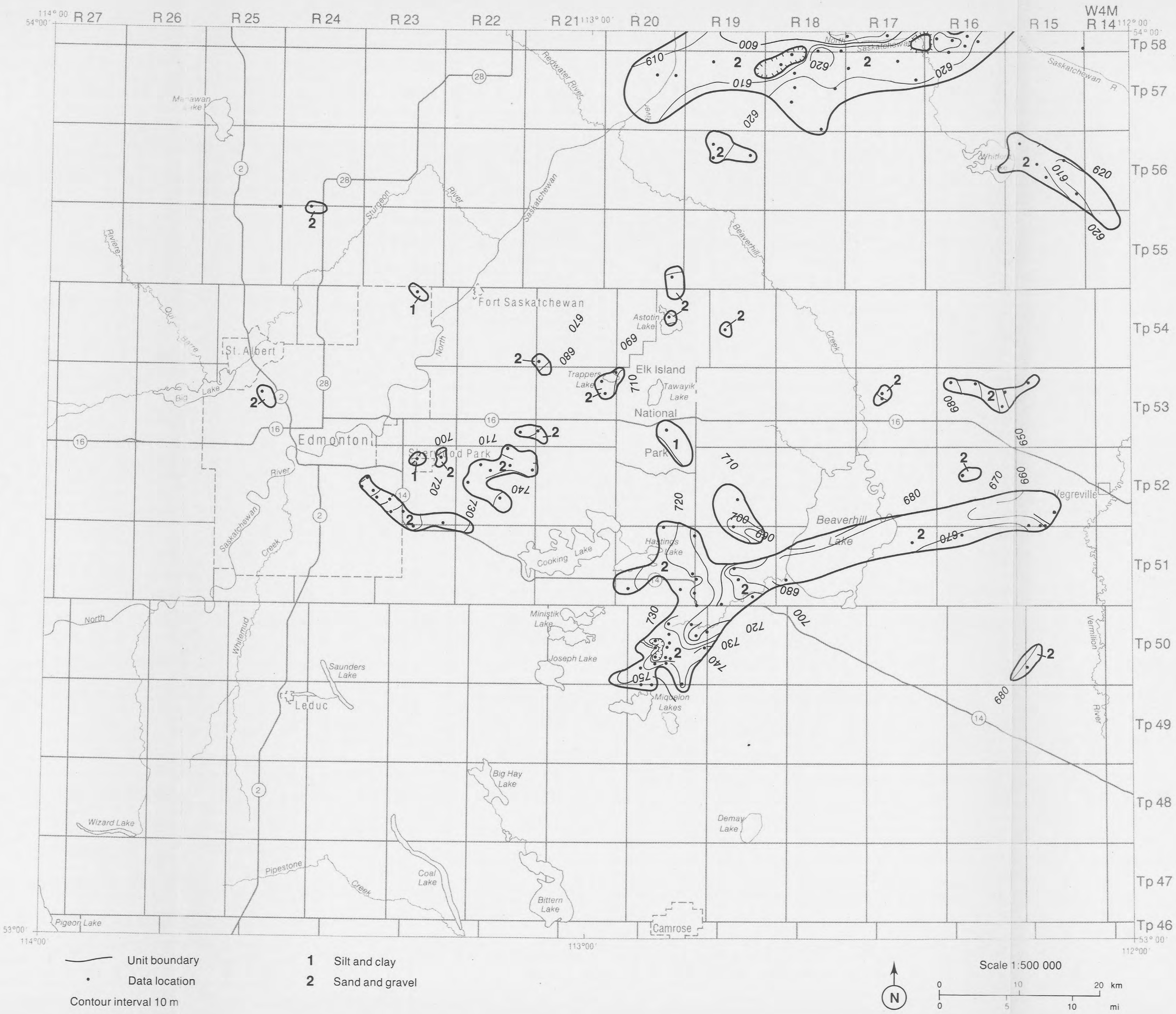


Structure Contours on the Surface of the Ministik Lake Stratified Sediments, Edmonton Map Area, NTS 83H.

Description of Unit
Stratified clay, silt, sand and gravel overlie the Lamont Till in a number of areas. These deposits are overlain by the Chipman Till in the area around Elk Island National Park, and by the stratigraphically higher Cooking Lake Till elsewhere. There are no lithologic properties that differentiate these deposits from older or younger stratified units. The unit is mapped by stratigraphic position, determined from borehole lithologs collected for this project between 1978 and 1981, as well as from existing water-well lithologs. Requests for data collected in this project should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

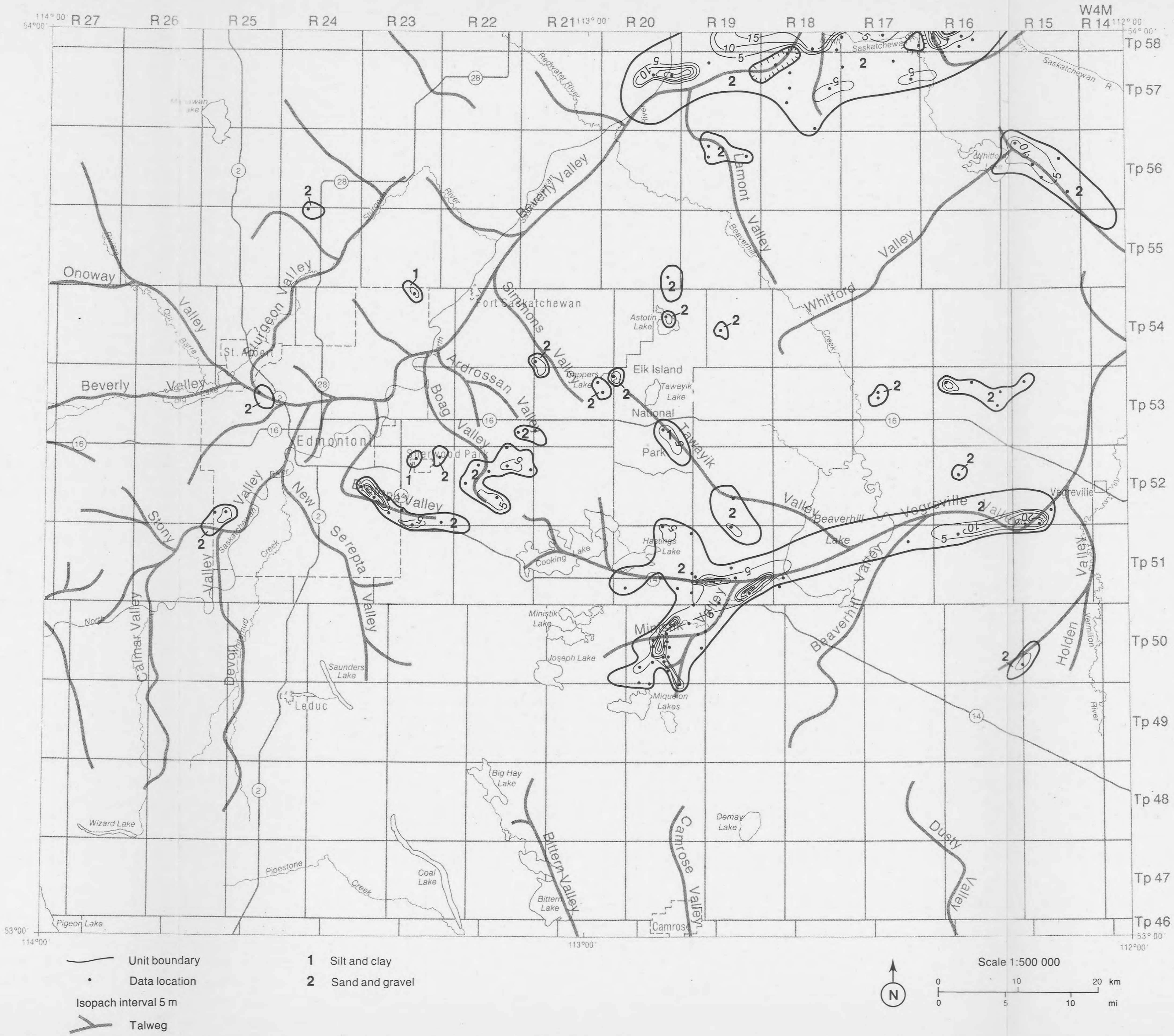
The Ministik Lake deposits are composed mainly of silty sand, or sand and gravel, likely of fluvial origin. Silt and clay are found only in a few small areas in the central part of the map area.

The reader is directed to the Alberta Research Council open file report 1983-20, titled "Preliminary Report of the Surficial Geology and Quaternary Stratigraphy of Edmonton, map area NTS 83H, 1983" for additional information on the stratigraphic interpretation in the Edmonton map area.

Distribution and Thickness
Extensive sand and gravel deposits are mapped near the junction of the Ministik and Vegreville valleys in Tps 50-52, Rgs 19-20. The close proximity of these deposits to the town of Tofield indicates that these may be the same sediments Warren (1954) mapped as the 'Tofield Sand'. This is uncertain however.

Extensive deposits are also mapped along the Beverly Valley in Tps 57-58, Rgs 16 to 20, and within segments of the Whitford, Boag, and Ardrossan valleys. Silt and clay deposits are confined to a few small areas at the north end of the Tawayik Valley, and along the Beverly Valley near Edmonton.

Ministik Lake deposits range in thickness from a few metres to more than 25 m in segments of the buried valleys. A large area of thick deposits (>15 m) lies along the Beverly Valley in the north part of the map area. Isolated deposits of thickness in excess of 15 m lie in a small valley in Tp 50, Rg 20, and along the Vegreville and Boag valleys.



Thickness of Ministik Lake Stratified Sediments, Edmonton Map Area, NTS 83H.

Description of Unit

Stratified clay, silt, sand and gravel overlie the Lamont Till in a number of areas. These deposits are overlain by the Chipman Till in the area around Elk Island National Park, and by the stratigraphically higher Cooking Lake Till elsewhere. There are no lithologic properties that differentiate these deposits from older or younger stratified units. The unit is mapped by stratigraphic position, determined from borehole lithologs collected for this project between 1978 and 1981, as well as from existing water-well lithologs. Requests for data collected in this project should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

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Structure Contours on the Surface of the Chipman Till, Edmonton Map Area, NTS 83H.

Description of Unit

The Chipman Till is the second lowest till in the stratigraphic sequence. It lies within segments of the buried valleys in the central parts of the map area and on the flat bedrock surface in the southern areas. The Chipman Till is most easily identified in the area around Elk Island National Park where it has been mapped from analyses of dry-auger borehole samples and electric log responses. Elsewhere, the till is mapped by stratigraphic position as determined from electric logs or water-well log descriptions. In many places in the south and west part of the map area, isolated areas are mapped where a lower till is overlain by stratified sediment that in turn is overlain by an upper till. On the basis of this stratigraphic setting, plus supporting information from analyses of samples from nearby boreholes, the lower till in these areas is mapped as the Chipman Till. The degree of confidence about this differentiation and correlation is low however, and for this reason these areas are flagged with the symbol '?' to denote this uncertainty.

