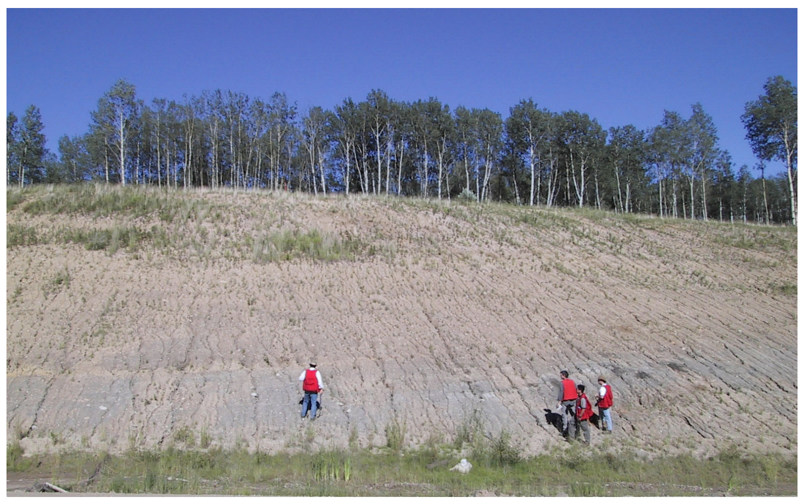
EUB/AGS Earth Sciences Report 2002-03

Quaternary Geological Setting of the Athabasca Oil Sands (In Situ) Area, Northeast Alberta



Alberta Energy and Utilities Board
Alberta Geological Survey

EUB/AGS Earth Sciences Report 2002-03

Quaternary Geological Setting of the Athabasca Oil Sands (In Situ) Area, Northeast Alberta

L. D. Andriashek, P.Geol.

Alberta Geological Survey

April 2003

ISBN 0-7785-1516-8

Andriashek, L.D. (2003): Quaternary geological setting of the Athabasca Oil Sands (In Situ) Area, northeast Alberta; Alberta Energy and Utilities Board, EUB/AGS Earth Sciences Report 2002-03.

Published April 2003 by:
Alberta Energy and Utilities Board
Alberta Geological Survey
4th Floor, Twin Atria Building
4999 – 98th Avenue
Edmonton, Alberta
T6B 2X3
Canada

Tel: (780) 422-3767 (Information Sales)
Fax: (780) 422-1918
E-mail: EUB.AGS-Infosales@gov.ab.ca

Web site: www.ags.gov.ab.ca

Cover Photo: Outcrop of till near the Christina River crossing along Secondary Highway 881.

Contents

Acknowledgments vii
Abstract viii
1 Introduction and Scope of Study Area 1
2 Area Topography and Physiography 1
3 Bedrock Topography and Buried Channels 6
3.1 Background and Methods of Interpretation 6
3.2 Bedrock Physiographic Units 9
3.2.1 May Hills Highland 9
3.2.2 Caribou Upland 17
3.2.3 Leismer Uplands 17
3.2.4 Amesbury Plains 19
3.2.5 Hangingstone Plains 19
3.2.6 Cowper Plains 20
3.2.7 Wiau Lowlands 20
3.2.8 Gordon Lowlands 22
3.3 Drift Thickness 22
3.4 Buried Bedrock Channels 23
3.4.1 Introduction 23
3.4.2 Buried Preglacial Channels 24
3.4.2.1 Wiau Channel 24
3.4.2.2 Christina and Kirby Channels 26
3.4.2.3 Leismer Channel 26
3.4.2.4 Amesbury Channel 27
3.4.2.5 Imperial Mills Channel 27
3.4.3 Buried Glacial Channels 28
4 Geology of the Late Tertiary and Quaternary Drift Succession 28
4.1 Introduction 28
4.2 Sources of Data for Stratigraphic Interpretations 30
4.2.1 Methods of Investigation 31
4.2.1.1 Field Methods 31
4.2.1.2 Laboratory and Data Processing Methods 31
4.3 Geology of AGS Coreholes 34
4.3.1 Corehole WEPA99-1 34
4.3.2 Corehole WEPA99-2 40
4.3.3 Corehole WR99-1 40
4.3.4 Corehole WEPA00-1 44
4.3.5 Corehole WEPA00-2 48
4.3.6 Corehole WEPA00-3 51
4.3.7 Corehole WEPA00-4 53
4.4 Constructing the Drift Hydrostratigraphy 54
4.4.1 Cyclicity in Petrophysical Log Responses of Multiple Till Units 57
4.4.2 Differentiation and Correlation of Till Units by Mineralogy and Geochemistry 57
4.4.3 Buried Weathered Profiles—Interglacial Event Markers 59
4.5 Regional Correlation of the Drift Stratigraphy 61
4.5.1 Tertiary–Quaternary Stratigraphy—Empress Formation 62
4.5.1.1 Empress Formation Unit 1 Preglacial Sand and Gravel 62
4.5.1.2 Empress Formation Unit 2 Silt and Clay 64
4.5.1.3 Empress Formation Unit 3 Glacial Sand and Gravel 67

4.5.1.4 Undifferentiated Empress Formation and Combined Empress Formation Channel Deposits 67
4.5.1.5 Empress Formation on the Interfluves of Bedrock Channels 72
4.5.2 Quaternary Stratigraphy 72
4.5.2.1 Bronson Formation 78
4.5.2.2 Muriel Lake Formation 78
4.5.2.3 Bonnyville Formation 78
4.5.2.4 Ethel Lake Formation 79
4.5.2.5 Marie Creek Formation 79
4.5.2.6 Sand River Formation 80
4.5.2.7 Grand Centre Formation 80
4.6 Implications to Hydrostratigraphic Interpretations: Layer-Cake Versus Labyrinth Architecture 81
4.7 Implications of Buried Channels to In Situ Oil Sands Development 81
5 Terrain Analysis of Surficial Deposits 85
5.1 Introduction 85
5.2 Discussion of the Surficial Geology 87
5.2.1 Morainal Landforms and Deposits 87
5.2.2 Glaciofluvial Landforms and Deposits 96
5.2.3 Glaciolacustrine Landforms and Deposits 96
5.2.4 Eolian Landforms and Deposits 96
5.2.5 Colluvial Landforms and Deposits 98
5.2.6 Recent Fluvial and Lacustrine Deposits 98
5.2.7 Organic Deposits 98
6 Summary 100
7 References 102
Appendix 1 – Surficial Geology Site Descriptions 104
Appendix 2 – Lithologic Descriptions of Alberta Geological Survey Coreholes
Appendix 2a – Lithologic Description of Corehole WEPA99-1. 122
Appendix 2b – Lithologic Description of Corehole WEPA99-2. 131
Appendix 2c – Lithologic Description of Corehole WR99-1. 139
Appendix 2d – Lithologic Description of Corehole WEPA00-1. 149
Appendix 2e – Lithologic Description of Corehole WEPA00-2. 156
Appendix 2f – Lithologic Description of Corehole WEPA00-3. 161
Appendix 2g – Lithologic Description of Corehole WEPA00-4. 168
Appendix 3 – Geochemical Analysis of Quaternary and Upper Bedrock Samples
Description of Geochemical Analytical Methods and Procedures 172
Procedure for Mercury Determination (CVAA) by ALS Chemex 172
Procedure for ICP Spectroscopy by ALS Chemex 172
Procedure for Neutron Activation Analysis (NAA) by Becquerel 172
Table A3-1: List of elements analyzed and method of geochemical analysis. 174
Table A3-2: Detection limits for elements analyzed, (Becquerel Laboratory Inc.) 175
Table A3-3: Geochemical analysis of samples from corehole WEPA99-1. 176
Table A3-4: Geochemical analysis of samples from corehole WEPA99-2. 192
Table A3-5: Geochemical analysis of samples from corehole WR99-1 212
Table A3-6: Geochemical analysis of samples from corehole WEPA00-1 220
Table A3-7: Geochemical analysis of samples from corehole WEPA00-2. 232
Table A3-8: Geochemical analysis of samples from corehole WEPA00-3. 240
Table A3-9: Geochemical analysis of samples from corehole WEPA00-4. 256

Appendix 4 – Alberta Geological Survey Laboratory Matrix Grain-Size and Carbonate- Analyses of Quaternary and Upper Bedrock Samples
Table A4-1: Matrix grain-size and carbonate analyses, corehole WEPA99-1. 264
Table A4-2: Matrix grain-size and carbonate analyses, corehole WEPA99-2. 268
Table A4-3: Matrix grain-size and carbonate analyses, corehole WR99-1. 273
Table A4-4: Matrix grain-size and carbonate analyses, corehole WEPA00-1. 276
Table A4-5: Matrix grain-size and carbonate analyses, corehole WEPA00-2. 279
Table A4-6: Matrix grain-size and carbonate analyses, corehole WEPA00-3. 281
Table A4-7: Matrix grain-size and carbonate analyses, corehole WEPA00-4. 285

Tables

Table 1. Dimensions and properties of buried bedrock channels. 25
Table 2. Analyses of hydrocarbon in till, corehole WEPA00-1. 47

Figures

Figure 1. Location of study area. 2
Figure 2. Stratigraphic column for study area. 3
Figure 3. Subcrop map of the bedrock geology in the study area. 4
Figure 4. Surface topography and physiography of the study area. 5
Figure 5. Physiographic subdivisions of the study area. 7
Figure 6. Bedrock topography of the study area showing talwegs of the buried channels. 8
Figure 7. Three-dimensional perspective of the bedrock topography in the study area. 10
Figure 8. Major bedrock physiographic units. 11
Figure 9. Geological cross-section A-A' showing stratigraphy of the drift and upper bedrock units. 12
Figure 10. Geological cross-section B-B' showing stratigraphy of the drift and upper bedrock units. 13
Figure 11. Geological cross-section C-C' showing stratigraphy of the drift and upper bedrock units. 14
Figure 12. Geological cross-section D-D' showing stratigraphy of the drift and upper bedrock units Wiau Channel. 15
Figure 13. Geological cross-section E-E' showing stratigraphy of the drift and upper bedrock units along the Leismer Channel. 16
Figure 14. Thickness of Late Tertiary and Quarternary drift. 18
Figure 15. Reoccupation and overdeepening of preglacial bedrock channels by glacial meltwater. 21
Figure 16. Deep incision of the bedrock surface by glacial meltwater, Gregoire Channel. 29
Figure 17. Wet-rotary coring rig. 32
Figure 18. Diamond-surfaced core bit for sampling Quaternary sediments. 32
Figure 19. Field logging of core samples. 32
Figure 20. Strip-log lithology legend. 33
Figure 21. Lithological and petrophysical log properties of corehole WEPA99-1. 35
Figure 22. Buried weathered and oxidized till at 62 m depth, corehole WEPA99-1. 36
Figure 23. Variations in arsenic concentrations in glacial sediments, coreholes WR99-1, WEPA99-1, WEPA99-2. 37
Figure 24. *Inoaceramus* fossils in marine shale of the La Biche Formation,WEPA99-1. 38
Figure 25. Petrological characteristics of tills in the Cold Lake area. 39
Figure 26. Lithological and petrophysical log properties of corehole WEPA99-2. 41
Figure 27. Lithological and petrophysical log properties of corehole WR99-1. 43
Figure 28. Lithological and petrophysical log properties of corehole WEPA00-1. 45
Figure 29. Hydrocarbon emulsion on surface of drilling mud tank, WEPA00-1. 46
Figure 30. Variations in arsenic concentrations in glacial sediments, coreholes WEPA00-1 to WEPA00-4. 49
Figure 31. Lithological and petrophysical log properties of corehole WEPA00-2. 50

Figure 32. Lithological and petrophysical log properties of in corehole WEPA00-3. 52
Figure 33. Lithological and petrophysical log properties of corehole WEPA00-4. 55
Figure 34: Table of Quaternary stratigraphic units in eastern Alberta, Cold Lake area (*from* Andriashek and Fenton, 1989). 56
Figure 35. Differentiation of tills from cyclic patterns in petrophysical logs. 58
Figure 36. Differentiation of tills by log response, matrix carbonate content, and geochemical properties.. 60
Figure 37. Correlation of tills by log response, geochemistry and weathered unconformities. 60
Figure 38. Thickness of Empress Formation Unit 1 preglacial sand and gravel. 63
Figure 39. Elevation of the top of Empress Formation Unit 1 preglacial sand and gravel......................... 65
Figure 40. Thickness of Empress Formation Unit 2 silt and clay. 66
Figure 41. Elevation of the top of Empress Formation Unit 2 silt and clay. 68
Figure 42. Thickness of Empress Formation Unit 3 glacial sand and gravel. 69
Figure 43. Elevation of the top of Empress Formation Unit 3 glacial sand and gravel............................. 70
Figure 44. Thickness of Empress Formation channel deposits. 71
Figure 45. Elevation of the top of Empress Formation channel deposits. 73
Figure 46. Thickness of Empress Formation interfluve terrace sand and gravel. 74
Figure 47. Elevation of the top of Empress Formation interfluve terrrace sand and gravel...................... 75
Figure 48. Thickness of the Empress Formation. 76
Figure 49. Elevation of the top of the Empress Formation. 77
Figure 50. Layer-cake hydrostratigraphic model. 82
Figure 51. Labryinth, stair-stepped hydrostratigraphic model. 82
Figure 52. Cartoon diagram of glacial channel incision through thin overburden above SAGD operation.. 84
Figure 53. Example of a 1:50 000 terrain analysis map (NTS sheet 73M/8). 86
Figure 54. Surficial materials in the study area, (NTS 73M, part of 74D and 84A). 88
Figure 55. Local relief of landforms in the study area. 89
Figure 56. Percentage of sand in the matrix of surface tills. 91
Figure 57. Percentage of clay in the matrix of surface tills. 92
Figure 58. Relationship between hydraulic conductivity and till-matrix grainsize.................................... 93
Figure 59. Suitability of till for clay-liner construction... 93
Figure 60. Poorly sorted outwash sand and sandy diamicton complex, Christina Lake area..................... 94
Figure 61. Sharp-crested ridges on hummocky, sandy moraine on the Mostoos Upland. 95
Figure 62. Sinuous-ridged hummocky, sandy moraine on the Mostoos Upland....................................... 95
Figure 63. Ice-contact glaciofluvial sand and gravel pit, east of Christina Lake, Christina Lake Plain. 97
Figure 64. Glaciofluvial sand and gravel pit on Stony Mountain Uplands. 97
Figure 65. Distribution of organic deposits in the study area... 99

Acknowledgments

The following Alberta Geological Survey staff members are acknowledged for the significant contributions they made to aspects of this report:

- S. Stewart for her assistance in logging the core samples, and providing editorial review of the manuscript.
- G. Jean for his contributions in managing the field drilling programs, for surveying the field installations, and for compiling the final report.
- T. Lemay for his many hours spent logging the core samples.
- J. Meeks for her contributions in converting hand drawings of terrain analysis maps to a geographic information system (GIS) platform, for her role in logging core samples and for the compilation of data toward the preparation of graphics for the report.
- D. Chao for his role in compiling the various map products into a GIS platform, for providing digital base maps for the project team, and for creating many of the ArcView® images used in this report.
- D. Goulet for conducting the grain-size and carbonate analyses at the Alberta Geological Survey laboratory.
- N. Crann and M. Protz for preparing the manuscript for final publication.

The following contractors and organizations provided essential services to the project:

- L. Leslie of Geo-Environmental Ltd. interpreted the aerial photographs for the preparation of the terrain analysis maps.
- I. Ranger interpreted the petrophysical logs for the construction of the bedrock topography maps and drift stratigraphy, as well as developed a stratigraphic database.
- McAuley Drilling conducted the drilling and coring of the Quaternary drift.
- Layne Christensen Canada Limited provided drilling and coring services, and downhole petrophysical logs.
- D. Sim of Electrolog Services Inc. conducted the downhole petrophysical logs in coreholes.
- Becquerel Laboratories Inc. performed the geochemical analyses of the Quaternary sediment samples.
- Norwest Labs conducted the hydrocarbon analyses on Quaternary sediment samples.
- Highland Helicopters.
- International Datashare Corporation digitized the petrophysical logs.
- Bob Davie at RnD Technical provided an editorial review of the manuscript
- The author acknowledges the significant funding to this project by the Federal Ministry of Western Economic Diversification through the Western Economic Partnership Agreement with the Province of Alberta.

Western Economic Diversification Canada

Canada

Lastly, the author greatly appreciates the comments and editorial review of this report by his colleagues K. Parks and M. Fenton.

Abstract

Earth Sciences Report 2002-03 summarizes baseline investigations by the Alberta Geological Survey (AGS) into the groundwater resources of the Athabasca Oil Sands (In Situ) Area of northeast Alberta. Specifically, this report describes the nature and distribution of thick Late Tertiary and Quaternary geological sediments that overlie the bedrock surface above the oil sands deposits in the region between the Cold Lake area and Fort McMurray.

The surface of the underlying bedrock in the study area represents one of the major unconformable surfaces of the Western Canadian Sedimentary Basin—the pre-Quaternary unconformity, which spans the period of erosion from the Late Cretaceous–Early Tertiary to the onset of glaciation in the Early Quaternary. The bedrock surface is an erosional landscape consisting of isolated upland remnants and deep, broad relicts of paleoriver channel systems that formed during the Late Tertiary, but which were later modified by glacial and present-day fluvial processes. Elements of the bedrock landscape have been grouped into four major physiographic units based on differences of elevation and relief. The geometry and physical attributes of the buried channels are discussed.

An understanding of the distribution and geometry of the paleoriver channel systems becomes important in the overall evaluation of groundwater resources as these are the loci for accumulations of thick, permeable sediment, which comprise the major drift aquifers of the region. A series of geological cross-sections provide slices through more than 300 m of Tertiary and Quaternary sediment that lie above the deepest of the bedrock channels, illustrating the major stratigraphic units of the drift. Eight Tertiary–Quaternary units have been defined primarily through the interpretation of oil and gas exploration logs. These log interpretations have been validated and calibrated by lithological and geochemical analyses of samples collected from seven coreholes drilled by AGS. An attempt has been made to correlate these stratigraphic units in accordance with the lithostratigraphic model developed for the Cold Lake area to the south.

The lowermost of the drift units, the Empress Formation, consists dominantly of coarse sediment deposited by preglacial and glacial fluvial systems. A series of structure contour and isopach maps illustrate that these basal fluvial sediments are present as thick sequences within the floors of the buried bedrock channels, as well as terrace caps on the bedrock interfluves that separate the channels. Collectively, these fluvial sediments of the Empress Formation constitute the largest drift aquifer in the region. The presence of weathered horizons on the surfaces of buried till units, as determined from core samples, prove the region was subjected to multiple glacial and interglacial intervals during the Quaternary. Glaciofluvial sediments that lie between these tills may also form local- to regional-scale aquifer systems. Sample analyses also highlight the natural occurrence of bitumen in tills from place to place, as well as increased levels of arsenic in buried weathered horizons of older tills. The current level of interpretation does not permit the subsurface mapping of the stratigraphic units other than the Empress Formation.

A terrain analysis map has been constructed primarily from the interpretation of aerial photographs to show the nature and distribution of landforms and surface geological materials deposited in the period from the last glaciation to the present. Although lacking the rigours of a surficial geology map, particularly with respect to a paucity of field ground truthing, the terrain analysis map provides useful information regarding the regional distribution of geological material, which affect land-use planning and construction of infrastructure related to the petroleum industry.

1 Introduction and Scope of Study Area

This report characterizes the regional bedrock topography and Quaternary geology in an area of northeast Alberta that is planned for major oil sands development. One of the intended purposes of the report is to provide the geological framework necessary for assessing the baseline hydrogeological and hydrogeochemical conditions in advance of industrial expansion. This project was funded jointly by the Government of Alberta, through the Alberta Energy and Utilities Board (EUB), and by the Government of Canada, through the Federal Ministry of Western Economic Diversification under the Western Economic Partnership Agreement.

The area of this study is the southeast part of the EUB-designated administrative area known as the Athabasca Oil Sands Area (Figure 1). In particular, this study examines that part of the area where commercially significant bitumen deposits are known to exist but are buried too deeply to economically mine from the surface. Because of the area's probable suitability for bitumen recovery by in situ methods, like Cyclic Steam Stimulation (CSS), Steam-Assisted Gravity Drainage (SAGD) or solvent extraction, the informal designation of the area for the purpose of this report is the Athabasca Oil Sands (In Situ) Area. This will distinguish it from the surface-mineable area north of Fort McMurray and the bitumen and heavy oil deposits in the EUB-designated Cold Lake Oil Sands Area to the south.

The area is a sparsely populated part of the province. The major community is the City of Fort McMurray located at the confluence of the Athabasca and Clearwater rivers (Figure 1). Provincial Highway 63 links Fort McMurray with smaller villages such as Wandering River and Mariana Lake located in the southwest part of the area. The only other major transportation corridors are Provincial Secondary Highway 881 and the Canadian National Railway Company line, both of which cross the central part of the map area, connecting the community of Lac La Biche (located south of the study area) with Fort McMurray. Road and aerial access are restricted in the southeast part of the study area, which is occupied by the Department of National Defence Cold Lake Air Weapons Range. Road access continues to increase in response to new economic activity in the region, primarily forestry and oil sands development.

The study area is geographically bounded by the Athabasca River to the west and northwest and the Clearwater River to the northeast. The Alberta–Saskatchewan Border defines the limit of the study area to the east. The political border fortuitously approximates the eastern limit of the Christina River subdrainage basin. The southern limit of the study area approximately coincides with the Mostoos Upland–May Hills ridge. This ridge forms the drainage divide between the subdrainage basins of the House, Horse and Christina rivers that drain northward to the Athabasca River as part of the Athabasca drainage basin, and the various smaller rivers that flow south into the Beaver River–Cold Lake drainage basin.

The geological scope of this report extends from the pre-Quaternary unconformity (bedrock surface) to the modern land surface (Figure 2). In all but the northeastern part of the study area, where sandstone of the Grand Rapids Formation forms the bedrock surface, the underlying bedrock geology consists mainly of thick and regionally extensive shale of the Joli Fou and LaBiche formations. Erosional remnants of sandstone and shale of the Wapiti Formation overlie the Colorado Group shale in the southwest part of the map area. Subcrop margins of the underlying bedrock geological units are illustrated in Figure 3.

2 Area Topography and Physiography

Major topographic and physiographic elements of the regional landscape have been formed and modified by Late Tertiary and Quaternary geological processes. A brief discussion of these provides a useful prelude to the interpretation of the bedrock topography and Quaternary geology. Topographic elements of the study area are depicted in a computer-generated, coloured digital elevation model (Figure 4), which shows that the surface elevation ranges from 250 m along the present-day Athabasca River valley in the

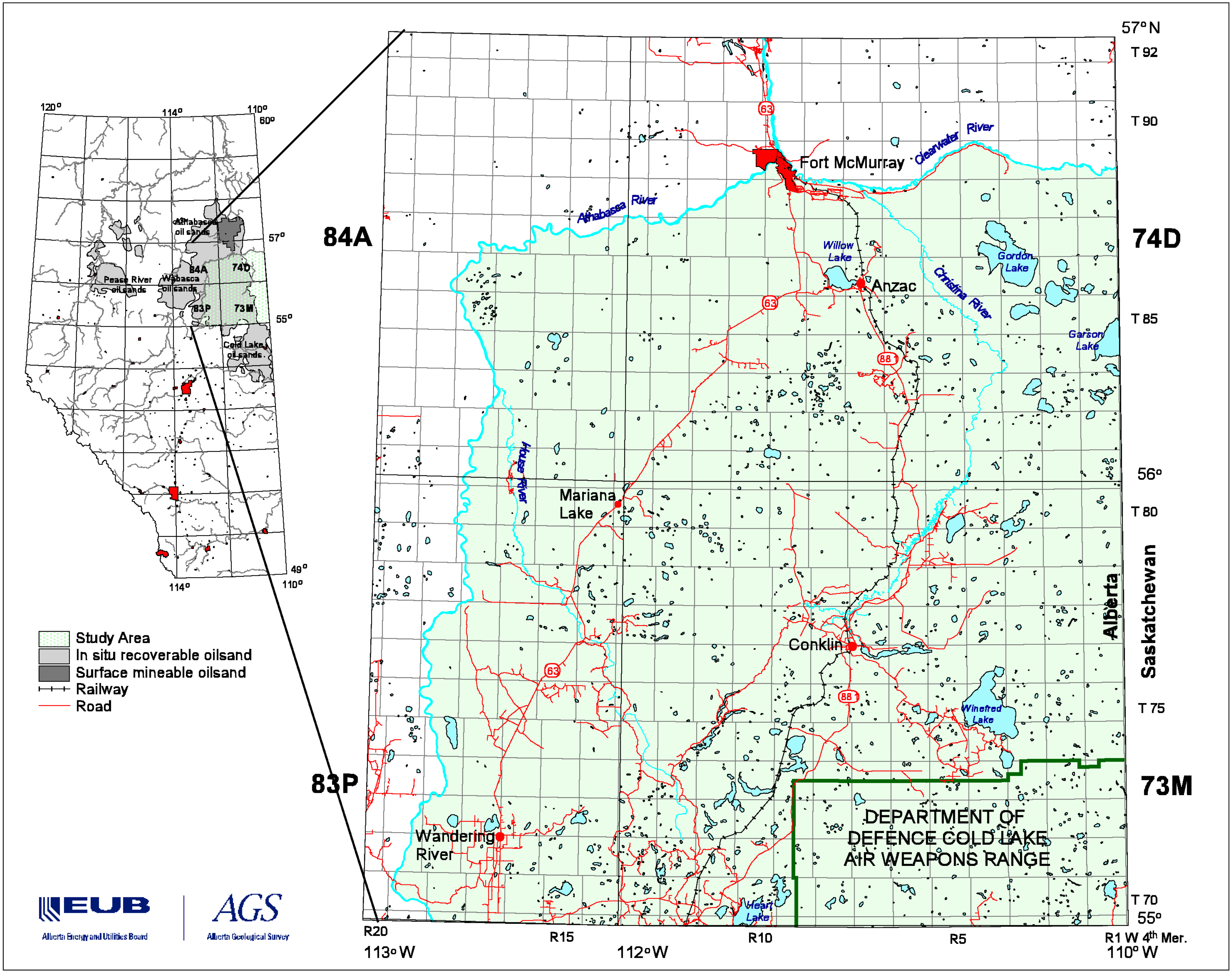


Figure 1. Location of study area.

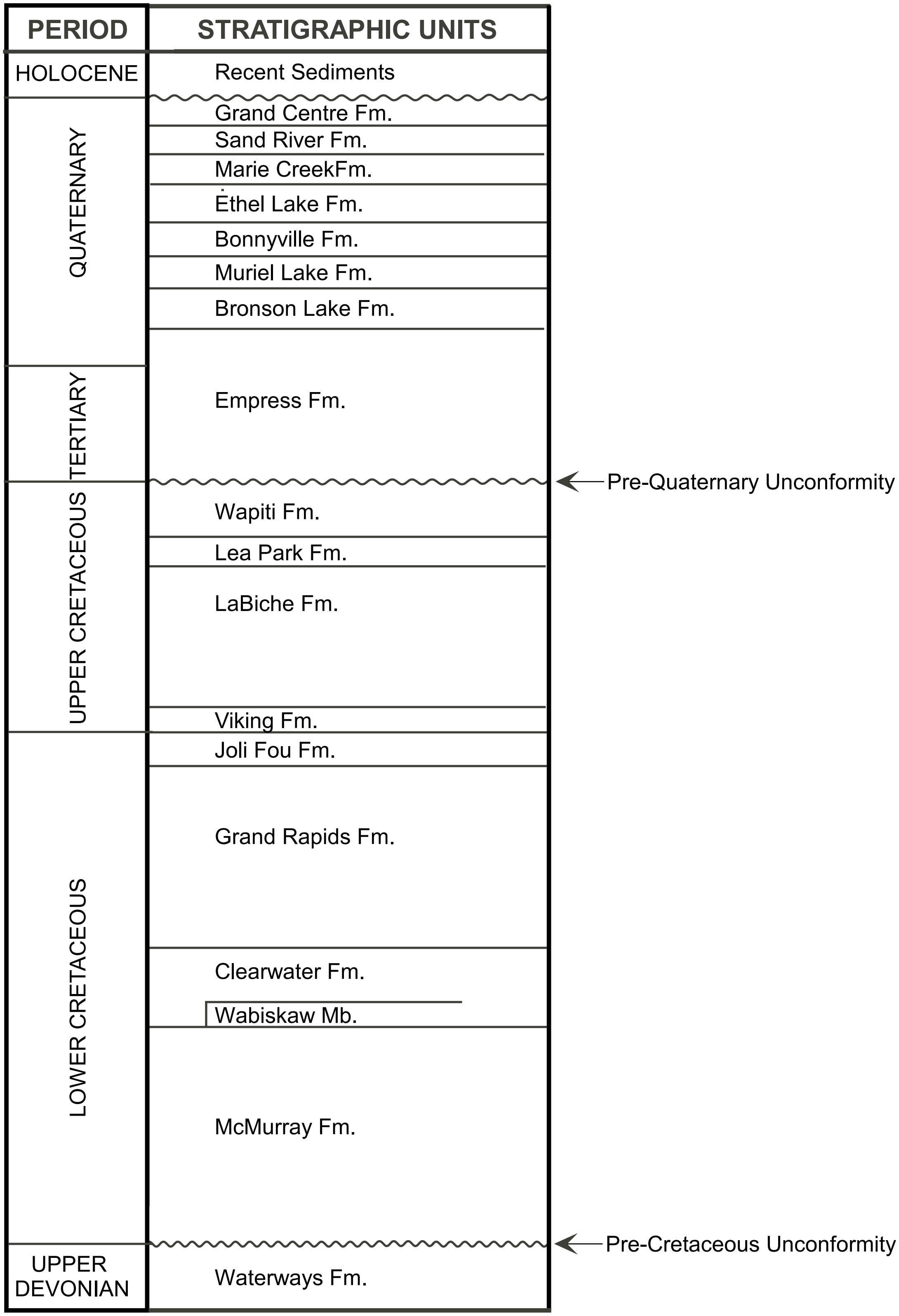


Figure 2. Stratigraphic column for study area.

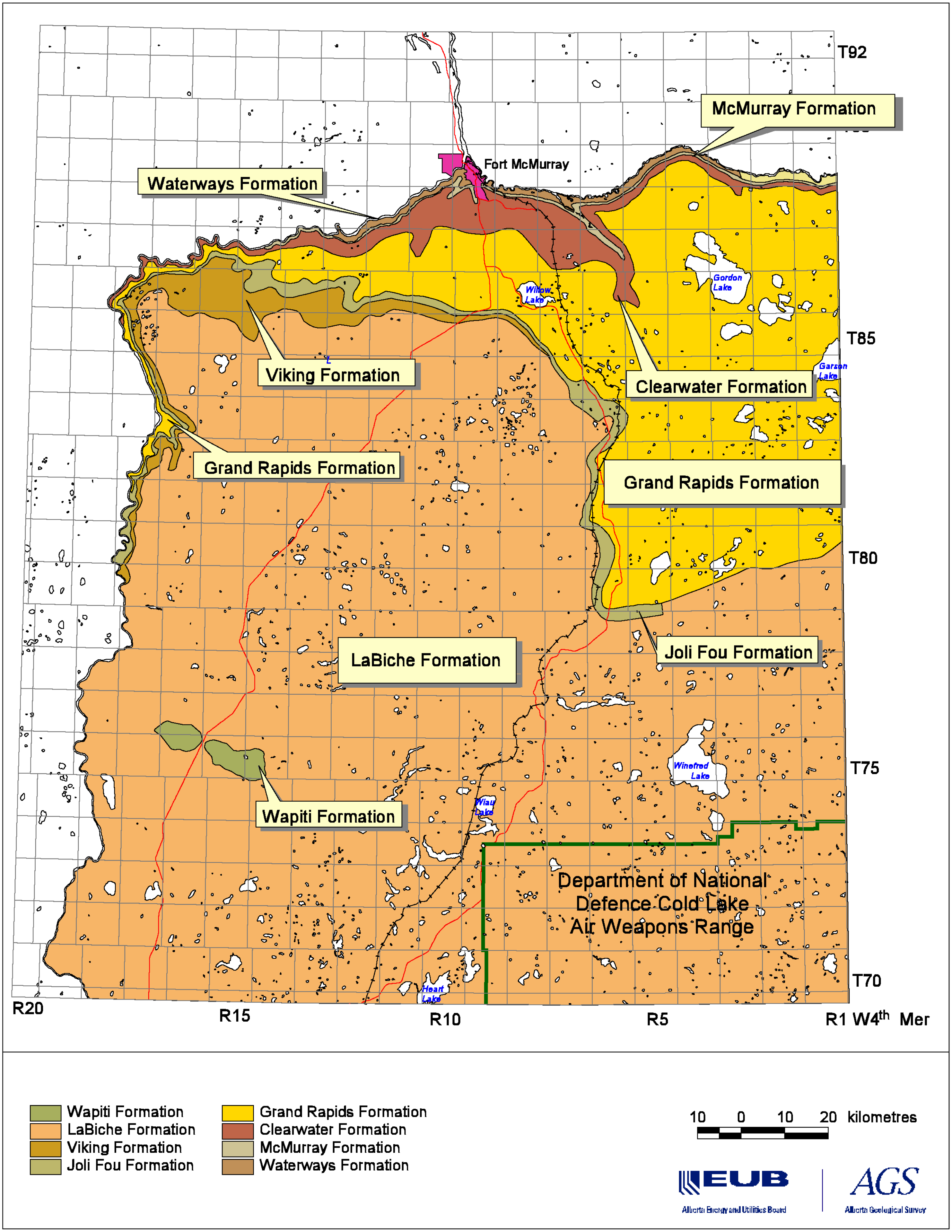
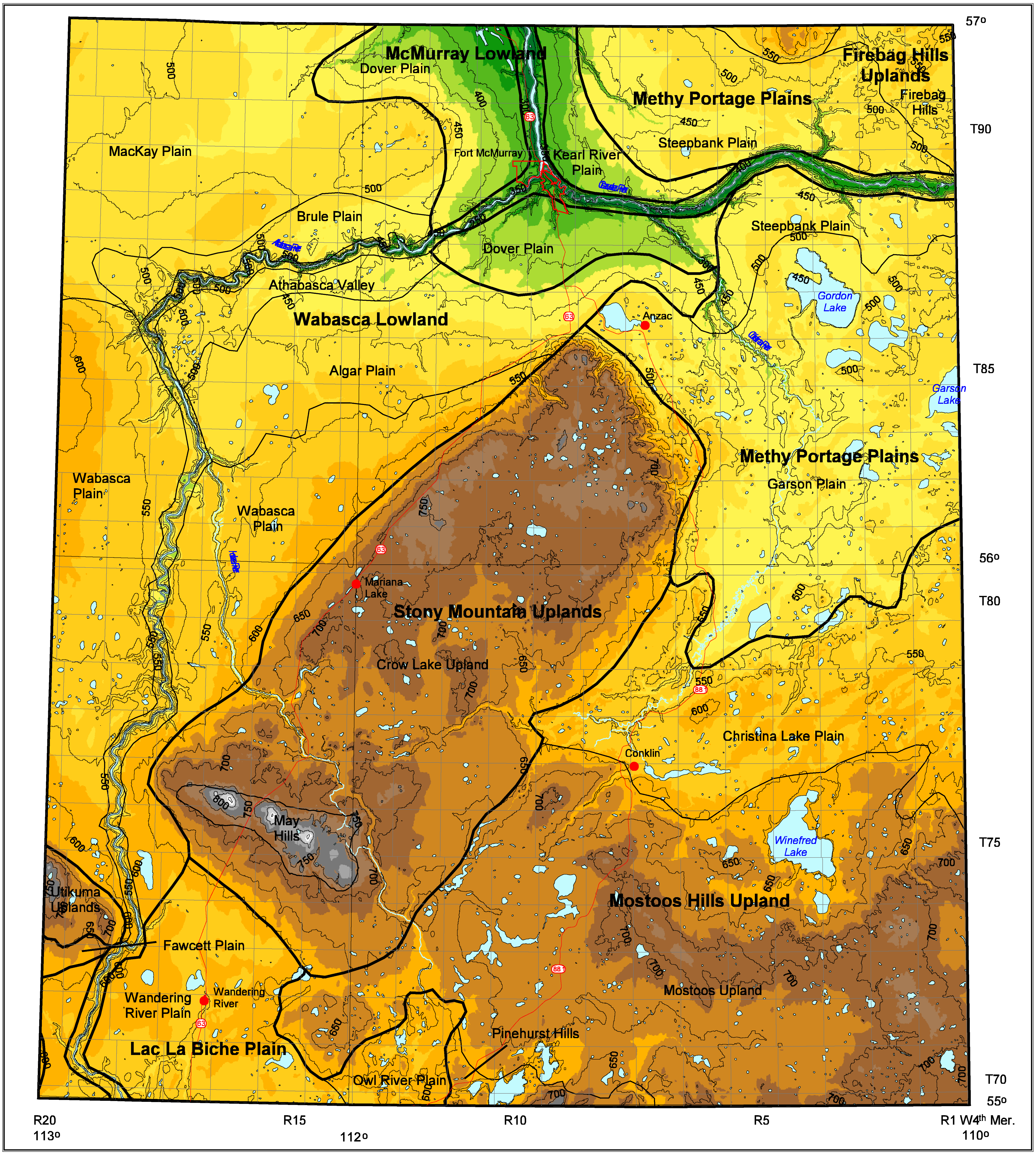


Figure 3. Subcrop map of the bedrock geology in the study area.



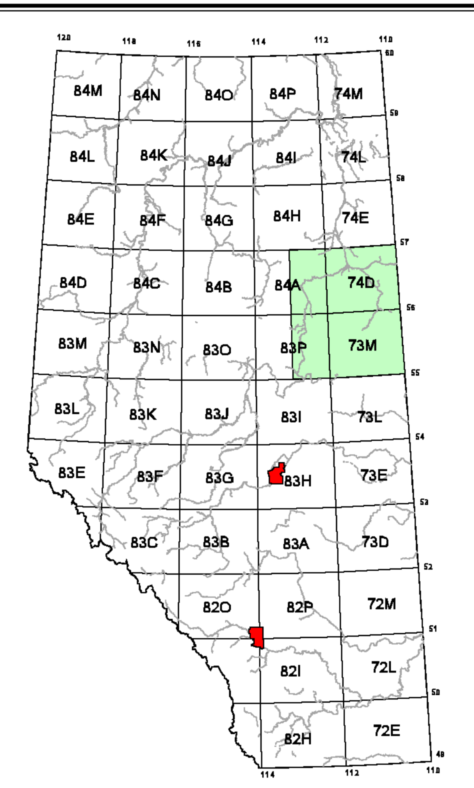


Figure 4
Surface topography and physiography of the study area

Digital Elevation Model (DEM) Data provided by: Geomatics Canada, Natural Resources Canada

Physiography from Pettapiece (1986)

EUB Alberta Energy and Utilities Board AGS Alberta Geological Survey north end of the study area, to as high as 850 m in the uplands directly north of the community of Wandering River in the southwest part of the study area. The major surface drainage features are the Athabasca and House rivers in the west, and the Clearwater and Christina rivers in the northern and eastern parts of the area.

Regional differences in topographic elements (elevation, drainage) form the basis for dividing the study area into seven major physiographic units, each of which include minor subdivisions (Pettapiece, 1986). The most prominent physiographic feature is a dogleg–style complex of uplands in the central part of the map area, formed by the northeast-trending Stony Mountain Uplands and the northwest-trending Mostoos Hills Upland (Figure 5).

The Stony Mountains Uplands is the more prominent of the two uplands, particularly when viewed from the north. Elevations within most of the Stony Mountain Uplands range from about 600 to 700 m, with the notable exception of the May Hills bedrock highland where the elevation is as high as 850 m. Surface water drains radially from the Stony Mountain Uplands, ultimately flowing into the Hangingstone, House, Horse and Christina river basins. The Mostoos Hills Upland (Figure 5) is the next most prominent feature. It includes two upland subdivisions: the Pinehurst Hills in the extreme south (650–750 m) and the Mostoos Upland in the southeast (600–700 m). The southern flank of the Mostoos Hills Upland drains south along the Sand and Owl rivers, and the northern flank drains north along the Winefred and Christina rivers.

A number of lower elevation plains and lowlands lie along the perimeter of the central uplands, including: the Lac La Biche Plain in the extreme southwest (500–600m), the Wabasca Lowland in the northwest (275–600 m), and the Christina Lake Plain (500–600 m) and Methy Portage Plains in the northeast (425–500 m). The Athabasca River and its tributaries, the House River, Horse River and Hangingstone River drain the Lac La Biche Plain and Wabasca Lowland. The Christina River, its tributaries, and the Clearwater River drain the Methy Portage Plains and the Christina Lake Plain (Figure 5).

3 Bedrock Topography and Buried Channels

3.1 Background and Methods of Interpretation

Bedrock topography maps of the study area depict a model of one of the major unconformable surfaces in the Western Canadian Sedimentary Basin—the pre-Quaternary unconformity, representing the period of erosion from the Late Cretaceous–Early Tertiary to the onset of glaciation in the Early Quaternary. The model presented in this study represents the current understanding of the paleotopography of the pre-Quaternary unconformity based on previous studies (Gold, 1983; Tokarsky and Epp, 1986; Stein et al., 1993; Stein and Andriashek, 1998) as well as new interpretations by the AGS.

The topography of the underlying bedrock surface is constructed almost entirely from borehole log information, supplemented with only a few observations from outcrops along natural exposures. Approximately 7300 well logs were evaluated to establish the top of the bedrock surface in the study area, the vast majority of which are oil and gas exploration industry petrophysical logs, supplemented with lithologs from the water-well drilling industry, and seven corehole logs obtained during drilling by the AGS as part of this study (Figure 6). Well information was entered into a digital database (Microsoft® Access™), which records location, well owner, elevation of top of the hole, as well as important contacts such as elevations of bedrock top, drift thickness and other stratigraphic markers within the drift succession.