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The Chipman Till has generally a sandy-clayey grain size that ranges between 33-47% sand, 20-35% silt, and 25-46% clay. In most places the till is sandier than the overlying Cooking Lake Till or the underlying Lamont Till.

The very-coarse-sand composition of the Chipman Till ranges between 35-56% Shield fragments, 25-39% quartz 1-2.5% quartzites, 2-6% Athabasca Sandstone, 4-12% limestone, 4-10% dolostone (total carbonate range 8-22%) and 2-10% bedrock fragments.

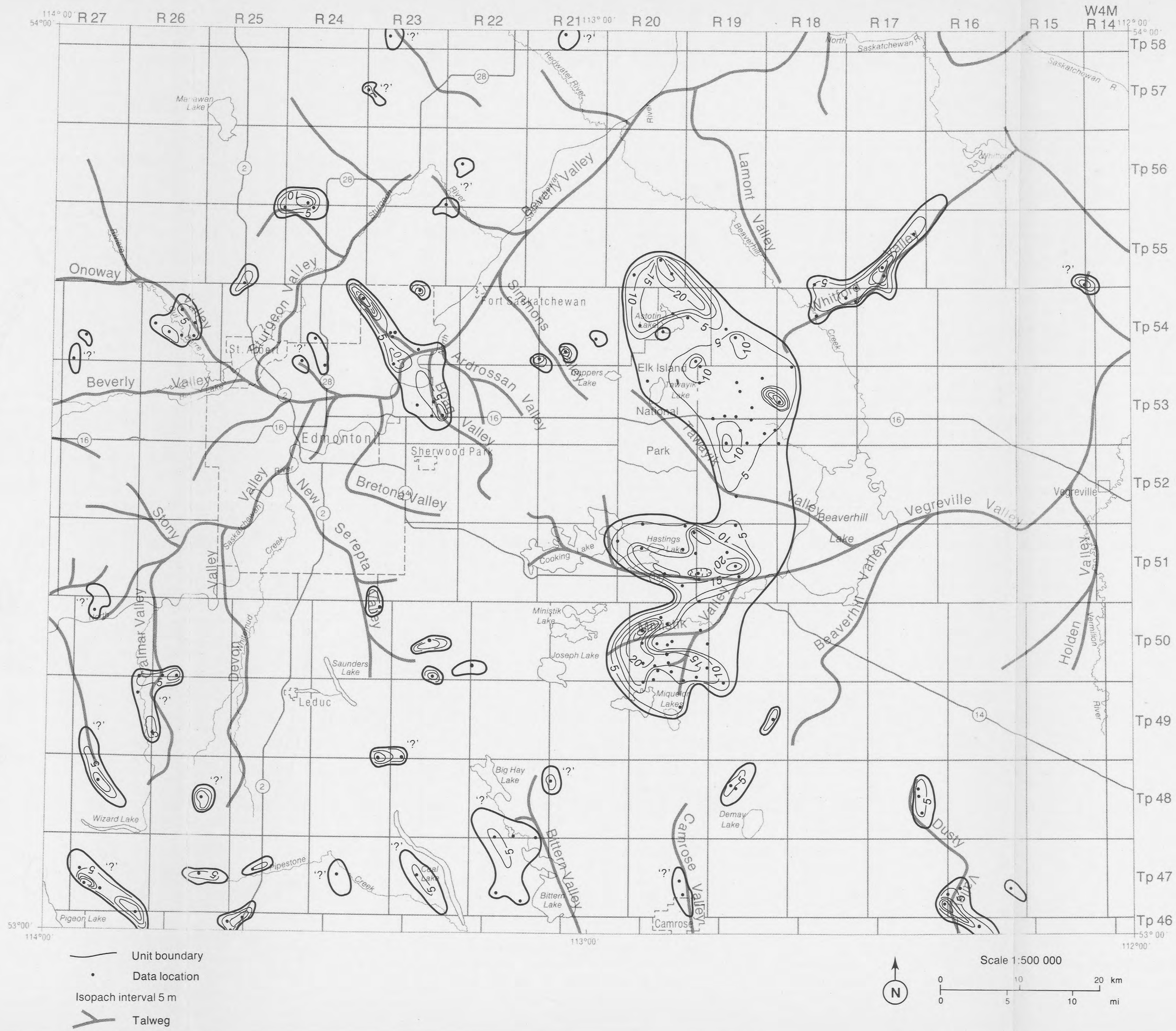
The carbonate content of the silt-clay fraction of the till ranges between 17-30%, and the calcite to dolomite ratio ranges between 0.2-0.4. In general, the carbonate contents of the very-coarse-sand, and silt-clay fractions are about twice that of either of the Cooking Lake or Lamont tills.

The top of the Chipman Till is consolidated and difficult to penetrate with a dry auger. Buried oxidized horizons were not recognized in the upper part of the till, but samples collected near the top commonly have a more olive-gray unoxidized color, compared to a dark gray unoxidized color of the overlying Cooking Lake Till. Where these two tills are in contact, electric log responses show that the Chipman Till has a much higher resistivity than the base of the Cooking Lake Till. The Chipman Till is also generally more sandy, richer in carbonate material, and contains fewer Shield rock fragments than either the overlying Cooking Lake Till or the underlying Lamont Till.

Distribution and Thickness

The most extensive deposit of the Chipman Till is found within the Cooking Lake Moraine in the central part of the map area, defined by Tps 50-55, Rgs 18-20. In this region the till lies within segments of the buried Vegreville, Tawayik, and Ministik valleys, as well as on the bedrock uplands adjacent to these valleys. Smaller areas of the till are mapped in the southwest segment of the Whitford Valley, and along segments of minor tributary valleys of the Beverly Valley in the west half of the map area. Isolated deposits are found scattered throughout most of the western and southern part of the map area.

The Chipman Till ranges in thickness from a few metres on the bedrock uplands, to as much as 34 m above segments of buried valleys. Thick deposits are found along the northern edge of the Cooking Lake Moraine in Tps 53-55, Rgs 18-20, along the southwest end of the buried Whitford Valley, at the junction of the Ministik and Vegreville valleys, in an unamed buried valley directly northeast of Edmonton, and in the Dusty Valley in the southeast part of the map area.



Thickness of the Chipman Till, Edmonton Map Area, NTS 83H.

Description of Unit

The Chipman Till is the second lowest till in the stratigraphic sequence. It lies within segments of the buried valleys in the central parts of the map area and on the flat bedrock surface in the southern areas. The Chipman Till is most easily identified in the area around Elk Island National Park where it has been mapped from analyses of dry-auger borehole samples and electric log responses. Elsewhere, the till is mapped by stratigraphic position as determined from electric logs or water-well log descriptions. In many places in the south and west part of the map area, isolated areas are mapped where a lower till is overlain by stratified sediment that in turn is overlain by an upper till. On the basis of this stratigraphic setting, plus supporting information from analyses of samples from nearby boreholes, the lower till in these areas is mapped as the Chipman Till. The degree of confidence about this differentiation and correlation is low however, and for this reason these areas are flagged with the symbol '?' to denote this uncertainty.

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The Chipman Till has generally a sandy-clayey grain size that ranges between 33-47% sand, 20-35% silt, and 25-46% clay. In most places the till is sandier than the overlying Cooking Lake Till or the underlying Lamont Till.

The very-coarse-sand composition of the Chipman Till ranges between 35-56% Shield fragments, 25-39% quartz 1-2.5% quartzites, 2-6% Athabasca Sandstone, 4-12% limestone, 4-10% dolostone (total carbonate range 8-22%) and 2-10% bedrock fragments.

The carbonate content of the silt-clay fraction of the till ranges between 17-30%, and the calcite to dolomite ratio ranges between 0.2-0.4. In general, the carbonate contents of the very-coarse-sand, and silt-clay fractions are about twice that of either of the Cooking Lake or Lamont tills.

The top of the Chipman Till is consolidated and difficult to penetrate with a dry auger. Buried oxidized horizons were not recognized in the upper part of the till, but samples collected near the top commonly have a more olive-gray unoxidized color, compared to a dark gray unoxidized color of the overlying Cooking Lake Till. Where these two tills are in contact, electric log responses show that the Chipman Till has a much higher resistivity than the base of the Cooking Lake Till. The Chipman Till is also generally more sandy, richer in carbonate material, and contains fewer Shield rock fragments than either the overlying Cooking Lake Till or the underlying Lamont Till.

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The most extensive deposit of the Chipman Till is found within the Cooking Lake Moraine in the central part of the map area, defined by Tps 50-55, Rgs 18-20. In this region the till lies within segments of the buried Vegreville, Tawayik, and Ministik valleys, as well as on the bedrock uplands adjacent to these valleys. Smaller areas of the till are mapped in the southwest segment of the Whitford Valley, and along segments of minor tributary valleys of the Beverly Valley in the west half of the map area. Isolated deposits are found scattered throughout most of the western and southern part of the map area.

The Chipman Till ranges in thickness from a few metres on the bedrock uplands, to as much as 34 m above segments of buried valleys. Thick deposits are found along the northern edge of the Cooking Lake Moraine in Tps 53-55, Rgs 18-20, along the southwest end of the buried Whitford Valley, at the junction of the Ministik and Vegreville valleys, in an unamed buried valley directly northeast of Edmonton, and in the Dusty Valley in the southeast part of the map area.

Structure Contours on the Surface of the Elk Island Stratified Sediments, Edmonton Map Area, NTS 83H.

Description of Unit

Stratified clay, silt, sand and gravel lie on the surface of the Chipman Till, and are overlain by the Cooking Lake Till, called Elk Island stratified sediments. These sediments have been recognized in borehole samples collected from dry-auger drill surveys conducted between 1978 and 1981, and from water-well electric logs and lithologs. Requests for data collected in this project should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

Elk Island stratified sediments cannot be differentiated from other inter-till stratified sediment except by stratigraphic position. In the Cooking Lake Moraine these deposits are correlated with a fair degree of confidence because in this area the Cooking Lake and Chipman tills are easy to differentiate. Elsewhere, the sediments are either difficult to differentiate from the Ministik Lake deposits or they occur within a till sequence in which the origin of the tills is unknown. For this reason, the correlation of most of the isolated and scattered deposits of the Elk Island unit in the map area is tenuous.