About 4300, or 65%, of the wells provided some useful information regarding the top of the bedrock surface. The majority of these data consist of electric logs, primarily resistivity and conductivity traces, recorded in uncased, open-hole conditions. In many areas where the drift was thick, drill-casing depths

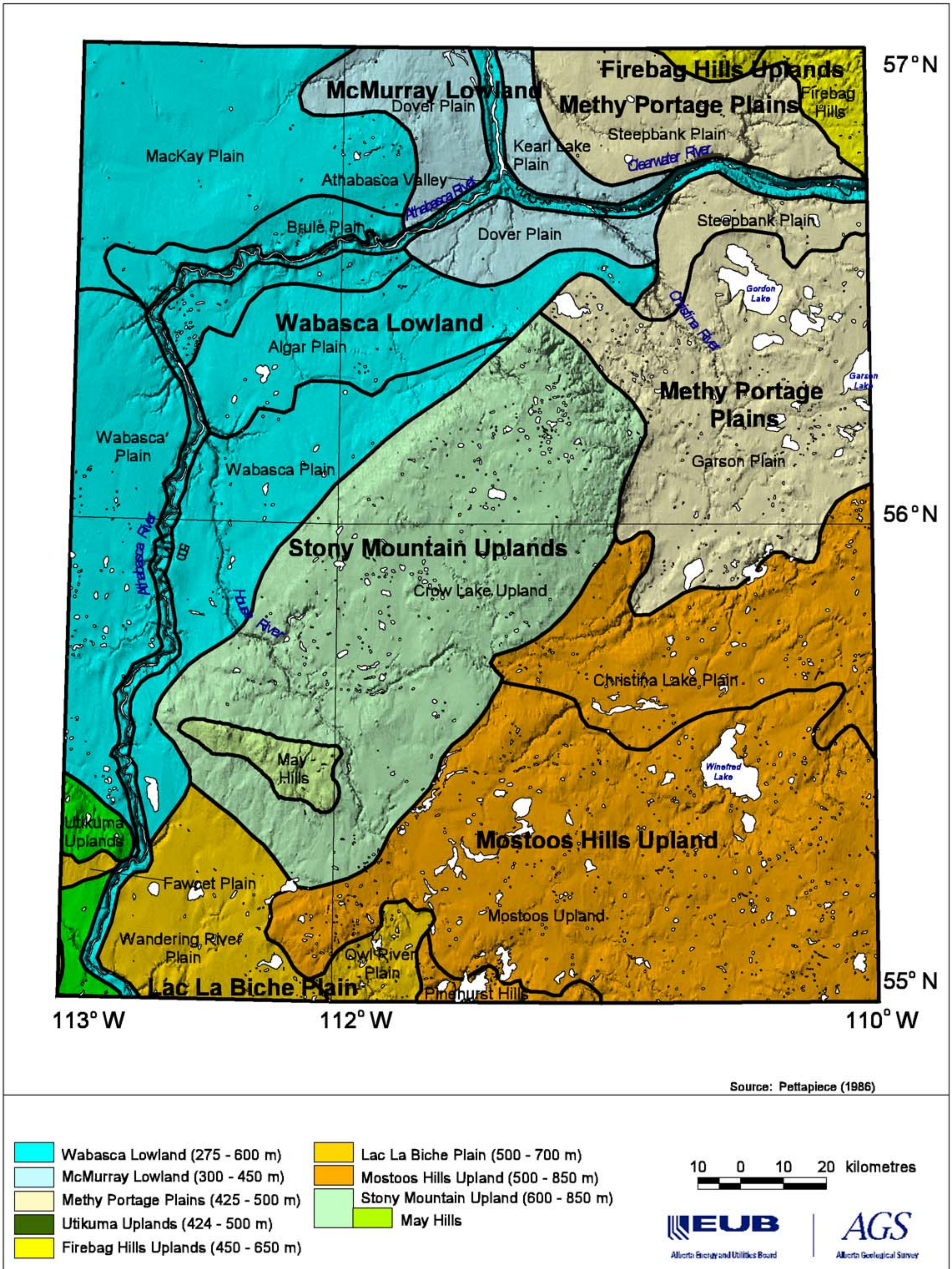
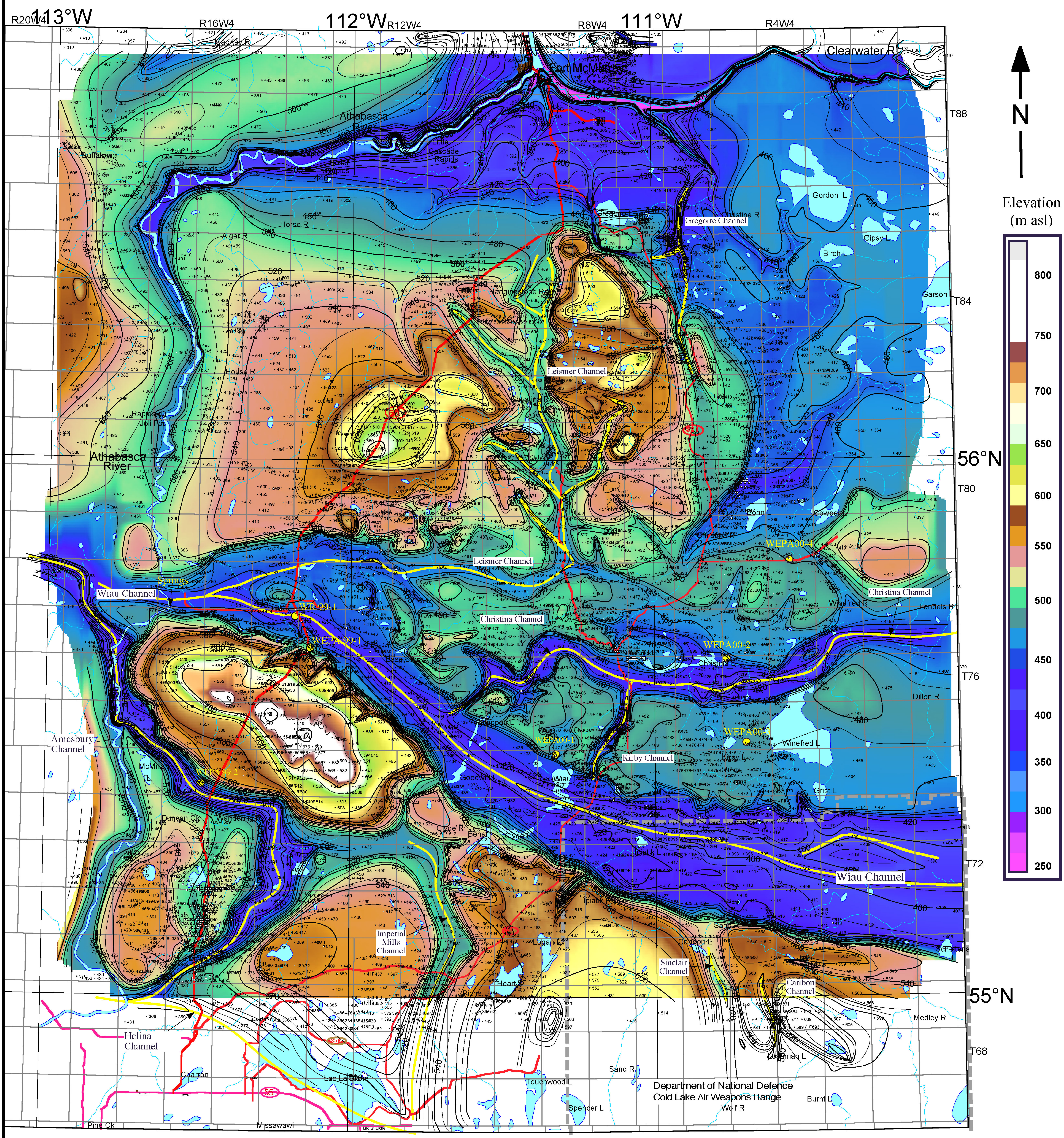


Figure 5. Physiographic subdivisions of the study area.



Data Legend

- ● 400 - Bedrock elevation (in m asl) equal to value shown
- ○ 400 - Bedrock elevation (in m asl) higher than value shown
- □ 400 - Bedrock elevation (in m asl) lower than value shown
- Channel talweg
- WEPA00-1 Alberta Geological Survey core hole

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD DEO Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 6. Bedrock topography of the study area showing talwegs of the buried channels.	
Contour interval 10 m	
(90 Km)	
L. D. Andriashek	
Date: 2/18/03	Scale 1:500 000

terminated within the drift sequence. Here, resistivity logs recorded the lower part of the Quaternary sequence, as well as the bedrock contact and deeper bedrock strata. Approximately 1750 wells recorded the drift–bedrock contact (shown as black-filled circles on Figure 6), and these established the baseline data to contour the bedrock surface. In the holes where the casing was set into the bedrock, the elevation of the bedrock surface cannot be determined from electric logs, but a 'higher-than-base-of-casing' elevation value is recorded in the database (about 2800 entries), and depicted on Figure 6 as white-filled circles. These 'higher than' values are useful as they provide some constraints on contouring the bedrock surface, particularly in areas of high bedrock relief. More recently, gamma-ray logs have been run in cased holes, providing a log record (somewhat suppressed in the section of steel casing) almost to surface. Approximately 200 boreholes, mostly water wells, were not drilled deep enough to intersect the bedrock surface. These are entered as 'lower than' values, indicating that the bedrock surface lies at an elevation lower than the bottom of the hole (shown as white-filled boxes on Figure 6). The lithologs from these wells do, however, provide useful information regarding the nature of Quaternary sediments beneath the site.

The map of the bedrock surface was created in digital format using MCadContour™ computer-mapping software. However, the data points were not contoured by the software application. Rather, these were digitally contoured on screen by hand to reflect the author's understanding and concept of fluvial erosional landforms and features. These digitally hand-drawn contour lines were later rendered into grid data to generate three-dimensional models of the bedrock surface, one view of which is shown in Figure 7.

3.2 Bedrock Physiographic Units

The topography of the bedrock surface of the study area represents a landscape that was extensively eroded during the Late Tertiary and later modified by glacial and present-day fluvial processes. Erosion and incision of the exposed bedrock produced a landscape characterized by isolated remnants of bedrock uplands and deep, broad relicts of paleoriver channel systems (Farvolden, 1963). An understanding of the distribution and geometry of these erosional elements of the bedrock landscape becomes important in the overall evaluation of groundwater resources because these are the loci for accumulations of thick, permeable sediment, which make up the major drift aquifers of the region.

In terms of the character of the bedrock landscape in the study area, the difference in elevation between the highest and lowest bedrock elements is about 600 m, ranging from a high of about 840 m in the May Hills in the southwest, to a low of about 240 m in bedrock outcrops along the present-day Athabasca River (Figure 6). Excluding the present-day Athabasca River channel, the lowest bedrock elevations correspond to the talwegs of buried channels, the deepest of which are the Wiau, Christina and Amesbury channels (Figure 6).

Just as physiographic classifications facilitate the discussion about present-day surface landforms (Pettapiece, 1986), the major elements of the bedrock topography can similarly be grouped into bedrock physiographic units for purposes of discussion. As Figure 8 illustrates, in the study area, elements of the bedrock landscape were classified in decreasing order of elevation and relief into one of four major bedrock physiographic units: highlands, uplands, plains and lowlands. Profiles of the bedrock surface are also depicted in a series of geological cross-sections that illustrate the stratigraphy of the drift in the study area (Figures 9 to 13).

3.2.1 May Hills Highland

The May Hills Highland (Figure 8) is the highest bedrock physiographic unit in the study area, ranging in elevation from about 600 m to as high as 840 m in a series of southeast-trending remnant bedrock knobs (Figure 6). The core of the highland consists of Upper Cretaceous Wapiti Formation siltstone, sandstone,

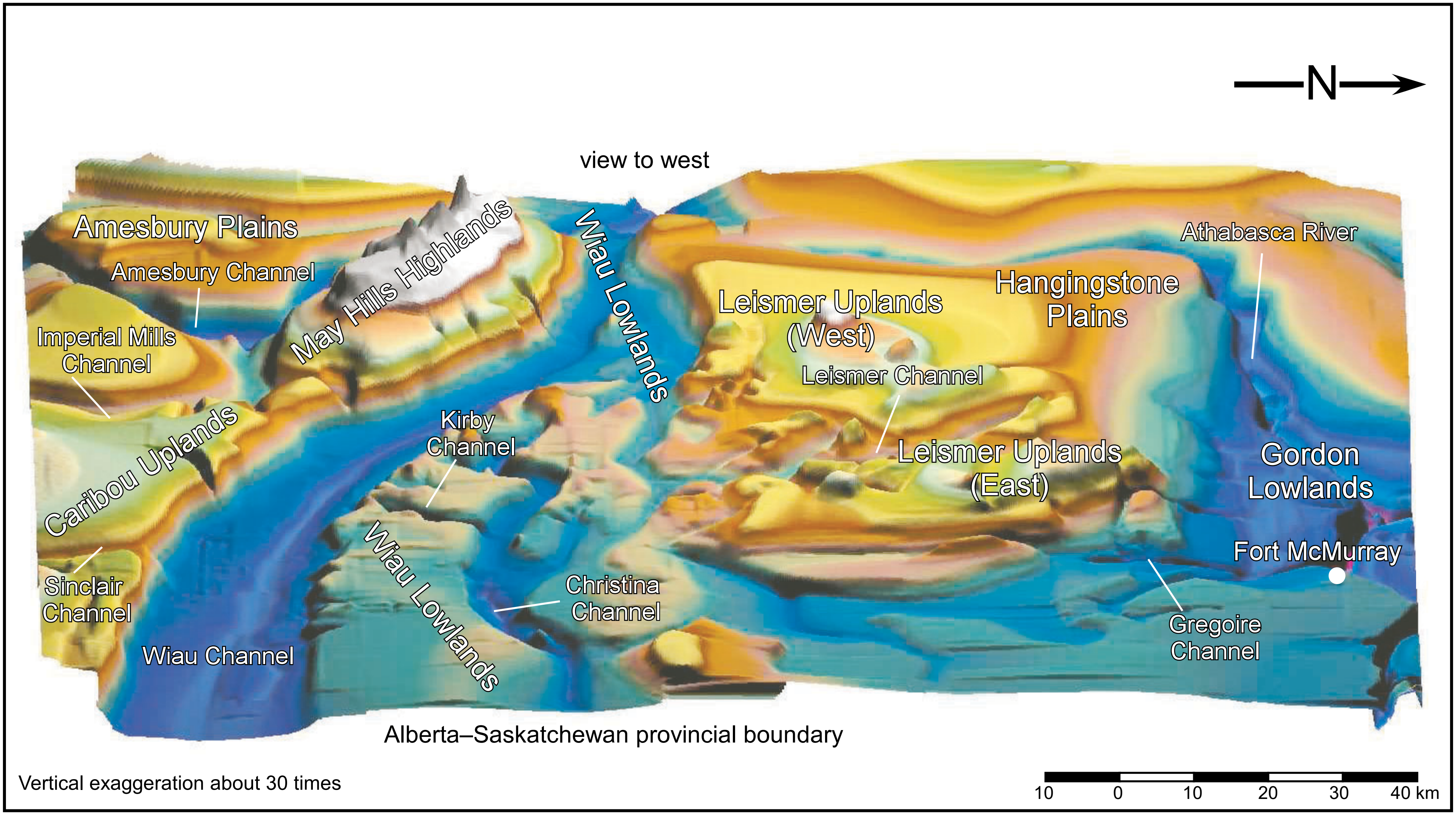


Figure 7. Three-dimensional perspective of the bedrock topography in the study area.

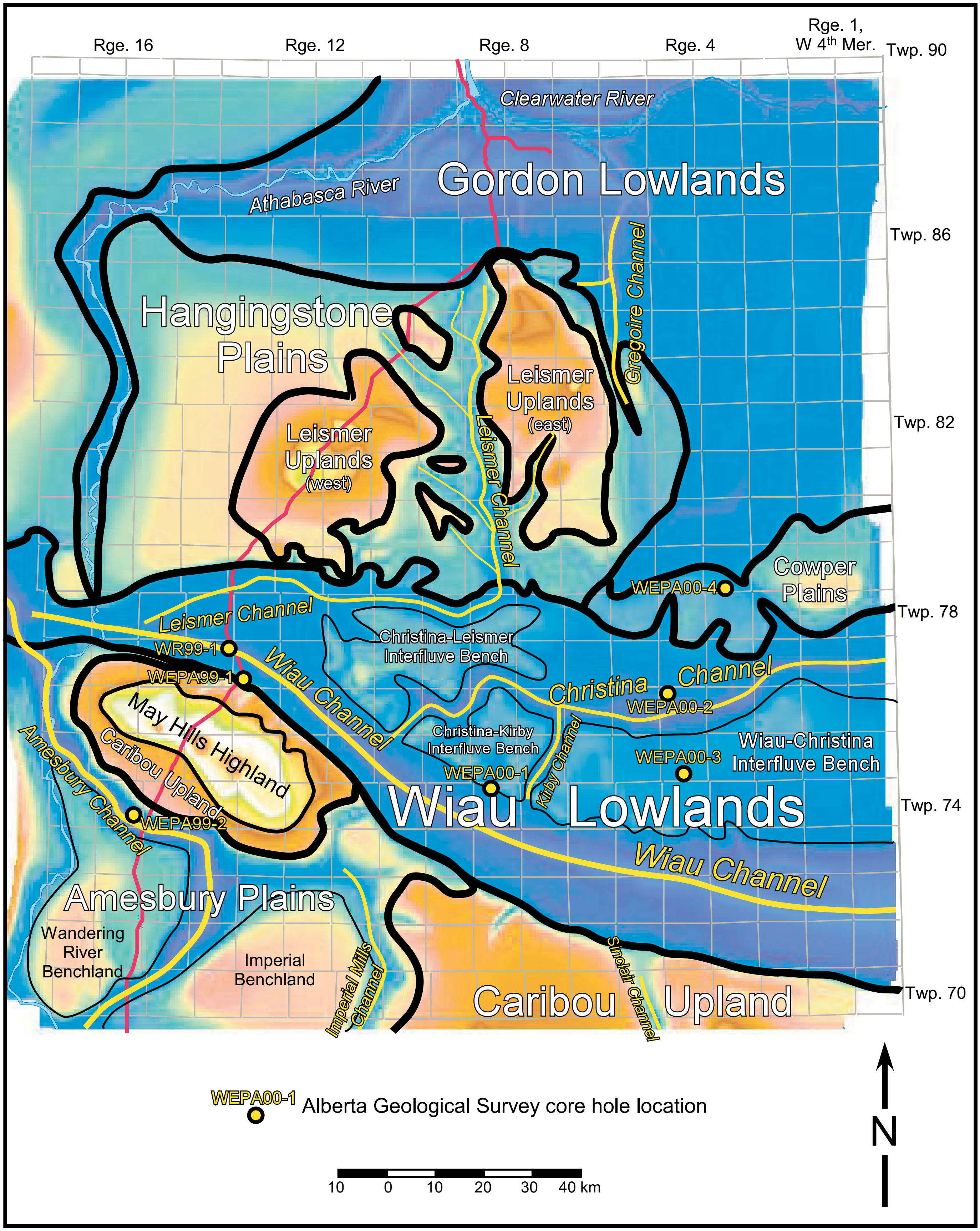


Figure 8. Major bedrock physiographic units.

Figure 9. Geological cross-section A-A' showing stratigraphy of the drift and upper bedrock units.

Figure 10. Geological cross-section B-B' showing stratigraphy of the drift and upper bedrock units.

Figure 11. Geological cross-section C-C' showing stratigraphy of the drift and upper bedrock units.

Figure 12. Geological cross-section D-D' showing stratigraphy of the drift and upper bedrock units along the Wiau Channel.

Figure 13. Geological cross-section E-E' showing stratigraphy of the drift and upper bedrock units along the Leismer Channel.

mudstone and coal (Figure 3). A comparison of the surface physiography with the bedrock physiography (Figures 4 and 6) shows that there is almost a one-to-one relationship between the boundaries of the May Hills Highland bedrock physiographic unit and the May Hills surface physiographic subdivision, indicating that bedrock lies at, or near the present-day land surface (Figure 11). Outcrops of the Wapiti Formation can be seen along road sections at the very top of the highland, where the drift cover is absent to only a few metres thick in places.

3.2.2 Caribou Upland

The Caribou Upland forms the next highest bedrock physiographic unit in the bedrock landscape (Figure 8). The unit lies along the southern part of the study area, forming a relatively steep southern margin with the adjacent Wiau Lowlands (Figure 8). The upland consists of two components: a western component, surrounding the May Hills Highland, and an eastern component along the southeastern border of the study area. The Amesbury Plains forms a saddle between the two upland features.

The elevation of the Caribou Upland ranges from a low of about 500 m to as high as 650 m in the extreme southern part of the study area (Figures 6 and 8). The majority of the upland, however, lies at an elevation between 550 and 600 m. Two buried channels, the Sinclair and Caribou channels, intersect the upland in Twp. 70, Rge. 5 and 6, W 4th Mer. (Figure 6). The lowest part of the south-trending Sinclair Channel lies at an elevation of about 500 m, although local channel scour extends the channel down as deep as 450 m in places.

Black marine shale of the Upper Cretaceous LaBiche Formation lies at the surface of most of the upland, with the possible exception of outliers of the younger Lea Park Formation shale in the highest parts of the upland to the south, and exposures of Lea Park Formation along the base of the May Hills Highland in the west, as shown in a series of geological cross-sections (Figures 9, 10 and 11). The upland is currently covered by about 90 to 150 m of drift (Figure 14).

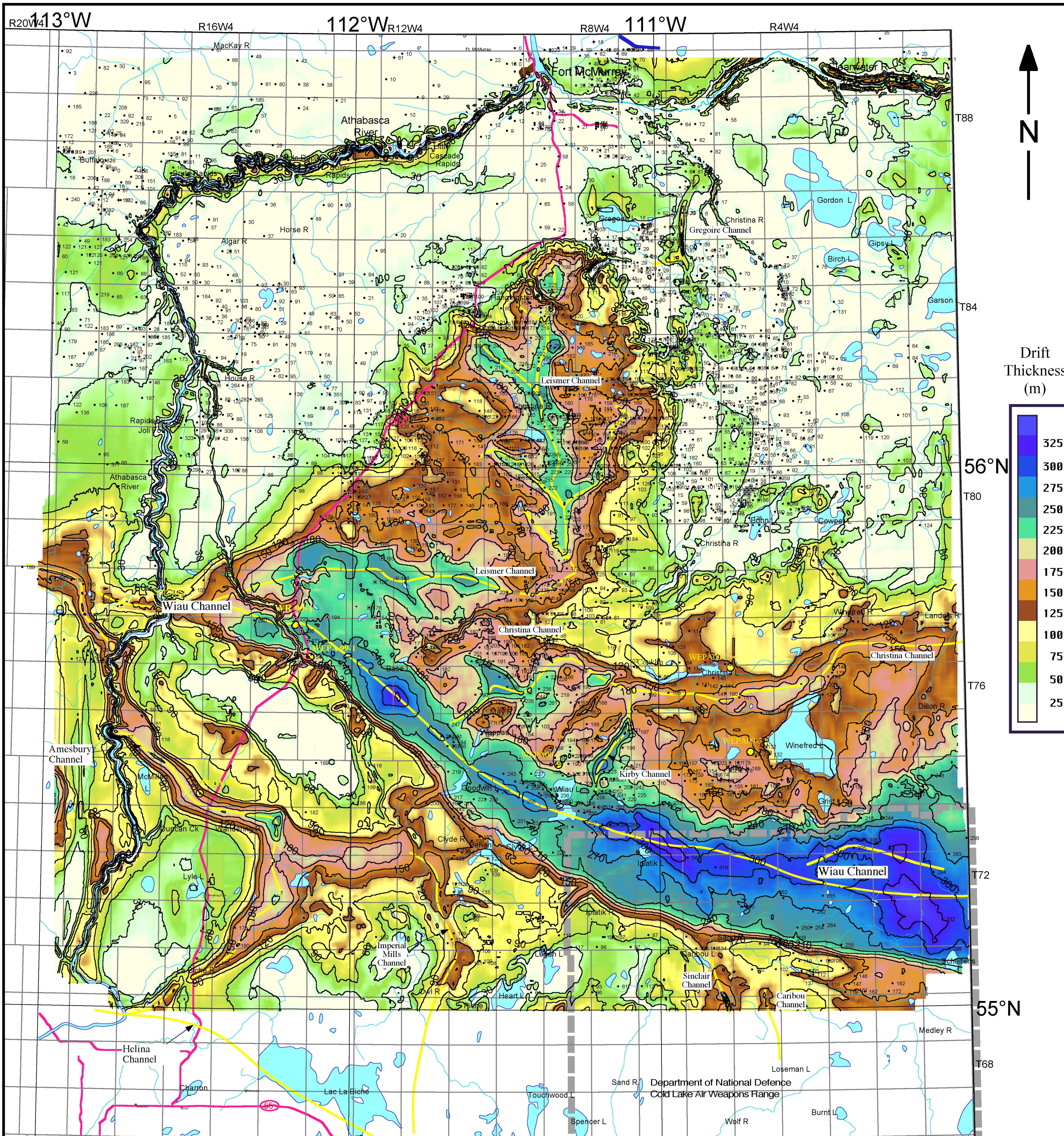
There is only a weak relationship between the boundaries of the Caribou Upland bedrock physiographic unit and the Mostoos Upland, which forms the overlying surface physiographic subdivision (Figures 4 and 8).

3.2.3 Leismer Uplands

The Leismer Uplands lie at roughly the same elevation as the Caribou Upland, but are located on the north, or opposite, side of the Wiau Lowlands (Figure 8). The uplands consist of a number of remnants of a formerly more extensive bedrock upland that was eroded and dissected by the Leismer Channel and its tributaries (Figure 8). The Leismer bedrock upland underlies the present-day Crow Lake Upland physiographic subdivision, but a comparison of the boundaries shows that the geometries of the two are quite dissimilar—the Leismer Upland being significantly less extensive and lower in elevation than the Crow Lake Upland (Figures 4 and 8).

For purposes of discussion, the Leismer Uplands can be considered to consist of two major upland features, the Leismer Uplands (west), and the Leismer Uplands (east), which are separated by the Leismer Channel. The elevation of the western feature ranges from about 550 to 630 m, with a maximum elevation of about 690 m in an isolated bedrock high in Twp. 81, Rge. 13, W 4th Mer. (Figure 6). The elevation of the eastern feature is lower, varying between 530 and 610 m. The Leismer Channel, and its tributaries, was incised as much as 150 m into the pre-existing upland such that the channel talweg lies at an elevation as low as 490 to 500 m.

Marine shale of the LaBiche Formation lies at the surface of most of the upland, with the possible exception of an outlier of Lea Park Formation siltstone and shale in the bedrock high in Twp. 81, Rge. 13,



Data Legend

- ● 100 - Thickness (in m) equal to value shown
- ○ 100 - Thickness (in m) less than value shown
- □ 100 - Thickness (in m) greater than value shown
- Channel talweg
- WEPA 99-2 Alberta Geological Survey core hole

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 14. Thickness of Late Tertiary and Quaternary Drift.

Isopach interval 30 m

(60 Km)

L. D. Andriashek

Date: 2/18/03	Scale 1:500 000

W 4th Mer. (Figure 3). In places, fluvial erosion within the Leismer Channel has cut down to intersect the top of the Viking Formation sandstone (Figure 13).

Drift thickness above the Leismer bedrock uplands averages about 100 m, and locally is as much as 150 m (Figure 14).

3.2.4 Amesbury Plains

Although the Amesbury Plains contains the most deeply incised bedrock channel in the study area, the Amesbury Channel, the Plains are considered to occupy a position intermediary in elevation to the Caribou Upland and the Wiau Lowlands, which lie to the north and east. Four physiographic subdivisions comprise the Amesbury Plains: the Imperial and Wandering River benchlands, incised into which are the Amesbury and Imperial Mills bedrock channels (Figure 8).

The northwest-trending Amesbury Channel dissects the Amesbury Plains into two bedrock interfluves, the Wandering River Benchland and the Imperial Benchland. Both benchlands have an undulating bedrock topography in which the elevation differs by less than 60 m, ranging from about 500 to 560 m (Figure 6). The eastern boundary of the Imperial Benchland is defined by the Imperial Mills Channel, which lies at an elevation of about 480 to 500 m at the foot of the Caribou Upland.

Unlike the relatively shallow Imperial Mills Channel, the Amesbury Channel is more deeply incised into the surrounding bedrock, as much as 100 m in the narrow channel segment within Twp. 74, Rge. 17, W 4th Mer., producing much steeper channel walls (Figure 6). Elevations within the channel decrease in a northerly direction from about 430 m in the southern corner of the study area to about 370 m in Twp. 78, Rge. 18, W 4th Mer., where the channel and the western end of the Wiau Channel both converge.

Black marine shale of the LaBiche Formation is believed to form the bedrock surface throughout all of the Amesbury Plains (Figure 3). With the exception of the more than 180 m of drift infill within the Amesbury and Imperials Mills channels, the remainder of the Amesbury Plains is covered by about 30 to 60 m of drift (Figure 14).

3.2.5 Hangingstone Plains

The Hangingstone Plains lie at roughly the same elevation as the Amesbury Plains, but are located on the north, or opposite, side of the Wiau Lowlands (Figure 8). The physiographic unit surrounds the more prominent bedrock features of the Leismer Uplands, and includes one subdivision, the Leismer Channel and its tributaries. Although data are sparse in the western part of the unit, the bedrock surface of the Hangingstone Plains is interpreted to slope gently toward the present-day Athabasca River (Figure 8). The bedrock surface has a steeper contact with the Gordon Lowlands along the eastern edge of the plains, where the topography drops deeply into the buried Gregoire Channel (Figure 6).

Elevation within the physiographic unit differs by less than 80 m, from a high of about 560 m at the contact with the Leismer Uplands, to a low of about 500 m along the talweg of the Leismer Channel. The northern and eastern boundary of the Hangingstone Plains roughly demarcates the north extent of shale of the LaBiche and Joli Fou formations, as well as sandstone of the Viking Formation. Sandstone, siltstone and shale of the Grand Rapids Formation outcrop north of the physiographic unit (Figure 3).

For much of the plains, the thickness of drift cover is 30 m or less (Figure 14). The thickest accumulations of drift are found above the northern part of the buried Leismer Channel and its tributaries, where as much 250 m of sediment have been mapped.

3.2.6 Cowper Plains

The Cowper Plains form a relatively shallow, east-west physiographic divide between the Wiau Lowlands to the south and the Gordon Lowlands to the north. The western part of the plains is similar in elevation to, and can be considered to be the northern complement of, the Wiau–Christina Interfluve Bench that lies on the opposite side of the Christina Channel to the south (Figures 8 and 9). The eastern part of the plains lies at a higher elevation, more similar to that of the Hangingstone Plains. The flanks along the western part of the Cowper Plains appear to show erosion and incision by local drainage flowing both south into the Christina Channel and north into the Gordon Lowlands. Headwater erosion and stream capture has breached the bedrock divide in Twp. 77, Rge. 2, W 4th Mer. to Twp. 79, Rge. 4, W 4th Mer., forming a shallow northwest-trending channel that transects the plains (Figure 6).

Regional differences in elevation within the plains are generally less than 60 to 70 m, ranging from a low of about 470 m in the channel in Twp. 78, Rge. 3, W 4th Mer., to a high of about 540 m directly east in Twp. 79, Rge. 2, W 4th Mer. (Figure 6). Marine shale of the LaBiche Formation forms the bedrock surface of the plains. The Cowper Plains are covered by 30 to 120 m of drift, with the thickest accumulations found above minor erosional features on the bedrock surface. Areas of thick drift also correspond to an accumulation of glacial sediment in a roughly east-trending morainal ridge, directly south of Cowper and Bohn lakes (Figure 14).

3.2.7 Wiau Lowlands

Broad lowlands nestled between the bedrock highs of the Caribou and Leismer bedrock uplands, referred to as the Wiau Lowlands, define the bedrock topography of the south-central part of the study area. The lowlands extend in an east-west direction for a distance of about 175 km in the study area, widening from about 10 km in the west to more than 75 km at the Alberta–Saskatchewan political boundary (Figure 8). The difference of elevation within the lowlands is about 100 m, ranging from a low of 380 m along segments of the buried Christina Channel, to a high of about 460 to 480 m at the base of the neighbouring uplands. A section across the Wiau Lowlands shows an asymmetrical profile with the southern margin characterized by an abrupt contact with the relatively steep, northern slope of the Caribou Upland, and the northern margin characterized by a gradual rise into the Hangingstone and Cowper plains (Figures 9 and 10).

The Wiau Lowlands physiographic unit includes a number of physiographic subdivisions: segments of four buried channels, the Wiau, Christina, Leismer and Kirby channels; and the interfluve benches or terraces that separate these channels, referred to as the Wiau–Christina Interfluve Bench, the Christina–Kirby Interfluve Bench and the Christina–Leismer Interfluve Bench (Figure 8). Although the Wiau Channel is considered to be the deepest of the four channels, with an elevation of about 390 m at the east end, segments of the Christina Channel, in Twp. 76, Rge. 5, W 4th Mer., display evidence of local scour down to an elevation of 375 m (Figures 6 and 9). The tops of the intervening interfluve benches are about 30 to 40 m higher than the channel floors, at an elevation of about 480 m. Opposing gradients, and the orthogonal nature of channel confluences, are indicative of a complex erosional history within the Wiau Lowlands, which is discussed in more detail in the next section.

Two natural gas-bearing horizons have been intersected and eroded by buried channels in the Wiau Lowlands: the relatively thin Viking Formation sandstone, which subcrops within the Wiau Channel; and the Grand Rapids Formation sandstone, the top of which subcrops beneath deeply scoured segments of the Christina Channel. Elsewhere, black marine shale of the Lower Cretaceous Joli Fou Formation or LaBiche Formation forms the bedrock surface (Figures 9 to 12 and 15).

The greatest accumulations of drift in the study area are found within the Wiau Lowlands, where more than 300 m have been mapped above the eastern segment of the Wiau Channel (Figure 14).

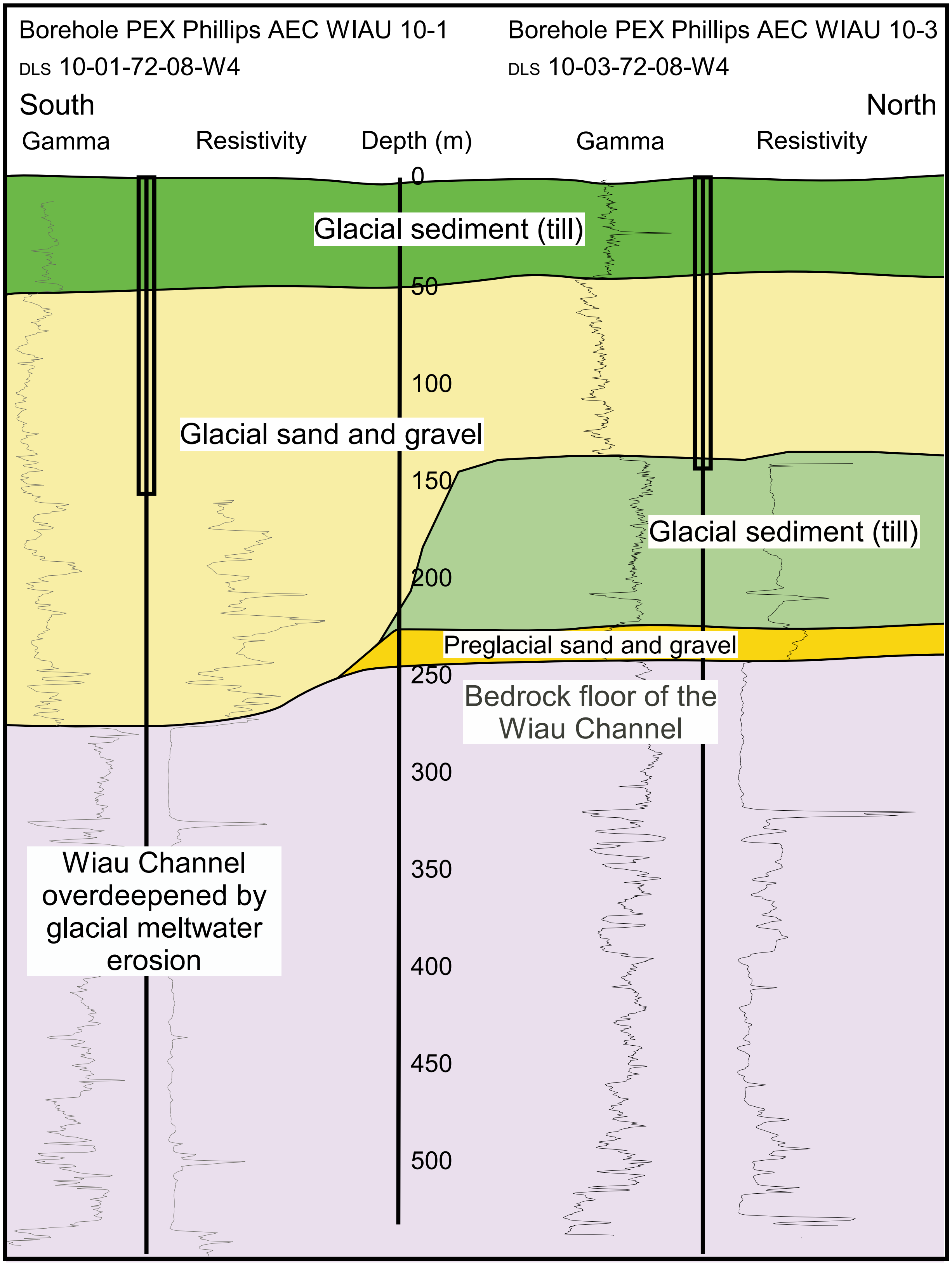


Figure 15. Reoccupation and overdeepening of preglacial bedrock channels by glacial meltwater.

3.2.8 Gordon Lowlands

The lowest elements of the bedrock topography in the study area are found in the Gordon Lowlands, a low relief, undulating to inclined bedrock landscape, which is incised by the present-day Athabasca and Clearwater rivers (Figure 8). In the west, where the unit has a gradational contact with the Hangingstone Plains, the 500 m contour level defines the upper part of the lowland. From here, the elevation decreases gradually northward to about 340 m along the Christina, Athabasca and Clearwater river valleys (Figure 6). In the east, the lowland has a similar gradational contact with the Cowper Plains to the south, but has an abrupt contact with the steeply rising Leismer Uplands in Twp. 84, Rge. 6, W 4^{th} Mer. This also coincides with the subcrop of the contact between shale of the Joli Fou Formation and sandstone of the Grand Rapids Formation (Figure 3). With the exception of deeply eroded channels of present-day river systems, the buried Gregoire Channel is the most prominent bedrock feature in the Gordon Lowlands (Figure 8). As it is currently defined, the channel consists of two segments: a north-trending segment situated in Twp. 82 to 87, Rge. 6, W 4^{th} Mer. and an orthogonal segment which trends in an east direction from Twp. 85, Rge. 6, W 4^{th} Mer. to Twp. 85, Rge. 8, W 4^{th} Mer, and from there, north to Twp. 87, Rge. 8, W 4^{th} Mer. (Figure 6).

The easternmost arm of the channel has been deeply eroded into the bedrock to a depth as much as 150 m below the surrounding bedrock surface, such that in Twp. 85, Rge. 6, W 4^{th} Mer. the elevation of the channel floor is about 285 m above sea level (Figure 6).

Grand Rapids Formation sandstone forms the bedrock surface for most of the lowlands, the exception being outcrops of oil sand of the Lower Cretaceous McMurray Formation, and carbonate of the Upper Devonian Waterways Formation along the valley walls of the Athabasca and Clearwater rivers (Figure 3). For the most part, the thickness of drift in the Gordon Lowlands is less than 30 m, and in most places, less than 20 m. The exception is the more than 180 m of drift that overlies the deepest parts of the Gregoire Channel (Figure 14).

3.3 Drift Thickness

A comparison of the surface and bedrock topography shows that the ranges in elevation of the two are similar, indicating that bedrock lies at, or near the present-day land surface in some areas. Examples of this include the May Hills bedrock highland, where the drift cover is only a few metres thick in places, and along the Athabasca, Clearwater and Christina rivers in the northern part of the study area where bedrock is exposed in the valley walls. Although elements of the present-day topography are coincident with the underlying bedrock topography in some areas, in many places the two surfaces diverge, separated by thick drift. A subtraction of the bedrock surface from the surface topography yields an isopach map of drift thickness (Figure 14), which shows that in excess of 325 m of sediment have accumulated above the talweg of the Wiau Channel, and at least 150 to 250 m above other bedrock channels such as the Christina, Leismer, Amesbury, Imperial Mills and Gregoire channels. The cover of drift in these channels is so thick that it has completely masked any surface expression of their surfaces.

In some cases, the drift has more than just filled in the channels; it has accumulated to form a positive morainal landscape, the highest points of which lie roughly above the deepest parts of the underlying bedrock surface. Perhaps the best example of this mirror-image relationship is in the south-central part of the study area, where thick drift has accumulated directly above the Wiau Channel to form the topographically high Mostoos Upland physiographic unit (Figure 9). In fact, an approximate outline of the eastern part of the underlying Wiau Channel can be traced by the contours of the highest parts of the present-day surface (Figures 4 and 6). A similar example, though somewhat less pronounced, is the relationship between the bedrock topography and surface topography within the Crow Lake Upland physiographic subdivision. The Crow Lake Upland is dominantly a constructional landscape in which thick accumulations of drift have exaggerated the form of the underlying Leismer bedrock upland

(Figures 4 and 14). This thick drift cover is greatest above the Leismer bedrock channel (and its tributaries), where, like the Wiau Channel, it has masked any expression of the underlying channel topography (Figure 13).

3.4 Buried Bedrock Channels

3.4.1 Introduction

Remnants of buried fluvial channels provide a historical record of the erosion that has occurred on the bedrock surface from the Late Cretaceous to the Late Pleistocene. To date, there have not been any techniques that establish the absolute dates or ages for these channels. Nevertheless, there are lines of evidence to determine the relative ages and sequences of erosive events.