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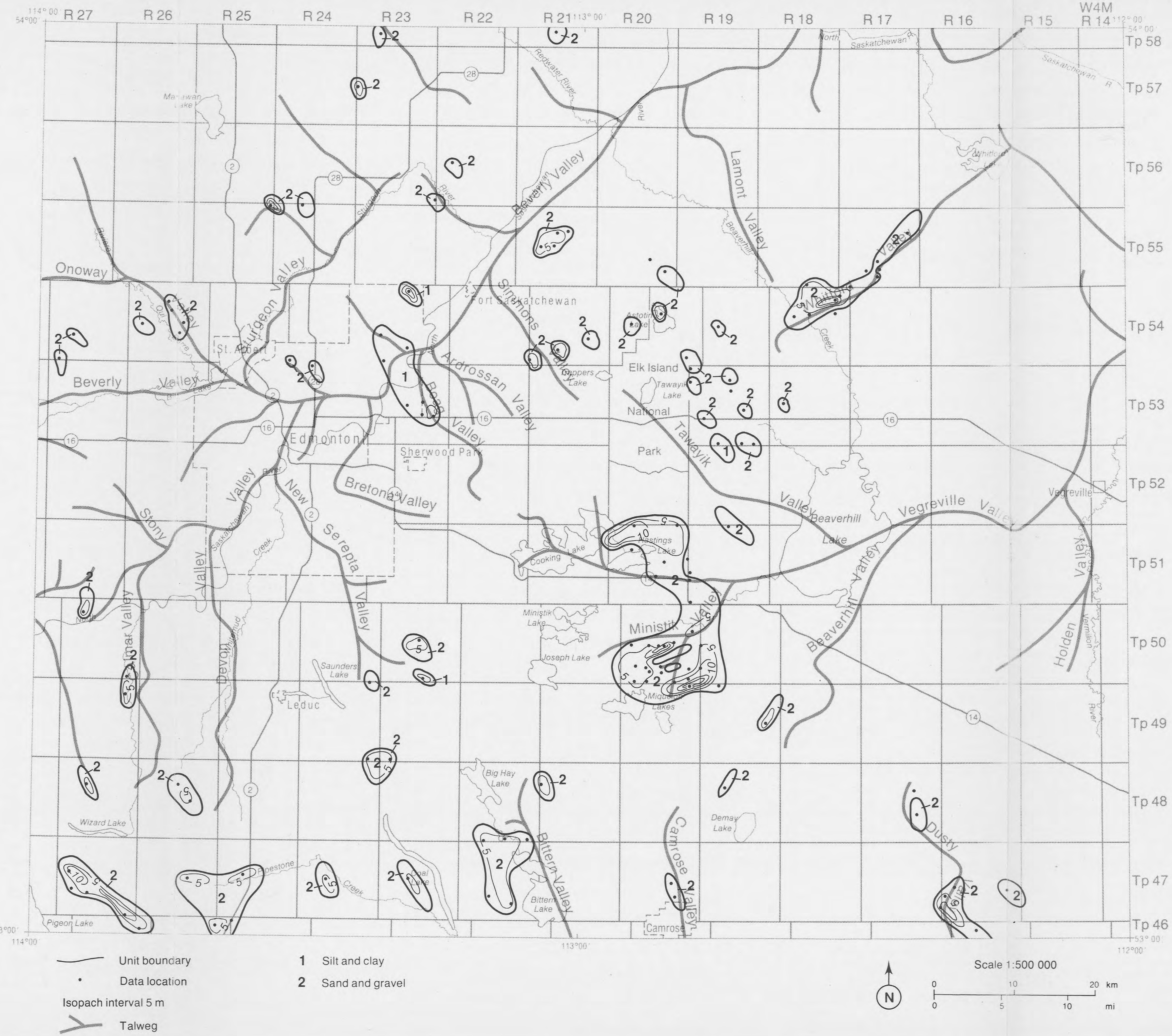
Distribution and Thickness

Elk Island sediments are generally not widespread throughout the map area. The most extensive deposit of sand and gravel of the unit lies within the Cooking Lake Moraine, in the area defined by Tps 50-52, Rgs 19-20. This deposit is situated near the town of Tofield and it is possible that this is the deposit that Warren (1954) mapped as the 'Tofield Sand'. Smaller deposits of sand and gravel are mapped above the southwest segment of the Whitford Valley, above the northern end of the Dusty Valley in the southeast, and on a bedrock upland in the extreme southwest corner of the map area. An extensive deposit of silt and clay lies above the buried Ardrossan Valley and an unnamed valley northeast of Edmonton.

Elk Island stratified sediments range in thickness from a few metres to more than 15 m above the buried Ministik Valley. For the most part, the deposits are less than 5 m thick.



Thickness of the Elk Island Stratified Sediments, Edmonton Map Area, NTS 83H.

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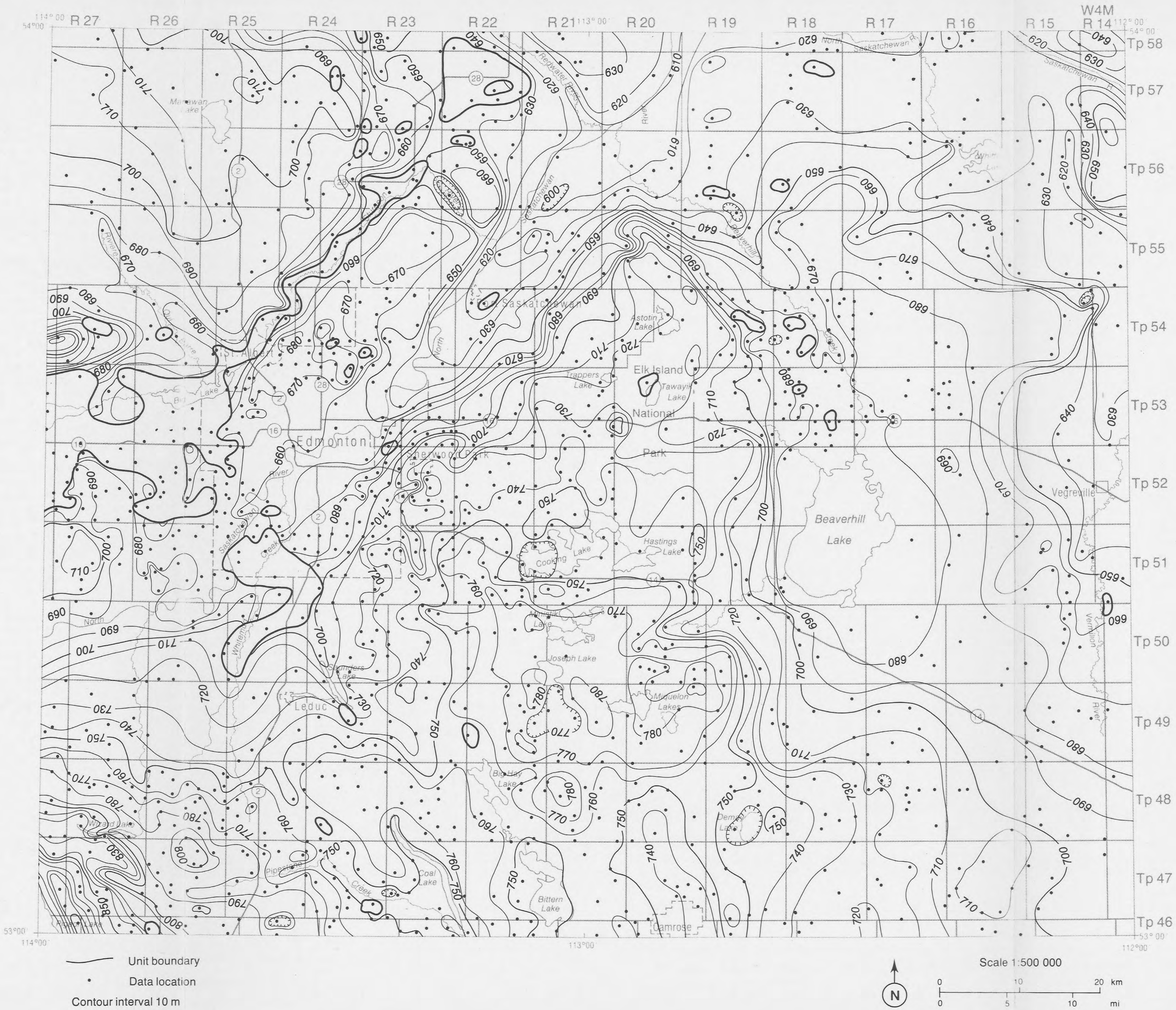

Structure Contours on the Surface of the Cooking Lake Till, Edmonton Map Area, NTS 83H.

Description of Unit

The Cooking Lake Till is the uppermost till unit in the stratigraphic sequence. It is widespread and for much of the map area it lies directly on the bedrock surface.

The Cooking Lake Till is identified primarily from outcrop descriptions and borehole sample analyses, but correlated primarily by stratigraphic position. In many places within the map area samples were not available to characterize the till, but a single till unit was identified from the water-well drillers' descriptions of the stratigraphic sequence. On the basis of stratigraphic position it is inferred that this till is the youngest and uppermost Cooking Lake Till.

Requests for borehole litholog descriptions and sample analyses that were done for this project should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

The grain size of the Cooking Lake Till ranges from sandy-clay in the west to clayey-sand in the east. In the Cooking Lake Moraine area the till has two grain-size facies; an upper, discontinuous sandy facies (referred to as the 'Elk Island Till' in Alberta Research Council open file report 1983-20) that averages about 40% sand, 25% silt, and 35% clay, and a lower clayey facies that averages about 30-35% sand, 22-30% silt, and 38-43% clay. On the low relief glacial topography east of the Cooking Lake Moraine, the Cooking Lake Till is generally very sandy, averaging about 40-50% sand, 20-25% silt, and 23-35% clay. West of the Cooking Lake Moraine the till is less sandy and more clayey, ranging between 24-44% sand, 22-32% silt, and 21-44% clay.

The composition of the very-coarse-sand fraction of the till averages about 40-50% Shield fragments, 33-43% quartz, 0.5-2.0% quartzite, 2.5-4.0% Athabasca sandstone, 3-10% limestone, 2-7% dolostone, and 5-15% local bedrock fragments.

Calcareous material in the silt-clay fraction of the till ranges about 13-34% (average about 18-20%) and the ratio of calcite to dolomite ranges between 0.06-0.34, averaging about 0.2.

In the Cooking Lake Moraine the Cooking Lake Till is oxidized a dark gray-brown color and is soft and easy to penetrate with a dry auger. In the Edmonton vicinity the till is more consolidated, is oxidized a lighter olive-brown color, and in outcrop forms steep faces, with columnar joints spaced about 0.5 to 1.0 m apart. Based on these differences in physical and grain size properties, the surface till in the Edmonton area was initially interpreted (see open file report 1983-20) to have a different origin throughout the area. However, the properties of the very-coarse-sand fraction show that surface till appears to have much the same composition and is now interpreted to be the same throughout. One possible reason why the upper part of the stratigraphic sequence was misinterpreted in the west part of the map area near Villeneuve is that a discontinuous veneer of glaciolacustrine diamicton appears to mantle the Cooking Lake Till in the lowlands.