Buried bedrock channels in the study area can be grouped into one of two relative-age categories—preglacial channels and Quaternary glacial and interglacial channels. Preglacial channels are considered to have formed prior to the onset of the first glaciation in the Early Quaternary. They represent the regional, northward and eastward drainage of the Western Canadian Sedimentary plains during the Late Cretaceous to Early Quaternary period. These channels are interpreted to have their headwaters either in the Rocky Mountains or in the local bedrock plains that lie east of the mountains. Preglacial channels are characterized by the following:

- Buried preglacial channels are typically very wide, in some cases as much as 10 km wide, with shallow valley walls. Compared to glacial channels, preglacial channels exhibit very high width-to-depth ratios, as much as 250:1. Channel widths are so great, in fact, that these systems are commonly referred to as ‘buried preglacial valleys’, to denote their broad width and shallow slopes. The choice of terms may be semantics, but the term ‘channel’ is preferred to differentiate from valleys formed by other geological processes such as tectonics or subsidence.
- Longitudinal profiles of preglacial channels generally have very shallow gradients, inclined in a single direction; exceptions to this occur where channel piracy and stream capture divert drainage into adjacent systems, causing apparent reversals in the gradient at the capture-end of the channel. Farvolden (1963) considered the uniformity of shallow gradients in preglacial channels to be evidence that erosion was more or less continuous since the end of the Miocene, and that the channels represent mature streams that drained mature landscapes. The reader is directed to Farvolden (1963) for additional insights regarding the sequential development of erosional features since the Late Oligocene.
- The clasts in the fluvial sediments that lie on the channel floors consist of resistant rock types. These include dominantly light-coloured metaquartzite and sandstone and dark-coloured chert derived from either Cordilleran rock sources, local Cretaceous bedrock sources or recycled gravel that was deposited during an earlier stage in the erosion of the bedrock landscape. This petrological composition gives the sand component a ‘salt-and-pepper’ appearance. Further, preglacial channel sediments are characterized not so much by the presence, but rather by the absence of two distinctive rock types—granite and gneiss derived from the Canadian Shield, which lies to the north and east, downstream of the study area. The presence of Shield clasts in channel sediment can only indicate a glacial source, in the northeast.
- Preglacial channels function as depositional basins for the accumulation of fluvial sediments and later, infill with glacial sediments. A record of multiple glacial events is commonly recorded in the stratigraphy within buried preglacial channels, including reoccupation and local bedrock scour by glacial meltwater.

Quaternary bedrock channels include channels formed by glacial meltwater during any one of a number of glaciations, together with interglacial fluvial drainage systems that developed during the nonglacial interval, similar to the drainage systems established on the present-day Alberta landscape. Glacial meltwater channels, in particular, are characterized by the following:

- They are interpreted to have been formed by single-event, catastrophic releases of meltwater in a supraglacial or subglacial environment. Meltwater flow was either on the glacier surface and was confined by ice, or flow occurred beneath the glacier where the hydraulic head was determined, in part, by the weight of the glacier and differences in head of water within the glacier. As a consequence, drainage was not necessarily confined to lows in the underlying bedrock topography and channels could have been incised into bedrock highs.
- Glacial channels are generally narrow and have relatively low width-to-depth ratios, in some cases as low as 5:1.
- Glacial channels commonly show lack of continuity at a regional scale, have abrupt truncations and may exhibit scoured, concave longitudinal profiles.
- They commonly have thick accumulations of glaciofluvial sediments, which contain abundant granite and gneiss clasts from the Canadian Shield. These fluvial sediments are commonly related to a single depositional event and thus can have a high variation in grain size, with abrupt transitions in size from fine (silt, sand) to extremely coarse (1 m boulders).

Aspects of the stratigraphy contained within each of the bedrock channels in the study area are discussed in more detail in Section 4.

3.4.2 Buried Preglacial Channels

3.4.2.1 Wiau Channel

The Wiau Channel is the most prominent bedrock feature in the study area. The channel is considered to be one of the widest, if not the largest, buried preglacial channels in the Plains region of North America. The Wiau Channel was named, and first studied, by Gold (1983). Later, the Alberta Research Council constructed preliminary maps of the channel and surrounding bedrock topography as part of a preliminary groundwater resource evaluation (Stein et al., 1993; Stein and Andriashek, 1998).

The clasts in the fluvial sediments resting on the floor of the Wiau Channel are of Cordilleran origin (metaquartzite and chert), indicating that the Wiau Channel was formed by preglacial drainage flowing eastward from the Rocky Mountains (Appendix 2c). Eastward drainage is also supported by a relatively shallow eastward gradient of the channel floor (Figure 6 and Table 1). The channel extends for a distance of more than 195 km within the study area before it exits into Saskatchewan. As discussed earlier, the thickest amount of drift in the study area occurs above the eastern segment of the Wiau Channel, where depth to bedrock (i.e., drift thickness) exceeds 300 m. Actual incision into the bedrock by preglacial drainage is only about half of that depth, ranging between 150 to 175 m (Figures 9 and 10).

Some sections of the Wiau Channel appear to show evidence of reoccupation and overdeepening of the bedrock channel floor by glacial meltwater. The bedrock topography map (Figure 6) shows a relatively narrow (1 km) channel along the southern flank of the Wiau Channel in Twp. 72, Rge. 8, W 4th Mer. which, as Figure 15 illustrates, is interpreted to have been scoured by glacial meltwater subsequent to the advance of the first glaciation over the channel.

Table 1. Dimensions and properties of buried bedrock channels.

Name	Origin	Width (km)	Depth to floor (m)	Length (km)	Elevation of floor (m)	Gradient (m/km)	Direction(s)
		min. – max.	min. – max.		min. – max.		
Wiau	preglacial	5 – 30	120 – 340	195	385 – 435	0.25	east
Leismer	preglacial	3 – 6	150 – 250	145	435 – 500	0.45	south & west
Christina	preglacial	1.5 – 8	140 – 270	120	380 – 430	<0.1	east
Amesbury	preglacial	3 – 10	150 – 240	140	370 – 435	0.5	north & northwest
Imperial Mills	preglacial	5 – 9	100 – 190	80	480 – 490	<0.1	south & northwest
Kirby	preglacial(?)	1.5 – 3	180 – 270	20	400 – 435	?	north? south?
Gregoire	glacial	0.8 – 1.5	60 – 190	35	285 – 410	<0.1	north

There are a number of other aspects regarding the geometry of the Wiau Channel that are worth discussing. At a first glance of the bedrock topography map of the area (Figure 6), it appears that the Amesbury Channel trends northward to join with the Wiau Channel in Twp. 78, Rge. 19, W 4th Mer., and that from there, the Wiau Channel continues westward beyond the boundaries of the study area. Although the density of data in that area is poor, a close examination of the confluence of the two systems shows that the talweg of the Amesbury Channel lies about 60 m deeper than that of the Wiau Channel, indicating that the Wiau Channel is, in fact, a hanging channel that was abandoned in favour of more recent drainage north and west along the Amesbury Channel. Thus, the Wiau Channel does not extend throughout all of central Alberta, as was once believed, but rather has its western boundary entirely within the study area. Similar examples of stream piracy and channel abandonment were recognized in the mapping of the bedrock topography and buried channels in southern Alberta (Farvolden, 1963).

Secondly, in comparison with neighbouring preglacial channels such as the Helina and Beverly channels, which lie about 60 km south of the study area (Andriashek and Fenton, 1989), the Wiau Channel exhibits a substantially greater width. Figure 6 shows that the channel broadens in an easterly direction, from about 5 km in Twp. 75 to 76, Rge. 11 to 13, W 4th Mer. to as much as 25 to 30 km at the Alberta–Saskatchewan border. The reasons for the greater channel width in the east remain speculative, and there are little to no borehole data east of the study area to increase our understanding of the location and geometry of the Wiau Channel in Saskatchewan. One possible influence on the channel geometry is the effect that dissolution and collapse of Middle Devonian Prairie Formation evaporites (Figure 10.3 in Mossop and Shetsen, 1994), had on the topography of the overlying Cretaceous bedrock strata. Gradual subsidence of the overlying strata by salt dissolution during the Late Cretaceous–Tertiary interval may have enhanced the lateral migration and erosion of the bedrock surface in that area. Similar effects could conceivably result from tilting of the floodplain surfaces in directions orthogonal to the downvalley direction as a result of deep-seated, half-graben tectonic subsidence (Bridge and Leeder, 1979).

Thirdly, a series of sections across the Wiau Channel illustrate two other features of note. The floor of the channel has two topographical elements: a broad, generally level plain, extending in width as much as 20 km, into which is incised a deeper, narrower channel (3 km wide), which defines the talweg (Figure 9). Farvolden (1963) attributed a more deeply incised channel within a broad erosional plain to represent enhanced erosion during a stage of relatively rapid uplift of a landmass, which ended with the onset of the first glaciation. The margins of the Wiau Channel exhibit cross-sectional asymmetry, with the southern margin being much steeper and higher than the northern margin (Figures 9 and 10). Asymmetrical profiles were also noted in other buried preglacial channels by Farvolden (1963, p. 59) but have never been satisfactorily explained. For example, in the case of the buried Beverly Channel in the Edmonton area (referred to as the North Saskatchewan Channel by Farvolden [1963]), it is the northern margin that rises steeply and the southern more gradually, the opposite of that in the Wiau Channel.

3.4.2.2 Christina and Kirby Channels

The Christina Channel is the second largest bedrock channel within the Wiau Lowlands. The channel lies about 20 km north of the Wiau Channel, and extends in an easterly direction for about 120 km before it exits the study area into Saskatchewan. Although the Christina Channel is considerably narrower than the Wiau Channel, ranging in width from about 1.5 to 8 km (Table 1), it is comparable in width to other preglacial channels south of the study area, such as the Beverly and Helina channels. As much as 270m of drift lies above the deepest parts of the Christina Channel, though the average thickness is about 180 m (Figure 14).

It is inferred that the Christina Channel was originally of preglacial fluvial origin, although sediment from the deepest part of the channel has not been evaluated to confirm a preglacial petrological composition. The channel possibly reflects a diversion of the main Wiau Channel as the eastward-flowing preglacial fluvial system migrated northward. Apparent confluence of the two systems is indicated by the orthogonal junction of the western end of the Christina Channel with the Wiau Channel in Twp. 75, Rge. 11, W 4th Mer. Elsewhere, the two channels are separated by the Wiau–Christina and Christina–Kirby bedrock interfluves. There is stratigraphic and morphological evidence that suggests the Christina Channel may have been reoccupied by glacial meltwater, which would account for the apparent scour and over deepening of the bedrock floor in a segment of the channel that lies in Twp. 76, Rge. 5, W 4th Mer. (Figures 6 and 9).

Of special note is the Kirby Channel, which breaches the bedrock bench and links the Christina Channel with the Wiau Channel in Twp. 74 to 76, Rge. 8, W 4th Mer. (Figure 6). The presence of this relatively small channel is based on limited data, and the origin is uncertain—it may represent headwall erosion and stream capture from the Wiau into the Christina system or it may represent a glacial meltwater channel that was eroded through the underlying drift and into the bedrock surface. Aspects of the channel morphology are summarized in Table 1.

3.4.2.3 Leismer Channel

The Leismer Channel, previously referred to as the Conklin Channel (Stein et al., 1993; Stein and Andriashek, 1998), represents a relatively mature and well-established drainage network, which, on the basis of the numerous tributaries that feed the main channel, is inferred to have developed on the bedrock surface during preglacial time (Figures 6 and 8). However, sediments from the floor of the channel have not been analyzed to confirm a preglacial petrological composition. At least four tributaries of the main Leismer Channel have been mapped, but remain unnamed at this time.

The geometry of the Leismer Channel exhibits two fundamentally distinct forms: a north-south segment within the Hangingstone Plains, which extends south from Twp. 85, Rge. 9, W 4th Mer. to Twp. 78, Rge. 9, W 4th Mer.; and an east-west segment in the Wiau Lowlands, which extends west from Twp. 78, Rge. 9, W 4th Mer. to an apparent confluence with the Wiau Channel in Twp. 78, Rge. 16, W 4th Mer. (Figures 6 and 8). The gradient of the channel floor in the section of the Leismer Channel that lies within the Wiau Lowlands is to the west, indicating that final drainage was in a direction opposite to that within the Wiau Channel.

The width of the Leismer Channel has been estimated to range between 3 and 6 km, though this value increases to as much as 10 km where the tributaries join the main channel, as in Twp. 80, Rge. 9, W 4th Mer. (Figure 6). As much as 250 m of drift have accumulated above the deepest parts of the channel.

3.4.2.4 Amesbury Channel

Although segments of the herein named Amesbury Channel were recognized in previous studies of the regional hydrogeology of northern Alberta (Tokarsky and Epp, 1986), the channel has only recently been studied and mapped in the study area (Figure 6).

The Amesbury bedrock channel is inferred to be of preglacial origin on the basis of its size and relationship with neighbouring preglacial channels such as the Helina Channel, which is situated directly south of the study area (Gold et al., 1985), and the Wiau Channel. Samples of the fluvial sediment that lies on the floor of the channel have not been analyzed to determine the petrological composition and confirm a preglacial age.

The channel enters the study area in Twp. 70, Rge. 17, W 4th Mer., forming a broad meander within the Amesbury Plains before exiting the area near the spot where it appears to join with the Wiau Channel in Twp. 78, Rge. 19, W 4th Mer. (Figure 6). Physical aspects of the channel are summarized in Table 1. A remnant of an early stage of the Amesbury Channel is mapped on a bedrock bench directly west of the main channel in Twp. 71, Rge. 17, W 4th Mer. (Figure 11). One feature worth highlighting is that unlike the nearby Imperial Mills Channel, the Amesbury Channel eroded much more deeply into the surrounding bedrock, as much as 100 m in the narrow, steep-walled segment of the channel in Twp. 74, Rge. 17, W 4th Mer. (Figure 6). In this regard, the morphology of this segment of the channel is more similar to that of channels formed by glacial meltwater erosional processes.

Elevations within the Amesbury Channel decrease from about 435 m in the southern segment to about 370 m in the northern segment, indicating that the last stage of drainage was to the northwest. As was discussed previously, the Amesbury Channel is about 50 to 60 m deeper than the Wiau Channel at the apparent junction of the two in Twp. 78, Rge. 19, W 4th Mer. This establishes that the Amesbury Channel postdates the erosion of the Wiau Channel, and is, therefore, younger. Drainage northward and westward along the Amesbury Channel also provides indirect evidence of a fundamental adjustment or shift in the regional gradient of the Western Canadian Sedimentary Basin that caused a reversal in the regional drainage direction (Gold, 1983). The obvious spatial relationship with the present-day Athabasca River, which occupies segments of the Amesbury Channel in Twp. 76, Rge. 18, W 4th Mer., suggests that the Amesbury Channel may represent the drainage path of the ancestral Athabasca River.

There is stratigraphic evidence to show that glacial processes have modified the Amesbury Channel, or at least segments of the channel. AGS corehole WEPA99-2, located on the northern flank of the channel in Twp. 74, Rge. 17, W 4th Mer. (Appendix 2b) shows that the coarse fluvial sediment that rests on the bedrock surface elsewhere along the channel, is absent at that location. Instead, glacial diamicton (till) rests directly on the bedrock, indicating that the basal fluvial sediment has been eroded by either glacial ice scour or glacial meltwater, with subsequent infill of the channel with till.

Approximately 150 to 240 m of drift has infilled the Amesbury Channel (Figure 14).

3.4.2.5 Imperial Mills Channel

Descriptions of preglacial-type sand deposits in lithologs of boreholes confirm that the Imperial Mills Channel is likely of preglacial age (Andriashek and Fenton, 1989). The Imperial Mills Channel is relatively shallow, with broad, gently sloping valley walls. The channel was eroded about 50 m into the local bedrock surface, the deepest parts of which lie at an elevation between 480 and 500 m, an elevation not too dissimilar to that segment of the Leismer Channel which lies within the Hangingstone Plains on the opposite side of the Wiau Channel (Figure 6). Other attributes of the channel are summarized in Table 1.

The Imperial Mills Channel was originally interpreted to join the Wiau Channel to the north and thought to have been formed by stream capture, which diverted flow south from the Wiau Channel into the Helina Channel (Andriashek and Fenton, 1989). However, the mapping conducted in this study indicates that the Imperial Mills Channel most likely does not merge with the Wiau Channel, but rather trends in a more westerly direction, toward the Amesbury Channel (Figures 6 and 8). Unfortunately, there are very little data to accurately define the junction of the Imperial Mills and Amesbury channels, so it is uncertain if drainage was confluent, or if the Amesbury Channel truncates the Imperial Mills Channel, as depicted in Figure 6. If flow were confluent, then the geomorphic evidence (i.e., the elevated position in the bedrock landscape, combined with the opposing gradients of the northern and southern segments of the channel) would indicate that the Imperial Mills Channel is the result of headwall erosion and stream capture of two preglacial tributary channels that merged to appear as one. On the other hand, if the ends of the channel have been truncated by the Helina and Amesbury channels, then the elevated position of the Imperial Mills Channel on the bedrock landscape would indicate that it is an abandoned channel formed in the early stage of erosion in the study area, even prior to erosion of the Wiau Channel.

3.4.3 Buried Glacial Channels

The presence of granite and gneiss fragments in the fluvial sediments resting on the bedrock floor of the buried Gregoire Channel confirms that at least one of the bedrock channels in the study area was eroded by glacial meltwater, possibly during the last glaciation of the Late Wisconsin. The Gregoire Channel is about 1 km wide and has been eroded as much as 150 m into the local bedrock to form a deep trench along the contact between the Gordon Lowlands and the Leismer Uplands (Figure 16). It has the highest depth to width ratio (~1:5) of any of the buried channels in the study area (Table 1). An absence of data prevents accurate definition of both ends of the channel, but it is believed that the channel may terminate abruptly within the study area: the north end terminating at an elevation of about 360 to 370 m and the south end terminating at an elevation of about 460 to 470 m (Figure 6).

Although the apparent northward gradient of the Gregoire Channel floor assumes drainage from south to north, this assumption may be incorrect — direction of flow may have been, in fact, from north to south, with water flowing uphill away from a northern Laurentide glacier margin. This is not inconsistent with fluvial erosion by meltwater in contact with glacial ice — meltwater can flow either on the glacier surface and downcut through the ice to intersect the underlying bedrock floor, or it can flow beneath the glacier under high hydrostatic head that enables it to flow 'uphill' and erode higher elements of the underlying bedrock landscape. There is morphological evidence in the Gregoire Channel to support this interpretation: a cross-section along the channel talweg displays a U-shaped longitudinal profile, showing as much as 100 m of overdeepening by meltwater scour in the middle segment of the channel (Figure 6, Sec. 29, Twp. 85, Rge. 6, W 4^{th} Mer.), indicating either supraglacial or subglacial fluvial erosion.

As Figures 6 and 8 illustrate, there is an east-oriented bedrock channel located directly north of the Leismer Uplands, which appears to have an orthogonal junction with the Gregoire Channel in the west part of Twp. 85, Rge. 6, W 4^{th} Mer. Data are inconclusive regarding the composition of the sediments in that unnamed channel, but if it proves to be of glacial origin, then this channel, and the Gregoire Channel, may be part of a glacial meltwater channel complex related to a single erosional event.

4 Geology of the Late Tertiary and Quaternary Drift Succession

4.1 Introduction

The north and central parts of Alberta contain some of the thickest deposits of heterogeneous, unconsolidated Tertiary and Quaternary sediment in the province, exceeding 300 m above segments of buried bedrock channels. Contained within this thick sedimentary sequence are extensive complexes of coarse, permeable stratified sediment found on the floors of bedrock channels and within the Quaternary

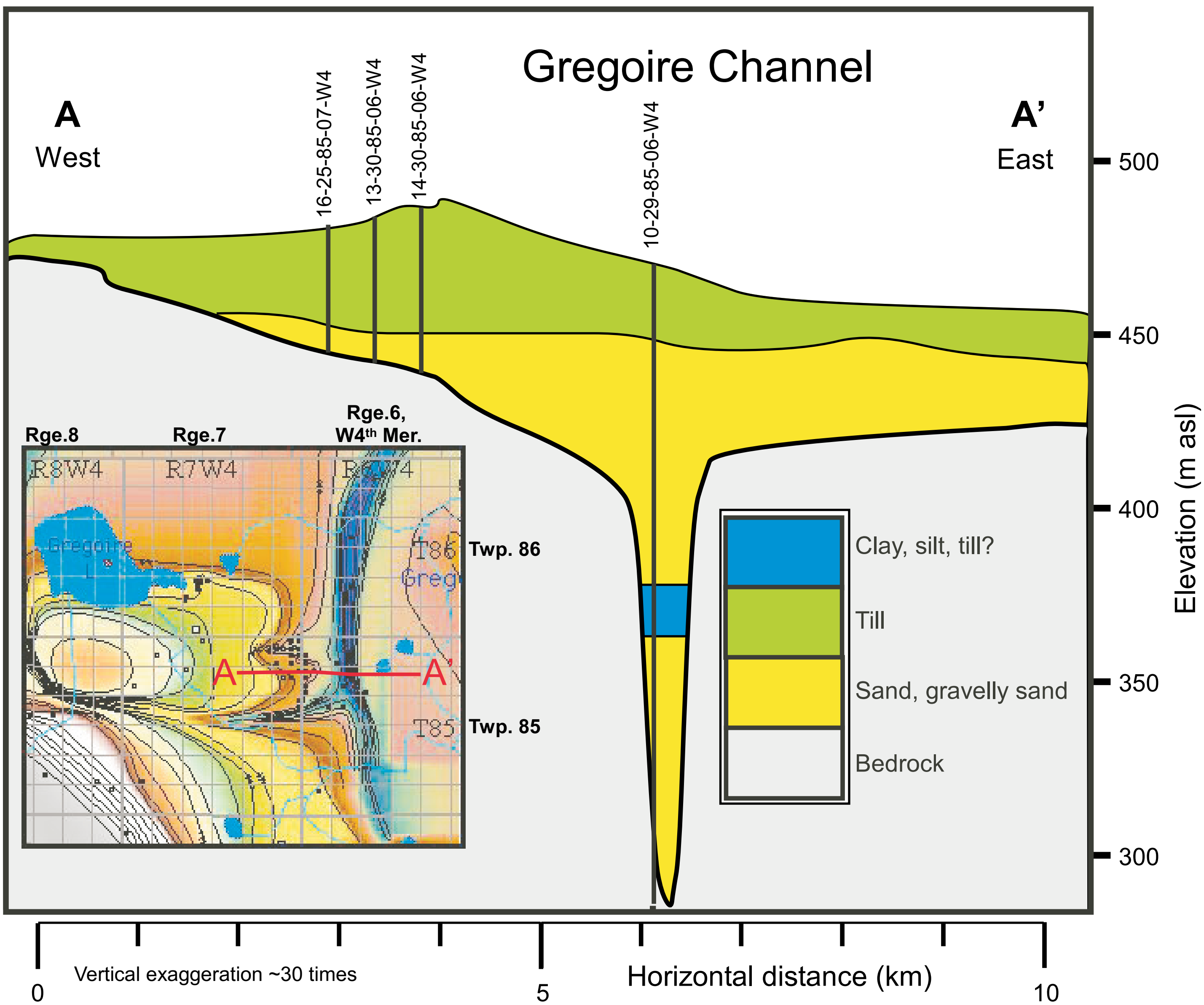


Figure 16. Deep incision of the bedrock surface by glacial meltwater, Gregoire Channel.

glacial stratigraphic succession. These complexes are saturated with water and are favoured targets for groundwater exploration and development, particularly by the petroleum industry in its quest for large volumes of freshwater needed for steam-enhanced recovery methods of bitumen. However, the occurrence and distribution of these aquifer systems is poorly known and incompletely mapped. Domestic well data are sparse and clustered in the sparsely settled areas, and generally consist only of drillers' lithological descriptions. Petrophysical logs from the oil and gas wells are abundant, but the wells are usually completed with surface casings across the stratigraphic intervals, providing little to no information about the uppermost drift sequence.

Further complicating the predictive mapping of these aquifers is

- the tendency of glacial genetic units to violate the law of original horizontality;
- the existence of unpredictable, vertically cross-cutting glacial sluiceways that can be infilled with sand, fine lacustrine clays or younger glacial tills;
- the existence of glacially thrusted terranes at depth and at surface; and
- the recognition that a regional layer-cake concept oversimplifies the depositional architecture of these sediments, it being more of a three-dimensional labyrinth or a jigsaw puzzle type.

Despite these complexities, a predictive stratigraphic model is emerging based on an understanding of the glacial history of the area. The key elements of this model are the recognition that

- the region has been subject to multiple glacial events, and associated with each are nonstratified diamict units (till sheets) and stratified fluvial complexes deposited during advance and retreat phases of each glaciation;
- the distinct mineralogy of till sheets can be used to determine relative stratigraphic age and assist in regional correlations;
- there is a cyclicity in the vertical facies associations; and
- the bedrock topography is a first-order control on the areal distribution of coarse-grained sediments.

This emerging glaciostratigraphic model of the area can be used to predict the occurrence of aquifer-quality sediments at any depth and location, provided some key information is collected. The conceptual model also lets us place reasonable bounds on the predicted extent and connectivity of the aquifer-quality sediments in the subsurface.

4.2 Sources of Data for Stratigraphic Interpretations

Probably the biggest obstacle to interpreting the Quaternary stratigraphy is the absence of high-quality subsurface data in the study area. Even though there is an abundance of oil and gas industry petrophysical logs, the upper part of the stratigraphic column is commonly not logged. There are few, if any, lithological descriptions of the material encountered, and those that are available consist of generalized field lithologs prepared by water-well drillers. Samples of Quaternary sediment are rarely collected. Fortunately, because of the thick drift in the region, there are numerous uncased portions of oil and gas exploration holes that record the lower half, or more, of the Quaternary units in the petrophysical logs. These borehole data, calibrated with key stratigraphic coreholes drilled by the Alberta Geological Survey, form the bulk of information used to construct the Quaternary stratigraphy in this area. The challenge in developing the interpretive model is to maximize the information gleaned from oil and gas petrophysical logs, before calibrating it with newly generated information from the field.

4.2.1 Methods of Investigation

4.2.1.1 Field Methods

Seven stratigraphic corehole sites were drilled by the AGS to assist the in the calibration of petrophysical logs and descriptive drillers' records collected from the petroleum and water-well industries. A wet-rotary drill and continuous-core recovery method was chosen to collect high-quality samples of the Quaternary sediment down to a depth of at least 200 m (Figure 17). The coring process involves a 7.5 cm (3 inch) diameter, diamond-surfaced, tungsten-carbide bit (Figure 18) attached to a hollow drill stem in which a split corebarrel 3 m long is recovered using wireline methods. Samples of core were visually examined, described and stored at the AGS Mineral Core Research Facility (MCRF) for further examination and sampling for laboratory analyses (Figure 19). The coring process was only marginally successful at collecting loose, unconsolidated sediment such as sand and gravel, thus, those geological horizons are under-represented by core samples. Where drilling conditions necessitated the use of a tricone rock bit to penetrate through difficult horizons such as gravel and cobble beds, samples of those units were examined from cuttings that circulated up to the surface in the drill mud.

Field lithologs typically recorded information about the drill site, the drill-depth interval, amount of sample recovered in each interval, the dominant lithology, and other descriptive parameters such as colours of weathered and nonweathered horizons. One observation of particular interest recorded in the field lithologs was the presence or absence of hydrocarbon odour in samples of Quaternary sediment. This is an attribute of the drift that typically is not recorded in the central and southern parts of the province.

A suite of logs were run in each corehole to provide a downhole record of the petrophysical properties of the sediment, and to permit correlations with petrophysical logs from nearby wells drilled by the petroleum industry. The log suite chosen to best characterize the properties of Quaternary sediments include the following: resistivity, self-potential, natural gamma, density, neutron and caliper. Petrophysical log traces were recorded in digital format using conventional LAS (Log ASCII Standard) industry standards.

4.2.1.2 Laboratory and Data Processing Methods

Fine-grained sediment, such as till, lacustrine silt and clay, and shale were sampled at 1 m intervals and submitted to the AGS laboratory for in-house analyses, and preparation for analyses by external laboratories. Analyses typically performed by the AGS laboratory include grain-size determinations of the less than 2 mm size fraction using the hydrometer and wet-sieve methods, and carbonate-content determinations of the silt–clay fraction using the Chittick gasometrical apparatus (Christiansen et al., 1975; Christiansen, 1992). The Chittick technique also provides information on the relative abundance of calcite and dolomite, which make up the total carbonate content of the samples. The results of AGS analyses are summarized in Appendix 4.

Samples of fine-grained sediment were also submitted to Becquerel Laboratories Inc. for geochemical analysis for gold and 53 other elements. The results of those analyses, including a description of the analytical methods, are included in Appendix 3.

Results from each corehole, including descriptions of lithology, grain-size distribution, matrix carbonate content and petrophysical log traces, are graphically portrayed in a series of strip logs, which were created using LogPlot™ software from Rockware™ to facilitate hole-to-hole comparisons and assist in regional correlations. A legend of the symbols and patterns shown in the strip logs of the coreholes is provided in Figure 20. Locations of the coreholes are also shown in Figures 6 and 8.

Figure 17. Wet-rotary coring rig.

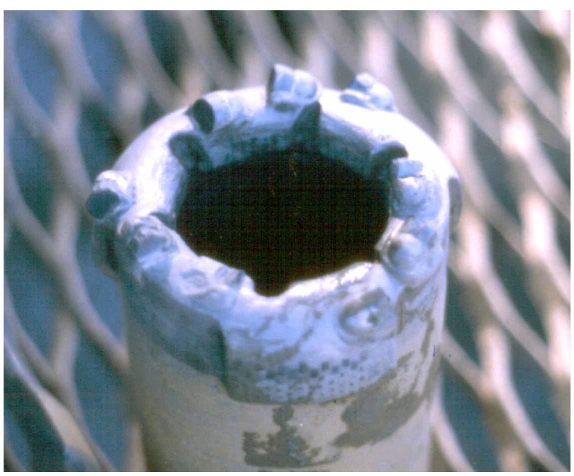


Figure 18. Diamond-surfaced core bit for sampling Quaternary sediments.

Figure 19. Field logging of core samples.

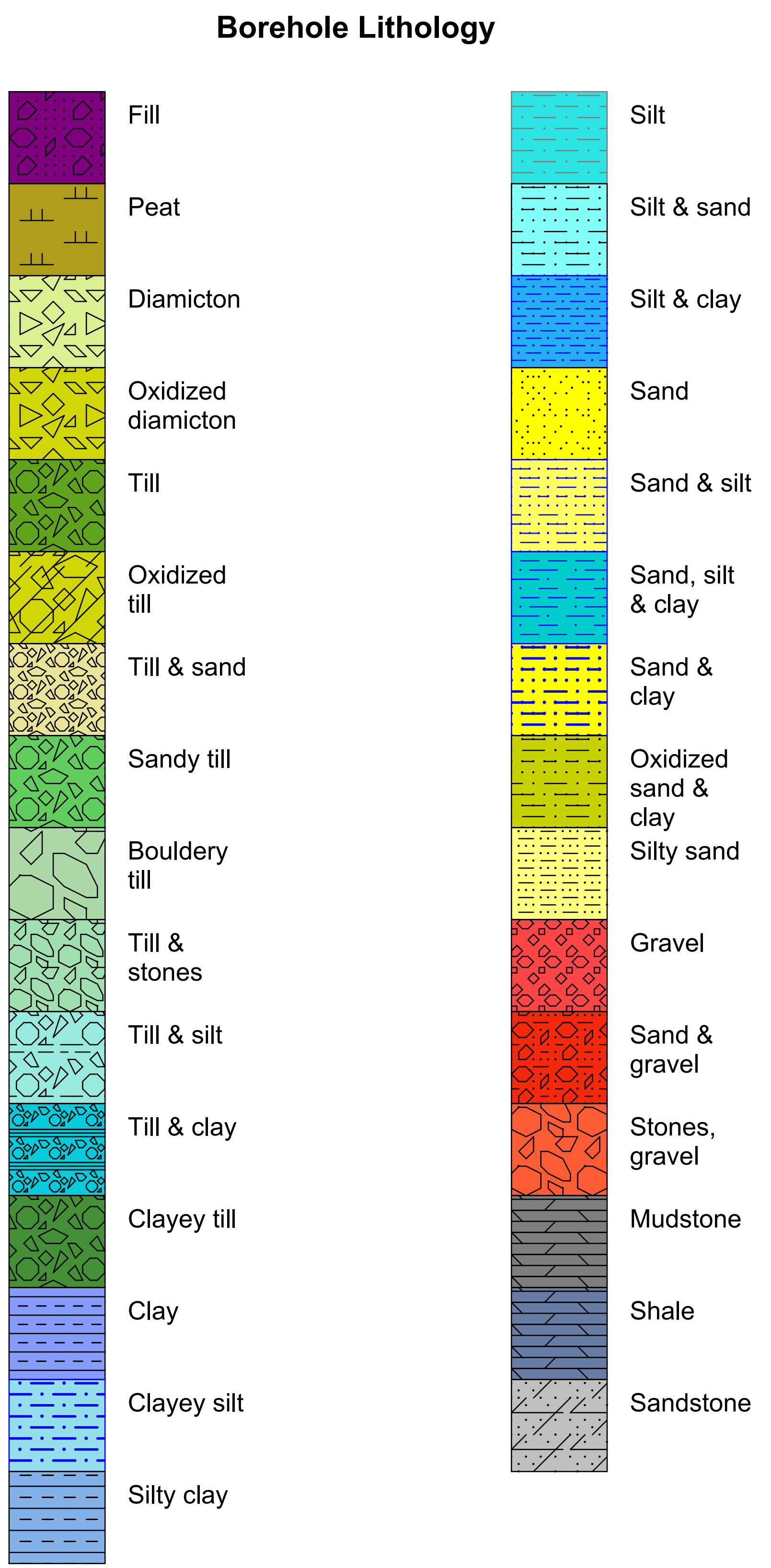


Figure 20. Strip-log lithology legend.

4.3 Geology of AGS Coreholes

4.3.1 Corehole WEPA99-1

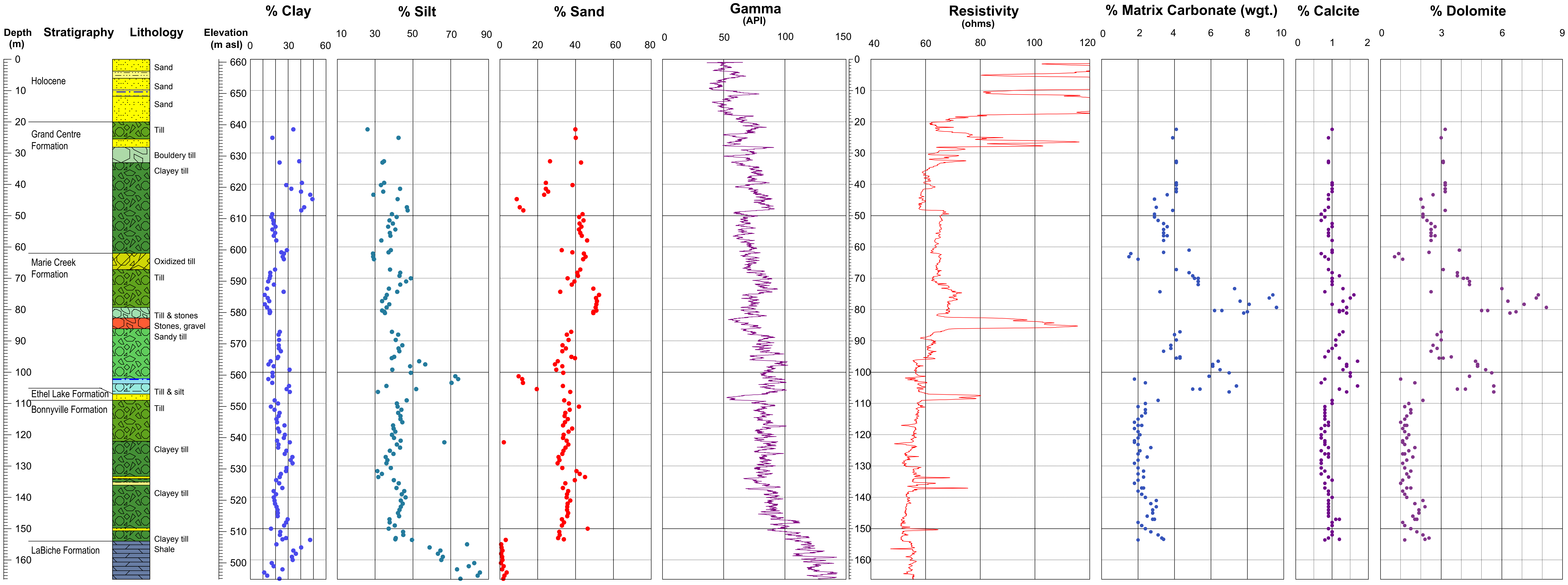
Corehole WEPA99-1 was located within an upper terrace of the House River in the Stony Mountain Uplands, L.S. 3, Sec. 8, Twp. 77, Rge. 14, W 4th Mer. The drill site was located in a sand and gravel quarry on the north side of the House River, along Provincial Highway 63. The site was selected to have the greatest probability of intersecting the surface of the underlying Caribou bedrock upland, on the southern edge of the Wiau Channel (Figures 6 and 8). The hole was drilled in Quaternary sediment to 154.5 m, at which depth it intersected bedrock consisting of black mudstone and siltstone of the LaBiche Formation. Drilling continued in bedrock until the hole was terminated at a total depth of 167.3 m.

Detailed field descriptions of core samples from this hole are provided in Appendix 2a, analytical laboratory results are presented in Appendices 3 and 4, and the lithology is summarized graphically in Figure 21. Some significant aspects of the geology within WEPA99-1 include the following:

- The upper 20 m or so consists of glaciofluvial outwash sand of the upper terrace of the House River.
- The till at 20 m shows progressively increasing amounts of clay in the matrix with depth, including more shale clasts in the pebble fraction. Clay and shale enrichment is interpreted to represent glacial erosion and incorporation of bedrock material. At about 50 m, the texture of the till changes abruptly to more sand and less clay. This is reflected in both the resistivity and gamma logs, and in the percentages of matrix clay and sand (Figure 21 and Table A4-1). A faint hydrocarbon odour was detected in freshly exposed core from a depth of about 48 m.
- At a depth of 62 m, there is a sharp contact between unoxidized till and the highly weathered oxidized till below (Figure 22). The oxidized profile on the surface of this lower till extends for a depth of about 5 m, at which point it is only visible as iron staining along fractures (Figure 22). This sharp unconformable contact is also reflected to a lesser degree on the resistivity log, and is well defined by an increase of percent of matrix carbonate in the oxidized till. Geochemical analysis of tills from this depth also showed an increase in calcium and magnesium in the till below the buried oxidized horizon (Table A3-3). As well, arsenic values increase dramatically in the buried weathered, oxidized till, then drop, and then become progressively higher toward the contact with the bedrock shale (Figure 23).
- The till between 95 and 154.5 m contains abundant clasts of shale and soft siltstone of the local bedrock. This imparts an overall more clayey composition to the till, as reflected by the lower resistivity and higher gamma values at that depth (Figure 21).
- The bedrock at depth 155 m consists of LaBiche Formation black marine shale, containing numerous calcareous *Inoaceramus* fossil shells (Figure 24). Contact between the bedrock and overlying Quaternary sediments is well defined by an increase in gamma-ray values, and atypically, an increase, rather than decrease, in resistivity.

In terms of till lithostratigraphy, the upper 62 m of low-carbonate till in corehole WEPA99-1 correlates with till of the Grand Centre Formation found in the Cold Lake area to the southeast (Figure 25). On the basis of the weathered profile and relatively high-carbonate content, the till in the 62 to 109 m interval is correlative with the oxidized, high-carbonate till of the Marie Creek Formation found in the Cold Lake area. The lower carbonate till below this interval is tentatively correlated with till of the Bonnyville Formation, which is also mapped in the Cold Lake area.

Hole Name: WEPA99-1
Location (DLS): 03-08-77-14-W4
Latitude: 55.6517371°
Longitude: 112.1468557°
Surveyed Ground Level: 660.92 m asl



Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada
Alberta Energy and Utilities Board
Alberta Geological Survey

Figure 21. Lithological and petrophysical log properties of corehole WEPA99-1.

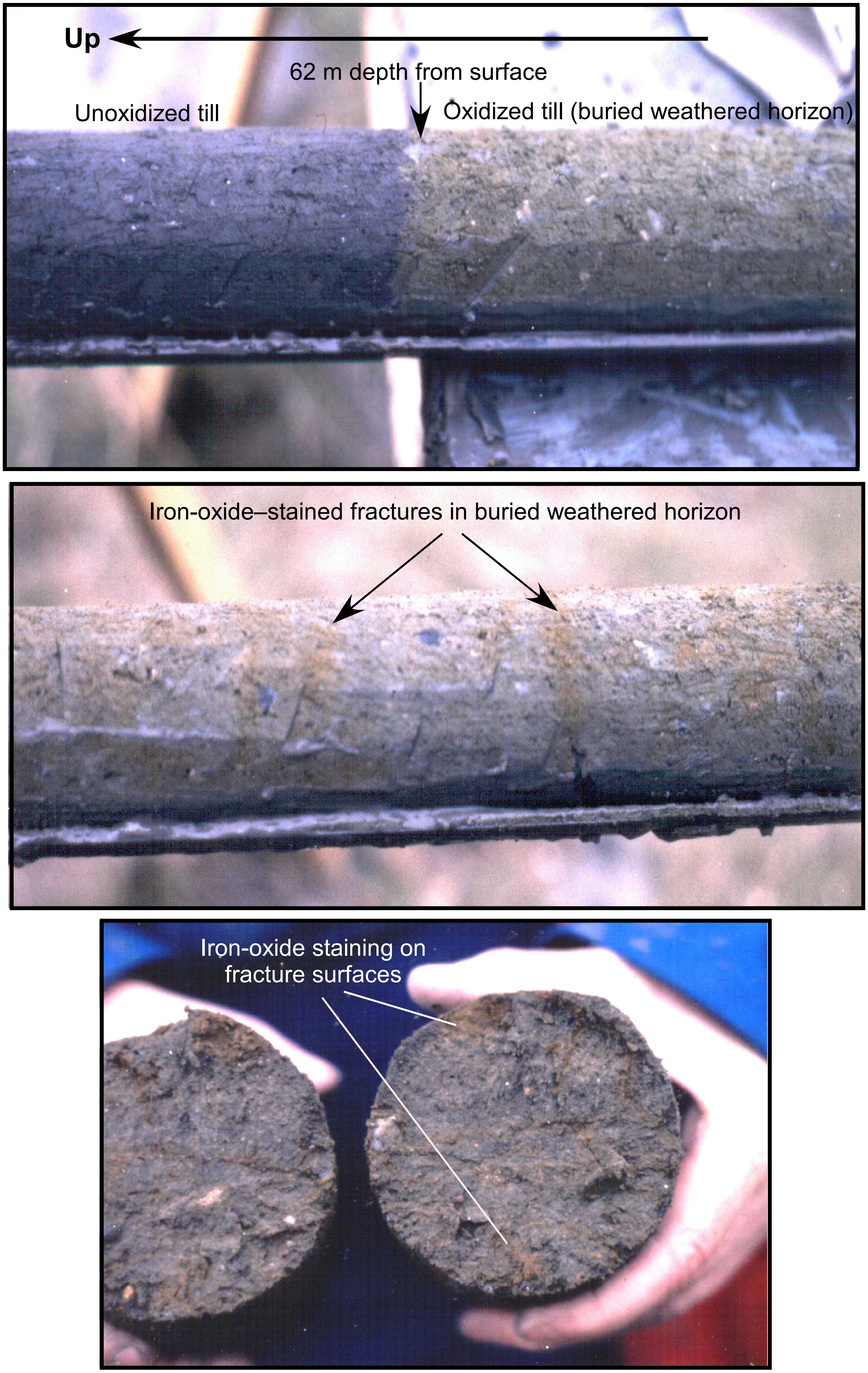


Figure 22. Buried weathered and oxidized till at 62 m depth, WEPA99-1.

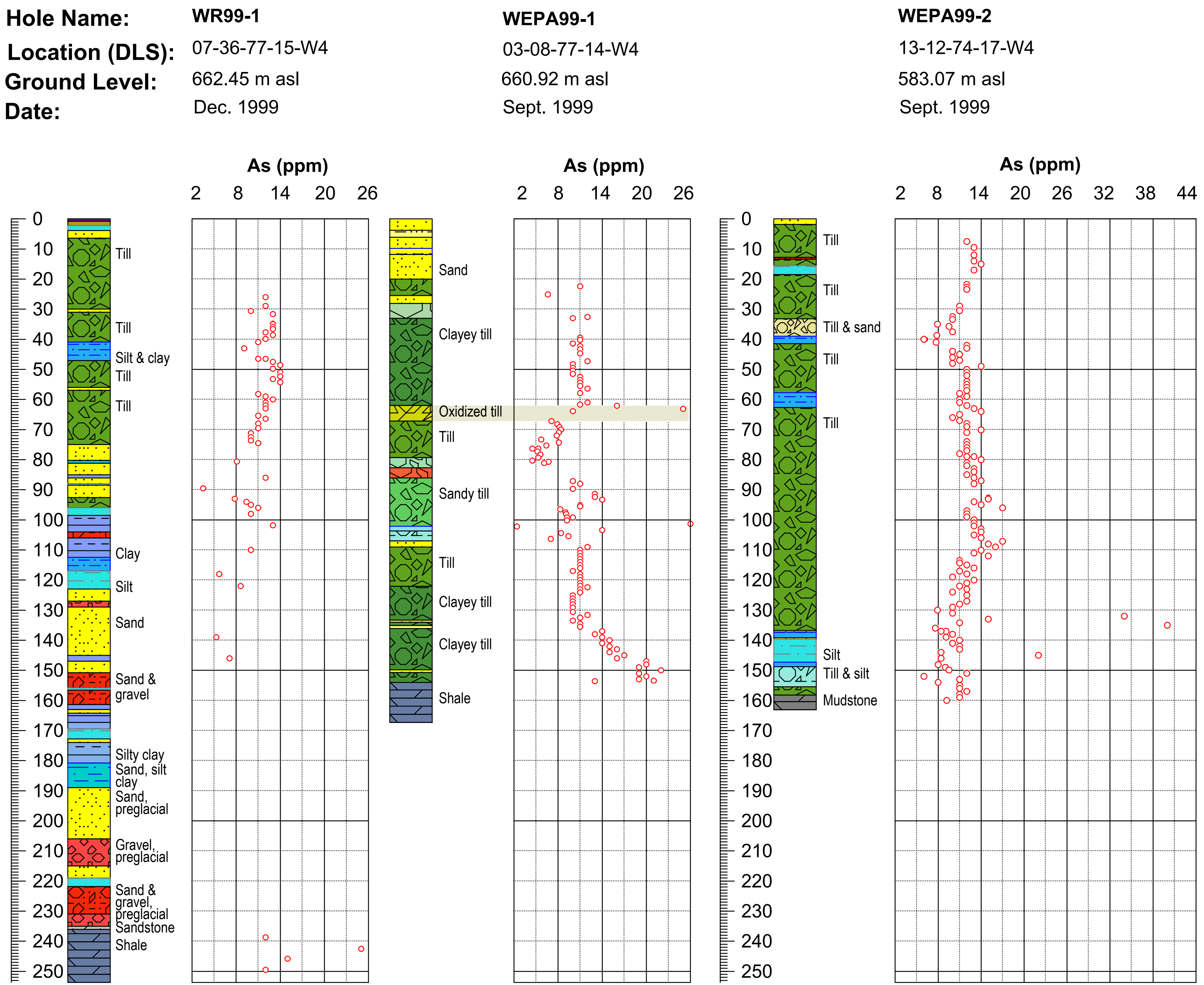
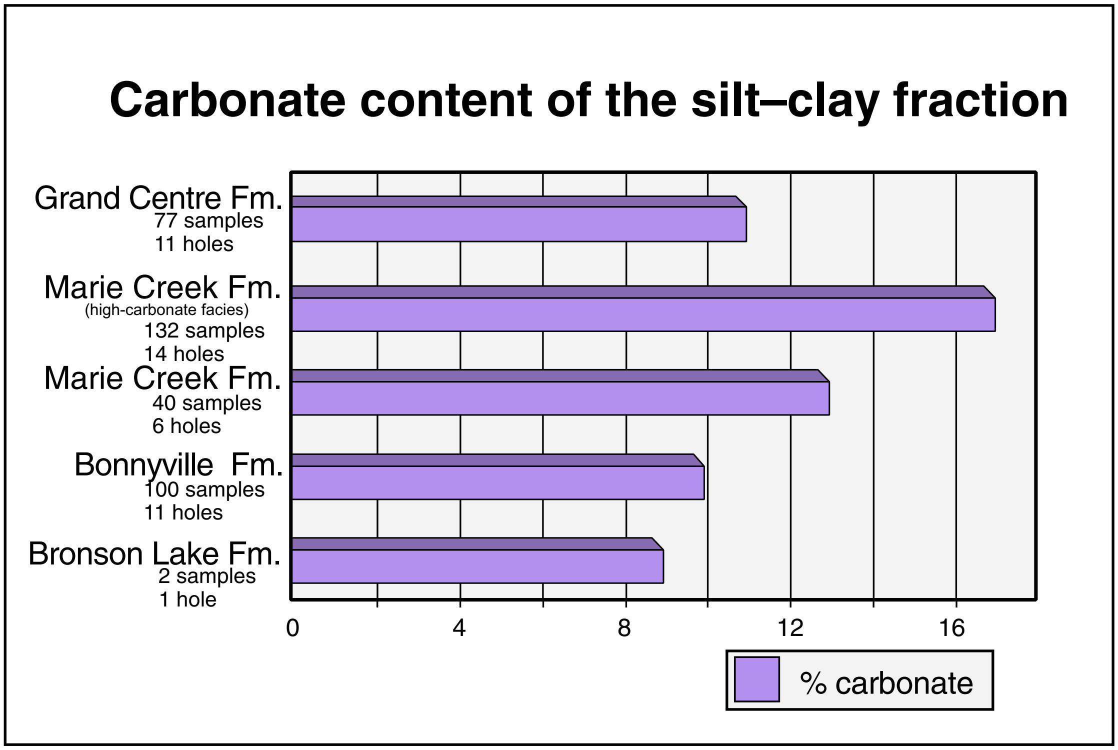


Figure 23. Variations in arsenic concentrations in glacial sediments, coreholes WR99-1, WEPA99-1, WEPA99-2.

Figure 24. Inoaceramus fossils in marine shale of the La Biche Formation, WEPA99-1.



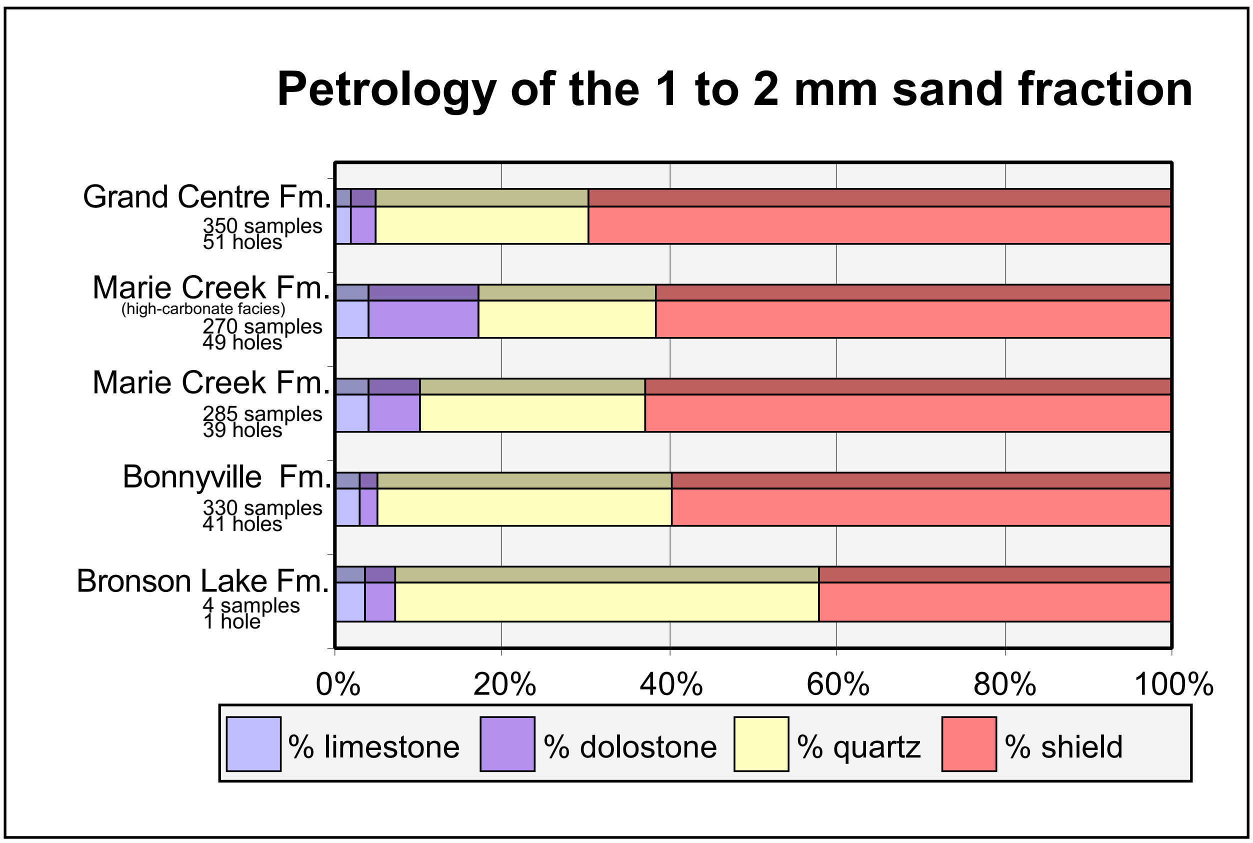


Figure 25. Petrological characteristics of tills in the Cold Lake area.

4.3.2 Corehole WEPA99-2

Corehole WEPA99-2 was located on a low relief, undulating morainal landscape within the Lac La Biche Plain in L.S. 13, Sec. 12, Twp. 74, Rge. 17, W 4th Mer. On the basis of water-well log information in the area, and in the absence of a bedrock topography map, the thickness of drift at the site was expected to be relatively thin, less than 50 m. However, as Figures 6 and 8 show, the information from the corehole established that the site is located almost directly above the talweg of a previously unmapped bedrock channel, the buried Amesbury Channel, where drift thickness exceeds 150 m. The hole was drilled in Quaternary sediment with a conventional water-well drill rig to about 158 m, at which depth it intersected bedrock consisting of black mudstone of the LaBiche Formation. The hole was terminated in bedrock only a few metres deeper at a depth of about 160.5 m, after it was deemed unsafe to drill farther because of the potential for escaping formation gas. Because of the shallow penetration, there is a high probability in situ bedrock was not reached at this site, and that the 2 m of bedrock material at the base of the hole may be an erratic of glacially displaced bedrock. It was the depth to bedrock and drift thickness information collected from this corehole that helped establish the location and characteristics of the buried Amesbury bedrock channel.

Detailed field descriptions of core samples from this hole are provided in Appendix 2b, analytical laboratory results are presented in Appendices 3 and 4, and the lithology is summarized graphically in Figure 26. Some significant aspects of the geology within corehole WEPA99-2 include the following:

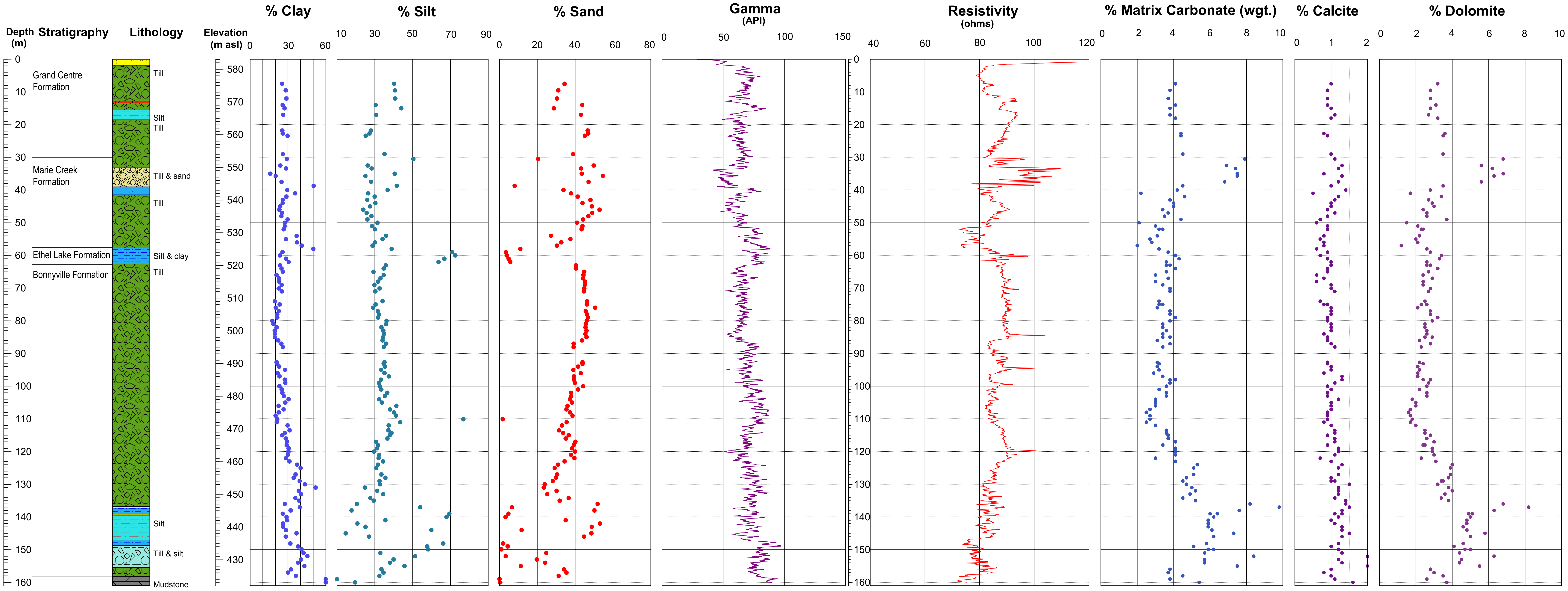
- Almost the entire 158 m of Quaternary succession at this site consists of till, with the exception of about 4 m of silt and clay at a depth of about 60 m, and about 18 m of silt at a depth of 137 m (Figure 26). Coarse-grained sediment (sand, gravel) resting on the bedrock floor of the Amesbury Channel, as interpreted later from petrophysical logs of nearby gas wells, is conspicuously absent.
- No buried weathered or oxidized horizons were encountered at this site.
- A relatively high-carbonate interval of till and sand at a depth between 30 and 58 m is tentatively correlated with the high-carbonate till at depths below 62 m in WEPA99-1.
- Arsenic values at a depth of about 130 to 145 m are as high as 40 ppm in samples of till with interbeds or lenses of silt (Table A3-4 and Figure 23).

In terms of till lithostratigraphy, the relatively high-carbonate till between 30 and 58 m is correlated with till of the Marie Creek Formation mapped in the Cold Lake area to the south (Figure 25). The correlation is considered highly tentative primarily because the contrast in carbonate values between the tills at this site is not strong. The till above 30 m is tentatively correlated with the Grand Centre Formation, and the low-carbonate till that lies below the lacustrine clay at 62 m is correlated with till of the Bonnyville Formation in the Cold Lake area (Andriashek and Fenton, 1989).

4.3.3 Corehole WR99-1

Corehole WR99-1 was located on an organic-covered, undulating morainal landscape within the Stony Mountain Uplands in L.S. 7, Sec. 36, Twp. 77, Rge. 15, W 4th Mer. The site was chosen to have the greatest probability of intersecting the talweg of the buried Wiau Channel, and to correlate the sediments that were recorded in petrophysical logs from nearby oil and gas wells with detailed lithological descriptions and analyses of samples. Of particular interest was an examination of the petrological composition of the fluvial sediments on the bedrock floor to verify a preglacial source and age. The anticipated great depth to bedrock (>200 m), and the high potential for intersecting natural gas migrated from subcrops of gas-bearing horizons, such as the Viking Formation, necessitated the use of oil-field drilling equipment and drill rigs equipped with some form of well blow-out prevention device to ensure safety of the operation. As a consequence, the upper 20 m of the hole was protected with steel casing,

Hole Name: WEPA99-2
Location (DLS): 13-12-74-17-W4
Latitude: 55.3985831°
Longitude: 112.4932875°
Surveyed Ground Level: 583.07 m asl



Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada
EUB Alberta Energy and Utilities Board
AGS Alberta Geological Survey

Figure 26. Lithological and petrophysical log properties of corehole WEPA99-2.

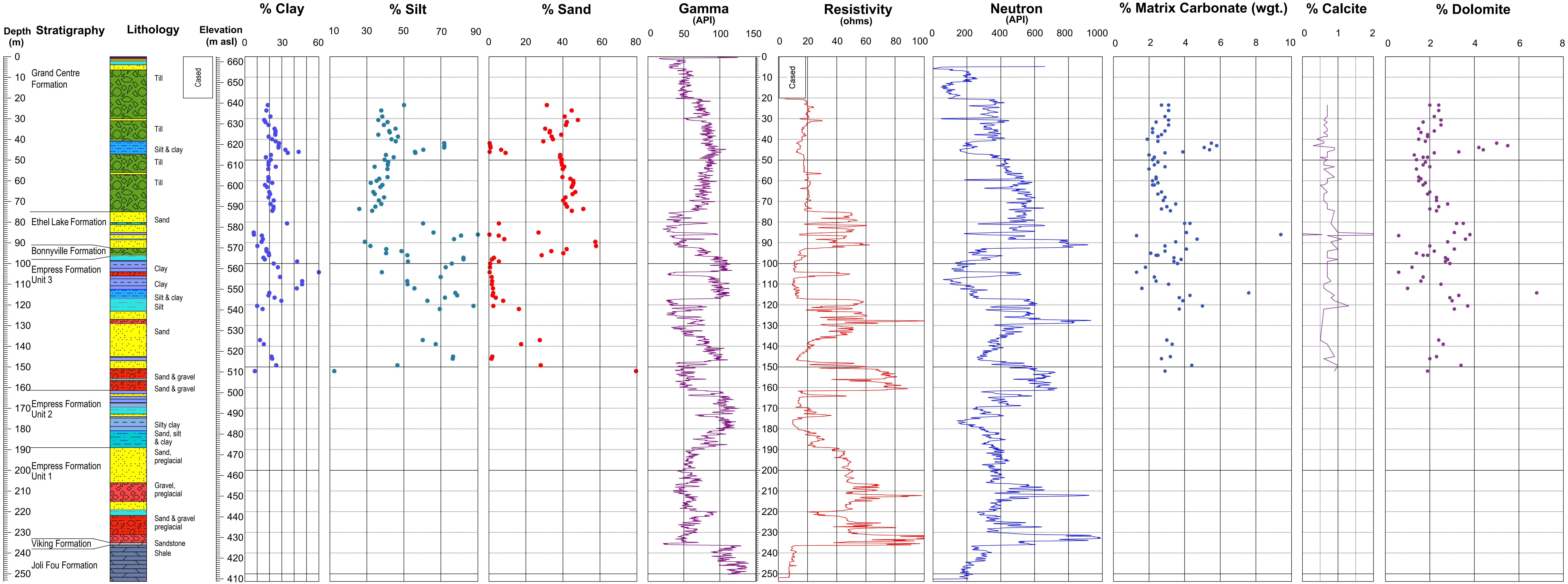
which prevented electrical logs from being run in this interval. As well, coring operations began below the 20 m casing depth, and thus representative samples are not available for the upper part of the succession. The drilling operator provided descriptions of the geological sediment in this upper 20 m interval, as AGS staff members were not on-site while casing was installed. This type of coring program is estimated to have cost almost four times that of a normal coring operation using a conventional water-well drill rig.

Total depth of investigation in this corehole was 253.7 m, of which the upper 235.3 m is Quaternary and Late Tertiary sediment (drift), and the lower 18.4 m is bedrock of the Lower Colorado Group. The drift–bedrock contact is defined by approximately 1 m of Viking Formation sandstone, which overlies about 17 m of Joli Fou Formation shale. Two water-well piezometers where installed at this site: one at a depth of 8 m, to serve as a water-table well, and one at a depth of 230 m within the lowermost sand and gravel unit in the hole.

Detailed field descriptions of core samples from this hole are provided in Appendix 2c, analytical laboratory results are presented in Appendices 3 and 4, and the lithology is summarized graphically in Figure 27. Some significant aspects of the geology within corehole WR99-1 include the following:

- Till comprises only about one-third (~ 75 m) of the stratigraphic succession, that being the uppermost third of the column. The bottom two-thirds of the succession (~160 m) is composed of two fining-upwards sequences, each of which grades from gravel to silt and clay. These are interpreted to be of fluvial origin.
- The composition of pebbles in the lower fining-upward cycle, as determined by field observations of cuttings and validated by microscopic examination of selected samples, shows a clast petrology indicative of a source from the Cordilleran Mountains and local bedrock, that is, metaquartzite and black chert. This differs from the sand and gravel in the upper fining-upwards cycle, which contains abundant granite and gneiss clasts brought into the area by Laurentide glaciers from the Canadian Shield. This validates the initial assumption that the bottommost fluvial sediments in the Wiau Channel are of preglacial origin and age. The preglacial sand and gravel deposits on the floor of the Wiau Channel are thus correlative with Empress Formation Unit 1 preglacial sand and gravel mapped in buried channels within the Cold Lake area to the south (Andriashek and Fenton, 1989). On the basis of stratigraphic position, the silt and clay in the interval between 161 and 191 m, which lies above basal preglacial gravel, is interpreted to be Empress Formation Unit 2 silt and clay. However, the presence of granite rock fragments in the sand fraction from this horizon, as described in the lithologs, indicates a glaciofluvial source. Thus, there remains some uncertainty regarding the origin and age of the silt and clay that rests above the preglacial sand and gravel at this site.
- There is also some uncertainty regarding the origin of the clay in the interval between 100 and 122 m. Lithologs of core at 105 m (Appendix 2c) describe the clay as black, highly broken, and deformed with slickensides, which possibly indicates that it is a block of glacially displaced shale. However, logs of the core at about 114 m describe the silt and clay as rhythmically bedded and containing one or two pebbles, typical of a glaciolacustrine deposit. For purposes of stratigraphic correlations, all of the silt and clay in this interval is considered to be glaciolacustrine sediment. A change in the drill method at a depth of about 162 m, from core barrel to tricone rock bit, resulted in poor sample recovery and poor descriptions of the silt and clay in the interval from about 165 to 190 m.
- There are no mineralogical or petrological indicators to suggest that more than one till is present at the site. Carbonate values of the till are low, indicating that the till is most likely the upper Grand Centre Formation encountered in the upper part of corehole WEPA99-1, although the till at WR99-1 appears much less clayey than the upper till at WEPA99-1 (Figures 21 and 27).

Hole Name: WR99-1
Location (DLS): 07-36-77-15-W4
Latitude: 55.7143794°
Longitude: 112.1879148°
Surveyed Ground Level: 662.45 m asl



Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada

Alberta Energy and Utilities Board

Alberta Geological Survey

Figure 27. Lithological and petrophysical log properties of corehole WR99-1.

4.3.4 Corehole WEPA00-1

Corehole WEPA00-1 was located on low to moderate relief, hummocky moraine on the higher reaches of the Mostoos Upland, in L.S. 6, Sec. 33, Twp. 74, Rge. 9, W 4th Mer. The hole was drilled to establish the stratigraphic succession along the northern margin of the Wiau Channel and to correlate it with petrophysical logs from numerous gas wells in the area. Of particular interest was the need to characterize the nature and origin of the clay-rich sediment previously logged at a depth of about 140 to 150 m, which typically has a distinctive low resistivity and a high gamma value on the petrophysical logs.

Although existing borehole information indicated that the depth to bedrock was more than 200 m in the area, corehole WEPA00-1 was drilled only to a total depth of 173.5 m, terminating in Quaternary sediment. The reason for prematurely ending the hole in drift rather than bedrock was the increased risk of encountering natural gas (as either in situ gas in bedrock strata or migrated gas in Quaternary strata,) beyond this depth, and the prohibitive cost of using an oil and gas drill rig needed to mitigate the risk.

A nest of four water-well piezometers was installed at this site to provide information on vertical gradients, as well as other hydrogeological parameters. Wells were completed in sand at depths of 15 (water-table well), 41, 76 and 120 m.

Detailed field descriptions of core samples from this hole are provided in Appendix 2d, analytical laboratory results are presented in Appendices 3 and 4, and the lithology is summarized graphically in Figure 28. Some significant aspects of the geology within corehole WEPA00-1 include the following:

- The succession of the 174 m of drift drilled at this site consists of about 35 m of till overlying about 45 m of sand and gravel, which overlies more than 94 m of till with interbeds of sand (Figure 28).
- The upper 20 m of till are characterized by a higher matrix carbonate content compared to values for the till below. The carbonate values decrease abruptly beneath a 2 m thick silt and clay bed, which rests on top of a buried, weakly oxidized till. Oxidation of this till is expressed primarily as rust-coloured iron staining along fractures and joints.
- Odours of hydrocarbon (similar to bitumen odour) and a faint ‘rotten egg’ smell (H_2S) were noted in core recovered from a depth of about 32 m, and hydrocarbon odour was evident in varying concentrations down to a depth of about 108 m, and a single observation at about 173 m (Figure 28). None of the cores of till showed any evidence of free hydrocarbon, or clasts and inclusions of hydrocarbon-bearing rocks such as bitumen-saturated sandstone. In addition to hydrocarbon odour, a dark oily emulsion was evident on the surface of the drill fluid in the circulation tank when the core bit reached a depth of about 32.5 m (Figure 29). This emulsion persisted on the surface of the drill-mud tank over a four-day period until the hole was abandoned. Also observed were bubbles rising up the borehole when the drill operations ceased momentarily at a depth of about 78 m in sand and gravel. The driller indicated the rig was not experiencing any problems with the seals on the mud pumps, which could have been introducing air into the drill fluid. Bubbles were also observed coming up in the borehole when coring at a depth of about 153 m. At a depth of about 35 m a decision was made to sample a section of till from the next core run which, on the basis of the previous run, was expected to have the most concentrated hydrocarbon odour. However, the lithology changed from till to sand at about 35.5 m, and the next encounter of sediment with odour was the relatively thin till bed between 45 and 47 m, at which depth a 15 cm thick sample of core was extracted and sealed in a glass vessel. The results of the hydrocarbon analysis (Table 2) confirm the field observations that hydrocarbons are present in the till, and also that the composition is similar to bitumen from Cretaceous oil sands deposits in northeastern Alberta (Andriashek and Pawlowicz, 2002). As significant as these till intervals with traces of hydrocarbon odours are, it is worth noting that the till in the lower part of the corehole showed no traces of odour. As a final comment, field observations indicated that none of the water samples from water-well piezometers completed at depths of 15, 41,

Hole Name: WEPA00-1
Location (DLS): 06-33-74-09-W4
Latitude: 55.4513762°
Longitude: 111.3298897°
Surveyed Ground Level: 666.83 m asl

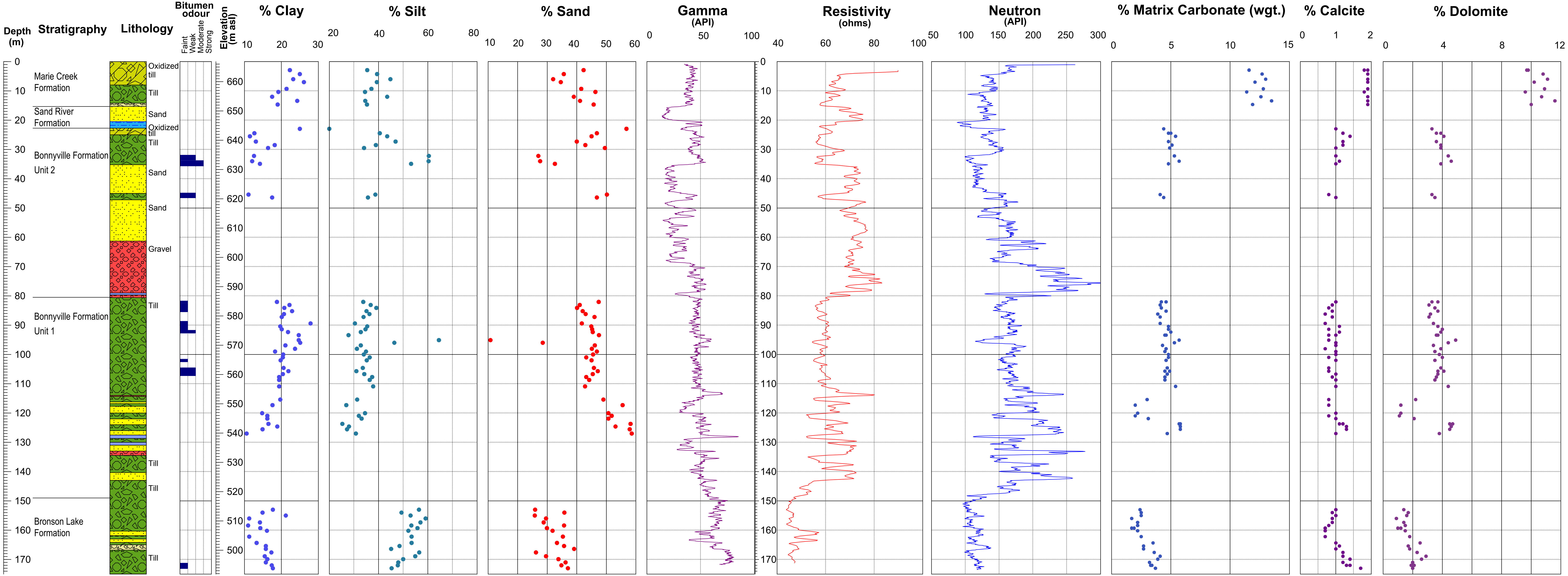


Figure 28. Lithological and petrophysical log properties of corehole WEPA00-1.

Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada
EUB
Alberta Energy and Utilities Board
AGS
Alberta Geological Survey

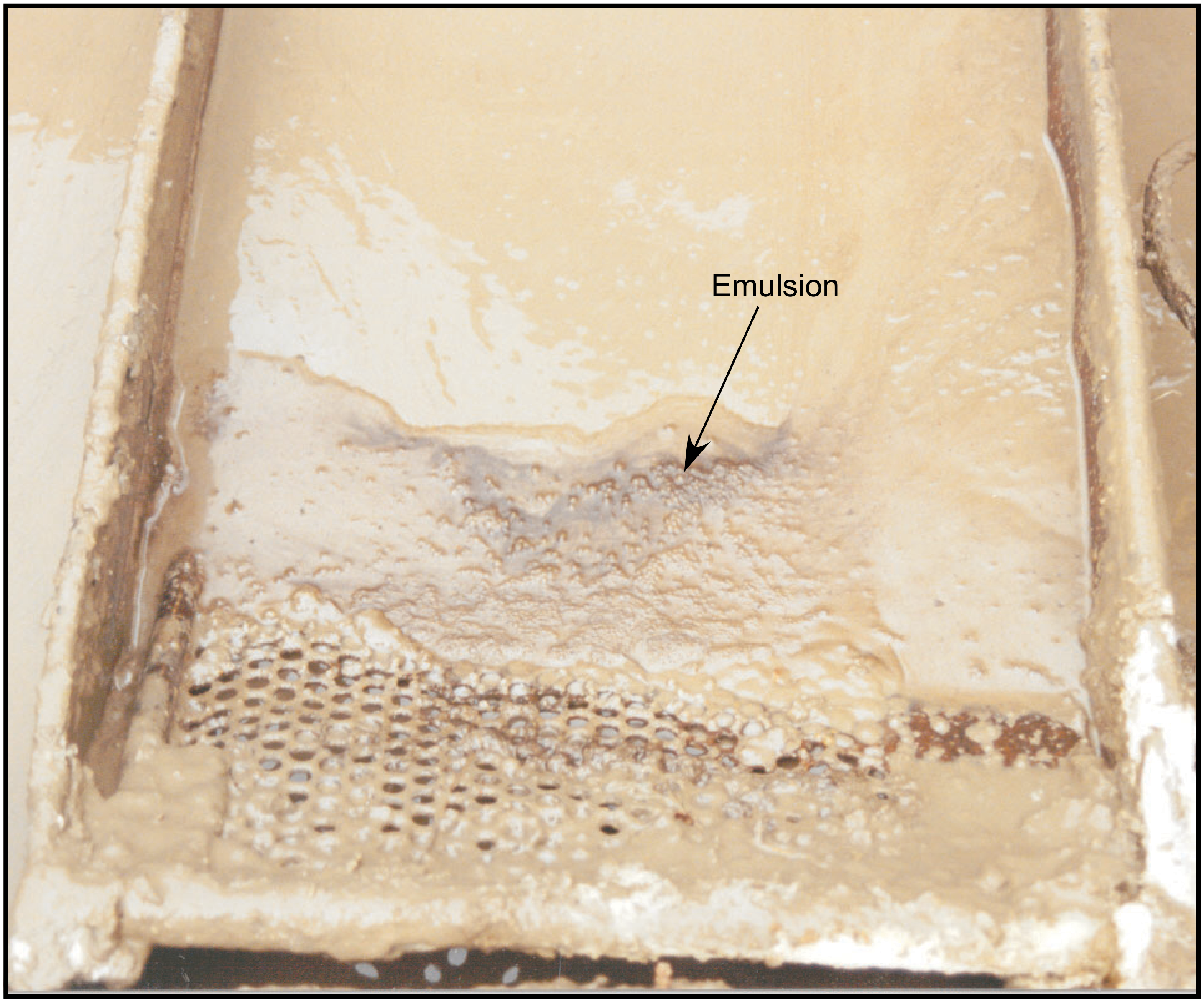


Figure 29. Hydrocarbon emulsion on surface of drilling mud tank, WEPA00-1. The emulsion was first observed when drilling in till at a depth of about 32.5 m, and was visible in the drill mud over the next four days, until the hole was abandoned at a depth of 173.5 m.

Table 2. Analysis of hydrocarbon in till, corehole WEPA00-1.

Carbon number	Total sample dry wt. (mg/kg)	Saturates fraction dry wt. (mg/kg)	Aromatics fraction dry wt. (mg/kg)	Detection limit
C11	<1	1	<1	1
C12	<1	2	<1	1
C13	2	3	<1	1
C14	5	5	<1	1
C15	7	6	1	1
C16	13	12	2	1
C17	17	12	3	1
C18	24	18	3	1
C19	29	22	4	1
C20	29	21	6	1
C21	31	23	6	1
C22	33	20	6	1
C23	30	25	8	1
C24	31	22	8	1
C25	32	22	9	1
C26	33	21	10	1
C27	34	22	11	1
C28	28	18	9	1
C29	36	22	12	1
C30	37	26	15	1
C31	44	21	13	1
C32	35	19	13	1
C33	28	15	11	1
C34	34	17	16	1
C35	39	20	13	1

Carbon number	Total sample dry wt. (mg/kg)	Saturates fraction dry wt. (mg/kg)	Aromatics fraction dry wt. (mg/kg)	Detection limit
C36	32	15	13	1
C37	31	14	13	1
C38	25	14	11	1
C39	37	11	13	1
C40	25	13	13	1
C41	30	13	10	1
C42	17	10	13	1
C43	28	9	10	1
C44	28	11	12	1
C45	22	6	10	1
C46	22	8	10	1
C47	16	10	10	1
C48	27	8	10	1
C49	22	7	10	1
C50	22	7	7	1
C51	16	5	10	2
C52	21	7	10	2
C53	22	6	8	2
C54	16	5	8	2
C55	16	5	13	2
C56	16	4	8	2
C57	22	6	8	2
C58	17	6	8	2
C59	23	4	10	2
C60+	619	74	238	20
Total	1803	693	665	

C_{11} - C_{60}+ Hydrocarbon Characterization

Fraction	Concentration dry wt. (mg/kg)	% of Total
Total saturates/aliphatics (C11-C60+)	693	38.4
Total aromatics (C11-C60+)	665	36.9
Polars and asphaltenes (by difference)	445	24.7
Total extractable hydrocarbons (C11-C60+)	1803	100.0

C_{60} Hydrocarbon Analysis Calibration Check

Carbon number	Actual mg/L	Recovered mg/L	% Recovery
C12	20	21	105
C14	30	32	107
C16	40	42	105
C18	50	53	106
C20	60	64	107
C22	80	85	106
C24	100	105	105
C26	120	127	106
C28	120	126	105
C30	100	106	106
C32	80	84	105
C36	60	64	107
C40	50	52	104
C44	40	42	105
C50	30	32	107
C60	20	21	105

76 and 120 m, had any visible traces of hydrocarbon. That is, a hydrocarbon odour was not detected, nor was an iridescent sheen visible on the surface of water samples. Water samples were not submitted for laboratory analysis of hydrocarbon to confirm this. The apparent absence of hydrocarbons in the samples of groundwater from sand bodies indicates that the source of hydrocarbon odour and emulsions of oily material are most likely derived from glacial erosion of oil sands material and incorporation within the till matrix.

- The core samples revealed that the low-resistivity, high-gamma signature at a depth of about 140 to 150 m in nearby petrophysical logs represents clay-rich till, and not glaciolacustrine silt and clay, as once believed. An interesting aspect of this clay-rich till is that in addition to the till matrix being more enriched in silt and clay and depleted in sand (Figure 28), the till is also enriched in large pebbles (2–3 cm) of shale and siltstone, which also imparts overall higher clay content to the bulk texture of the till (Appendix 2d). This clay (shale)-rich unit is well defined on many of the petrophysical logs above the Wiau Lowlands, and is a good marker horizon for stratigraphic correlations.
- Relatively high arsenic values (13–20 ppm) are recorded for samples from the oxidized till profile at about 23 m, and from the clay (shale)-rich till at about 153 m (Table A3-6 and Figure 30). It is inferred that these high values are attributed to the arsenic adsorbed on ferromagnesium colloids that stain fractures in the buried weathered till, and to the presence of bedrock material (black marine shale of the LaBiche Formation), which contains naturally occurring arsenic (Andriashek, 2000).

On the basis of high carbonate values, the 15 m of till at the top of the hole is locally correlated with the high-carbonate till buried at a depth of about 62 m in corehole WEPA99-1, and regionally correlated with till of the Marie Creek Formation, mapped south of the study area in the Cold Lake area (Figure 25). On the basis of the low carbonate content and a buried oxidized horizon, the till at a depth of about 23 m is correlated with till of the Bonnyville Formation, which is also mapped south of the study area (Andriashek and Fenton, 1989). The presence of the high-carbonate Marie Creek till at the top of the hole indicates that the uppermost low-carbonate Grand Centre till, which lies at the surface in the Cold Lake area, is absent at this site. The clay-rich (shale-rich) till at a depth of about 150 m is tentatively correlated with the clay-rich Bronson Formation found in buried channels in the Cold Lake area (Andriashek and Fenton, 1989).

4.3.5 Corehole WEPA00-2

Corehole WEPA00-2 was located in a gravel pit on the north flank of an ice-contact glacial meltwater-channel complex directly northeast of Christina Lake in L.S. 7, Sec. 31, Twp. 76, Rge. 5, W 4th Mer. (Figure 6). The hole was drilled to establish the stratigraphic succession above the buried Christina Channel and to correlate it with the numerous petrophysical logs from oil and gas, and water-well industry activities in support of oil sands development in the area.

WEPA00-2 was drilled, cored and logged to a depth of about 115 m, and was terminated while still in Quaternary sediment, primarily because of the risk of encountering natural gas in bedrock formations, or gas that migrated into the Quaternary sediments from bedrock horizons below.

Detailed field descriptions of core samples from this hole are provided in Appendix 2e, analytical laboratory results are presented in Appendices 3 and 4, and the lithology is summarized graphically in Figure 31. Some significant aspects of the geology within corehole WEPA00-2 include the following:

- The succession of the 115 m of drift drilled at this site can be summarized as about 34 m of till overlying about 54 m of stratified sediment, mostly silt and clay, which overlies about 22 m of till, and lastly, about 5 m of sand and silt.