The Cooking Lake Till is differentiated from the underlying Chipman Till on the basis of its lower carbonate content, lower resistivity, and generally higher clay content. The Cooking Lake Till may be difficult to differentiate from the lowermost Lamont Till, if the two are in contact, because both have a similar grain size and very-coarse-sand composition.

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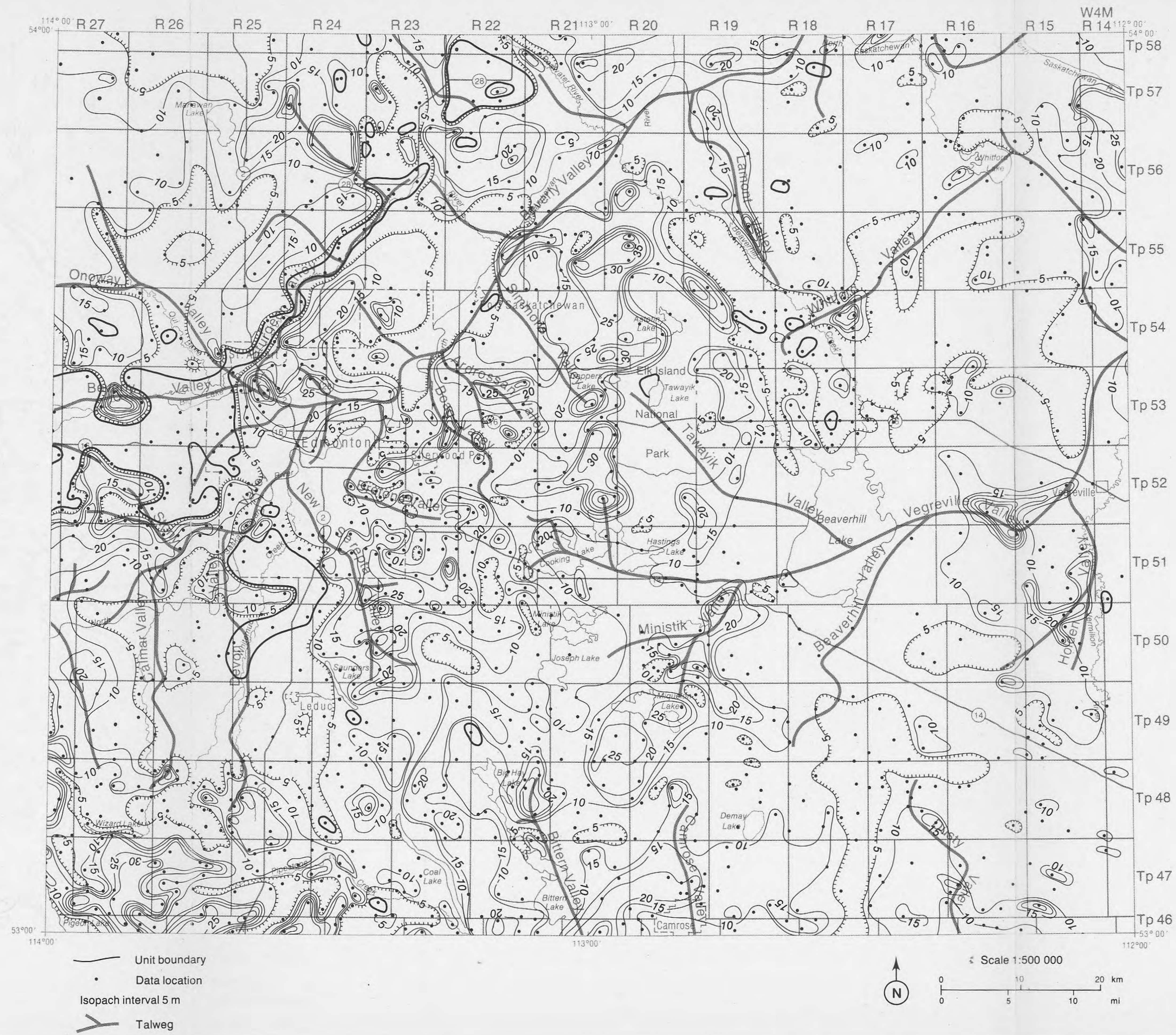
Distribution and Thickness

Although the properties of the Cooking Lake Till are not uniform throughout the map area, the till is extensive and is not confined only to the Cooking Lake Moraine, as originally suggested in the open file report 1983-20. The till is absent over a widespread area in the west part of the map area (east of the town of Spruce Grove, extending northeast along the present day Sturgeon valley). The till is interpreted to have been once present in those areas but was eroded by fluvial and lacustrine processes during the early stages of Glacial Lake Edmonton. The Cooking Lake Till was also eroded in the area directly south of Edmonton. This likely occurred during the latter stages of Glacial Lake Edmonton, as it drained southeast along the Gwynne Meltwater Channel. Small areas where the till is absent are mapped along the northeast base of the Cooking Lake Moraine, defined by Tps 53-54, Rgs 18-19. Meltwater flowing along the base of the moraine likely eroded the till in this area.

The Cooking Lake Till differs considerably in thickness, ranging from less than 5 m in the east-central and southwest parts of the map area, to more than 40 m in some areas within the Cooking Lake Moraine. The till appears to thicken directly southwest, or down-glacier, of the major bedrock contacts in the map area. For example, the till is very thick along the contact between the Horseshoe Canyon and Bearpaw-Belly River formations in Tps 54-55, Rg 20 (this contact marks the northeast edge of the Cooking Lake Moraine), and it thickens in the far southwest corner directly downglacier of the Paskapoo and Horseshoe Canyon formations. Glacial compression, thrusting and incorporation of underlying material at these bedrock contacts likely accounts for the observed thickness of till. Glacial thrusting and deposition also accounts for the depression presently occupied by Beaverhill Lake, and the thick till mapped southwest, or down-glacier, of the lake in Tps 48-50, Rgs 19-20.



Thickness of the Cooking Lake Till, Edmonton Map Area, NTS 83H.

Description of Unit

The Cooking Lake Till is the uppermost till unit in the stratigraphic sequence. It is widespread and for much of the map area it lies directly on the bedrock surface.

The Cooking Lake Till is identified primarily from outcrop descriptions and borehole sample analyses, but correlated primarily by stratigraphic position. In many places within the map area samples were not available to characterize the till, but a single till unit was identified from the water-well drillers' descriptions of the stratigraphic sequence. On the basis of stratigraphic position it is inferred that this till is the youngest and uppermost Cooking Lake Till.

Requests for borehole litholog descriptions and sample analyses that were done for this project should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

The grain size of the Cooking Lake Till ranges from sandy-clay in the west to clayey-sand in the east. In the Cooking Lake Moraine area the till has two grain-size facies; an upper, discontinuous sandy facies (referred to as the 'Elk Island Till' in Alberta Research Council open file report 1983-20) that averages about 40% sand, 25% silt, and 35% clay, and a lower clayey facies that averages about 30-35% sand, 22-30% silt, and 38-43% clay. On the low relief glacial topography east of the Cooking Lake Moraine, the Cooking Lake Till is generally very sandy, averaging about 40-50% sand, 20-25% silt, and 23-35% clay. West of the Cooking Lake Moraine the till is less sandy and more clayey, ranging between 24-44% sand, 22-32% silt, and 21-44% clay.

The composition of the very-coarse-sand fraction of the till averages about 40-50% Shield fragments, 33-43% quartz, 0.5-2.0% quartzite, 2.5-4.0% Athabasca sandstone, 3-10% limestone, 2-7% dolostone, and 5-15% local bedrock fragments.

Calcareous material in the silt-clay fraction of the till ranges about 13-34% (average about 18-20%) and the ratio of calcite to dolomite ranges between 0.06-0.34, averaging about 0.2.

In the Cooking Lake Moraine the Cooking Lake Till is oxidized a dark gray-brown color and is soft and easy to penetrate with a dry auger. In the Edmonton vicinity the till is more consolidated, is oxidized a lighter olive-brown color, and in outcrop forms steep faces, with columnar joints spaced about 0.5 to 1.0 m apart. Based on these differences in physical and grain size properties, the surface till in the Edmonton area was initially interpreted (see open file report 1983-20) to have a different origin throughout the area. However, the properties of the very-coarse-sand fraction show that surface till appears to have much the same composition and is now interpreted to be the same throughout. One possible reason why the upper part of the stratigraphic sequence was misinterpreted in the west part of the map area near Villeneuve is that a discontinuous veneer of glaciolacustrine diamicton appears to mantle the Cooking Lake Till in the lowlands.

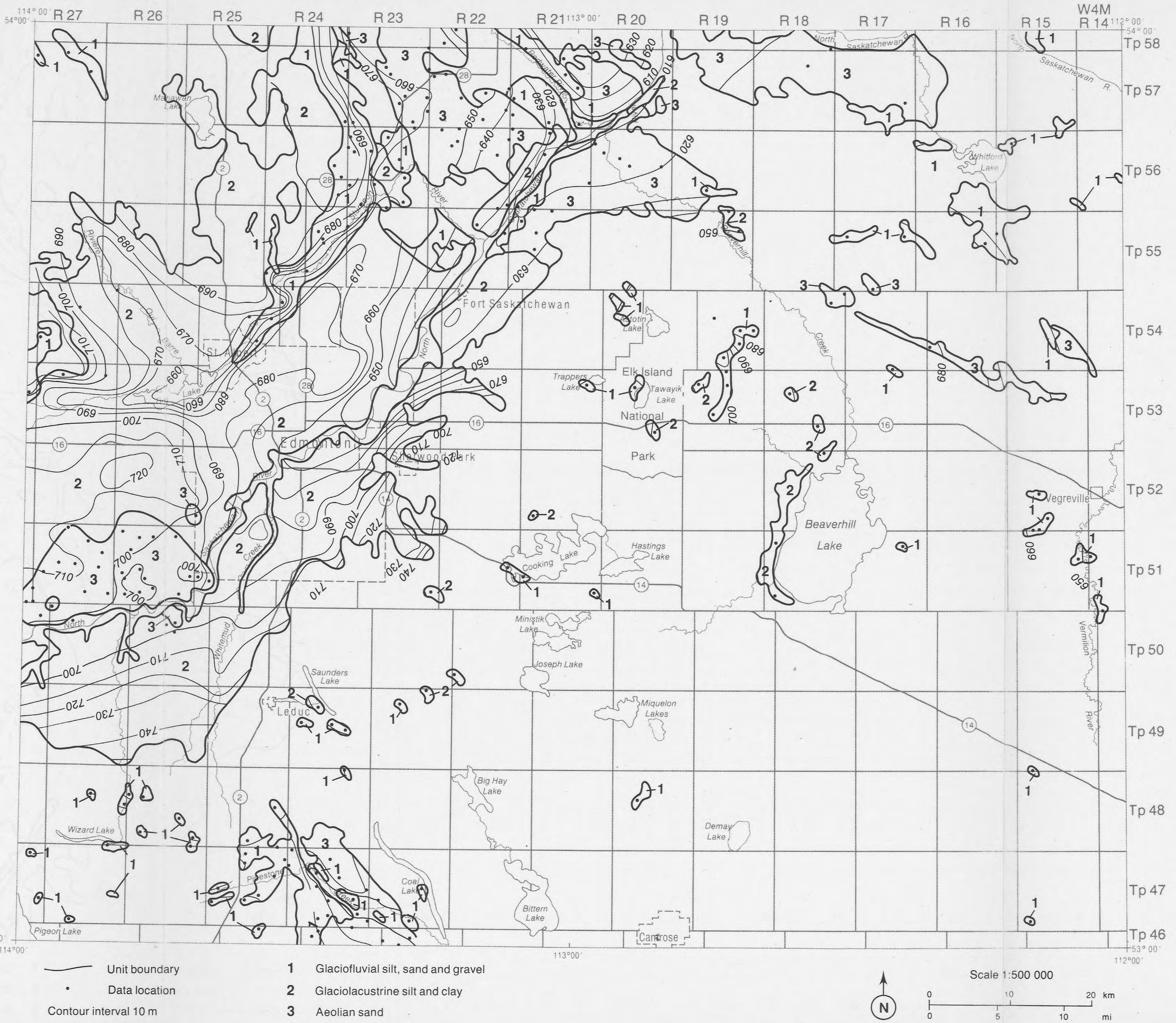
The Cooking Lake Till is differentiated from the underlying Chipman Till on the basis of its lower carbonate content, lower resistivity, and generally higher clay content. The Cooking Lake Till may be difficult to differentiate from the lowermost Lamont Till, if the two are in contact, because both have a similar grain size and very-coarse-sand composition.

The reader is directed to the Alberta Research Council open file report 1983-20, titled "Preliminary Report of the Surficial Geology and Quaternary Stratigraphy of Edmonton, map area NTS 83H, 1983" for additional information on the stratigraphic interpretation in the Edmonton map area.

Distribution and Thickness

Although the properties of the Cooking Lake Till are not uniform throughout the map area, the till is extensive and is not confined only to the Cooking Lake Moraine, as originally suggested in the open file report 1983-20. The till is absent over a widespread area in the west part of the map area (east of the town of Spruce Grove, extending northeast along the present day Sturgeon valley). The till is interpreted to have been once present in those areas but was eroded by fluvial and lacustrine processes during the early stages of Glacial Lake Edmonton. The Cooking Lake Till was also eroded in the area directly south of Edmonton. This likely occurred during the latter stages of Glacial Lake Edmonton, as it drained southeast along the Gwynne Meltwater Channel. Small areas where the till is absent are mapped along the northeast base of the Cooking Lake Moraine, defined by Tps 53-54, Rgs 18-19. Meltwater flowing along the base of the moraine likely eroded the till in this area.

The Cooking Lake Till differs considerably in thickness, ranging from less than 5 m in the east-central and southwest parts of the map area, to more than 40 m in some areas within the Cooking Lake Moraine. The till appears to thicken directly southwest, or down-glacier, of the major bedrock contacts in the map area. For example, the till is very thick along the contact between the Horseshoe Canyon and Bearpaw-Belly River formations in Tps 54-55, Rg 20 (this contact marks the northeast edge of the Cooking Lake Moraine), and it thickens in the far southwest corner directly downglacier of the Paskapoo and Horseshoe Canyon formations. Glacial compression, thrusting and incorporation of underlying material at these bedrock contacts likely accounts for the observed thickness of till. Glacial thrusting and deposition also accounts for the depression presently occupied by Beaverhill Lake, and the thick till mapped southwest, or down-glacier, of the lake in Tps 48-50, Rgs 19-20.



Structure Contours on the Surface of Glacial Lake Edmonton Sediments and Postglacial Fluvial and Aeolian Sediments, Edmonton Map Area, NTS 83H.

Description of Unit

Glacial Lake Edmonton sediments consist of stratified clay, silt, sand and gravel deposited in a proglacial lake during the late stages of the last glaciation. In this study Glacial Lake Edmonton sediments are separated into two units: unit 1, a lower silt, sand and gravel unit, and unit 2, an upper clay and silt, with minor sand, unit. Unit 1 sediments likely were deposited by glaciofluvial meltwater in an ice-contact deltaic environment during the developing stages of Glacial Lake Edmonton. Unit 2 silt and clay were deposited overtop unit 1 sand and gravel as Glacial Lake Edmonton expanded over the region.

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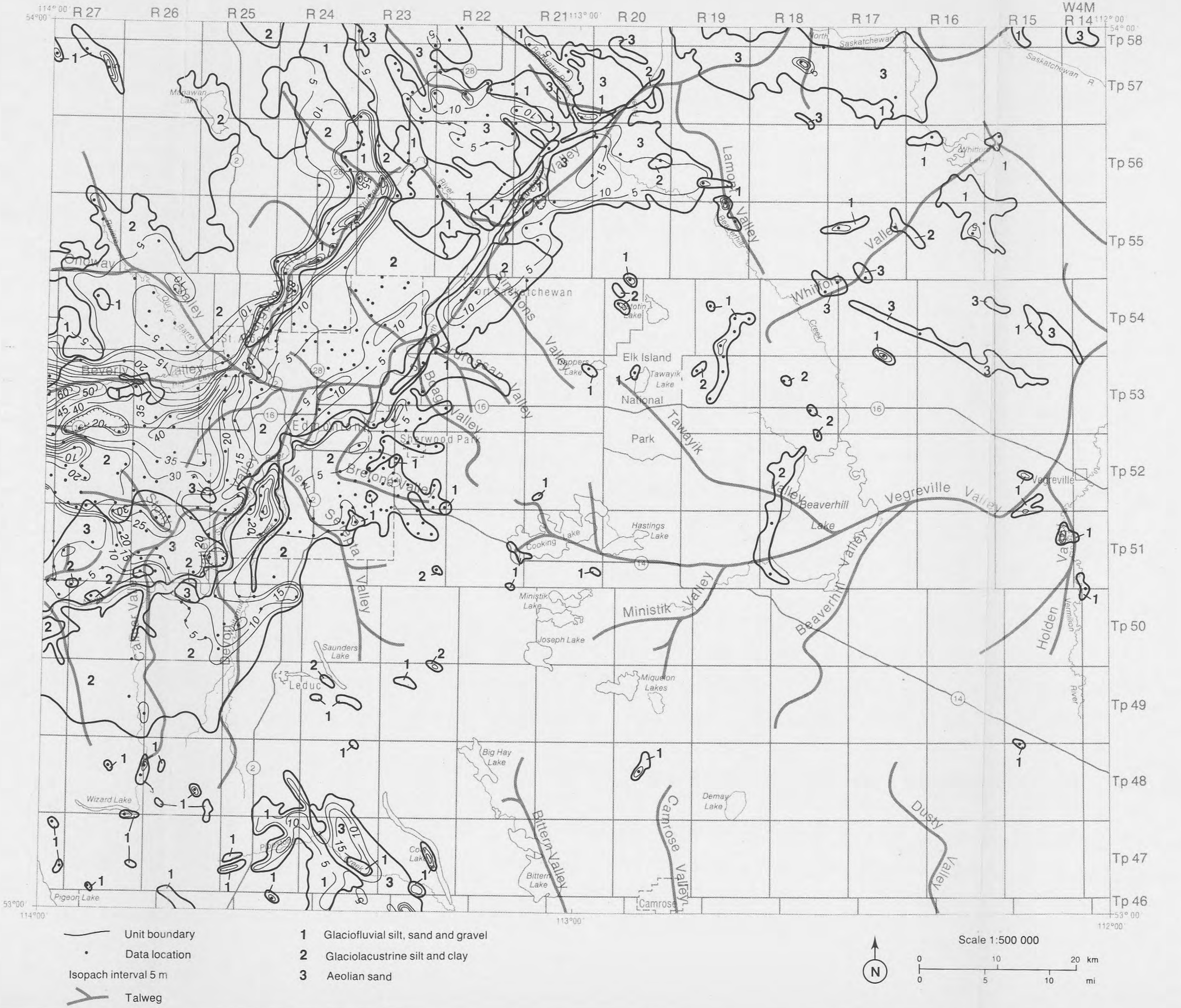

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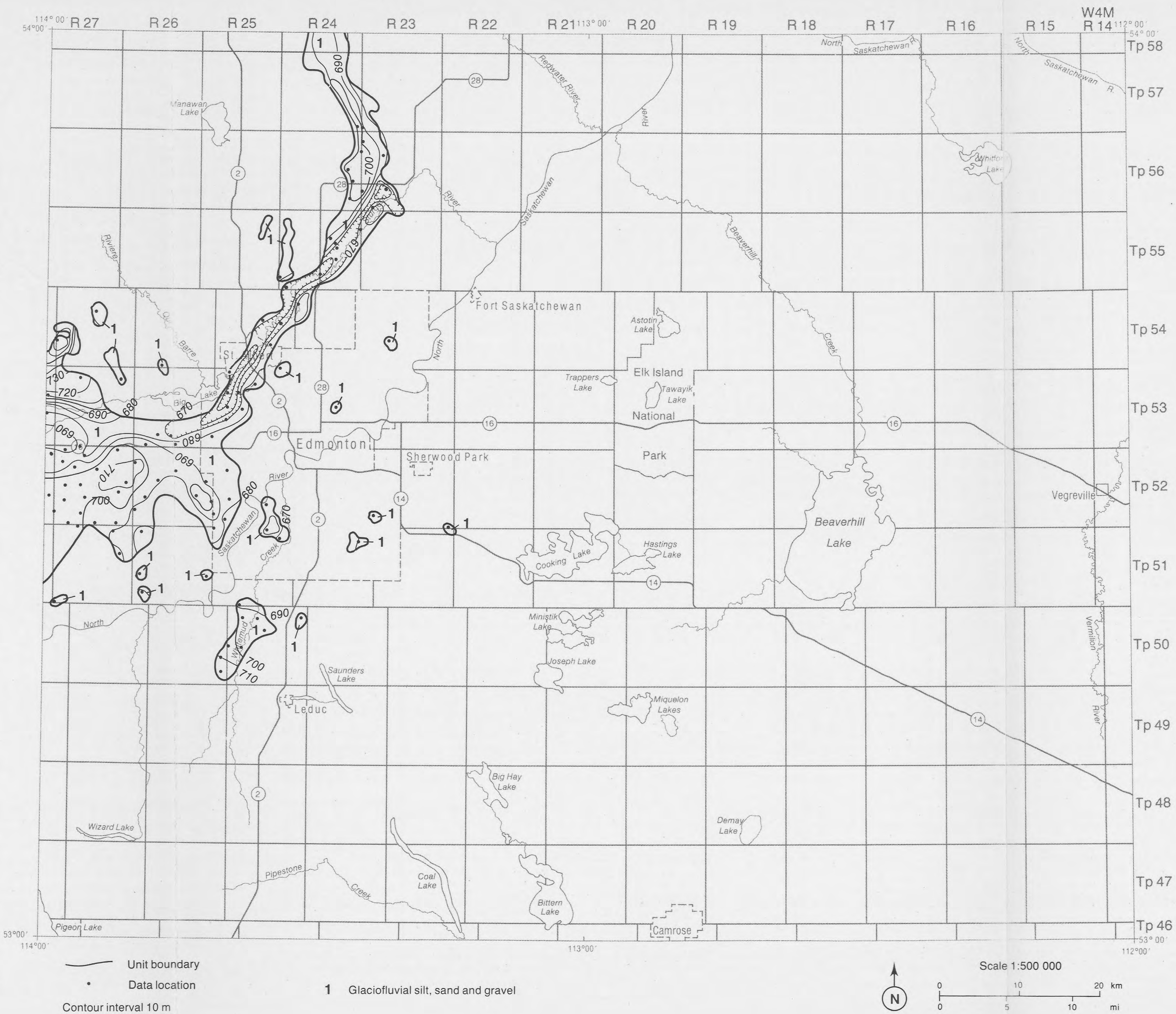