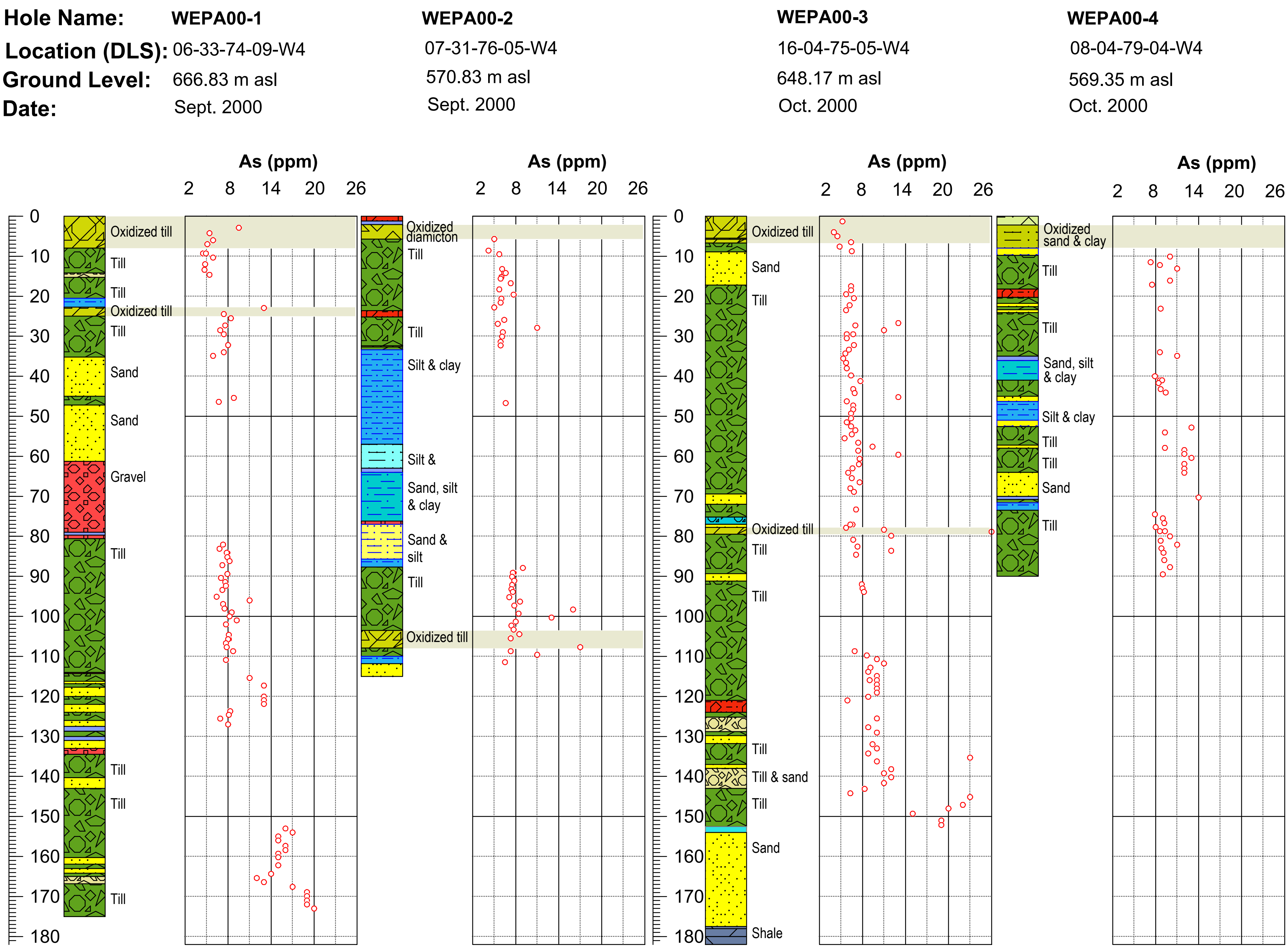
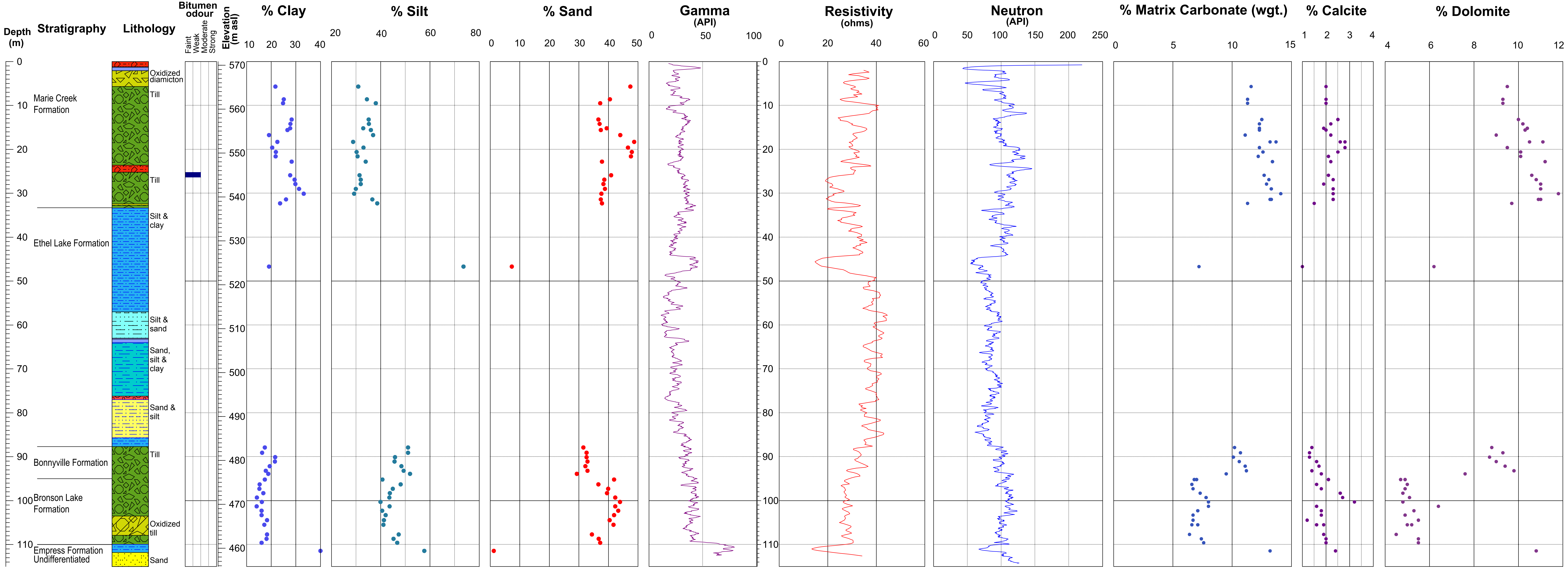


Figure 30. Variations in arsenic concentrations in glacial sediments, coreholes WEPA00-1 to WEPA00-4.

Hole Name: **WEPA00-2**
Location (DLS): 07-31-76-05-W4
Latitude: 55.6275339°
Longitude: 110.7614465°
Surveyed Ground Level: 570.83 m asl



Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada
EUB Alberta Energy and Utilities Board
AGS Alberta Geological Survey

Figure 31. Lithological and petrophysical log properties of corehole WEPA00-2.

- The till in the upper 34 m of the hole has an apparently higher carbonate content than the till below 88 m. The carbonate values of the upper till are comparable to that of the high-carbonate tills in coreholes WEPA99-1 and WEPA00-1, which are correlated to the Marie Creek Formation in the Cold Lake area.
- The thick sequence of silt, clay and sand at 34 to 88 m displays deformed, rhythmic bedding with silt lenses or laminae, which appear to be rip-up clasts. Thin beds of till (0.2–0.35 m thick) within the sand, silt and clay succession described in the field litholog between 83 and 88 m (Appendix 2e) are thought to have been deposited in an ice-proximal, proglacial lacustrine environment.
- Fine sand and silt partings in the till at a depth of about 95 to 104 m appear to cause an increase in the amount of sand within the matrix, even though the petrophysical logs at this depth indicate lower resistivity and higher gamma values, characteristic of more clayey sediment. This change in grain size is also reflected in the carbonate values, which decrease abruptly below 95 m (Figure 31).
- A buried oxidized profile is present within the till at a depth of about 104 to 108 m. It is not apparent that this oxidized horizon demarcates a weathered surface of an older regional till, as there does not appear to be a corresponding change in any of the other parameters such as carbonate content, grain size or petrophysical log character to indicate the presence of a different till. As in other buried oxidized profiles, arsenic values in this oxidized horizon are also relatively high (Table A3-7 and Figure 30).
- A weak hydrocarbon odour was detected in the till at a depth of about 25 m, directly below a bed of gravel.

In terms of till lithostratigraphy, three tills can be differentiated at this site: a high-carbonate sandy till from surface to a depth of 33 m, which is tentatively correlated with till of the Marie Creek Formation in the Cold Lake area (Figure 25); a moderately high-carbonate silty till from 88 to 94 m, somewhat similar in character to the upper till but correlated with till of the Bonnyville Formation in the Cold Lake area; and, a sandy, low-carbonate till from 94 to 110 m in which a 4 m thick oxidized profile is present in the middle of the interval. This till has been correlated with the Bronson Formation in the Cold Lake area.

4.3.6 Corehole WEPA00-3

Corehole WEPA00-3 was located directly west of Winefred Lake on a moderate-relief, hummocky morainal landscape, in L.S. 16, Sec. 4, Twp. 75, Rge. 5, W 4th Mer. The corehole was situated above the interfluve bench that separates the Wiau and Christina channels in the Wiau Lowlands bedrock physiographic unit (Figures 6 and 8). The hole was drilled to establish the lithostratigraphic-framework above the bedrock bench and to determine the petrological composition of the fluvial sediments that rest on the bedrock floor, which would establish whether the sand is of glacial or preglacial age and origin.

Corehole WEPA00-3 was drilled to a depth of 182 m and terminated after sampling a few metres into the top of shale of the LaBiche Formation. The contact between Quaternary sediments and the bedrock surface was intersected at a depth of about 177.5 m (Figure 32). Coring operations ceased at a depth of about 156 m after encountering difficult drilling conditions due to rocks and boulders. The remainder of the hole was logged from descriptions of drill cuttings from a tricone rock bit. A nest of three water-well piezometers was installed at this site, in sand beds at 17 (water-table well), 79 and 158 m.

Detailed field descriptions of core samples from this hole are provided in Appendix 2f, analytical laboratory results are presented in Appendices 3 and 4, and the lithology is summarized graphically in Figure 32. Some significant aspects of the geology within corehole WEPA00-3 include the following:

Hole Name: WEPA00-3
Location (DLS): 16-04-75-05-W4
Latitude: 55.4730401°
Longitude: 110.7072983°
Surveyed Ground Level: 648.17 m asl

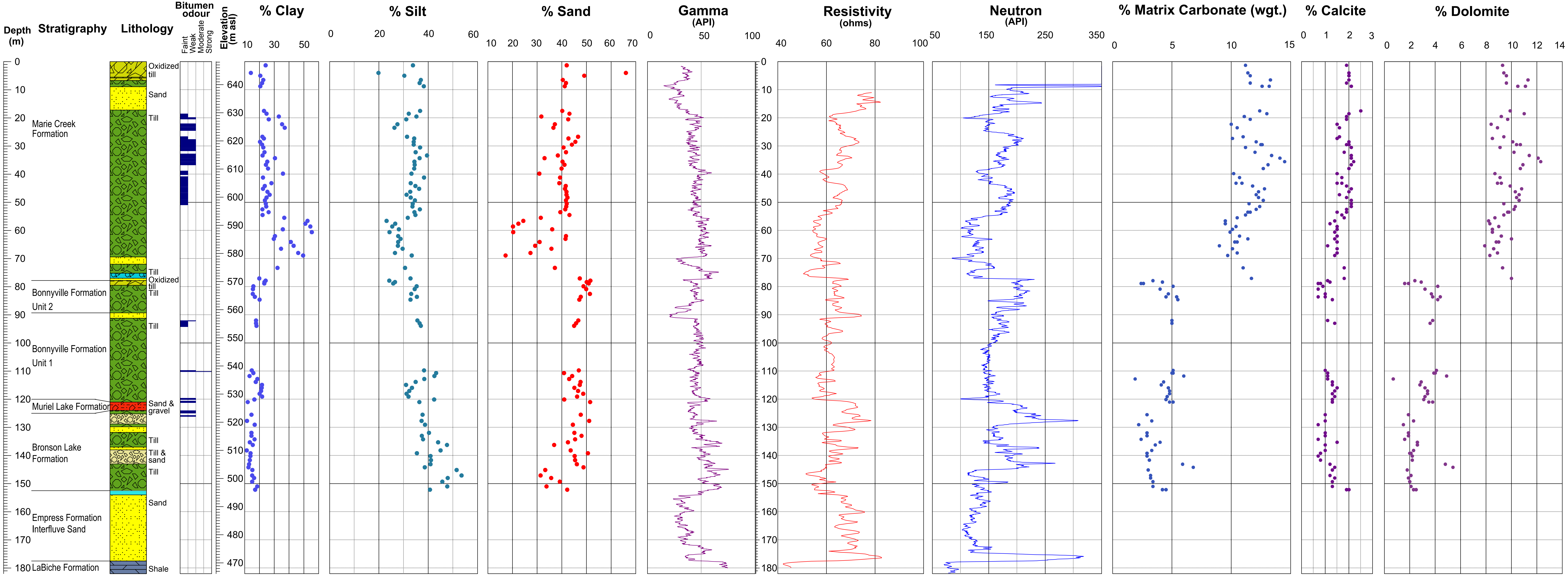


Figure 32. Lithological and petrophysical log properties of corehole WEPA00-3.

Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada
EUB Alberta Energy and Utilities Board
AGS Alberta Geological Survey

- From top down, the succession of Quaternary sediment (drift) at this site consists of about 10 m of till, about 8 m of sand, as much as 136 m of till with minor beds of sand and gravel, and lastly, about 24 m of sand.
- The field descriptions of the petrology of the sand at the bottom of the hole highlight the presence of abundant granite and gneiss from the Canadian Shield, confirming that at this site the fluvial sediment on the bedrock floor had a glacial source (Appendix 2f).
- There are a number of properties that differentiate the upper 78 m of till from the till below. The main difference is the higher carbonate content, particularly dolomite content, in the upper 78 m, as shown in Figure 32. Further, the contact is also well defined by a 1.5 to 2 m thick oxidized horizon on the surface of the low-carbonate till. This contact is also well expressed on the petrophysical logs, the lower till showing a higher resistivity, lower gamma, and in particular, higher neutron value. Lastly, the contact is also marked by an increase in the percent sand and a decrease in percent clay in the lower till.
- The resistivity of the upper 78 m of till shows progressively decreasing values with depth, indicating possible enrichment of the till matrix with clay. The grain-size analyses support this interpretation, showing a particularly clay-rich zone near the base of the till unit from about 58 to 75 m (Figure 32). This increase of finer textured material with depth is repeated to a lesser degree in the bottom part of the lower till. At the 135 to 150 m depth interval, an increase in the silt content appears to be expressed as a higher value in the gamma log and a lower value in the resistivity log.
- The geochemical data show significantly elevated values for arsenic in samples from the buried oxidized till at 79 m, similar to elevated values in buried oxidized tills in other coreholes (Table A3-8 and Figure 30). Arsenic values are also relatively higher below 110 m, and in particular, at a depth between 143 and 151 m where the lithologs describe abundant shale clasts in the till. High arsenic values at this depth may be reflecting the naturally occurring high concentrations of arsenic that are found in shale of the local bedrock.
- Weak odours of hydrocarbon were detected in samples of till at numerous intervals within the corehole. Odours were first detected at a depth of about 18 m, and persisted in core samples down to a depth of about 50 m. Hydrocarbon odours were not detected again until a depth of about 92 m, approximately 14 m below the top of the buried oxidized horizon. Odours were detected intermittently from 92 m to down to about 125 m, and none below that depth, specifically none in the samples of shale at the bottom of the corehole. As in all of the other core samples of till in which hydrocarbon odours were detected, there was no visible evidence of free hydrocarbon in the till, nor clasts or inclusions of hydrocarbon-bearing rock fragments.

In terms of till lithostratigraphy, three tills can be differentiated:

- a high-carbonate till that extends from surface down to 78 m, which is correlated with till of the Marie Creek Formation in the Cold Lake area (Figure 25);
- a middle, low-carbonate till that extends from 78 to 125 m, the surface of which has an oxidized weathered profile, and is correlated with till of the Bonnyville Formation in the Cold Lake area;
- a lower, clay-rich, low-carbonate till containing numerous shale pebbles, which is tentatively correlated with the Bronson Formation in the Cold Lake area (Andriashek and Fenton, 1989).

4.3.7 Corehole WEPA00-4

Corehole WEPA00-4 was located on a high-relief morainal ridge situated south of Cowper and Bohn lakes in L.S. 8, Sec. 4, Twp. 79, Rge. 4, W 4th Mer. The site was chosen to determine the nature of the drift stratigraphy and to establish if an east-oriented complex of high-relief landforms in the area (Figure 8) represents a bedrock highland or an accumulation of thick moraine.

Corehole WEPA00-4 was drilled to a depth of 90 m, and terminated in drift. Detailed field descriptions of core samples from this hole are provided in Appendix 2g, analytical laboratory results are presented in Appendices 3 and 4, and the lithology is summarized graphically in Figure 33. Some significant aspects of the geology within corehole WEPA00-4 include the following:

- The hole established that here the high-relief landform is composed of thick drift, and not thin drift draped on a bedrock topographic high. The corehole data supports observations of thick sections of drift along recently constructed roads in the area.
- The Quaternary succession can be summarized as till with beds of gravel, sand, silt and clay to 45 m, bedded sand, silt and clay to 53 m, till to 64 m, sand to 70 m and till below that to 90 m (Figure 33). Carbonate values for the upper 45 m of till and stratified sediment are generally higher than values for the till in the bottom 37 m of the hole.
- Arsenic values in the till increase slightly at a depth (~60 m) where abundant shale clasts are present in the till (Figure 30).
- No hydrocarbon odours or buried oxidized profiles were recorded from the core samples.

In terms of till lithostratigraphy, the upper 10 m of sediment are very tentatively correlated with the Grand Centre Formation to the south. The next 35 m of till are tentatively correlated with the high-carbonate till found in WEPA00-3 and WEPA99-1, which is regionally correlative with the Marie Creek Formation in the Cold Lake area (Figure 25). Both correlations are highly speculative primarily because the carbonate values are not as contrasting as in the tills in corehole WEPA00-3. It is possible that the second till at this site is, in fact, more correlative with the uppermost till in the eastern part of the province, the Grand Centre Formation. On the basis of the very low carbonate content, the till in the bottom 37 m of the hole is correlated with the till at a depth of 78 m in corehole WEPA00-3, which is regionally correlated with till of the Bonnyville Formation in the Cold Lake area to the south.

4.4 Constructing the Drift Hydrostratigraphy

The object of most stratigraphic investigations of drift in the study area is to locate buried aquifers for the purposes of extracting water. As such, the natural focus is to identify, correlate and map the buried permeable units, such as preglacial and glacial sand and gravel, in order to quantify groundwater resources. This exercise, while successful at a local scale, can prove flawed when attempting to map buried glacial aquifers at a regional scale. As mentioned previously, there is a tendency of glacial units to violate the law of original horizontality. Glacial meltwater can flow on, within or beneath the ice surface, and under high hydraulic head. Fluvial sediments can therefore be draped on apparent topographic highs. Subsequent catastrophic glacial meltwater releases can lead to the existence of unpredictable, vertically cross-cutting glacial sluiceways that can be infilled with sand and gravel that is superposed on older meltwater deposits. Differentiation of these fluvial deposits on the basis of mineralogy or clast petrology proves difficult to impossible because the source rock for the coarse clast component is essentially the same for each Laurentide glacial event.

The reconstruction of the drift stratigraphy in this study area is based on the premise that in northeast Alberta multiple and episodic glaciations occurred during the Quaternary. This is a valid assumption in that at least three, and possibly four, glacial events are recorded in the stratigraphic sequence of the Cold Lake area, located directly south of, and down-glacier, of the study area (Figure 34). The model used to reconstruct the stratigraphy is a variant of a genetic-stratigraphic model that relates local groups of sediments to larger, regional-scale, genetically related strata (Bleuer, 1999). The model considers glacial

Hole Name: **WEPA00-4**
Location (DLS): 08-04-79-04-W4
Latitude: 55.8156450°
Longitude: 110.5576402°
Surveyed Ground Level: 569.35 m asl

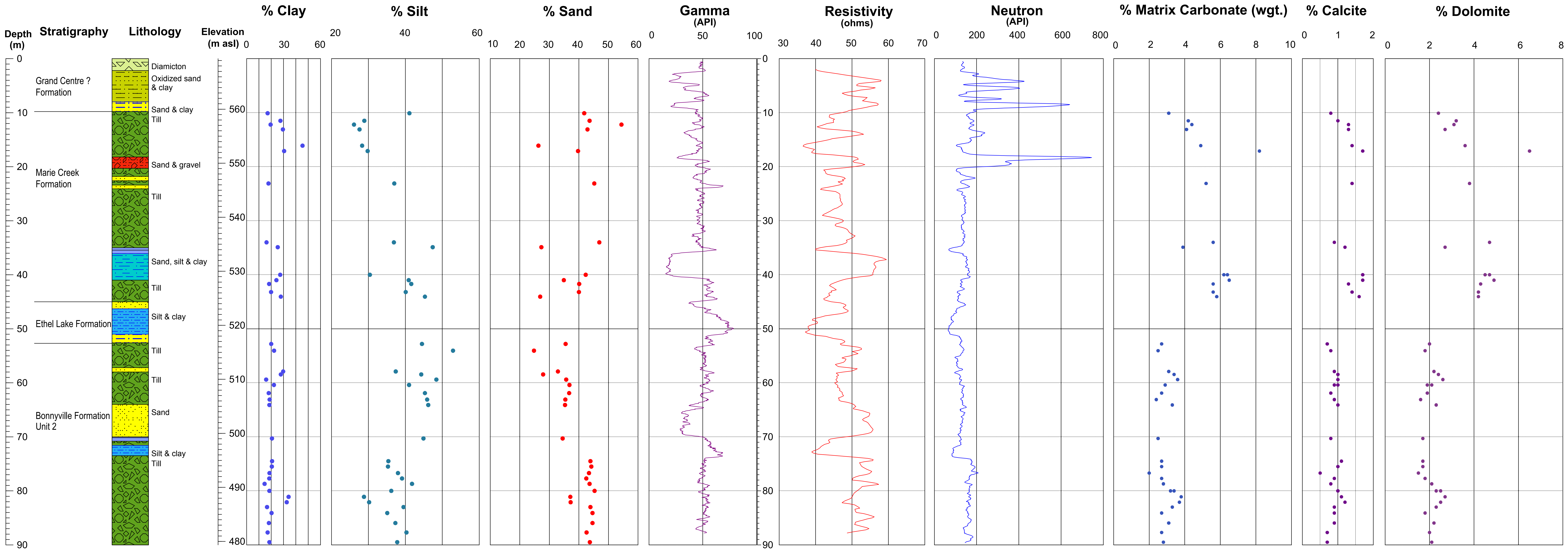


Figure 33. Lithological and petrophysical log properties of corehole WEPA00-4.

TIME UNITS	STRATIGRAPHIC UNITS
	surficial stratified sediments
QUATERNARY	**Grand Centre Fm.**
	Sand River Fm. stratified sediments
	Marie Creek Fm.
	Ethel Lake Fm. stratified sediments
	Bonnyville Fm.
	Muriel Lake Fm. stratified sediments
	Bronson Lake Fm.
TERTIARY	**Empress Fm. Unit 3** stratified sediments **Empress Fm. Unit 2** stratified sediments **Empress Fm. Unit 1** stratified sediments

Figure 34. Table of Quaternary stratigraphic units in eastern Alberta, Cold Lake area (from Andriashek and Fenton, 1989).

advances analogous to marine transgressions, or 'flooding events', but involving water in the solid state (ice) rather than liquid. Associated with each glaciation, or 'transgression', are regionally extensive deposits that record the 'flooding' event. In the case of continental glaciers, the diamicts, or tills, represent the sedimentary record of these events, and are considered as a primary sequence boundary (Bleuer, 1999). Tills of these glacial events thus provide stratigraphic boundaries to stratified fluvial or lacustrine sediments that were deposited in the advance or retreat phase of a glacial event. The challenge in mapping the Quaternary sediments in northeast Alberta is being able to differentiate and classify the tills and associated stratified sediments of multiple glacial events in a stratigraphic succession that is more than 300 m thick. It is only after the glacial genetic stratigraphy is defined that the task of correlating and mapping aquifer units can be successfully undertaken.

The following discusses some of the guiding principles in the interpretation of the glaciogenetic sequences in the study area.

4.4.1 Cyclicity in Petrophysical Log Responses of Multiple Till Units

The base of each till sheet, regardless of age or source, appears to be enriched with fine-grained material, which results from the glacial comminution and incorporation of the underlying local bedrock. In the study area, the local bedrock is dominantly black marine Cretaceous shale, and bedrock material may be incorporated as clay enrichment in the till matrix or as discrete slabs of intact, but displaced, shale. This enrichment with clay can be seen in the results of grain-size analyses or identified on petrophysical logs. The net effect is that there is cyclicity in the grain-size distribution within the stacked sequence of till sheets, with the base of each till sheet, or cycle, showing enrichment with clay. These can, in fact, be considered analogous to the ‘hot shales’ of a marine transgression (e.g., Galloway, 1989).

Figure 35 illustrates this cyclicity in the logs of the Quaternary drift from three oil and gas boreholes. Major till sheets can be differentiated by the decreasing resistivity values with depth, reflecting the upward-coarsening trend in grain size in the individual tills. The contact between two till units is most striking in places where one till directly overlies another, as in the Amoco Kirby 10-19 well (Figure 35). Figure 35 also demonstrates that even though till units 2 and 3 directly overlie coarse fluvial sediment, the composition of the base of the till is more fine grained, reflecting enrichment with clay from the underlying shale. While recognition of log cycles permits the first-order differentiation of till sheets, generally insufficient information exists to permit correlation of units from hole to hole, other than by stratigraphic position. Nonetheless, in the absence of any additional information, a first-order till stratigraphic framework can be constructed from cyclic patterns on the logs.

4.4.2 Differentiation and Correlation of Till Units by Mineralogy and Geochemistry

The petrological composition of a till deposit is very much influenced by the petrology of the underlying rock units exposed up-ice at the time of glaciation. At a gross scale, there is a petrologic differentiation within the entire glacial drift sequence that reflects the nature and degree of exposure of the underlying rock types traversed by each successive glacier. Schreiner (1990) proposed a model in which each glacial advance strips off the younger bedrock geological units and exposes the underlying, older units (presumably partially stripping off previously deposited tills as well). Applying this concept to northwest Alberta, the earliest and oldest glaciation would strip off Upper Cretaceous shale and sandstone rock units. Tills associated with this glaciation would therefore be enriched with sedimentary rock material, primarily clay from the regionally extensive shale of the Colorado Group. The next glaciation would strip off the underlying Paleozoic carbonate rock units, and the resulting tills down-ice would be enriched with carbonate material. Lastly, the youngest glaciations would erode the underlying Precambrian rocks of the Canadian Shield, and the tills would show enrichment with igneous and metamorphic material.

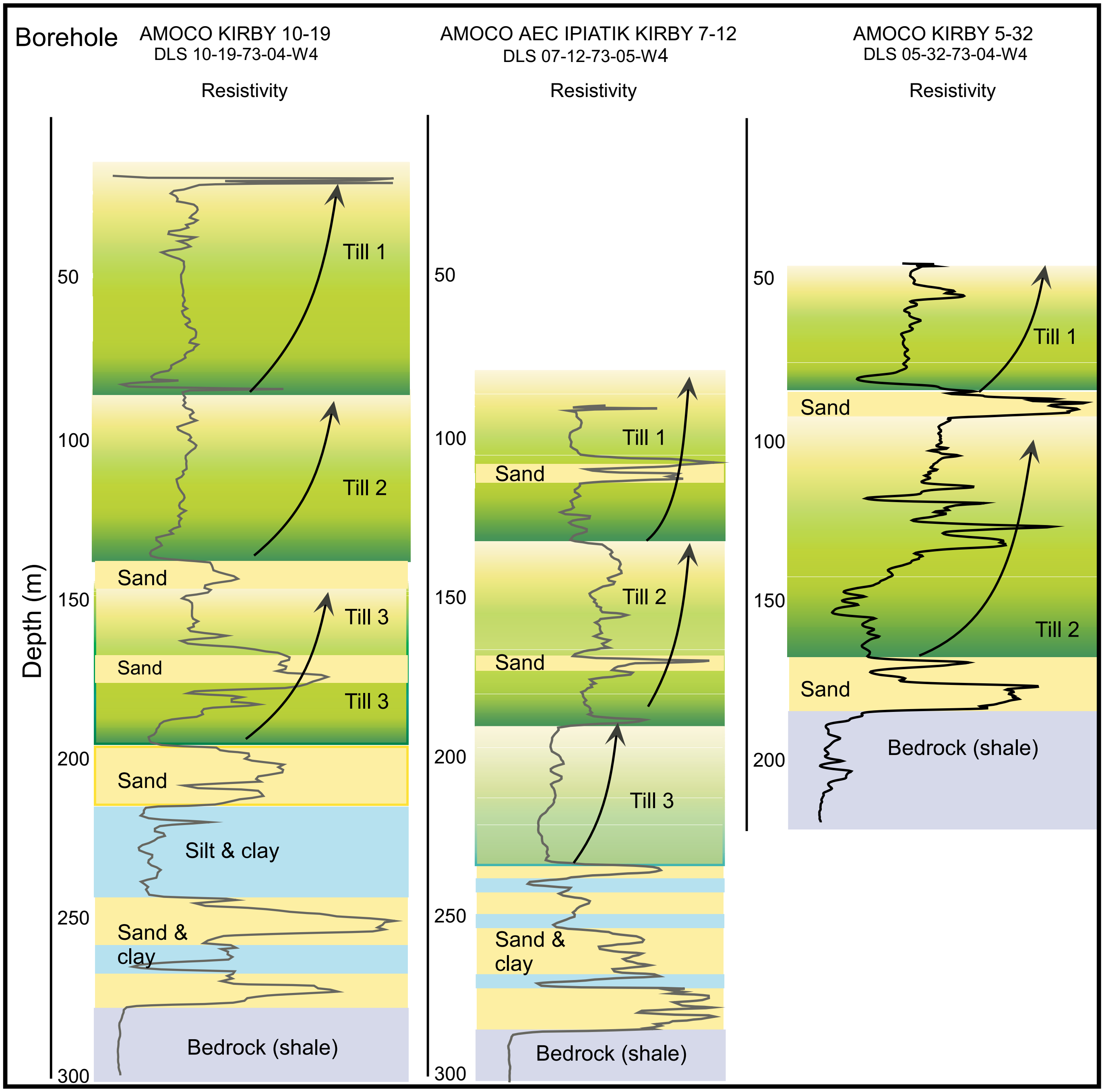


Figure 35. Differentiation of tills from cyclic patterns in petrophysical logs. Log cycles defined by the enrichment of fine-grained material at the base of till sheets.

The presence of the underlying bedrock material in the till can be observed as differences in the grain-size distribution, in the petrological composition of the coarse clast fraction (pebbles, granules, coarse sand), or in the mineralogical composition of silt and clay fractions of the till matrix. For example, the mirroring of the underlying bedrock units in the Quaternary stratigraphic record is well documented in the petrology of the coarse sand fraction of tills in the Cold Lake area, south of the study area (Andriashek and Fenton 1989). The uppermost Grand Centre Formation of the Cold Lake area is enriched with Precambrian shield rock fragments, the middle Marie Creek Formation is enriched with Paleozoic carbonate fragments, mostly dolostone, and the lowermost Bonnyville and Bronson formations are enriched with either quartz or shale fragments, likely from Cretaceous rock units (Figure 25).

Other petrological methods, such as the Chittick method, involve gasometrical techniques to determine the amount of carbonate minerals in the till matrix (Christiansen et al., 1975; Christiansen, 1992; Andriashek and Fenton, 1989). This provides an indirect method of differentiating tills by provenance, specifically Paleozoic carbonates. While both matrix grain size and carbonate analysis have proved successful there are certain drawbacks in that they require relatively large sample sizes that can be difficult to collect from rotary chip cuttings. Also, in the case of coarse sand petrology counts, sample collection is operator dependent and labour intensive. In the case of matrix carbonate analysis, specialized laboratory equipment and procedures not commonly found in the industry are required. More recently, the geochemical analysis of till samples for gold and 54 other elements is being conducted on the silt–clay fraction to characterize and correlate tills. Figure 36 demonstrates the application of both the Chittick gasometrical method and aspects of the geochemical analysis (i.e., percentage of calcium and magnesium) to differentiate tills from corehole WEPA99-1. Although the petrophysical logs demonstrate at least five coarsening cycles, the relative amounts of matrix carbonate, and the abundance of calcium and magnesium (which most probably are reflections of the abundance of limestone and dolostone in the till matrix), permit the grouping of the five cycles into three major till units, with the middle unit having a significantly greater amount of carbonate compared to the tills above and below. Although calcium and magnesium appear to be effective parameters for differentiating tills, there may very well be other geochemical parameters that can be used to differentiate the tills. A rigorous analysis of the geochemical data remains to be done on the data collected during this study and in past studies in the area.

Figure 37 illustrates how both electric log response and till petrology assist in the correlation of tills sampled from two coreholes in the study area. Three clearly defined log cycles are evident in corehole WEPA00-3, but the geochemistry indicates that these are not the same three major log cycles found in WEPA99-1. However, magnesium concentrations indicate the high-carbonate till found in WEPA99-1 can also be recognized in WEPA00-3. The bottommost cycle in WEPA00-3 appears to be a different, and older, till unit. It is also noteworthy that in some cases sand and gravel deposits are nested within till units, while others lie at the contact of major till units. The correlation and depiction of these sand and gravel units on a regional map would be fundamentally different as a result of the interpretation of the till contacts.

4.4.3 Buried Weathered Profiles—Interglacial Event Markers

Each major glaciation was followed by a prolonged interglacial period, during which time a weathered profile developed on the surface of the exposed till. In the analogy to marine regressions, Bleuer (1999) considers the development of paleosols equivalent to the onlap of the ‘atmospheric sea’. Where preserved, these weathered, oxidized profiles serve as stratigraphic markers, and are especially useful in establishing the unconformable contact between different tills. They also help confirm that major till units are of distinctly different glacial events, and not simply lithopetrological facies of a single event.

At least three weathered stratigraphic horizons were intersected by coreholes drilled in this study. Figure 37 shows buried oxidized profiles recognized in core from two of the seven AGS coreholes. In corehole WEPA99-1, the top of the high-carbonate till (Marie Creek Formation) is strongly weathered to a depth of

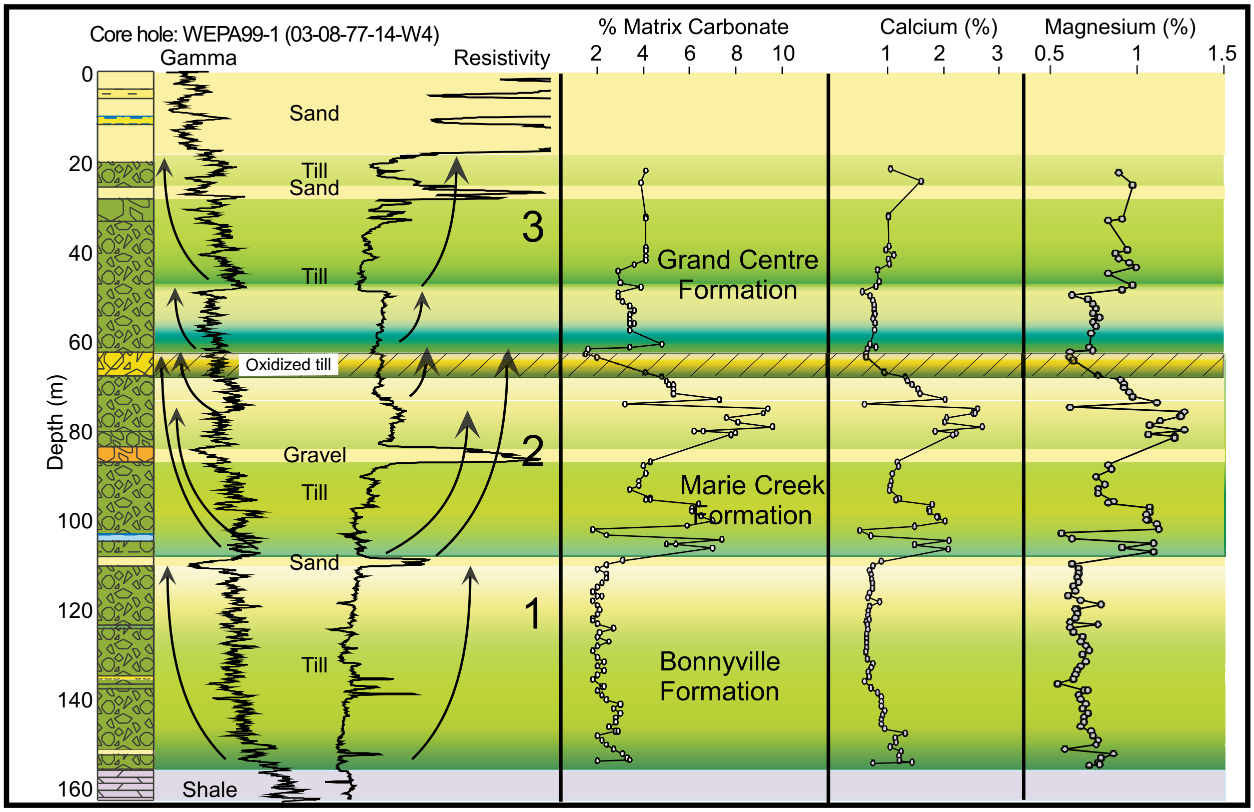


Figure 36. Differentiation of tills by log response, matrix carbonate content, and geochemical properties.

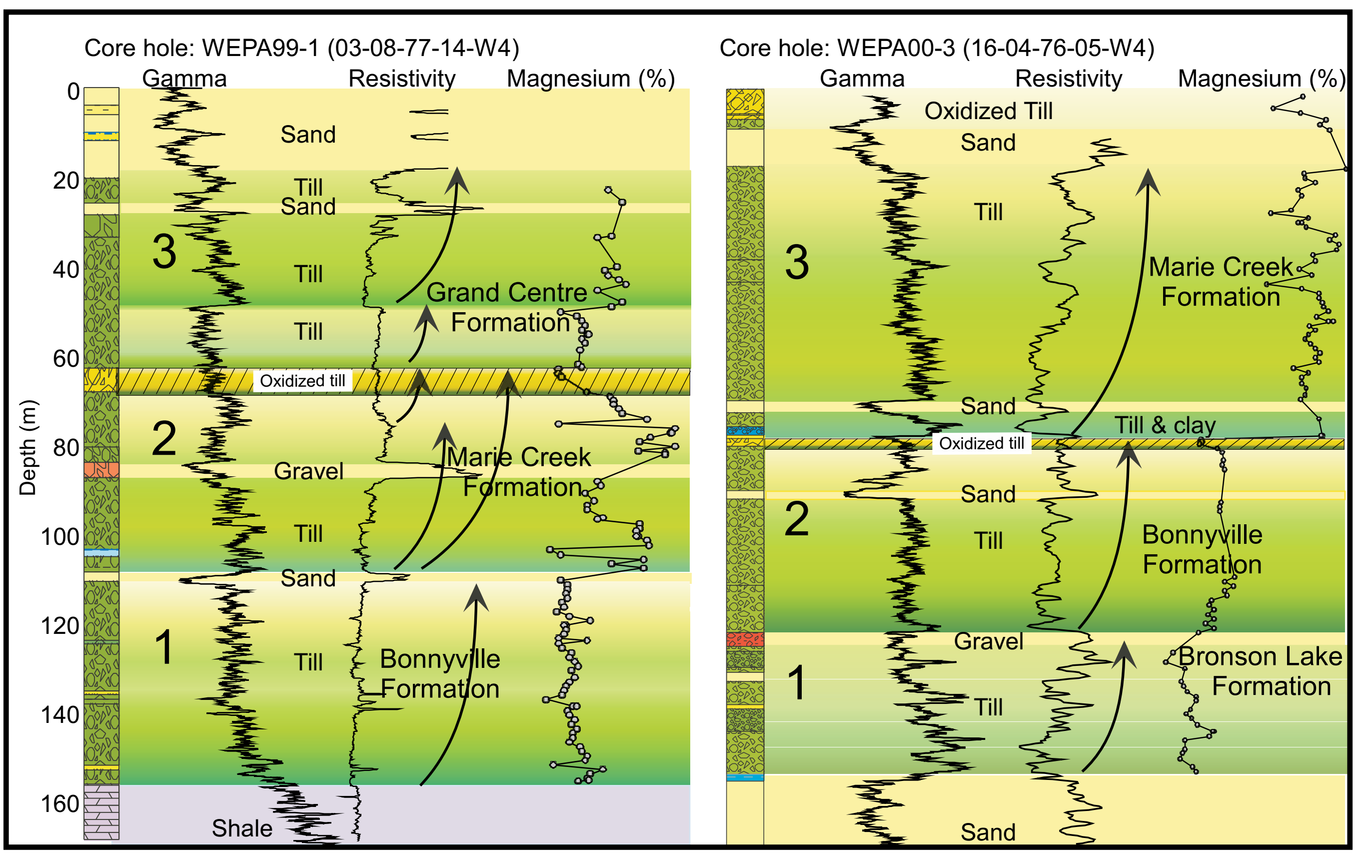


Figure 37. Correlation of tills by log response, geochemistry, and weathered unconformities.

at least 5 m, whereas in corehole WEPA00-3 a 1 to 2 m thick horizon is oxidized on the surface of the low-carbonate till (Bonnyville Formation Unit 2). In both cases, the weathered profiles further support the differentiation and correlation of the till units that was based initially on log responses and mineralogical properties. The buried weathered horizon encountered at great depth in corehole WEPA00-2 is somewhat of an enigma in that it occurs in the middle of an apparent single till unit. There do not appear to be corresponding changes in any of the other parameters such as carbonate content, grain size or petrophysical log character in this interval. As in other buried oxidized profiles, arsenic values in the oxidized horizon in WEPA00-2 are also relatively high. The horizon might demarcate the boundary between the Bonnyville and Bronson formations, but this remains speculative.