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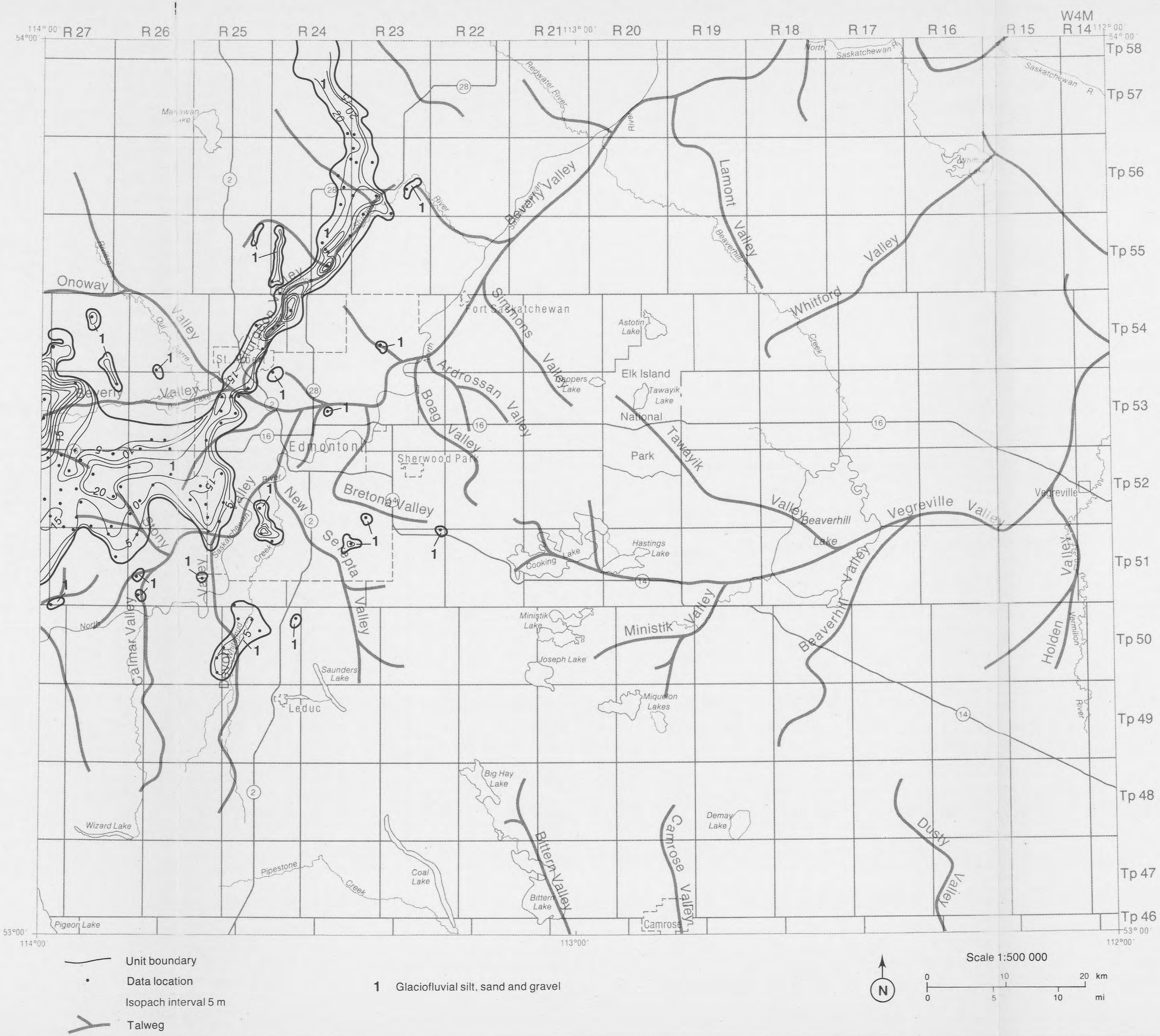

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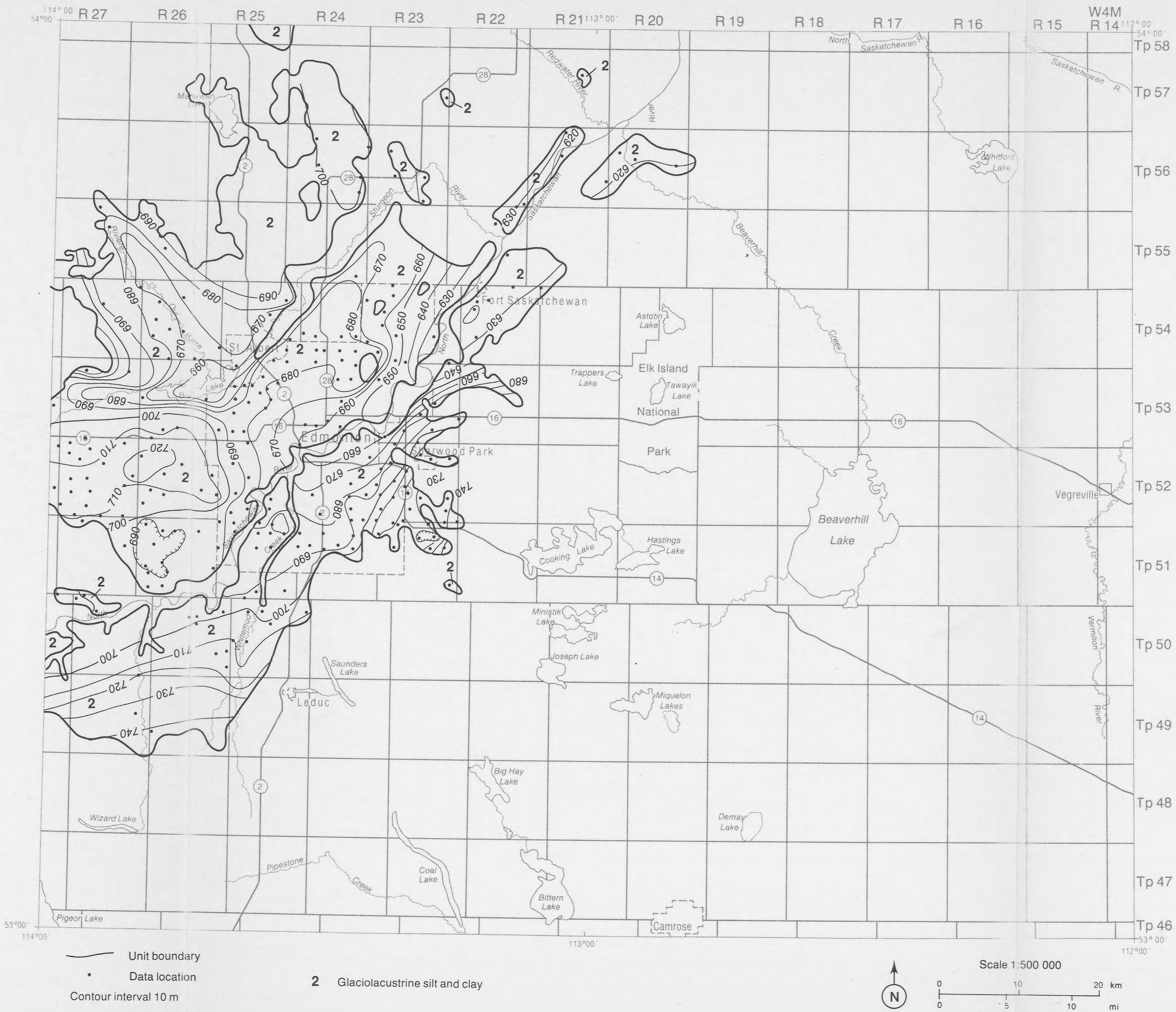