In the ideal case, weathered profiles would be considered the primary stratigraphic marker on which to base a glaciogenetic stratigraphic framework. There are a number of reasons why this is neither possible nor feasible. Firstly, weathered surfaces are generally not widespread, either because surfaces were not uniformly oxidized everywhere or, more likely, because weathered horizons are not well preserved due to fluvial or glacial erosion during successive glacial events. Secondly, weathered horizons can only be recognized when using high-quality, expensive data-collection methods, such as drill core. In very few cases is this quality of data available. Till deposits, on the other hand, represent a depositional event, and have a much higher preservation potential. Furthermore, borehole logs are relatively abundant in the study area and better show the till units, permitting more regional correlations. For these reasons, interpretations of till log cycles provide a better subsurface method on which to develop a working stratigraphic framework.

The significance of buried weathered profiles to hydrostratigraphy is twofold. Firstly, these horizons can be potential zones of hydrogeochemical anomalies resulting from the precipitation and concentration of dissolved minerals along joint and fracture faces. Secondly, weathered profiles establish a major hiatus in the depositional environment. Sand and gravel units resting on top of weathered tills are deposited subaerially, and therefore likely to be more extensive than sand and gravel beds deposited syngenetically with tills.

4.5 Regional Correlation of the Drift Stratigraphy

The calibration of numerous petrophysical logs from the petroleum industry with data from the seven AGS coreholes permits a first-order attempt at constructing a regional correlation of the Late Tertiary and Quaternary stratigraphic succession within the more than 300 m of drift in the study area. Given the inherent heterogeneity of sediments deposited in glacial environments, and the abrupt changes in sediment properties over short distances, the amount of data and resources required to resolve local-scale variations in the Quaternary stratigraphy are beyond the scope of this project. Nonetheless, a regional-scale architecture of the Quaternary drift has been constructed, adopting the stratigraphic model developed by the Alberta Geological Survey for the Cold Lake area to the south (Figure 34). The proposed framework provides the basis for further stratigraphic interpretations, following completion of this initial baseline study.

Five cross-sections have been constructed to illustrate the drift stratigraphy in the study area. There are three north-south cross-sections (Figures 9, 10 and 11), and two sections along the talweg of buried channels: the Wiau Channel (Figure 12) and the Leismer Channel (Figure 13). Although it may seem contrary, there is generally a higher confidence in the correlations of the lower half of the drift succession than in the upper part, primarily because the availability of petrophysical log data decreases near the top as a result of wells being cased off and not logged. Further, the data from the seven coreholes are insufficient to permit, with confidence, the calibration and correlation of all of the logs in the study area. As a result, only the lowermost of the drift units can be mapped — the higher units are depicted only in cross-section form. A description of each of the units, from the bottom of the section upwards, follows.

4.5.1 Tertiary–Quaternary Stratigraphy—Empress Formation

The Empress Formation constitutes the lowermost of the drift units resting on the bedrock surface. The formation was formally assigned 'group' status by Whitaker and Christiansen (1972) to include the "stratified gravel, sand, silt, and clay of fluvial, lacustrine, and colluvial origin that overlies Cretaceous and nonmarine Tertiary bedrock, and underlies glacial till of Quaternary age in southern Saskatchewan and adjoining areas of Alberta." Andriashek and Fenton (1989) later suggested adopting the formation name, rather than group name, to describe the same stratigraphic interval in the Cold Lake area.

It is important to keep in mind that the term 'Empress Formation' is a lithostratigraphic mapping term to describe all stratified sediments that rest on bedrock and are covered by the first occurrence of glacial till in the area. As a consequence, stratified sediments of different petrology, origin and age can all be included as part of the Empress Formation, provided they meet the defining stratigraphic requirements. That being said, the Empress Formation in eastern Alberta can be divided into three units on the basis of lithological and petrological properties, stratigraphic position and mappable extent. From bottom to top these are referred to as: Unit 1 preglacial sand and gravel; Unit 2 silt and clay; and Unit 3 glacial sand and gravel.

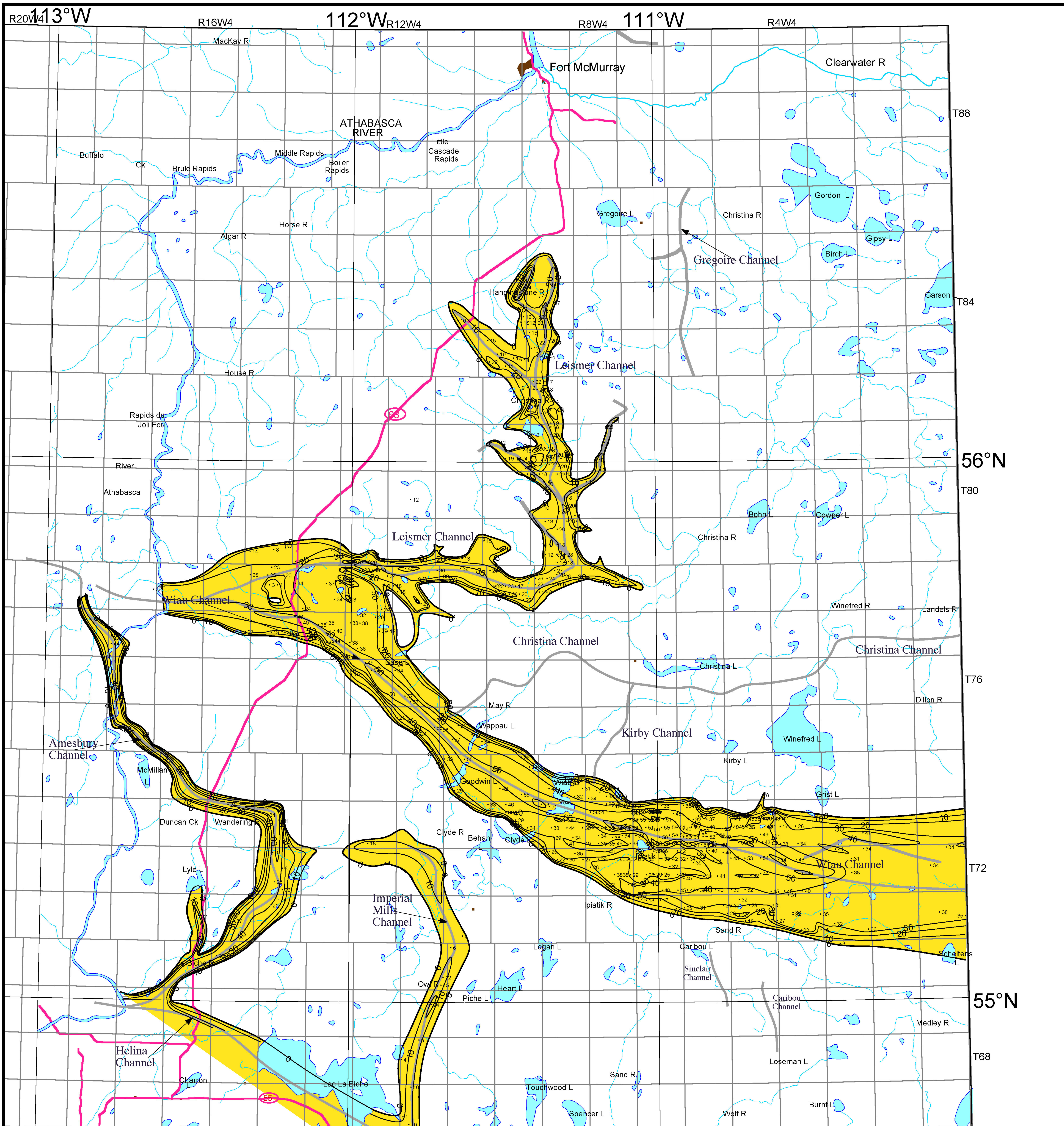
4.5.1.1 Empress Formation Unit 1 Preglacial Sand and Gravel

Empress Formation Unit 1 preglacial sand and gravel is composed of light-coloured metaquartzite, dark-coloured chert and other resistant rock types derived from the Rocky Mountains and local bedrock. The sediment was deposited by eastward-flowing rivers on the Alberta bedrock surface prior to the advent of the first Laurentide glaciation. Hence, granite and gneiss fragments, which were transported into Alberta by glaciers flowing from the Canadian Shield, are conspicuously absent in this unit. Unit 1 preglacial sand and gravel deposits, therefore, can only be differentiated from stratigraphically younger glacial sand and gravel if information on clast petrology enables the distinction to be made, or where a lithological distinct unit, such as a regionally extensive silt and clay unit, separates the two. Where neither of these conditions can be met, sand and gravel resting on the bedrock floor can only be classified as Empress Formation of undifferentiated age and origin.

Extensive and continuous deposits of Empress Formation Unit 1 sand and gravel are mapped on the floors of preglacial channels, including the Wiau, Leismer, Amesbury and Imperial Mills channels (Figure 38). However, a preglacial composition has been verified only in samples from the Wiau Channel. The assignment of a preglacial age to the sand and gravel that rests on the floors of the other channels is only inferred by stratigraphic position and channel morphology. Although the Christina Channel is also believed to have been eroded by preglacial drainage, some uncertainty exists regarding the age and origin of the fluvial sediments that rest on the channel floor. For this reason, Christina Channel sand and gravel is mapped as Undifferentiated Empress Formation deposits.

Petrophysical log traces show that finer textured fluvial sediment also occur as beds within Unit 1 sand and gravel. These fine-grained beds are widespread and common within the eastern segment of the Wiau Channel (Figure 12) and within the northern segment of the Leismer Channel that lies in the Hangingstone Plains bedrock physiographic unit (Figure 13).

More than 70 m of Empress Formation Unit 1 have been mapped in the study area, the thickest deposits occurring along the talweg of the Wiau and Amesbury channels (Figures 9, 11 and 38). Variations in thickness within the Wiau Channel have an apparent linear form, likely reflecting channel scour and infill as the paleoriver migrated across the broad bedrock lowland. Unit 1 deposits within the Leismer Channel are generally less than 30 m thick, the exception being at the extreme north end of the channel in Twp. 84, Rge. 10, W 4th Mer. where more than 50 m of channel sediment are mapped. Sediments inferred to be



Data Legend

- ● 20 - Thickness (in m) equal to value shown
- ○ 20 - Thickness (in m) less than value shown
- □ 20 - Thickness (in m) greater than value shown

Channel talweg

Distribution of Empress Formation Unit 1 sand and gravel

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD DEO Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 38. Thickness of Empress Formation Unit 1 preglacial sand and gravel

Isopach interval 10 m

(80 Km)

L. D. Andriashek

Date: 2/18/03

Scale 1:500 000

Unit 1 also lie on the floors of the tributaries of the main Leismer Channel and on the floor of the Imperial Mills Channel.

Structure contours on the surface of Unit 1 indicate a range in elevation of about 110 m, from a low of about 420 m on the nothern end of the Amesbury Channel, to a high of about 530 m in the extreme north end of the Leismer Channel (Figure 39). The gradient of the surface of the deposits reflects that of the underlying bedrock channel surface—that is, deposits within the Leismer Channel have an apparent surface gradient to the south and west, the deposits in the Wiau channel have an apparent gradient to the east, and the deposits in the Amesbury Channel slope to the north and west. Cross-section D-D' (Figure 12) also shows that the Empress Formation Unit 1 sediments within the western segment of the Leismer Channel are stratigraphically equivalent and correlative with sediments in the western end of the Wiau Channel, indicating confluence of drainage between these two channel systems. The same cannot be said about the stratigraphical relationship between Unit 1 deposits in the Amesbury Channel, which lie at an elevation of about 420 m, and those in the western end of the Wiau Channel, which are estimated to lie at an elevation of about 470 m (Figure 39). This disjunction demonstrates that drainage within the two systems likely was not confluent, and that deposition of Unit 1 in the Amesbury Channel most likely followed that in the Wiau Channel.

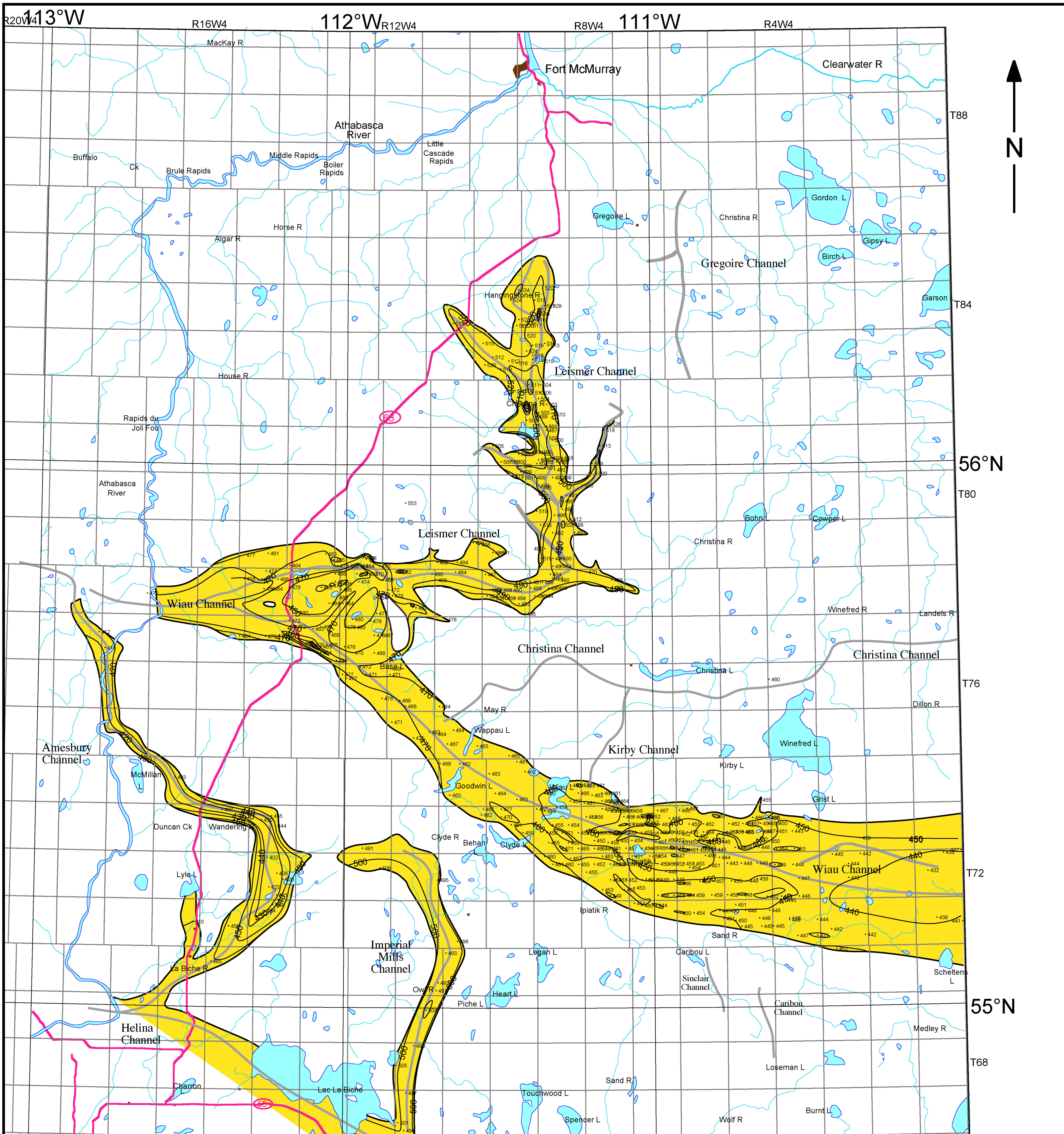
Probably the most striking aspect regarding the distribution of Unit 1 is the great lateral and continuous extent of the preglacial sand and gravel within the Wiau Channel. Figure 38 shows that Unit 1 extends for almost 30 km across the channel at the eastern end of the study area, making this one of the most widespread and thickest buried fluvial deposits of Tertiary–Quaternary age in the Western Canadian Sedimentary Basin.

4.5.1.2 Empress Formation Unit 2 Silt and Clay

Empress Formation Unit 1 deposits characteristically fine upwards into silt and clay of undifferentiated fluvial and lacustrine origin, referred to as Empress Formation Unit 2 silt and clay. Andriashek and Fenton (1989) interpret these fine-grained sediments to represent the influence of the first glaciation in the region. This glaciation blocked the regionally eastward drainage in the channels causing suspended sediment to be deposited in the ponded water. Samples of Empress Unit 2 silt and clay were encountered and logged in only one corehole, WR99-1, in the interval from about 161 to 189 m (Figure 27). The unit was described as sand, silt and clay based on small chip samples recovered using a tricone rock bit and on data from the petrophysical logs.

Extensive and continuous deposits of Empress Formation Unit 2 silt and clay are mapped primarily in the eastern two-thirds of the Wiau Channel (Figures 9, 10, 12 and 40). They have not been recognized in the Amesbury or Christina channels, and are mapped only sporadically within the Imperial Mills Channel. Until such time as samples of the Quaternary are collected from the Leismer Channel, it is uncertain if the clay-rich unit that lies above the Empress Formation Unit 1 sand and gravel in the Leismer Channel consists of till, as currently interpreted (Figure 13), or silt and clay. If the latter, then the clayey sediment in the Leismer Channel may be correlative with silt and clay of Empress Formation Unit 2, and the extent of the Unit 2 may be greater than that shown in Figure 40.

The thickest deposits of Unit 2 silt and clay are mapped in corehole WR99-1, in the western end of the Wiau Channel. However, as discussed previously, there is some ambiguity regarding the origin of the thick fluvial sediment above the preglacial sand and gravel at this site. The top of Unit 2 lies about 20 m higher at WR99-1 than elsewhere in the Wiau Channel, indicating that the sequence may represent deposits of a later glaciofluvial event, which downcut and superposed younger sediments, including silt and clay. Other thick deposits (>25 m) of Unit 2 silt and clay are mapped in the extreme east end of the Wiau Channel in Twp. 71, Rge. 1, W 4th Mer. (Figure 40). Elsewhere, Unit 2 ranges in thickness generally between 10 and 15 m.



Data Legend

- ● 400 - Elevation (in m asl) equal to value shown
- ○ 400 - Elevation (in m asl) higher than value shown
- □ 400 - Eevation (in m asl) lower than value shown
- Channel talweg
- Distribution of Empress Formation Unit 1 sand and gravel

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD DEO Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 39. Elevation of the top of Empress Formation Unit 1 preglacial sand and gravel.

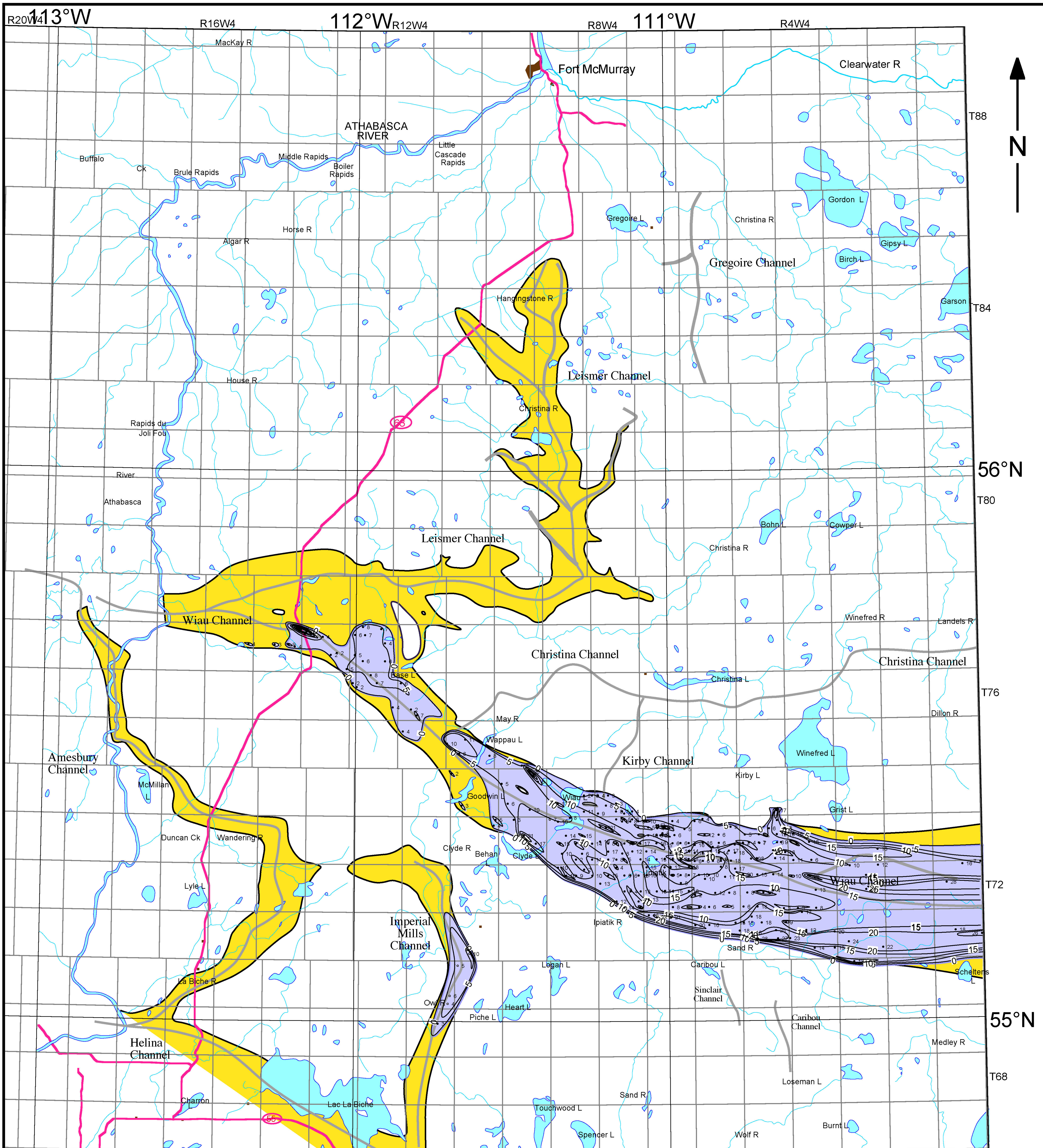
Contour interval 10 m

(90 Km)

L. D. Andriashek

Date: 2/18/03

Scale 1:500 000



Data Legend

- ● 20 - Thickness (in m) equal to value shown
- ○ 20 - Thickness (in m) less than
- □ 20 - Thickness (in m) greater than value shown
- Channel talweg
- Distribution of Empress Formation Unit 2 silt and clay
- Distribution of Empress Formation Unit 1 preglacial sand and gravel

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada

Figure 40. Thickness of Empress Formation Unit 2 silt and clay.

Isopach interval 5 m

(60 Km)

L. D. Andriashek	
Date: 2/18/03	Scale 1:500 000

The top of Unit 2 silt and clay shows relatively little change in elevation, which is expected for fluvial or lacustrine sediments that are deposited in a broad depositional basin. The surface elevation is highest in the western part of the Wiau Channel, between 485 and 490 m, and decreases gradually to a low of about 455 to 460 m in the east (Figure 41). For most of the channel, however, the elevation varies by only 10 m or so, ranging between 460 and 470 m.

4.5.1.3 Empress Formation Unit 3 Glacial Sand and Gravel

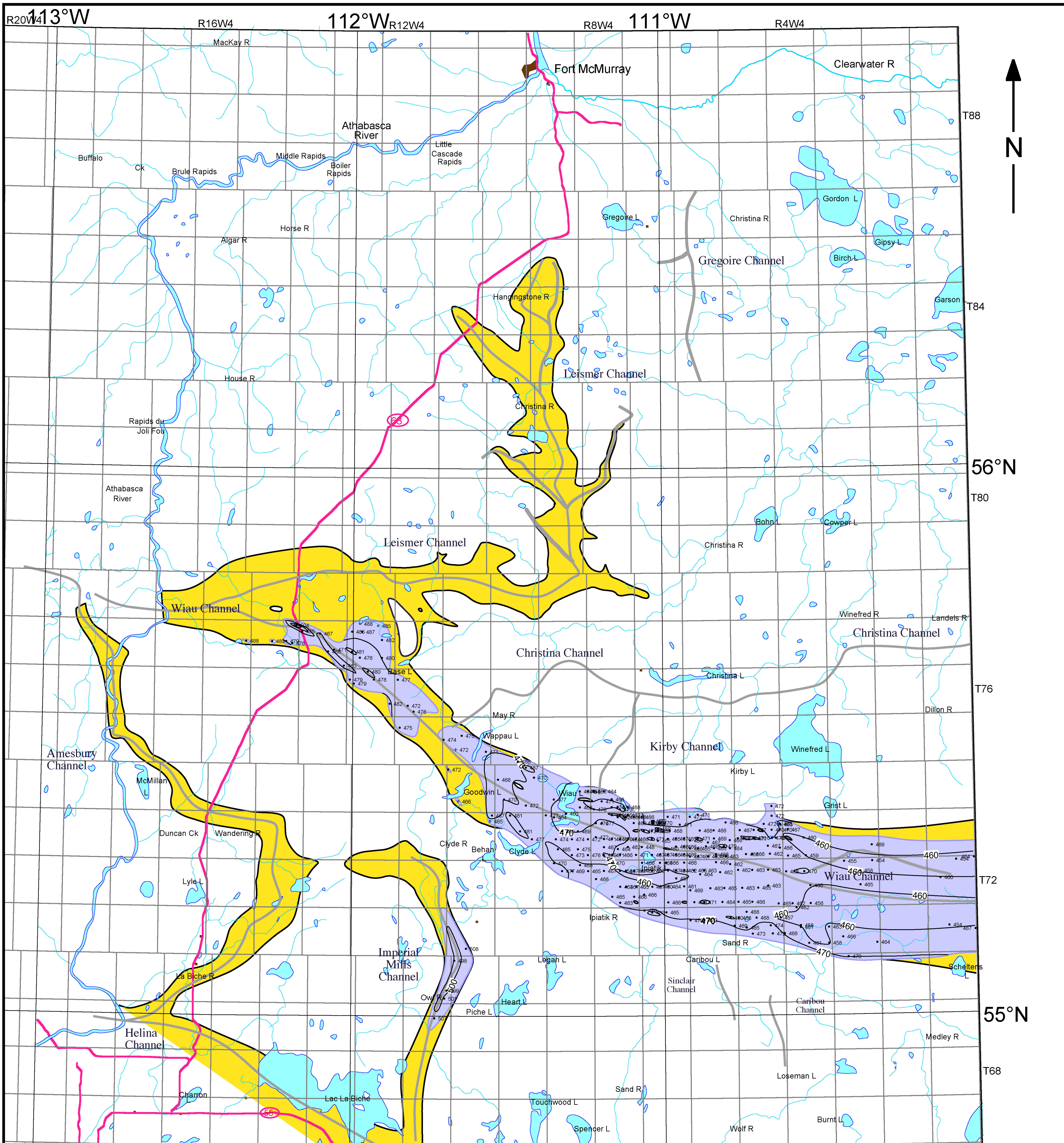
Empress Formation Unit 3 glacial sand and gravel is the youngest of the units in the Empress Formation, and constitutes the first deposit of glacial origin in the study area. As discussed previously, Empress Unit 3 deposits are characterized by an abundance of granite and gneiss fragments derived from the Canadian Shield, which differentiates them from the metaquartzite and chert sand and gravel of Empress Formation Unit 1. In almost all cases, however, information that permits this petrological differentiation is absent from boreholes in the study area. Thus, Units 1 and 3 can only be differentiated when petrophysical logs show appropriate variations and intervening silt and clay deposits of Unit 2 are present. For this reason, the distribution of Unit 3 glacial sand and gravel, as shown in Figure 42, is confined to the same areal boundaries that define the extent of Empress Unit 2 silt and clay. Glacial sand and gravel of Unit 3 may have greater extent than shown, but if Unit 3 is in direct contact with Unit 1 sand and gravel the two cannot be differentiated.

Empress Formation Unit 3 sand and gravel is mapped in two settings: within the Wiau Channel, where petrophysical logs and a few lithologs indicate that glacial sand and gravel overlies Empress Unit 2 (Figures 9, 10, 11 and 12), and within the buried Gregoire Channel, where samples confirm that glacial sand and gravel rests directly on the bedrock channel floor (Figure 9). The thickness of Empress Unit 3 deposits can reach as much as 40 m in the western end of the Wiau and more than 70 m in the Gregoire Channel. A number of sites of thick (>20 m) Unit 3 deposits have correspondingly higher elevations than Unit 3 deposits in the surrounding areas, indicating that at these locations stratigraphically higher glaciofluvial sediments may be superposed on Empress Formation sediments. Examples of this include the area west of Wiau Lake in Twp. 73, Rge. 9, W 4th Mer., and the western segment of the Wiau Channel in Twp. 77, Rge. 13 to 15, W 4th Mer. (Figure 43). The quasi-linear trend of the structure contours on the surface of Unit 3 above the Wiau Channel, as depicted in Figure 43, lend credence to a scour-and-fill glaciofluvial depositional model. Unit 3 deposits in the Gregoire Channel are interpreted to have infilled the channel during a single depositional event following the catastrophic erosion of the bedrock channel by subglacial meltwater.

4.5.1.4 Undifferentiated Empress Formation and Combined Empress Formation Channel Deposits

In parts of the study area, the petrology and origin of the fluvial sediments resting on the floors of bedrock channels are unknown, and the sedimentary succession of those fluvial sediments consists of only one sediment type, generally coarse-grained sediment (sand or sand and gravel). Until the petrology of the sediment can be determined to establish the source and age, deposits of this type cannot be classed into any of the three units of the Empress Formation, but rather are grouped under the general heading of Undifferentiated Empress Formation.

The sediments within the Christina Channel currently fall under this category of Undifferentiated Empress Formation sediments (Figure 44). For the most part, the sediment within the Christina Channel appears to be sand or sand and gravel, but not necessarily of the same age and source. Although the channel is inferred to be of preglacial age, formed by the same processes that created the Wiau Channel, elements of the channel floor exhibit overdeepening by scour, which may be attributed to downcutting by glacial meltwater at a later time. If so, then sediments that rest on the floor of the Christina Channel may be of multiple origins. Figures 9 and 44 shows that more than 90 m of sediment have infilled an apparent overdeepened scour that lies in the segment of the Christina Channel in Twp. 76, Rge. 4 and 5, W 4th Mer.



Data Legend

- ● 400 - Elevation (in m asl) equal to value shown
- ○ 400 - Elevation (in m asl) higher than value shown
- □ 400 - Eevation (in m asl) lower than value shown

Channel talweg

Distribution of Empress Formation Unit 2 silt and clay

Distribution of Empress Formation Unit 1 sand and gravel

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD DEO Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 41. Elevation of the top of Empress Formation Unit 2 silt and clay.

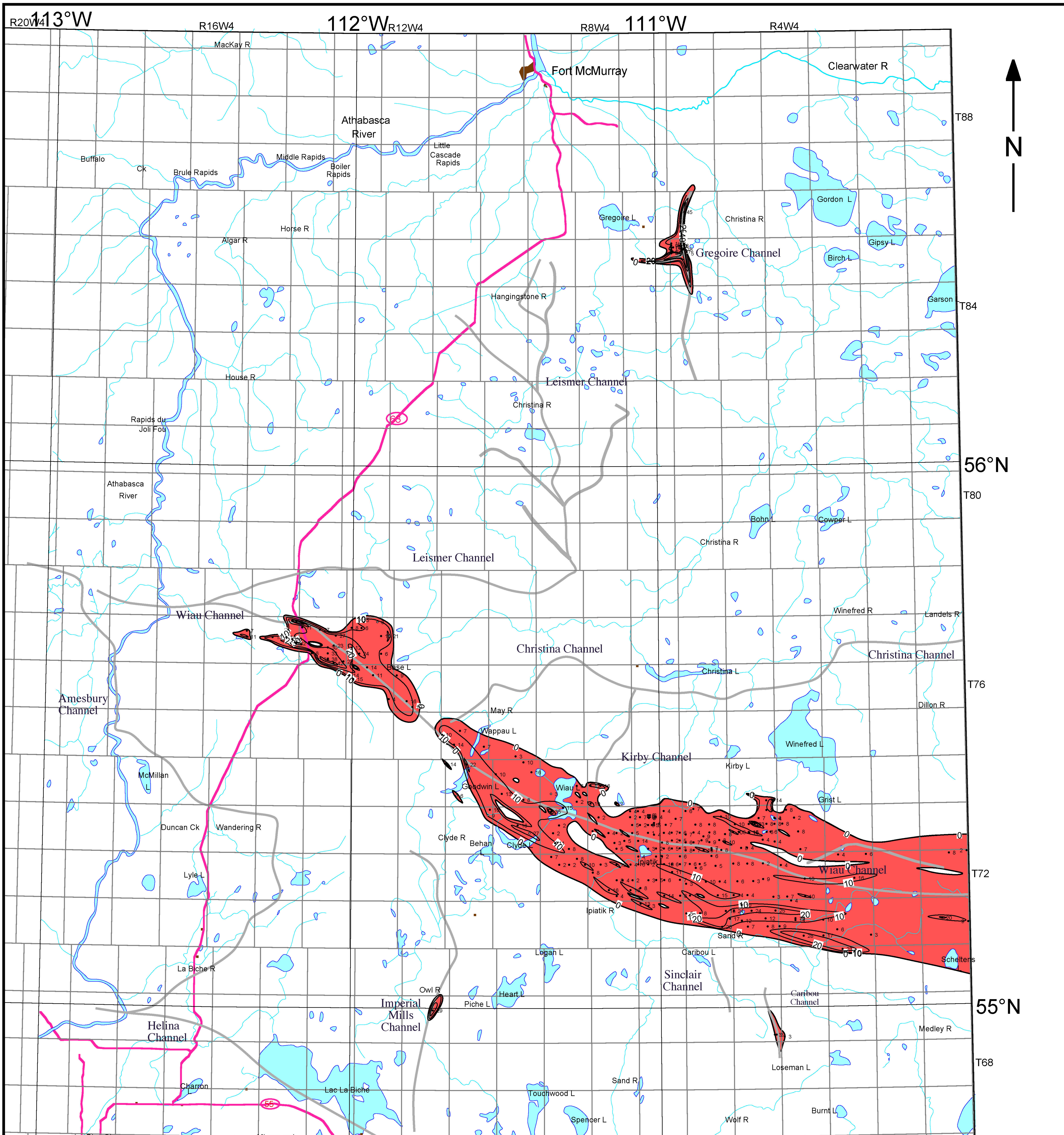
Contour interval 10 m

(70 Km)

L. D. Andriashek

Date: 2/18/03

Scale 1:500 000



Data Legend

- ● 20 - Thickness (in m) equal to value shown
- ○ 20 - Thickness (in m) less than value shown
- □ 20 - Thickness (in m) greater than value shown

Channel talweg

Distribution of Empress Formation Unit 3 glacial sand and gravel

Alberta Energy and Utilities Board

Alberta Geological Survey

Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada

Figure 42. Thickness of Empress Formation Unit 3 glacial sand and gravel.

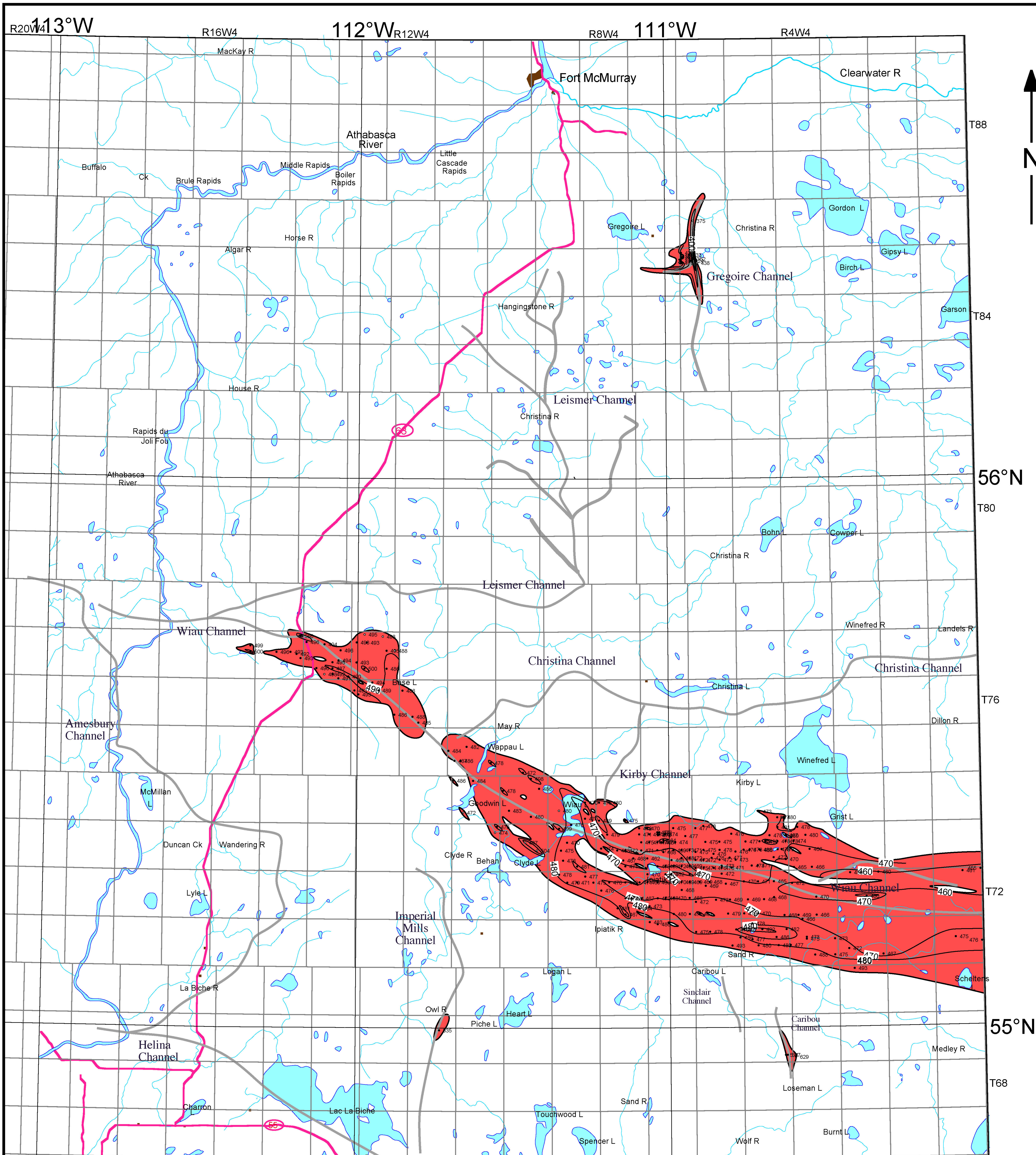
Isopach interval 10 m

(70 Km)

L. D. Andriashek

Date: 2/18/03

Scale 1:500 000



Data Legend

- ● 400 - Elevation (in m asl) equal to value shown
- ○ 400 - Elevation (in m asl) higher than value shown
- □ 400 - Eevation (in m asl) lower than value shown

Channel talweg

Distribution of Empress Formation Unit 3 glacial sand and gravel

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

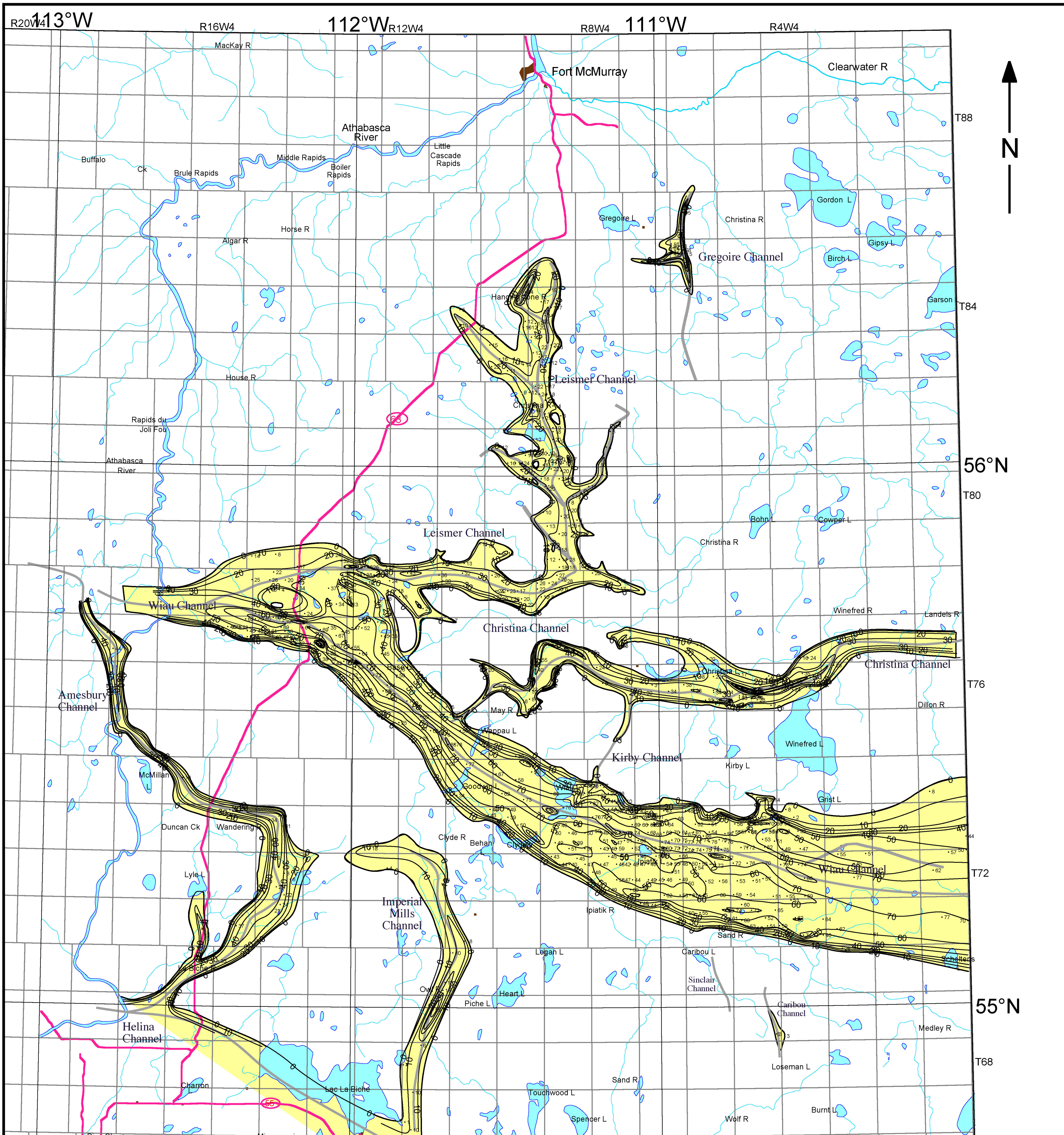
Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 43. Elevation of the top of Empress Formation Unit 3 glacial sand and gravel.

Contour interval 10 m

(80 Km)

L. D. Andriashek	
Date: 2/18/03	Scale 1:500 000



Data Legend

- ● 20 - Thickness (in m) equal to value shown
- ○ 20 - Thickness (in m) less than value shown
- □ 20 - Thickness (in m) greater than value shown

Channel talweg

Distribution of Empress Formation channel deposits (undifferentiated and combined Units 1,2 and 3)

Alberta Energy and Utilities Board

Alberta Geological Survey

Western Economic Diversification Canada
Diversification de l'économie de l'Ouest Canada

Figure 44. Thickness of Empress Formation channel deposits.

Isopach interval 10 m

(60 Km)

L. D. Andriashek	
Date: 2/18/03	Scale 1:500 000

A similar overdeepening of the channel occurs in Twp. 77, Rge. 9, W 4th Mer., where 70 m of sediment are mapped. An average of 20 to 30 m of sediment are mapped elsewhere in the channel. Structure contours on the surface of the Christina Channel sediments are depicted in Figure 45.

Figure 44 also shows the distribution and combined thickness of all three units of the Empress Formation, which essentially represents all stratified sediment resting on the floors of bedrock channels. It illustrates that there are substantial areas along the talweg of Wiau Channel where the cumulative thickness of preglacial and glacial sand and gravel, and fluvial or lacustrine silt and clay is as much as 70 to 80 m. Structure contours on the surface of the combined units are also shown in Figure 45.

4.5.1.5 Empress Formation on the Interfluves of Bedrock Channels

The bedrock interfluves between the major channels of the Wiau Lowland are mantled by thick deposits of sand and gravel that lie at an elevation generally higher than the uppermost fluvial sediments within the buried channels (Figures 9, 10 and 46). In the initial work on the regional Quaternary stratigraphy of the area, Stein et al. (1993) speculated on the origin and concluded that, in absence of petrological information, it was reasonable to assume the interfluve sediments were likely to be of preglacial age and composition, representing higher level terrace lag deposits of the Wiau–Christina fluvial system. However, field descriptions and examination of recent core samples from AGS corehole WEPA00-3 in Twp. 75, Rge. 5, W 4th Mer. (Appendix 2f) show that the sand and gravel resting on the bedrock interfluve at this location are of glacial composition and origin.

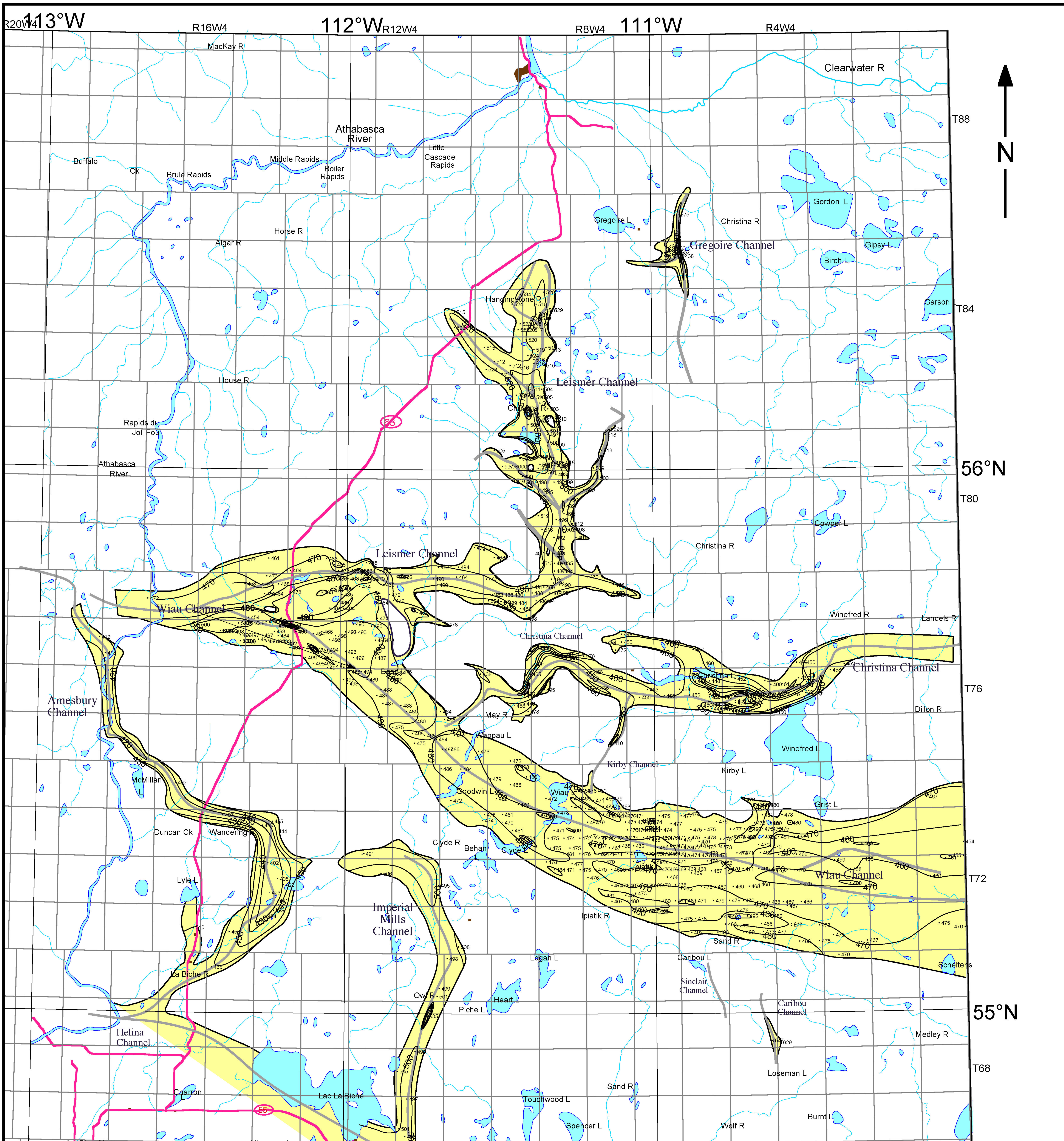
Figure 46 shows that interfluve deposits are mapped in five geographic areas: in the interfluve between the Wiau and Christina channels, both east and west of the Kirby Channel; in the interfluve between the Christina and Leismer channels; as terrace bench deposits on the north side of the Leismer Channel; within three poorly defined channels on the north side of the Christina Channel; and within a poorly defined channel that parallels the south side of Wiau Channel beneath Clyde Lake in Twp. 72 to 73, Rge. 9 to 10, W 4th Mer. Interfluve deposits are as thick as 40 m directly west of Winefred Lake, but elsewhere generally range between 10 and 20 m thick. Structure contours on the surface of the interfluve deposits indicate that they generally lie at an elevation above 480 m, which is the upper limit for the elevation of Empress Formation Unit 3 deposits in the Wiau Channel. Interfluve deposits that have an anomalously great thickness and high elevation, such as those in Twp. 76, Rge. 3, W 4th Mer. (Figures 46 and 47), likely represent areas where younger deposits have been superposed on the bedrock surface by later glaciofluvial scour and infill events.

The current assessment of the distribution, thickness and elevation of the tops of all of the Empress Formation channel and interfluve deposits is depicted in Figures 48 and 49. In total, the Empress Formation within the study area is considered to constitute one of the largest, if not the largest, bodies of coarse-grained sediment that lies on the bedrock surface anywhere within the Western Canadian Sedimentary Basin. In this regard, it is the major drift aquifer above the oil sands in northern Alberta.

4.5.2 Quaternary Stratigraphy

The interpretation of the Quaternary strata that lie above the Empress Formation in the study area is currently at a stage that only permits depiction of the results in cross-section form. That is to say, there are insufficient interpreted data to enable mapping of the subsurface distribution, thickness and topography of the tops of the units at this time.

At least five glacial diamicton (till) units, and associated intertill stratified units, can be differentiated and tentatively correlated within the study area. This interpretation is based on information from petrophysical logs in conjunction with lithological and petrological information from the seven AGS coreholes. A brief discussion of each till unit follows.



Data Legend

- ● 400 - Elevation (in m asl) equal to value shown
- ○ 400 - Elevation (in m asl) higher than value shown
- □ 400 - Eevation (in m asl) lower than value shown

Channel talweg

Distribution of Empress Formation channel deposits (undifferentiated and combined Units 1, 2 and 3)

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

DEO

Figure 45. Elevation of the top of Empress Formation channel deposits.

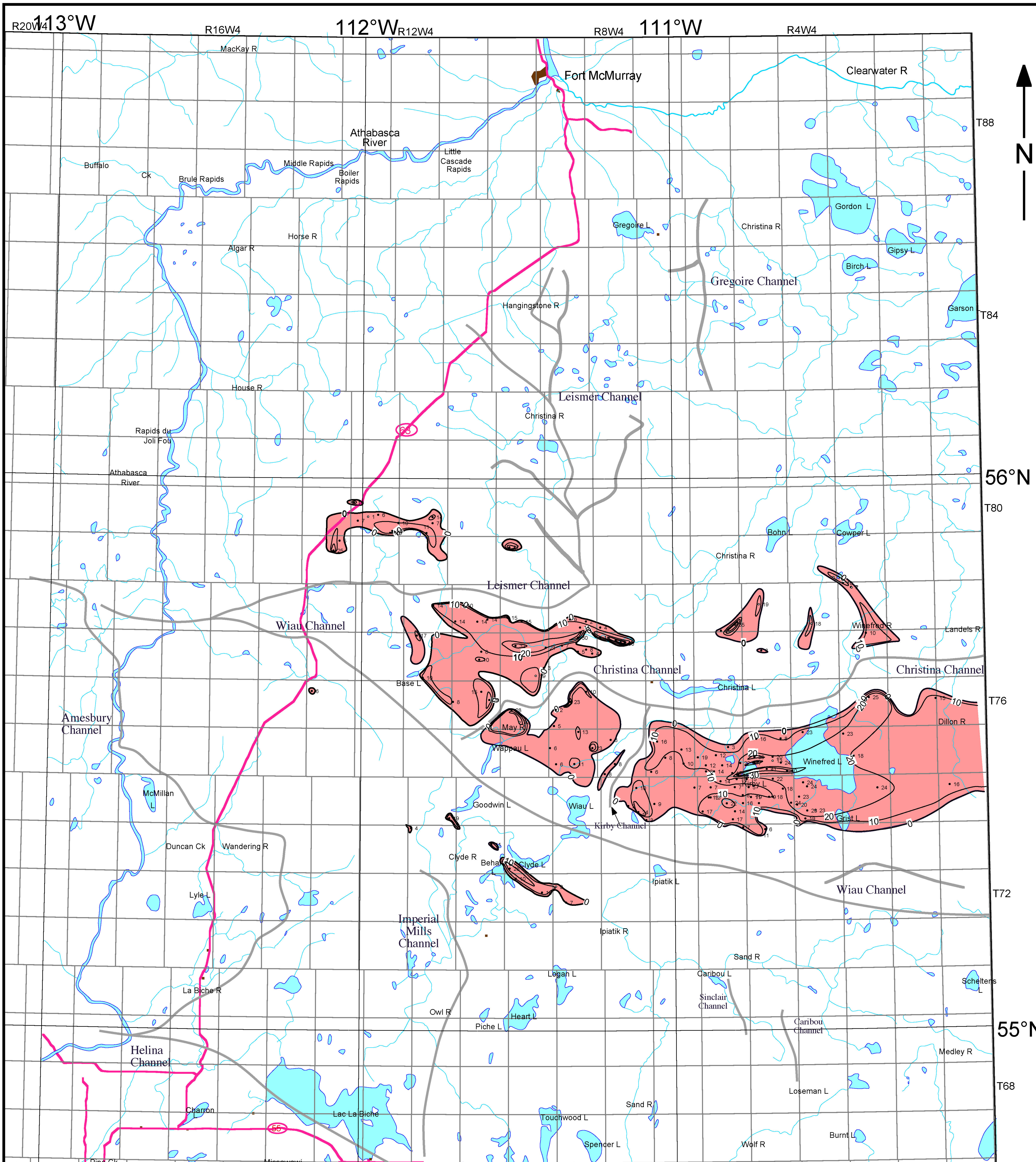
Contour interval 10 m

(70 Km)

L. D. Andriashek

Date: 2/18/03

Scale 1:500 000



Data Legend

- ● 20 - Thickness (in m) equal to value shown
- ○ 20 - Thickness (in m) less than value shown
- □ 20 - Thickness (in m) greater than value shown

Channel talweg

Distribution of Empress Formation interfluve terrace sand and gravel

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD DEO Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 46. Thickness of Empress Formation interfluve terrace sand and gravel.

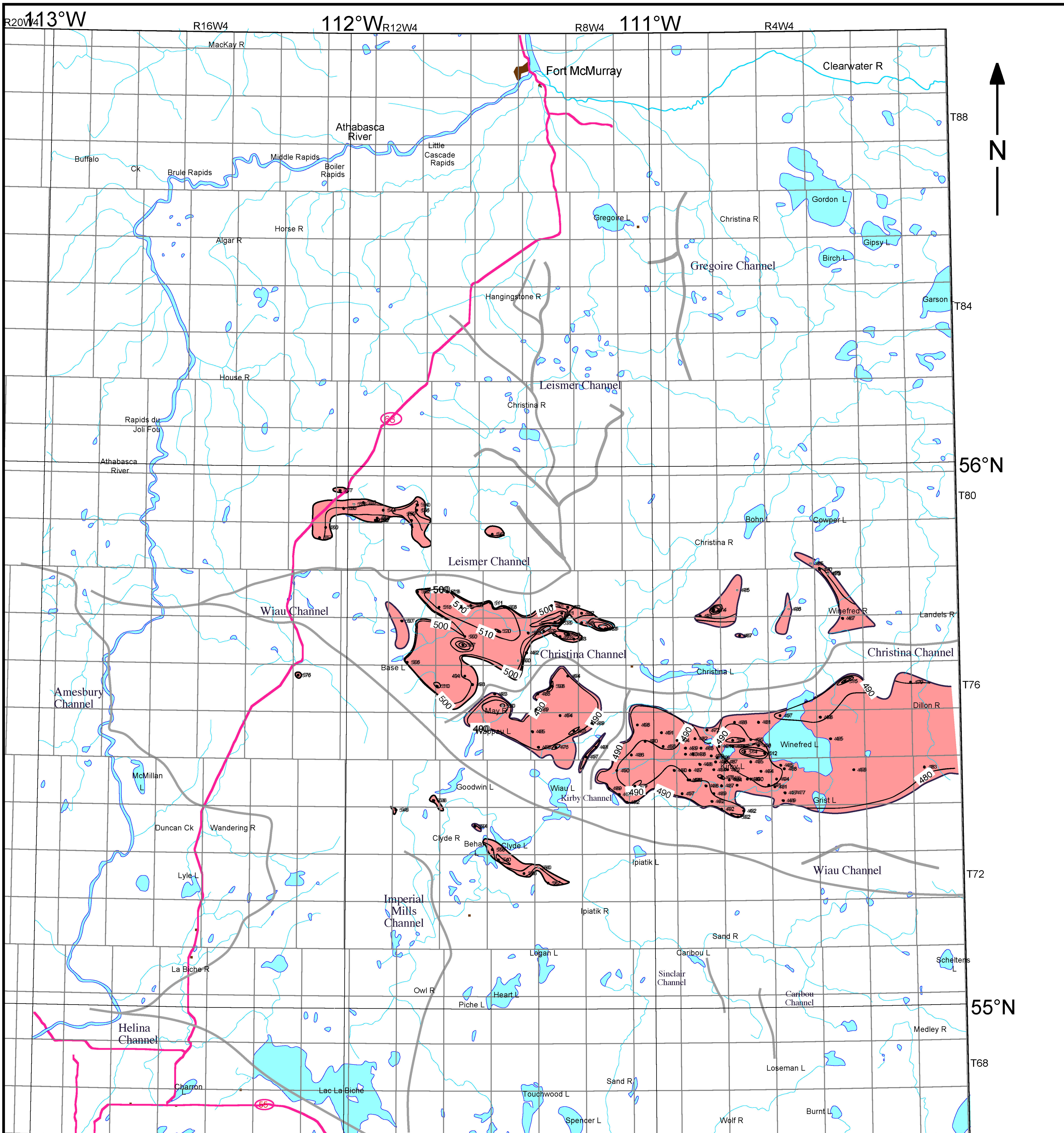
Isopach interval 10 m

(80 Km)

L. D. Andriashek

Date: 2/18/03

Scale 1:500 000



Data Legend

- ● 400 - Elevation (in m asl) equal to value shown
- ○ 400 - Elevation (in m asl) higher than value shown
- □ 400 - Elevation (in m asl) lower than value shown
- Channel talweg
- Distribution of Empress Formation interfluve terrace sand and gravel

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD DEO Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 47. Elevation of the top of Empress Formation interfluve terrace sand and gravel.

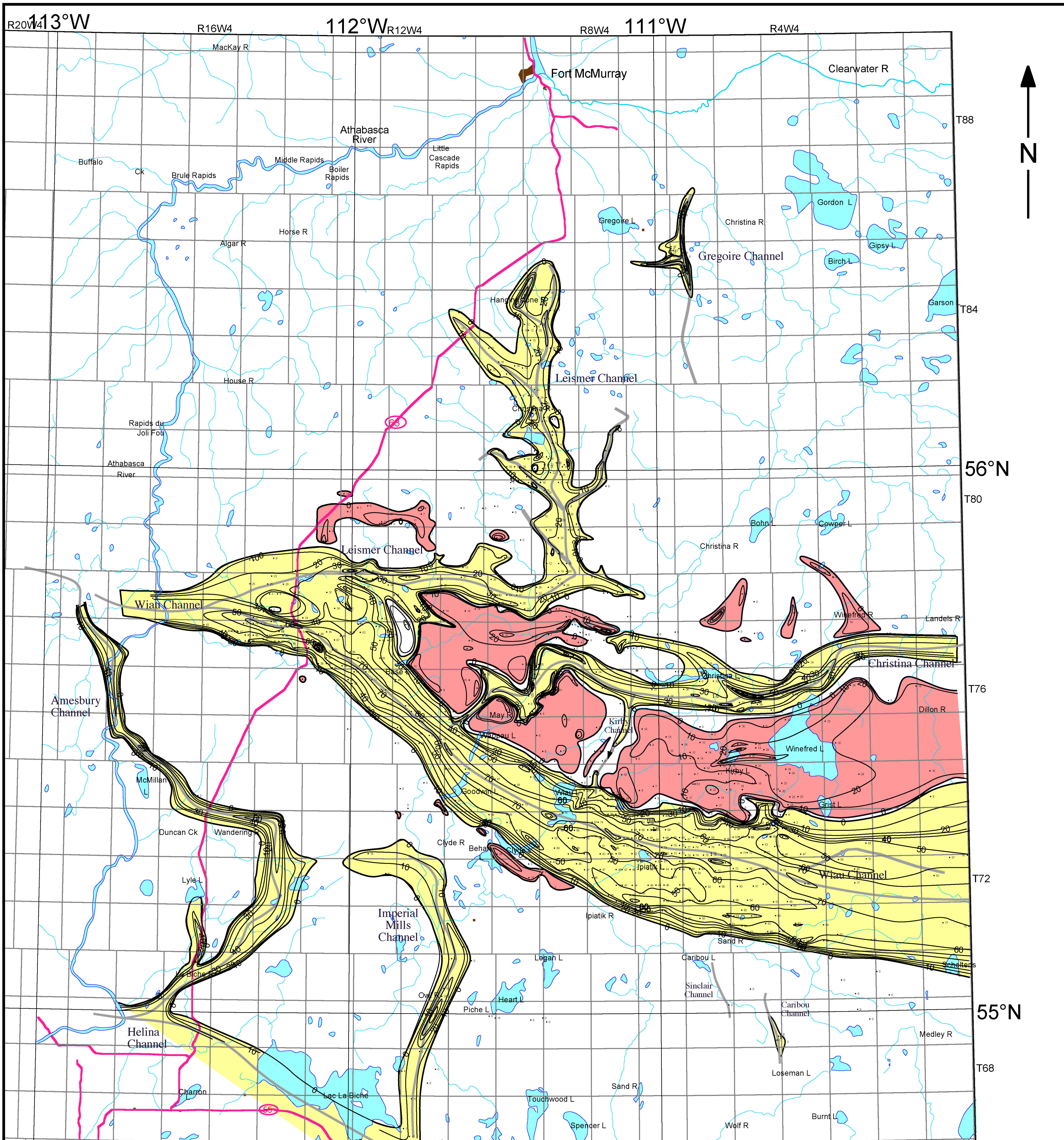
Contour interval 10 m

(90 Km)

L. D. Andriashek

Date: 2/18/03

Scale 1:500 000



Data Legend

- ● 20 - Thickness (in m) equal to value shown
- ○ 20 - Thickness (in m) less than value shown
- □ 20 - Thickness (in m) greater than value shown

Channel talweg

Distribution of Empress Formation interfluve terrace sand and gravel

Distribution of Empress Formation channel deposits (undifferentiated and combined Units 1, 2 and 3)

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD DEO Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

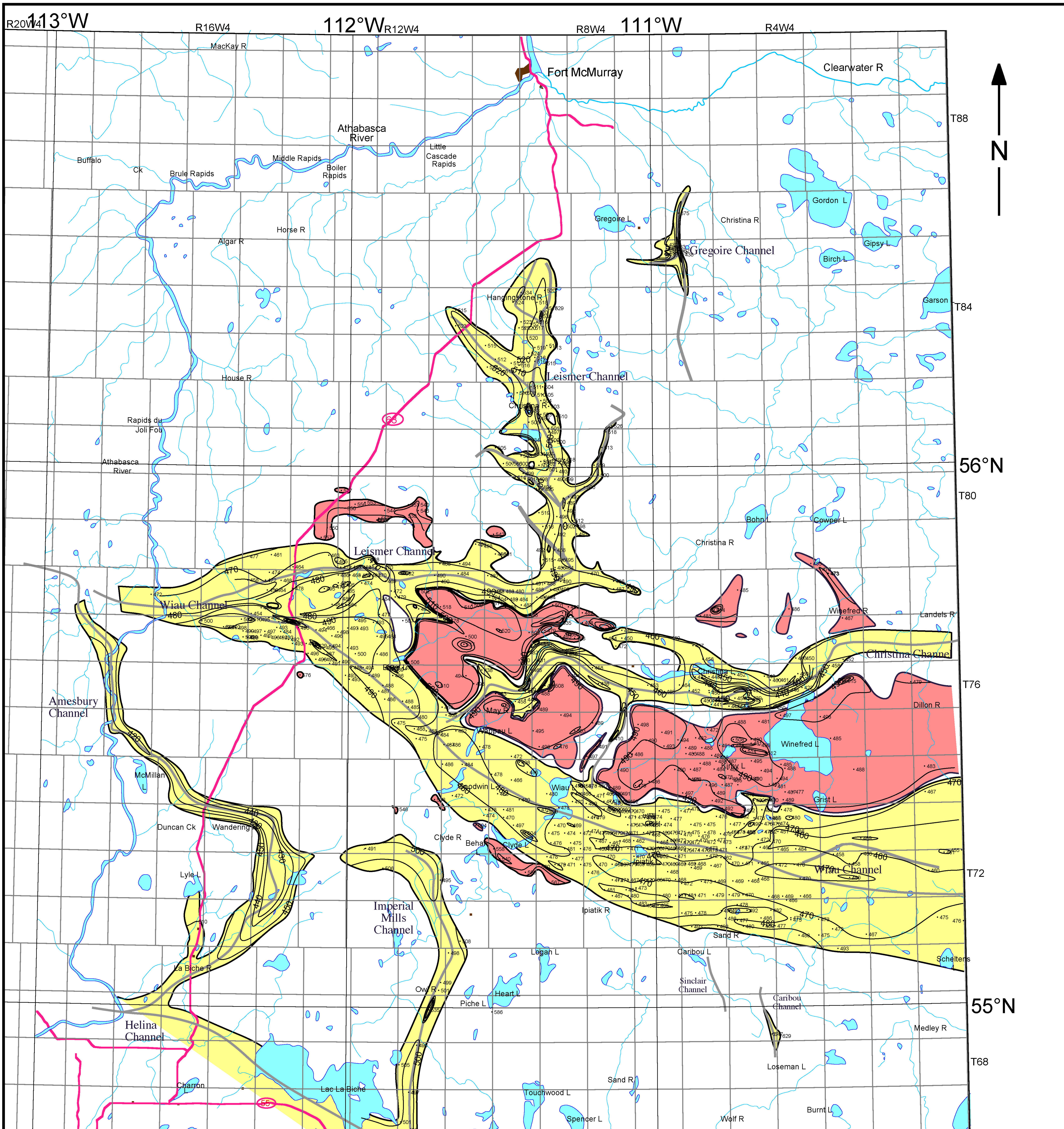
Figure 48. Thickness of the Empress Formation.

Isopach interval 10 m

(40 Km)

L. D. Andriashek

Date: 2/18/03 | Scale 1:500 000



Data Legend

- ● 400 - Elevation (in m asl) equal to value shown
- ○ 400 - Elevation (in m asl) higher than value shown
- □ 400 - Eevation (in m asl) lower than value shown
- Channel talweg
- Distribution of Empress Formation interfluve terrace sand and gravel
- Distribution of Empress Formation channel deposits (undifferentiated and combined Units 1,2 and 3)

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

WD DEO Western Economic Diversification Canada / Diversification de l'économie de l'Ouest Canada

Figure 49. Elevation of the top of the Empress Formation.

Contour interval 10 m

(50 Km)

L. D. Andriashek	
Date: 2/18/03	Scale 1:500 000

4.5.2.1 Bronson Formation

The Bronson Formation is the lowermost diamicton (till) in the Quaternary succession (Figure 34). The till is preserved primarily in the Wiau bedrock lowlands, where it directly overlies Empress Formation sediments. The Bronson till is characterized by the following:

- It has the most clayey composition of the till units, approaching the same value as shale on the resistivity logs (Figure 9).
- The high clay content can be attributed to enrichment with pebble-sized shale clasts in the till matrix.
- The till matrix has a low carbonate content.

The Bronson till likely represents sediment deposited by the first glaciation in the region, although it is possible that the clay-rich till simply represents a basal clay-rich facies of a stratigraphically higher till. Weathered horizons have not been recorded on the surface of the till (although an oxidized profile is recorded in the middle of the unit in corehole WEPA00-2), but the occurrence of thick, fluvial sediments of the Muriel Lake Formation overlying some areas of the till suggests a nonglacial period of fluvial deposition. In either case, the distinctive sharp contact at the top of the clay-rich till makes it a prominent unit mappable in stratigraphic correlations in the region, and for this reason it is useful to consider it as a separate till unit. Further work on the till geochemistry may provide additional criteria that enable the Bronson till to be differentiated from other till units.

The Bronson till is currently mapped within the Wiau and Christina channels in the Wiau Lowlands and in the Leismer Channel in the Hangingstone Plains. Within the Leismer Channel, the Bronson till appears to be relatively thin (~10 m) possibly because it was eroded by glacial meltwater that later deposited the relatively thick sand and gravel of the Muriel Lake Formation on the till surface (Figure 13).

4.5.2.2 Muriel Lake Formation

The Muriel Lake Formation consists dominantly of sand and gravel, with lesser amounts of silt and clay, of glaciofluvial origin. The formation is currently interpreted to be extensive and continuous along the eastern segment of the Wiau Channel (Figure 12) and along the Leismer Channel (Figure 13), though this interpretation may be revised in future stratigraphic studies. There is a strong possibility that locally within both of these channels, the Bronson Formation is eroded and Muriel Lake Formation sediments directly overlie Empress Formation stratified sediments. This stratigraphic superposition would account for some of the anomalously thick deposits that are mapped as the Empress Formation, as discussed in the Empress Formation.

4.5.2.3 Bonnyville Formation

The Bonnyville Formation consists of three lithologically distinct units: a lower clayey diamicton (till), referred to as Unit 1; a stratified middle unit composed of sand and gravel; and an upper, sandier diamicton unit, referred to as Unit 2. Collectively, till of both units is characterized by a very low carbonate content in the silt–clay fraction of the till matrix (Figure 25). Individually, the two units are characterized by the following:

- Unit 1 is more clayey than Unit 2, which is reflected by a lower resistivity on the petrophysical logs.
- Glaciofluvial sand and gravel commonly, though not always, separate the upper unit from the lower unit. The sand and gravel is thick (~10–15 m) and laterally extensive along the eastern segment of the Wiau Channel (Figure 12), and along the western segment of the Leismer Channel, where it merges with the Wiau Channel (Figure 13).

- A buried oxidized profile is present on the surface of Unit 2 from place to place, but has not been recognized on the surface of Unit 1. The occurrence of this oxidized horizon is presented as evidence that the surface of the till was exposed to subaerial weathering for a substantial period of time, and that it represents a major interglacial time interval.
- There is a relative abundance of sand beds within Unit 2, which though not correlative at a regional scale, are widespread throughout the study area.

Andriashek and Fenton (1989) have conceptually treated both till units of the Bonnyville Formation in the Cold Lake area to be textural facies of glacial sediment deposited by a single glacial event. However, the presence of thick and relatively extensive sand and gravel between the two till units in the study area suggests that deposition of till occurred as a result of two glacial episodes, in between which time glaciofluvial sediment was deposited. What is unknown is the time difference between these glacial episodes—do the units simply reflect pulses in the advance of a single glacier or do they represent two separate glacial events?

Unit 2 of the Bonnyville Formation represents the first of the drift units in which the deposition was not confined, or constrained, by the basin-effects of the Wiau Lowlands. That is to say, the units below the base of Unit 2 of the Bonnyville Formation progressively infilled the regional basin-like physiography of the Wiau Lowlands, such that the deposition of Unit 2 till was no longer confined to the lowland valley.

The elevation of the top of the Bonnyville Formation approximates the depth at which surface casing is installed in many of the oil and gas wells, consequently, the upper part of the formation is not as well recorded in the borehole data as the lower stratigraphic units. However, where data are available, they show that the cumulative sum of Units 1 and 2 of the Bonnyville Formation constitute the thickest of all of the drift units, exceeding 120 m in the Stony Mountain and Mostoos uplands (Figure 10).

Mapping of the stratigraphic succession above the top of the Bonnyville Formation becomes highly speculative because of the paucity of data. It is for this reason that a series of question marks appear on the upper stratigraphic units depicted in the geological cross-sections (Figures 9 to 13).

4.5.2.4 Ethel Lake Formation

The Ethel Lake Formation consists of stratified clay, silt, sand and gravel that lie on the surface of Bonnyville Formation Unit 2 till. The petrophysical data density at this level of the stratigraphic succession is poor, consequently little is known about the characteristics and distribution of this formation. The formation is interpreted to have been deposited by glacial meltwater, either in proglacial lakes or in glacial meltwater channels (Andriashek and Fenton, 1989). Thus, there is potential for this unit to be widespread, if not continuous, on the surface of the Bonnyville Formation. If the thick occurrence of the Ethel Lake Formation encountered at corehole WEPA00-2 can be considered representative of the formation in that area, then the Ethel Lake Formation may constitute a significant intertill aquifer above the Christina Channel (Figure 9). Further stratigraphic interpretations of the drift may permit the subsurface mapping of this formation in that area.

4.5.2.5 Marie Creek Formation

The Marie Creek Formation consists primarily of glacial diamicton (till) characterized by a relative abundance of carbonates, primarily dolomite and dolostone, in the coarse-sand and silt–clay fractions of the till matrix (Figure 25). In addition, it has the following attributes:

- A buried oxidized profile is present on the till surface (Figure 22). This is evidence that the surface of the till was exposed to subaerial weathering for a substantial period of time, and that it represents a major interglacial time interval. Andriashek and Fenton (1989) interpret this weathering to have occurred during the mid-Wisconsin, making the Marie Creek till of Early Wisconsin age (Figure 34).

- The till is generally less clayey than till of the overlying Grand Centre Formation, at least at corehole WEPA99-1.
- Outcrops of the till along Highway 881 at the Christina River crossing near the community of Conklin show numerous interbeds of sand within the till.

The relative abundance of carbonates in the silt–clay fraction, combined with the oxidized weathered surface (where preserved), makes the Marie Creek till the most easily differentiated till within the Quaternary succession in eastern Alberta, particularly where it is nested between the low-carbonate till of the Grand Centre Formation and the low-carbonate till of the Bonnyville Formation.

The Marie Creek Formation is interpreted to be a pre-Late Wisconsin till, and therefore is expected to be covered by Late Wisconsin till of the Grand Centre Formation. Surprisingly, however, the Marie Creek Formation appears to lie at, or very near to, the present-day surface in the southeast part of the study area (Figures 9 and 10), as determined by the carbonate analyses data from coreholes WEPA00-1, WEPA00-2, and WEPA00-3. This contrasts with the data from corehole WEPA99-1 to the west, which shows at least 40 m of Grand Centre Formation overlying the Marie Creek Formation at that site (Figure 11). The apparent absence of the uppermost Grand Centre Formation in the southeast is at odds with the geomorphic evidence in that area. Ice-flow patterns on the present-day surface (Figure 54) are identical to those on the surface of Grand Centre Formation south of the study area in the Cold Lake area, indicating that the last glacier (which deposited the Grand Centre Formation) crossed the study area before entering the Cold Lake area. If so, then little, or no, Grand Centre Formation till was deposited by the last glacier that flowed over the southeast part of the study area. This is a stratigraphic issue that will require the evaluation of more high-quality data from additional coreholes before it can be resolved.

4.5.2.6 Sand River Formation

The Sand River Formation consists of stratified sediments that were deposited by glacial meltwater on the surface of the Marie Creek Formation (Andriashek and Fenton, 1989). Based on the current level of interpretation, very few occurrences of the Sand River Formation exist in the study area. It is anticipated that future work will show that the formation has limited extent, but where present, may consist of relatively thick stratified sediments deposited in a buried glacial channel setting. Consequently, at a local scale, the formation has the potential to be a significant drift aquifer.

4.5.2.7 Grand Centre Formation

The Grand Centre Formation consists primarily of diamicton (till) deposited during the last glaciation in the area, during the Late Wisconsin (Andriashek and Fenton, 1989). In this regard, the till outcrops on present land surface, however, as discussed previously, there remains uncertainty regarding the occurrence and distribution of the Grand Centre Formation in the study area. The till is widespread in the Cold Lake area to the south, but, on the basis of carbonate values, appears to be either very thin or absent in the southeastern part of this study area. Furthermore, mapping of this till is made difficult by the absence of abundant petrophysical log data in this stratigraphic unit. Consequently, there is a high degree of uncertainty at this time regarding the distribution and thickness of the uppermost Grand Centre Formation, and the occurrence of the till as depicted in Figures 9 to 13 should be treated as conceptual only.

4.6 Implications to Hydrostratigraphic Interpretations: Layer-Cake Versus Labyrinth Architecture

The discussion to this point has only focussed on the lithostratigraphy (rock framework and architechture) of the 300 m or more of drift sediments in the study area. The discussion has not yet addressed the issue of the water contained within these strata. However, in terms of baseline groundwater assessments, these strata must be evaluated in terms of their capacity to either transmit economical supplies of water or retard the movement of groundwater. In other words, the Quaternary sedimentary units must be assessed in terms of their hydraulic properties, and discussed in terms of hydrostratigraphic units operating on an engineering timescale.

The 'glacial flooding' model, in which till sheets represent major depositional events, provides the framework for the classification and correlation of coarse, permeable strata that occur in the drift succession. Local sand and gravel units which occur as inclusions within an individual till unit can now be differentiated from proglacial or interstadial fluvial deposits that were deposited on the surface of major till units, and which are more likely to have limited extent and continuity.

Thick Quaternary successions have conceptually been treated as layers of a cake, with coarse, permeable units (aquifers) sandwiched between tills of low hydraulic permeability (aquitards) (Figure 50). However, glacial environments are not characterized by the gradual and predictive erosional and sedimentary facies typified by a marine environment. Rather, at times glaciers are conducive to sudden and catastrophic releases of meltwater, resulting in the localized deep scour of the underlying sediments and the subsequent infill with coarse fluvial sediment, or in some cases, till. Given the multiple till stratigraphy and thick drift in the study area, the opportunity for multiple glacial meltwater scour and channel infill sequences to be present in the stratigraphic record is high. Channelization and infill can occur over lateral distances of a kilometre or less, making the prediction and mapping of the resulting sediment sequence a difficult task. Further, underlying topographic lows during the time of meltwater release can focus the discharge path so that multiple stacked flood sequences may occur over buried bedrock channels (Figure 51). The cumulative effect is that hydraulic pathways and connections can conceivably extend from near surface to the bedrock, greatly increasing the potential for surface water–channel aquifer interaction. Increases in groundwater withdrawal may therefore be affected over much shorter time frames as a result of aquifer interconnection.

Weber and van Geuns (1990) proposed a three-fold division of clastic reservoir types and conceptual approaches to their characterization for flow modelling. In their scheme, reservoirs vary from straightforward layer-cake models to labyrinths to jigsaw puzzle types. With progressive complication of stratigraphic architecture, the data needs for adequate characterization, exploration or production forecasting grow exponentially. Recognition of the labyrinth to jigsaw puzzle-type architecture of the Quaternary succession will lead the hydrogeologist to the most appropriate characterization 'toolkit' for groundwater exploration and management.

4.7 Implications of Buried Channels to In Situ Oil Sands Development

Thick, coarse infills of glacial channels can be reservoirs of high-quality groundwater needed for steam injection at a local SAGD scale, and the presence of a major glacial channel aquifer on an operator's leased property can improve economic viability of that operation. However, there are some aspects of glacial channels that can hinder or limit oil sands development, including the following:

- Glacial channels can be difficult to locate. Thick drift cover can mask them and their narrow width and abrupt truncations may not allow them to be detected at standard exploration borehole spacing. Other methods, such as high-resolution seismic surveys, would be required to locate the channels.

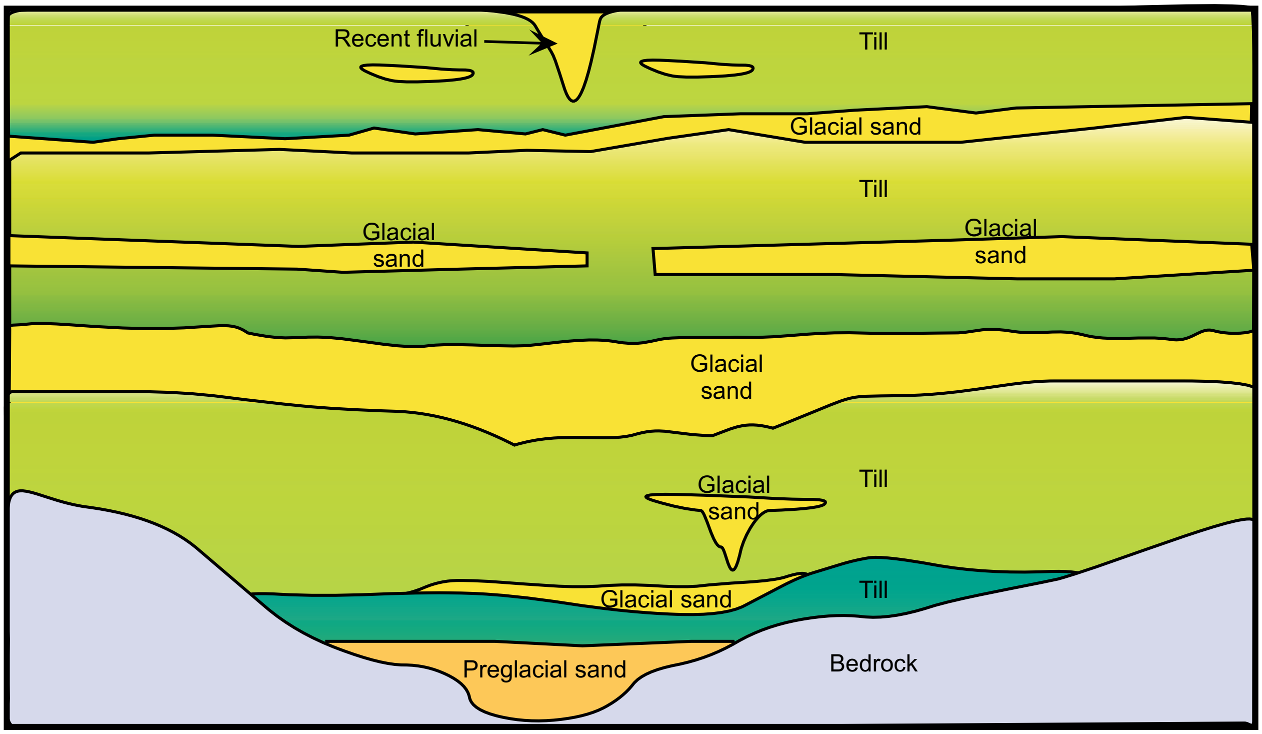


Figure 50. Layer-cake hydrostratigraphic model. Coarse, permeable aquifer units (sand) are sandwiched between aquitards (bedrock, till) and are hydraulically isolated.