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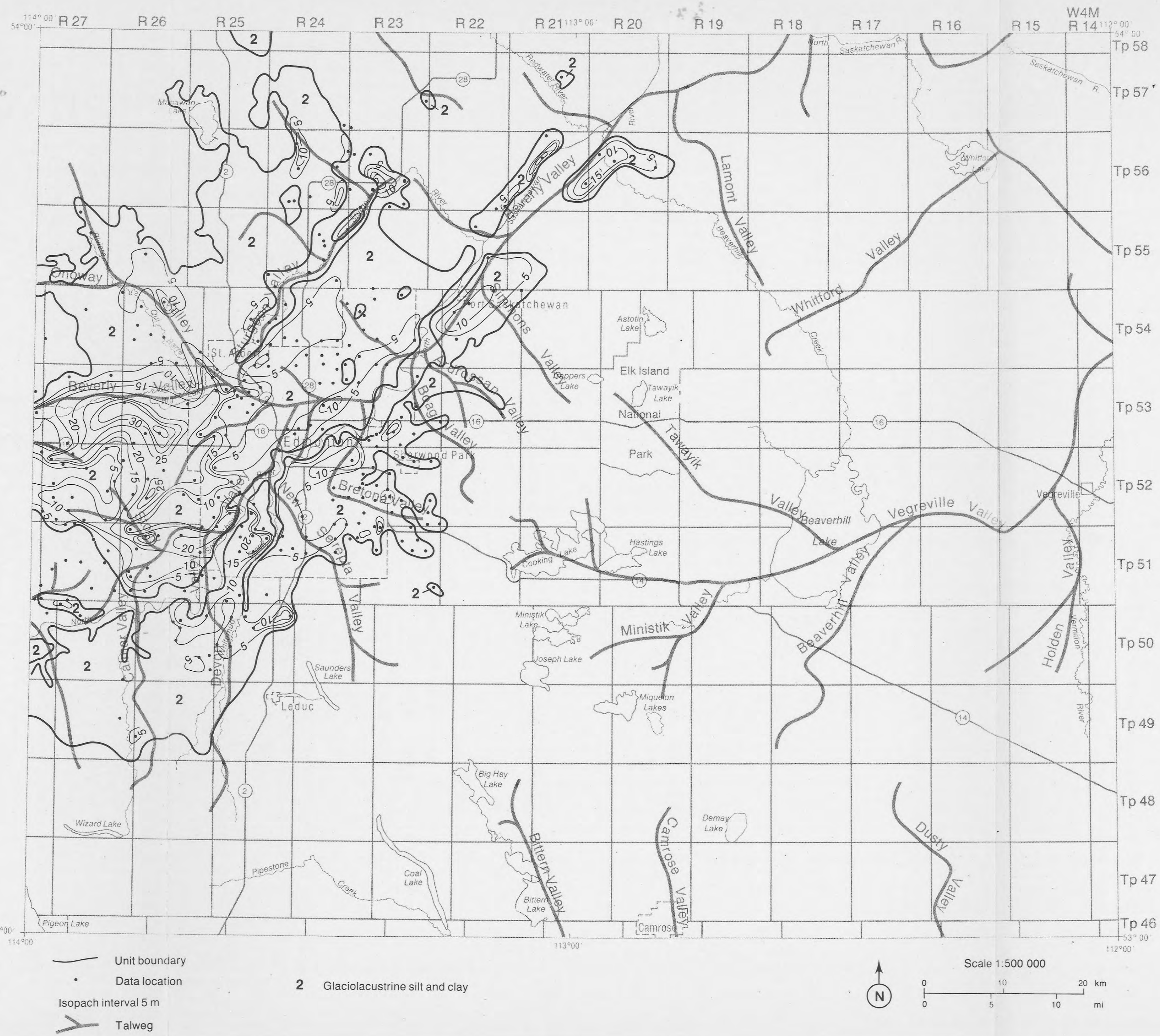
Extensive aeolian deposits are located southeast of major sources of glaciolacustrine or glaciofluvial sand. Three large dune fields are recognized. The first is located southwest of Edmonton, between Devon and Spruce Grove, in Tps 50-52, Rgs 26-28. Glacial Lake Edmonton silt and sand appear to be source for this field. The second field lies between Bruderheim and Opal in the north-central part of the map area. Glaciofluvial outwash sand is the source for this field. The third field lies northwest of Andrew, in Tps 57-58, Rgs 17-19. Bayrock (surficial geology map of Edmonton, 1972) comments that this dune field migrated out of the source area and onto till although glacial outwash from a series of meltwater channels in Tps 57-58, Rgs 18-19 may once have contributed sediment.

Aeolian deposits vary considerably in thickness, depending on the proximity to individual dunes. As much as 27 m of and are mapped within major dunes north of Devon, but generally the dunes are 15 m or less in thickness. Along the perimeter of the fields, the sand may only be a thin veneer.



Thickness of Unit 2 Sediments of Glacial Lake Edmonton, Edmonton Map Area, NTS 83H.

Description of Unit

Glacial Lake Edmonton sediments consist of stratified clay, silt, sand and gravel deposited in a proglacial lake during the late stages of the last glaciation. In this study Glacial Lake Edmonton sediments are separated into two units: unit 1, a lower silt, sand and gravel unit, and unit 2, an upper clay and silt, with minor sand, unit. Unit 1 sediments likely were deposited by glaciofluvial meltwater in an ice-contact deltaic environment during the developing stages of Glacial Lake Edmonton. Unit 2 silt and clay were deposited overtop unit 1 sand and gravel as Glacial Lake Edmonton expanded over the region.

Glacial Lake Edmonton sediments were mapped from dry-auger drill surveys and outcrop examinations conducted between 1978 and 1981, as well as from water-well drillers' electric logs and lithologs. Supplementary information was provided from drill records and surficial geology maps at the Alberta Research Council (Bulletin 32, "Urban Geology of Edmonton," by Kathol and McPherson (1975) and 1:250 000 scale map, "Surficial Geology Edmonton, NTS 83H" by Bayrock (1972)). Requests for data collected in this project should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

The unit boundaries shown in the series of Glacial Lake Edmonton sediment maps, particularly the silt and clay deposits, are derived in large part from the boundaries shown on Bayrock's surficial geology map.

Distribution and Thickness of Unit 1

Unit 1 deposits are found primarily in the west part of the map area. For the most part they are buried by silt and clay of unit 2 but outcrop along an ice-contact meltwater channel occupied by the present-day Sturgeon River in Tp 55, Rg 24, and an abandoned channel in Tp 56-57, Rg 24. Ice-contact, kame deposits of sand and gravel are found in Tp 50, Rg 25, and in Tps 51-52, Rg 25, in the area known as Rabbit Hill.

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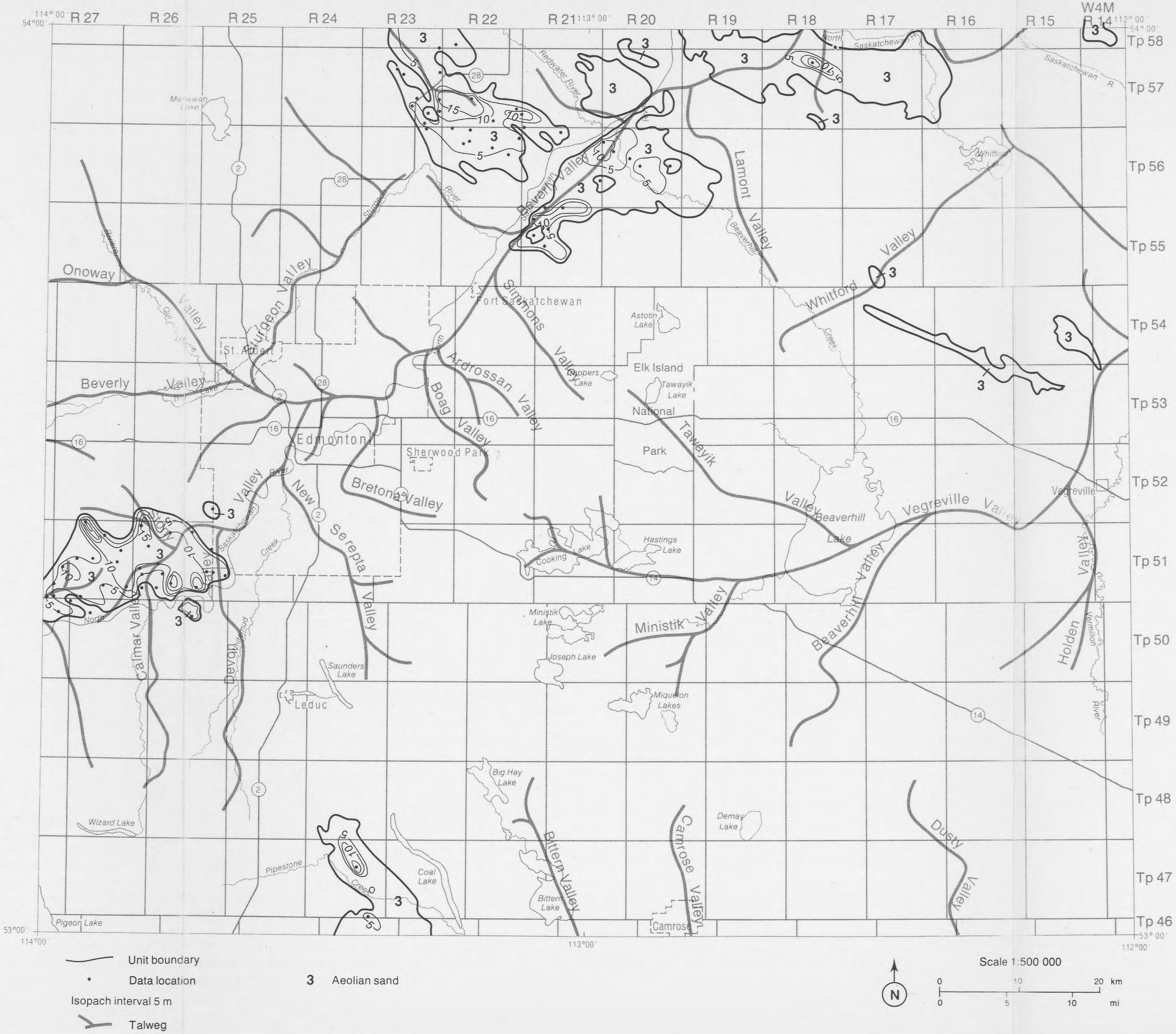

Thickness of Aeolian Sand Edmonton Map Area, NTS 83H.

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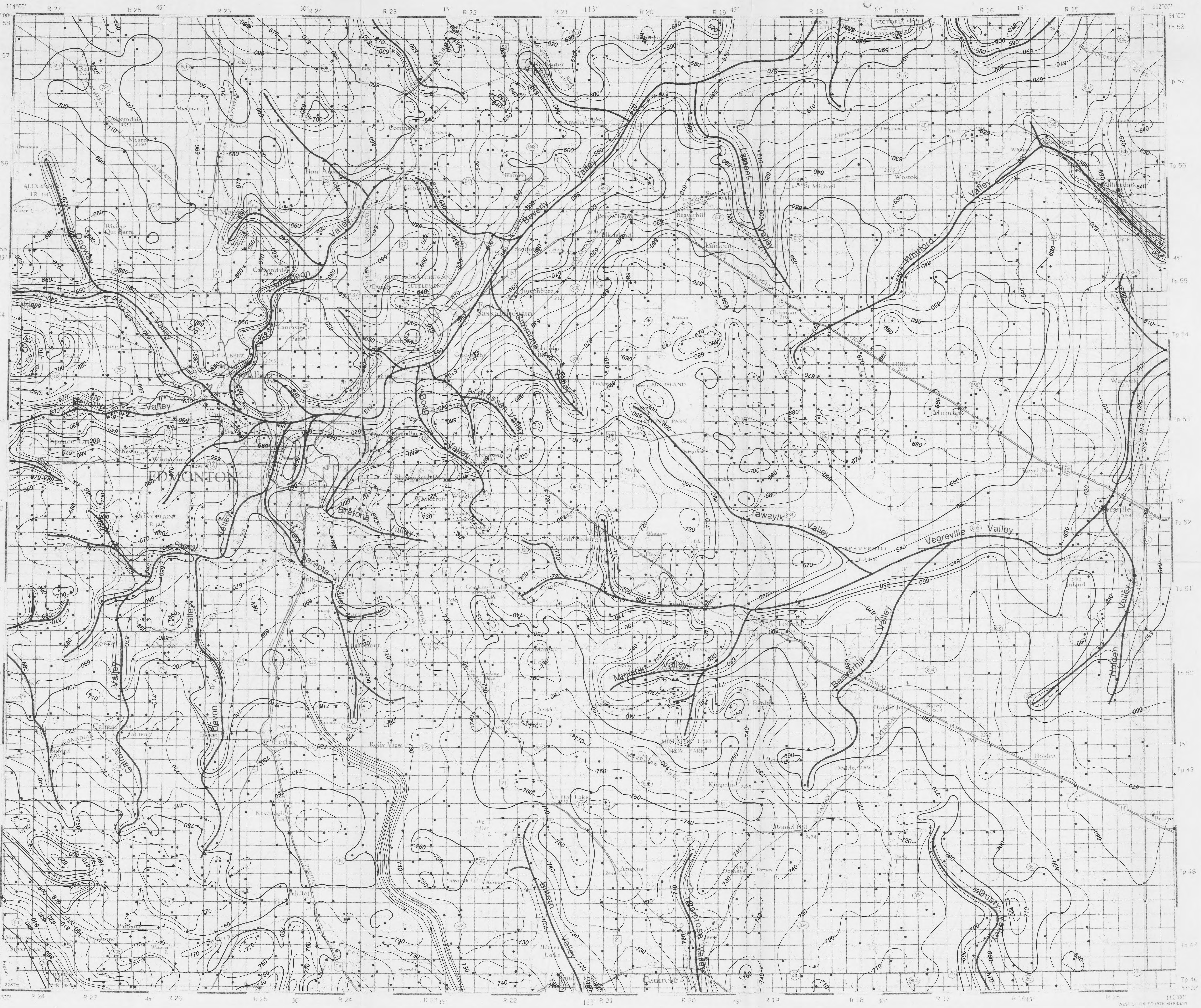

Bedrock Topography, Buried Valleys and Drift Thickness

The bedrock topography and drift thickness maps were generated using data from various sources. These include Alberta Research Council dry-auger drill data from geological surveys, Alberta Environment groundwater investigation well logs, water-well drillers' electric and litholog descriptions, and oil exploration structure testholes. Information and concepts were derived from previous Alberta Research Council geological, hydrogeological and bedrock topography studies, completed for portions of the area by Carlson (1966), Bibby (1974), McPherson and Kathol (1973, 1975) and Stein (1976, and unpublished data). Carlson's (1966) study presents a detailed report of the bedrock topography and valleys in the Edmonton vicinity.

Borehole data for this project was collected from dry-auger drill surveys conducted between 1978 and 1981. These data include outcrop descriptions, borehole litholog descriptions of the surface materials down to bedrock, as well as laboratory analyses performed for samples of the till units. Requests for these data should be directed to the Terrain Sciences Department of the Natural Resources Division of the Alberta Research Council.

In excess of two thousand drift data points were evaluated and coded in a computerized file. Initial bedrock topography and drift isopach maps were made using SURFACE II computer graphics software at the Alberta Research Council. These preliminary contour maps were then evaluated and manually edited or altered to correspond with known, or assumed, trends in the bedrock topography and drift thickness.

The bedrock topography of the Edmonton area can be described as a regional northeast sloping bedrock surface disected by numerous channels of preglacial and glacial fluvial origin. The bedrock surface ranges in elevation from about 900 m in the extreme southwest corner of the map area, to as low as 560 m within the buried Beverly Valley in the northeast corner. Major preglacial valleys in the map area are the Beverly Valley, Onoway Valley, and the Vegreville Valley. From southwest to northeast, the major tributaries of the Beverly Valley include the Stony Valley and its tributaries (Calmar, Devon, and New Sarepta valleys), the Boag Valley, the Ardrossan Valley, the Simmons Valley, and the Lamont Valley. The Sturgeon Valley is the only tributary of the Onoway Valley in the map area. From west to east, the tributaries of the Vegreville Valley include the Ministik, Tawayik, Beaverhill, Holden valleys, as well as the Whitford Valley which likely joins the Vegreville Valley in the Vermilion map area to the east. A number of poorly defined valleys in the south part of the map area are tributaries of the preglacial Red Deer River valley that lies south of the Edmonton map area. These include the Dusty, Camrose, and Bittern valleys.

Drift thickness in the Edmonton map area ranges from less than 10 m over flat-lying bedrock surfaces, to more than 70 m within the Cooking Lake Moraine and a number of buried valleys. Extensive areas of thin drift are found in much of the east third of the map areas, as well as within the northwest corner. Thin drift is also found in the southwest part of the map area where Glacial Lake Edmonton drained and eroded some of the existing drift cover. Extensive areas of thick drift (>50 m) are found as infill of major preglacial valleys, particularly the Beverly, Onoway and Stony valleys and headwaters of the Vegreville and Whitford valleys. Stratified drift in excess of 80 m thickness is also present along the flanks of the buried Sturgeon Valley. Thick drift, mainly till, is found within the Cooking Lake Moraine where glacial thrusting eroded Cretaceous sediment along the contact of the Horseshoe Canyon and Bearpaw/Belly River formations. Glacial thrusting and deposition of material from the Vegreville Valley beneath Beaverhill Lake, likely accounts for the thick drift sequence located southwest of the lake in Tp 50, Rg 20.

Map location

• Data location

Scale 1:250,000

0 5 10 15 20 25 km

Contour interval 10 m

Bedrock Topography and Valley Talwegs of the Edmonton Map Area

NTS 83H

L.D. Andriashek

Published 1987

ALBERTA RESEARCH COUNCIL

Natural Resources Division
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Base maps provided by the Surveys and Mapping Branch, Alberta Transportation, Edmonton
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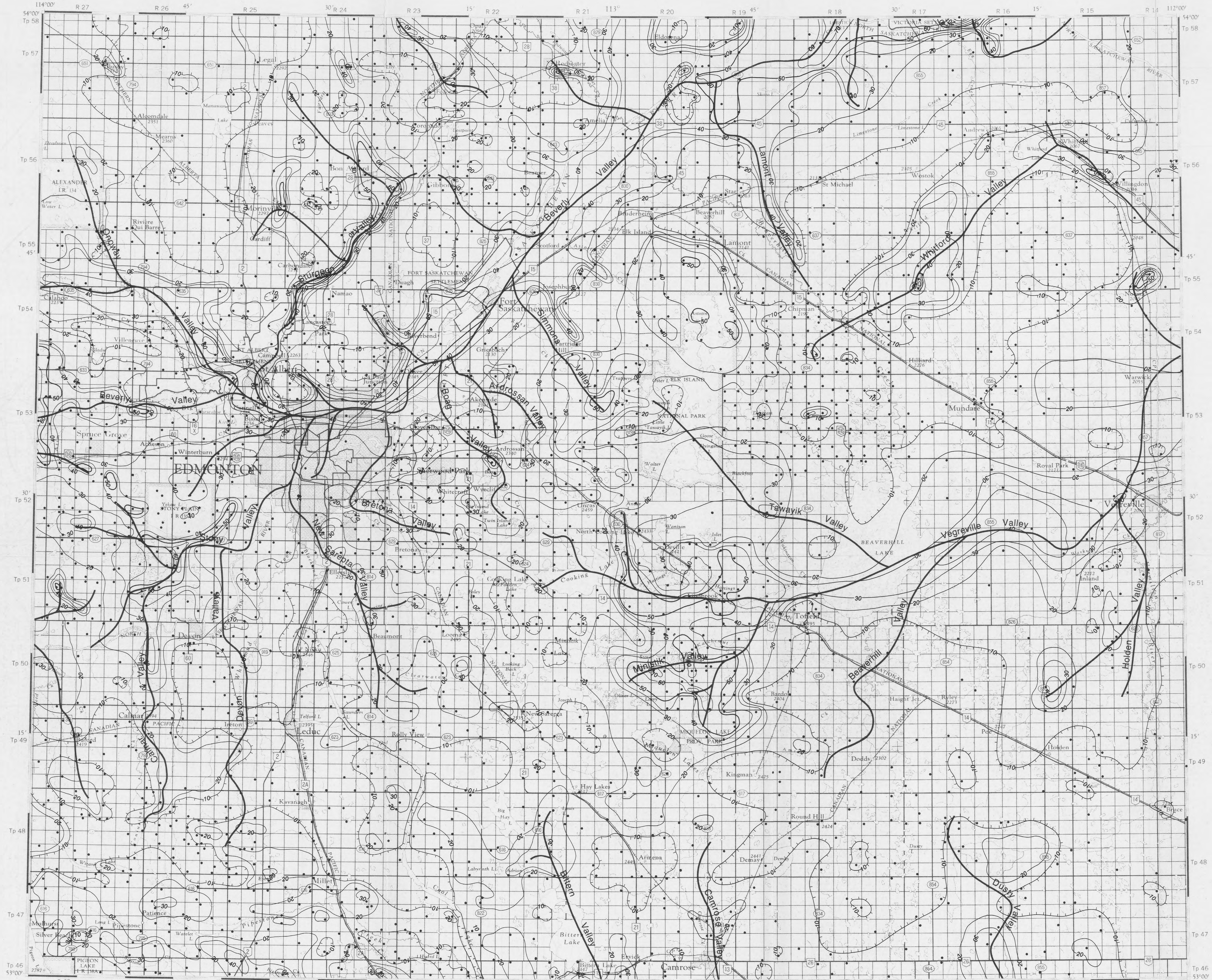

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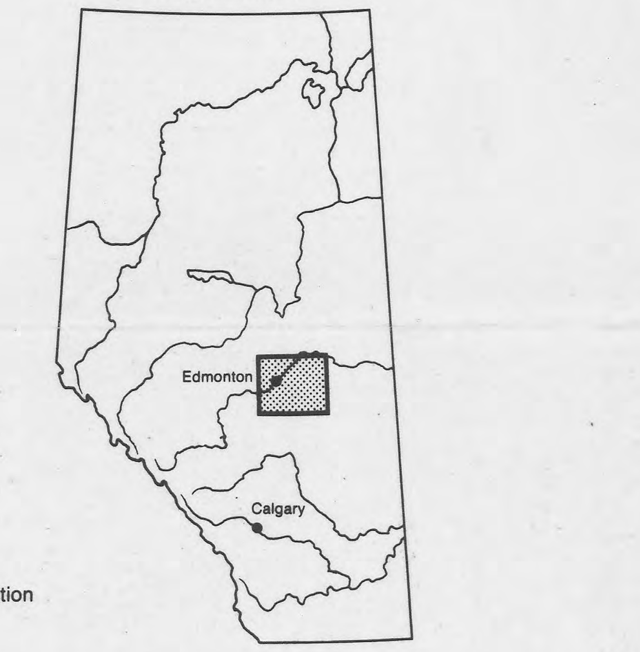

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Talweg

Scale 1:250,000

0 5 10 15 20 25 km

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Drift Thickness of the Edmonton Map Area

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