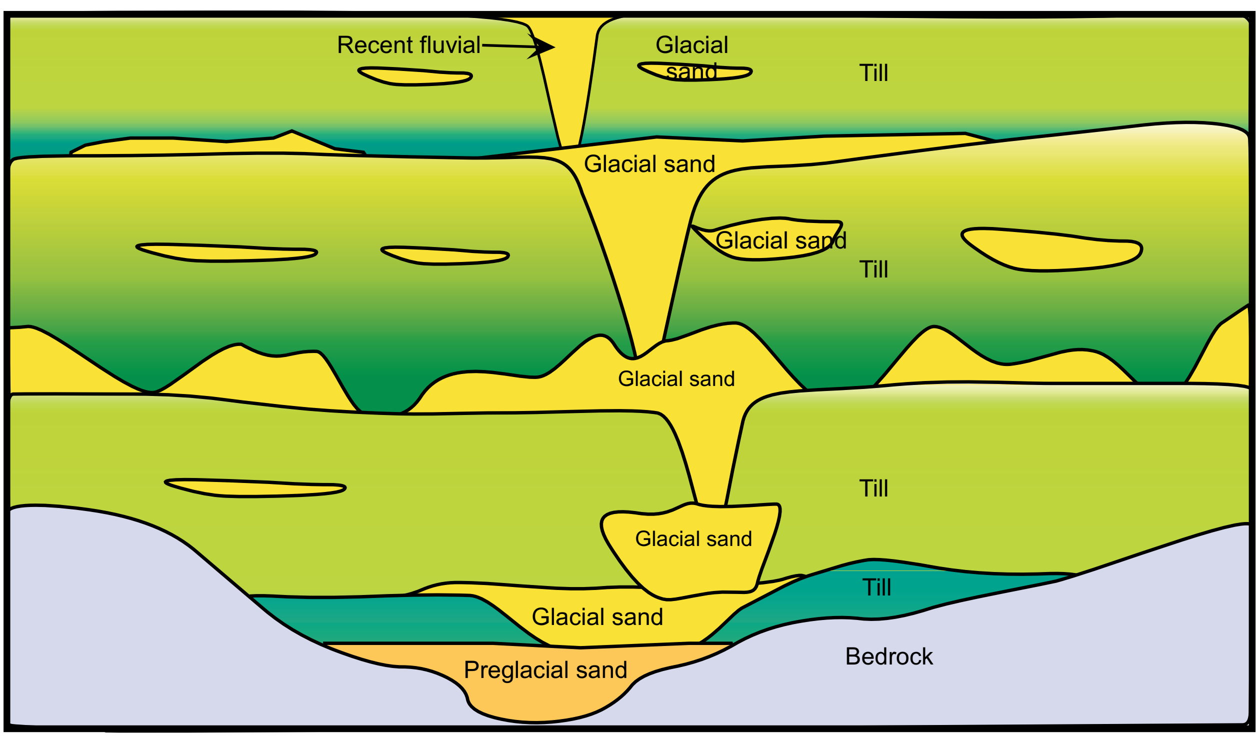


Figure 51. Labryinth, stair-stepped hydrostratigraphic model. Coarse, permeable units are hydraulically connected as a result of downcutting through aquitards and superposition of younger glaciofluvial deposits.

- The catastrophic erosional and depositional environment associated with the formation of glacial channels increases the likelihood that sediments contained within are varied in their composition and subsurface distribution (e.g., glacially displaced bedrock, high-wall slump blocks). Deposits may exhibit a wide range in hydraulic conductivity values.
- Gravelly, boulder horizons in glacial channels pose drilling problems including the loss of circulation and drill fluid, impeded drilling rates and equipment damage.
- Glacial channel aquifers may have limited recharge areas and would be capable of supplying only a few operators in the area. Hence water licensing and use restrictions become a regulatory issue.
- In areas of shallow overburden (drift and bedrock), glacial channels may intersect oil sand horizons, resulting in
    - loss of oil sand pay zone;
    - discontinuity of capping shales above SAGD steam chambers;
    - direct hydraulic link with near-surface water bodies; and
    - increased potential for hydrocarbon migration into potable aquifers (Figure 52).

Preglacial channel settings may be considered more favourable for oil sands development because:

- preglacial channel floors are covered by thick, extensive and permeable fluvial sediment making them large regional aquifers capable of supplying major amounts of groundwater to multiple users; and
    - preglacial channels function as basins for the deposition of multiple tills and numerous intertill glaciofluvial deposits, the latter of which can also form regional aquifers.

However, there are associated risks or issues associated with preglacial channels as well, such as:

- complexity in hydrogeological interpretations and modelling of buried preglacial channel successions resulting from
    - stratigraphic superposition of younger glacial aquifers on top of deeper aquifers, leading to increased vertical permeability and hydraulic communication; and
    - glaciotectonic deformation or displacement of aquifer and aquitard units during successive glacial events;
- water-use conflicts arising from competing users (domestic users, agriculture, municipalities and various industries); and
- increased drilling costs and risks due to
    - deeper surface casing depth requirements than in shallower glacial channels (>300 m in some cases);
    - loss of drill fluid and circulation in coarse permeable zones;
    - damage and/or delays due to boulder horizons; and
    - the potential for encountering migrated natural gas—this can have negative or positive economical aspects depending on the value of the gas and the costs associated with extracting it, as in the example of the Sousa area of northwestern Alberta (Canadian Discovery Digest, 2001).

Knowledge of the occurrence, distribution, and enabling and limiting aspects of these fundamentally different channel systems will enable in situ oil sands developments to proceed in both an economically and environmentally sound manner.

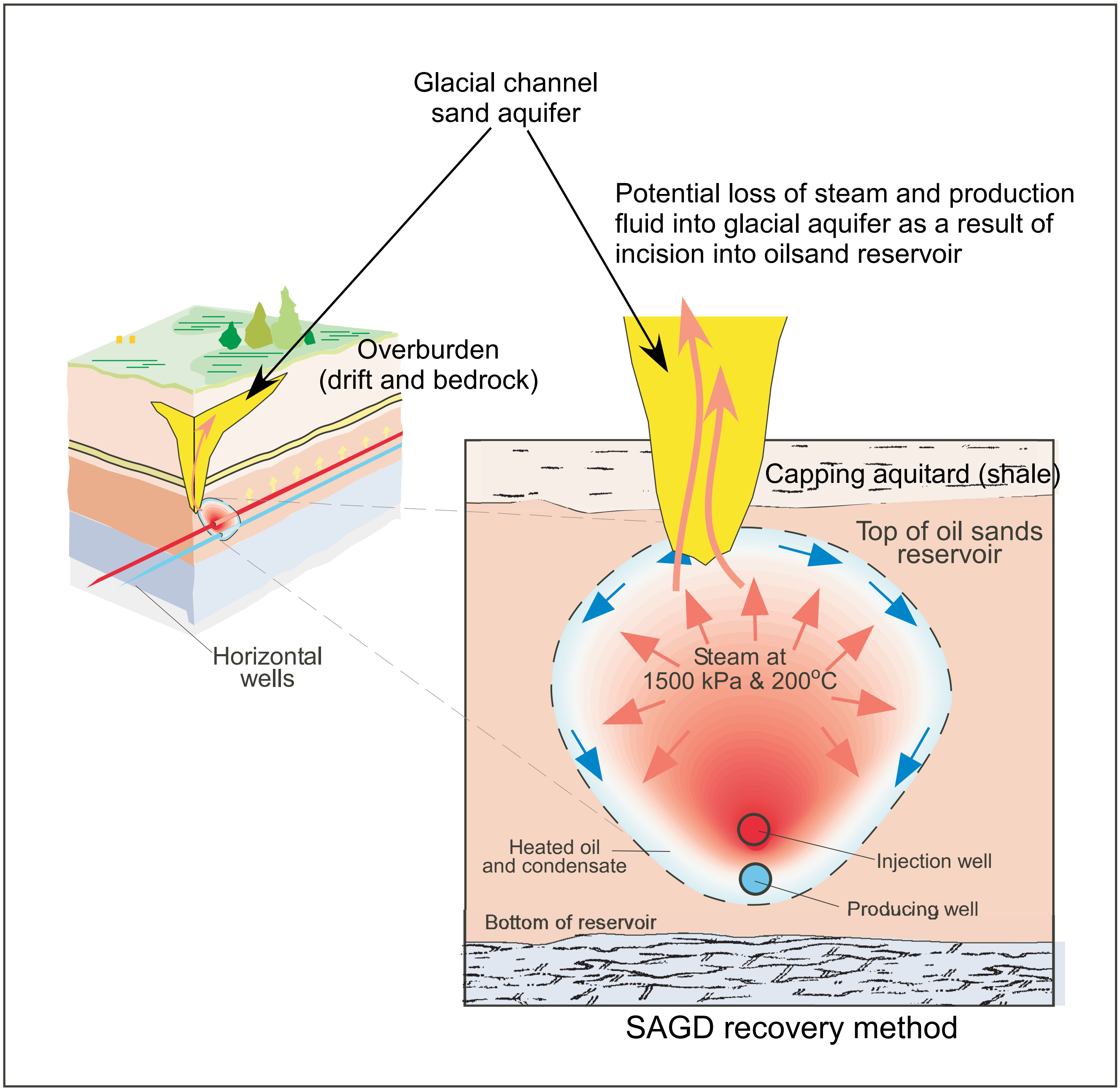


Figure 52. Cartoon diagram of glacial channel incision through thin overburden above SAGD operation.

5 Terrain Analysis of Surficial Deposits

5.1 Introduction

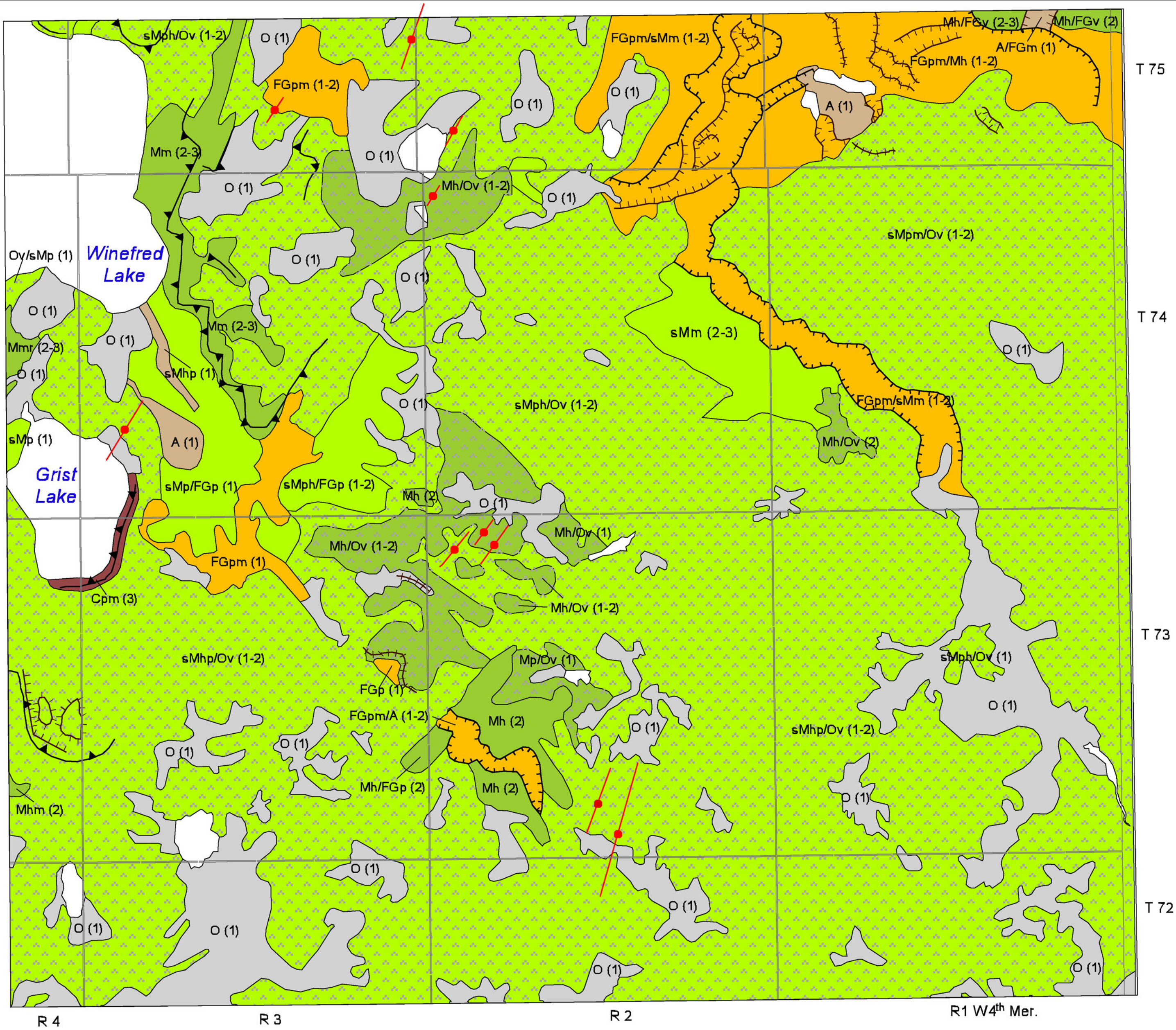
Analysis of surficial geological materials, aspects of local relief, and morphological characteristics of surface landforms form an integral component in the evaluation of recharge fluxes to regional groundwater flow systems. To assist in the evaluation of groundwater recharge, terrain analysis maps were constructed in GIS format at a scale of 1:50 000 and 1:250 000 for most of the study area, including all of map NTS 73M (Winefred), the southern three-quarters of map NTS 74D (Waterways), and the southeast part of NTS 84A (Algar). Surficial geology maps of the portion of the study area that lies within map area NTS 83P (Pelican) are currently being published by the surficial geology group in the Minerals Section of the Alberta Geological Survey.

The terrain analysis maps were constructed almost entirely from the interpretation of 1:60 000 scale aerial photographs, supplemented with only a minor amount of ground verification. Classification of the terrain was based on interpretations of landform types, tonal reflections of surface materials, differences in vegetative cover, and differences in drainage patterns and characteristics, all of which can be identified on aerial photographs. It is for this reason that the maps are referred to as aerial photograph terrain analysis maps, rather than surficial geology maps, which generally have a greater amount of ground verification. The reader is therefore cautioned that a higher degree of uncertainty exists regarding the information depicted on the terrain analysis map, compared to that on a surficial geology map.

The photo-interpreted surficial deposits were transcribed onto 36 mylar transparencies at 1:50 000 scale and scanned into images. These images were then georeferenced and rectified based on a minimum of four known coordinates. The projection used for georeferencing was Zone 12 Universal Transverse Mercator (UTM) in NAD83. The average registration error is 3 m. The rectified images were converted (vectorized) into lines in ArcInfo™. These lines were extracted into separate files (ArcInfo™ coverages) based on their feature types—all unit boundaries were put into one coverage while surface linear features such as esker, glacial fluting, etc. were placed into separate coverages. Editing was performed on all coverages in ArcEdit (the editing module in ArcInfo) with special emphasis on map unit boundaries, which must be closed and properly identified to create polygon topology. These processes were performed on all 36 of the 1:50 000 scale maps that cover the study area. Combining the information in the 36 maps into one created a 1:250 000 scale compilation map of surficial materials in the study area. Deposit boundaries from all adjacent maps were dissolved and many of the more detailed surface linear features were simplified. The final map compilation was accomplished in ArcView™. Copies of the 1:50 000 scale maps are not included in this report, but are available from the Alberta Geological Survey publications office.

The mapping scheme chosen for the 1:50 000 scale terrain classification is a variant of the scheme adopted by Andriashek and Fenton (1989) to map the surficial geology of the Sand River area, NTS 73L, directly south of the study area. In this terrain classification scheme, each map unit includes a component of genesis, morphology and relief (Figure 53). Where available, additional information regarding the properties of the genetic unit was included as a genetic modifier. For example, the map unit 'sMh1' denotes hummocky (h), low relief (1), sandy (s) moraine (M). Genesis of geological material is considered to be the primary component of the map unit thus colours on the map depict differences in genesis. In the above example, the map unit colour would correspond to the legend colour chosen for moraine (M). An attempt has been made to reclassify the surficial geological units depicted in the surficial geology map of area NTS 74D (Bayrock and Reimchen, 1973) using this mapping scheme, without significantly changing the polygon shapes of that previous work.

The mapping scheme chosen permits the use of complex map unit notations to describe areas in which two (or more) major genetic classes are present within the map polygon (Figure 53). An example of this is



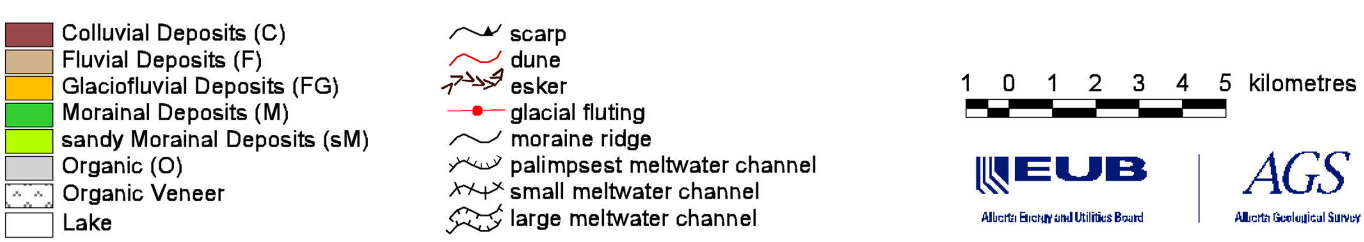
Geological material modifiers (prefixes to genetic unit)
c clayey
s sandy
g gravelly
pb pebbly

Morphological modifiers (suffixes to genetic unit)
f fan
h hummocky
m rolling
p plain
pi pitted
r ridged
v veneer - a blanket of sediment, generally less than 1 m thick; veneers of organic sediment are depicted by '^' symbol

Relief modifiers (suffixes to genetic unit)
1 low: local relief generally less than 3 m
2 medium: local relief generally between 3 and 10 m
3 high: local relief generally more than 10 m

The mapping scheme permits the use of complex map unit notations to describe areas in which two (or more) major genetic classes are present within the map polygon. An example of this is an area where both glaciofluvial sediment and till may be present, but which cannot be differentiated at the map scale presented, as in the unit 'Mmp1/FGm1'. A decision is made as to which is likely to be the dominant material exposed at the surface, and this is reflected in the both map unit colour, and the order in which units are depicted in the unit notation (primary units are always identified in the first part of the notation). In the above example, glaciofluvial sediment (FG) is considered to be less continuous or extensive than the till (M), and therefore the map unit colour depicts moraine (till), the dominant component. A complex map unit notation is also applied where thick (>1 m) sediments of one genetic process overlie sediment of a different process, either as a continuous blanket, or as small, isolated deposit, as in the example 'O/Mh2' (not shown on this figure), meaning thick (>1 m) organic sediment (O) overlying moderate relief (2), hummocky (h) moraine (M). In the special case of widespread, but discontinuous to thin (<1 m thick) organic sediment, the '^'symbol is placed on the coloured geological map unit to denote a thin to discontinuous veneer.

Multiple or combinations of morphological and relief modifiers can be used to also denote areas with transitional morphological features or relief, or to describe areas in where two or more elements are present but which cannot be differentiated at the scale presented. An example of such a map unit is 'FGhm1-2', which describes hummocky to rolling (hm), low to moderate relief terrain (1-2) composed of glaciofluvial sediment.



EUB
Alberta Energy and Utilities Board
AGS
Alberta Geological Survey

Figure 53. Example of a 1:50,000 scale terrain analysis map (NTS sheet 73M/8).

primary or dominant material exposed at the surface. This is reflected in the both map unit colour and the order in which units are depicted in the unit notation (primary units are always identified in the first part of the notation). In the above example, glaciofluvial sediment (FG) is considered to be less continuous or extensive than the till (M), and therefore the map unit colour depicts moraine (till), the dominant component. A complex map unit notation is also applied where thick (>1 m) sediments of one genetic process overlie sediment of a different process, either as a continuous blanket, or as small, isolated deposits, as in the example 'Mh2/O', meaning thick (>1 m) organic sediment (O) overlying moderate relief (2), hummocky (h) moraine (M).

Multiple or combinations of morphological and relief modifiers are also used to denote areas with transitional morphological features or relief, or to describe areas where two or more elements are present but cannot be differentiated at the scale presented. An example of such a map unit is "FGhm1-2", which describes hummocky to rolling (hm), low to moderate relief terrain (1-2) composed of glaciofluvial sediment.

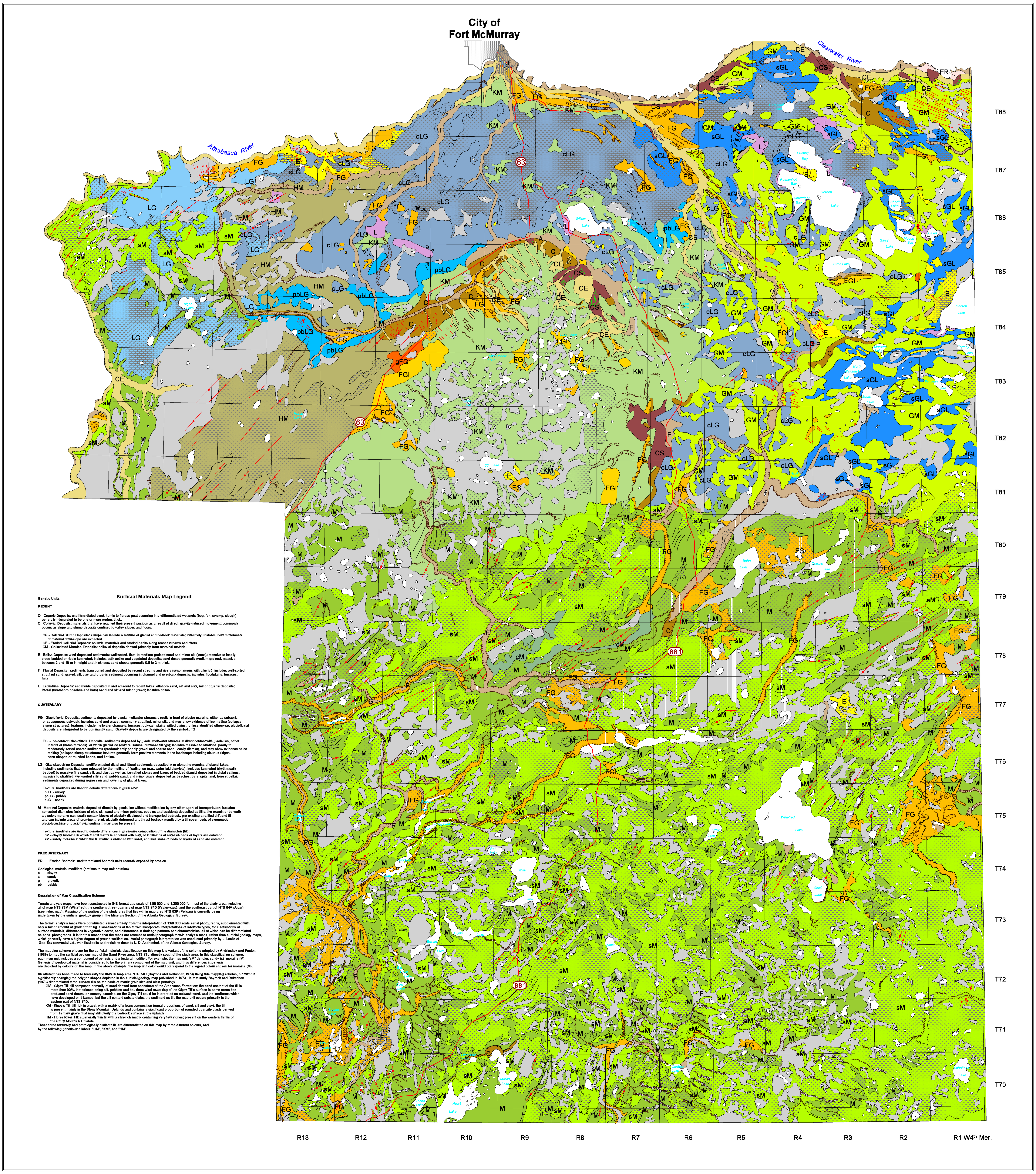
GIS digital maps enable each of the elements of the mapping scheme to be depicted as separate, stand-alone map entities, and at various scales. Figure 54 is a 1:250 000 scale compilation of the 1:50 000 scale terrain maps, showing only the distribution of the dominant surficial material on the landscape, irrespective of relief or morphology. In the special case of organic deposits, symbols are used to denote veneers on the underlying geological material. Similarly, the range and variability in local relief of surficial landforms can be portrayed independent of surficial material and morphology, as shown in Figure 55.

5.2 Discussion of the Surficial Geology

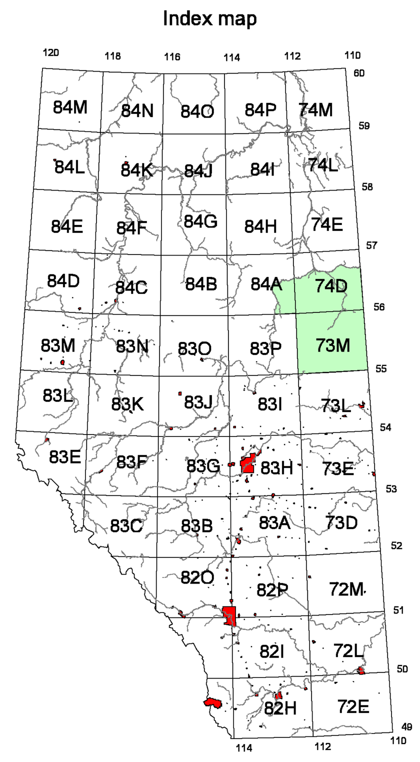
5.2.1 Morainal Landforms and Deposits

Most of the surficial geological features are the result of the Late Wisconsin glaciation, which began to wane approximately 11 000 to 12 000 BP in the study area. Morainal landforms form the major surficial geological features in the study area and are differentiated on the terrain analysis maps on the basis of variations in matrix grain size: sandy moraine (map unit 'sM'), in which the sand fraction constitutes the major component of the till matrix, and/or, sand is interbedded with till; clayey moraine (map unit 'cM') in which silt and clay are the dominant constituents of the till matrix; and undifferentiated moraine (map unit 'M') in which the till matrix is interpreted to be composed of roughly equal amounts of sand, silt and clay.

Morainal landforms fall into one of two major morphological categories: active-ice, streamlined features, such as flutes and drumlinoid ridges (depicted by red glacial flute symbols on Figures 53 and 54), and stagnant, dead-ice features characterized by hummocky landforms (map unit 'Mh' on Figure 53). Orientations of glacially streamlined landforms reveal the dominant ice-flow direction during the late stages of the last glaciation was from the northeast, with local flow directions varying between due north and due east (Figure 54). Morphological features and outcrop observations indicate that at some time during the glacial history, glaciotectonic thrusting and displacement of underlying sediments occurred in parts of the study area. Examples include: the drumlinized, ridged landform directly southwest, or down-ice, of Winefred Lake, inferred to be material glacially displaced from beneath the lake; stair-stepped scarps along the eastern edge of Winefred Lake, which are interpreted to be tear-faulted features; the scarp-edged landforms north of Piche, Heart and Logan lakes in the southwest part of the map area, also inferred to be glacial tear-fault features; and glacially displaced shale and siltstone observed in outcrop within a high-relief, ridged landform in Twp. 78, Rge. 7 to 9, W 4th Mer. (Figure 54). Glacial thrusting may have also played a role in forming the high-relief, ridged to rolling ice-marginal landscape that characterizes the area around Bohn and Cowper lakes in Twp. 79 to 82, Rge. 1 to 5, W 4th Mer. (Figures 54 and 55). Borehole and outcrop observations in that area indicate a highly varied composition to the



Index map



References

73L - Surficial geology Sand River, NTS 73L
M. Fenton and L. Andriashek, 1983; 1:250,000 map, Bulletin 57, Alberta Geological Survey, Alberta Research Council

73M - Terrain Analysis Winefred, NTS 73M
L. Leslie and L. Andriashek, 2002; 1:50,000 and 1:250,000 (Map 250) digital maps, Alberta Geological Survey, Alberta Energy and Utilities Board

74D - Surficial geology Waterways, NTS 74D
L. Bayrock and T. Reimchen, 1974; 1:250,000 map Alberta Geological Survey, Alberta Research Council

74D - Terrain Analysis Waterways, NTS 74D (1-2)
L. Leslie and L. Andriashek, 2002; 1:50,000 and 1:250,000 digital maps, Alberta Geological Survey, Alberta Energy and Utilities Board

74E - Surficial geology Bitumount, NTS 74E
L. Bayrock, 1971; Map34, 1:250,000; Alberta Geological Survey, Alberta Research Council

83I - Surficial geology Dapp Creek, NTS 83I (9,10,15,16)
S. Richard, 1981; Map 1-1979, 1:100,000; Geological Survey of Canada

83P - Surficial geology Pelican, NTS 83P
J. Campbell, M. Fenton and J. Pawlowicz, in. prep.; 1:100,000 (Map 243) and 1:250,000 digital maps, Alberta Geological Survey, Alberta Energy and Utilities Board

84A - Terrain Analysis Algar, NTS 84A (1,2,7,8)
L. Leslie and L. andriashek, 2002; 1:50,000 and 1:250,000 digital maps, Alberta Geological Survey, Alberta Energy and Utilities Board

Scale 1:250 000

5 0 5 10 15 20 25 30 Kilometres

5 0 5 10 15 20 Miles

Projection: UTM zone 12
Datum: NAD83

RECENT

- Thick discontinuous Organic Deposits Thickness (>1 m)
- Thin discontinuous Organic Deposits Thickness (<1 m)
- Organic Deposits (O)
- Colluvial Deposits (C)
- Colluvial Slump Deposit (CS)
- Eroded Colluvial Deposits (CE)
- Eolian Deposits (E)
- Fluvial Deposits (F)
- Lacustrine Deposits (L)
- Glaciofluvial Deposits (FG)

QUATERNARY

- gravelly Glaciolfluvial Deposits (gFG)
- Ice-contact Glaciofluvial Deposits (FGI)
- Glaciolacustrine Deposits (LG)
- clayey Glaciolacustrine Deposits (cLG)
- pebbly Glaciolacustrine Deposits (pbLG)
- sandy Glaciolacustrine Deposits (sLG)
- Morainal Deposits (M)
- clayey Morainal Deposits (cM)
- Horse River Till (HM)
- Kinosis Till (KM)
- sandy Morainal Deposits (sM)
- Gipsy Till (GM)

PREQUATERNAY

- Eroded Bedrock (ER)

Features Legend

- scarp / steep slope
- dune
- esker
- glacial fluting
- moraine ridge
- palimpsest meltwater channel
- small meltwater channel
- large meltwater channel
- beach
- slump

Figure 54
Surficial Materials in the Study Area (NTS 73M, part of 74D and 84A)

Interpretation: L. Leslie
Edited: L. D. Andriashek
GIS/Cartography: D. Chao and J. Meeks

Digital base maps provided by:
Spatial Data Warehouse

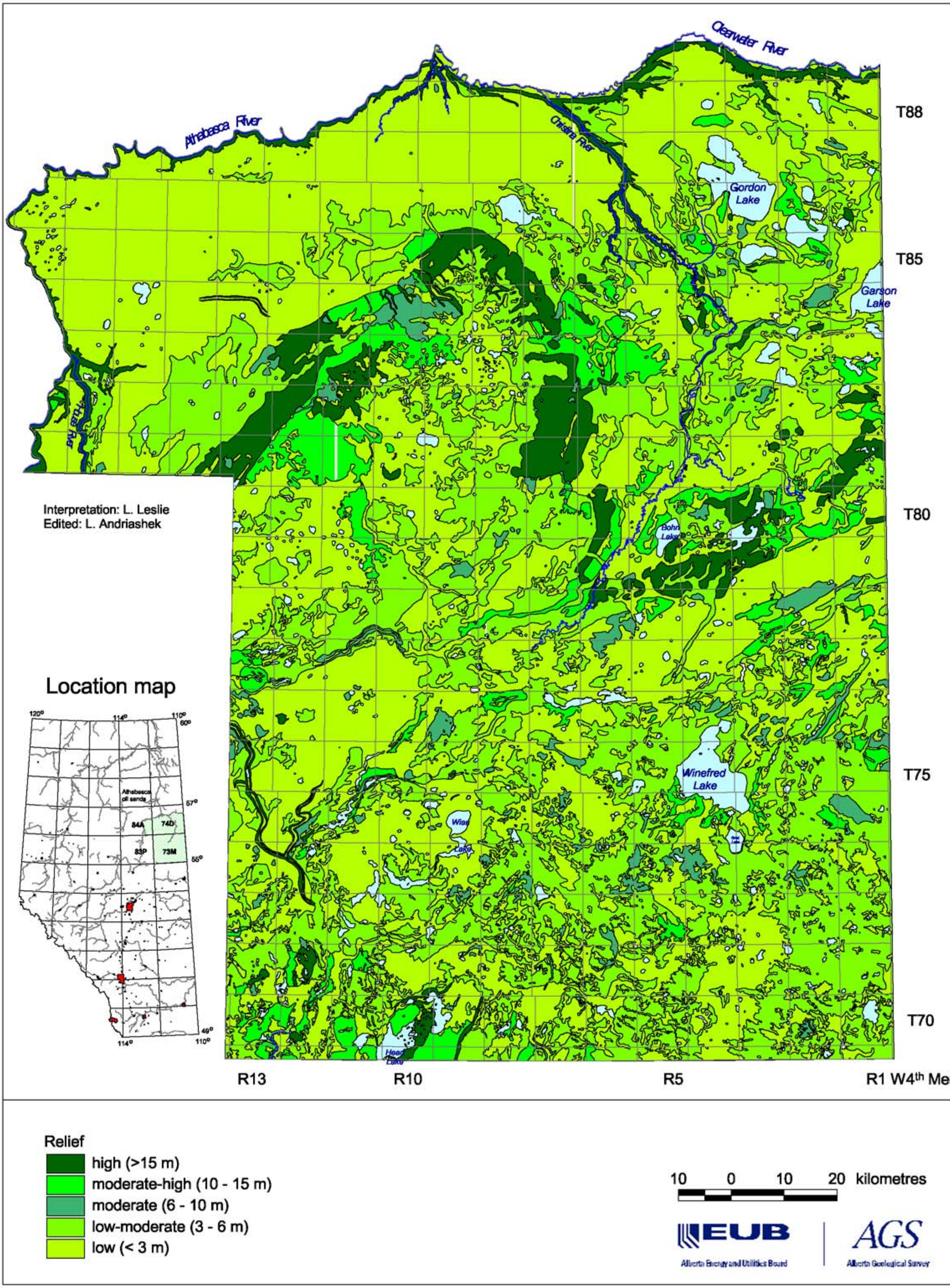


Figure 55. Local relief of landforms in the study area.

moraine, including thick masses of glacial sand, which may have been deposited by ice-thrust or ice-contact glaciofluvial processes.

Stagnant, dead-ice collapse features are the dominant morainal landforms on the Stony Mountain Uplands and Mostoos Hills Upland physiographic units (Figures 4 and 5). The moraine is characterized by circular to semi-circular, closed-ridged, till hummocks with organic sediment occupying the central depressions, depicted by the ‘organic veneer’ map symbol superimposed on the hummocky moraine (Mh) map unit (Figures 53 and 54).

From the limited surficial geology information collected in the field (Appendix 1), some comments can be made regarding regional differences in the internal composition of the moraine in the study area. In general, large areas in the east half of the study area are characterized by till with a greater sand content than till to the west (map unit 'sM', Figure 54). In the northeast part of the area, defined by the Methy Portage Plains physiographic unit (Figure 5), Bayrock and Reimchen (1973) described the till as being composed of more than 90% sand, with the remainder being silt, pebbles and boulders (Gipsy Till, map unit ‘GM’, Figure 54). The sand content of the till in the northeast is so great that these authors initially interpreted the landscape as ice-contact glaciofluvial sand deposited as kames. However, on the basis of the amount of silt in the matrix, the landscape was reinterpreted as till, formed by glacial overriding and reworking of outwash sand that was derived from sandstone of the Athabasca Formation.

Grain-size analyses of a small number of representative till samples also illustrate that the surface till is generally more sandy and less clayey in the area east of the Stony Mountain Uplands, corresponding with the observations made by Bayrock and Reimchen (1973) (Figures 56 and 57). Although the sand content of the surface till decreases southward as the till becomes enriched with silt and clay, in the Mostoos Upland the till matrix still contains as much as 50% sand, yielding a sandy clay loam texture (Figure 53, map unit 'sM').

Tills have favourable geotechnical properties for construction of earth-built structures such as roads, berms, containment ponds and clay liners, primarily because tills in Alberta generally have an abundance of clay, and particles within the matrix are well graded. With the increase in construction as a result of oil sands development in the region, it is anticipated that tills will be used to construct a number of facilities related to the petroleum industry, including clay liners of waste-treatment and settling ponds. Alberta Energy and Utilities Board guidelines (Alberta Energy and Utilities Board, 2001) stipulate that clay liners must be constructed of materials, which, after being reworked, homogenized and emplaced, have a hydraulic conductivity value of 1×10^{-7} cm/s or less. This generally translates to materials that are well graded with at least 20% clay and no obvious permeable layers such as sand lenses or other discontinuities, such as cracks or fissures, to a depth of at least 3 m. Figure 58 summarizes the results of a number of studies on the hydraulic conductivity values for a range of tills with varied amounts of matrix sand, silt and clay (Stephenson et al., 1988). It shows that hydraulic conductivity exceeds 1×10^{-7} cm/sec when the amount of matrix sand exceeds 40 to 50%, and the amount of clay is generally less than 20%. It becomes apparent from Figure 59, which illustrates the suitability of different tills for clay-liner construction, that much of the surface till in the east half of the study area is either too sandy or has insufficient clay to meet the required hydraulic conductivity criteria for the construction of primary clay liners.

In addition, interbeds of sand are commonly found in the upper 2 to 3 m of the till in the east part of the area, giving an overall sandy composition to the moraine and increasing the internal drainage characteristics (Figure 60). This aspect of high internal drainage is reflected in the sharp crests of hummock ridges (denoting sandy composition) and a vegetative cover of plant species such as caribou moss and pines, which have a tolerance for dry, well-drained soils (Figure 61). In places sinuous, sharp-crested till hummocks have an appearance very similar to that of ice-contact glaciofluvial eskers, and the

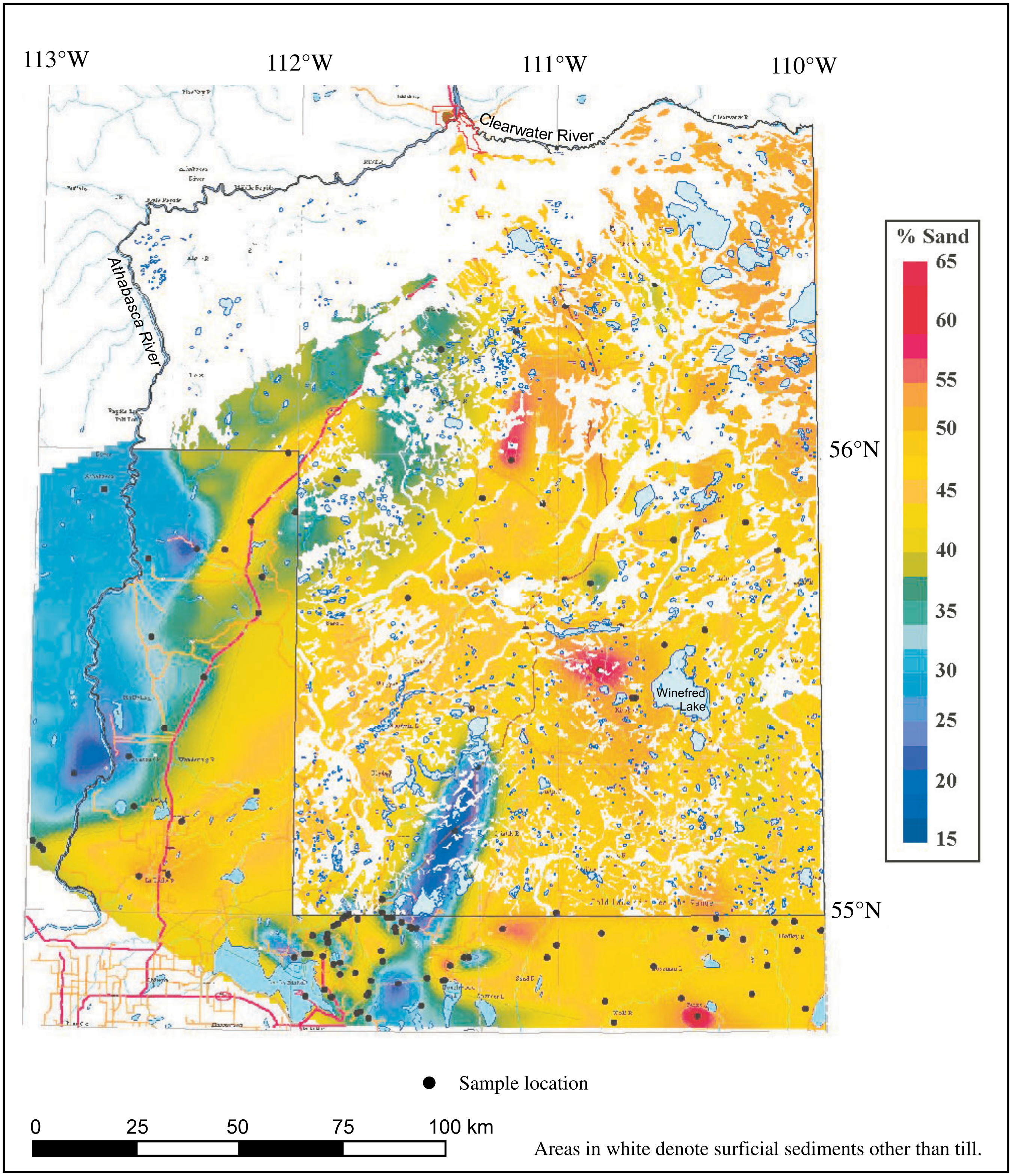


Figure 56. Percentage of sand in the matrix of surface tills.

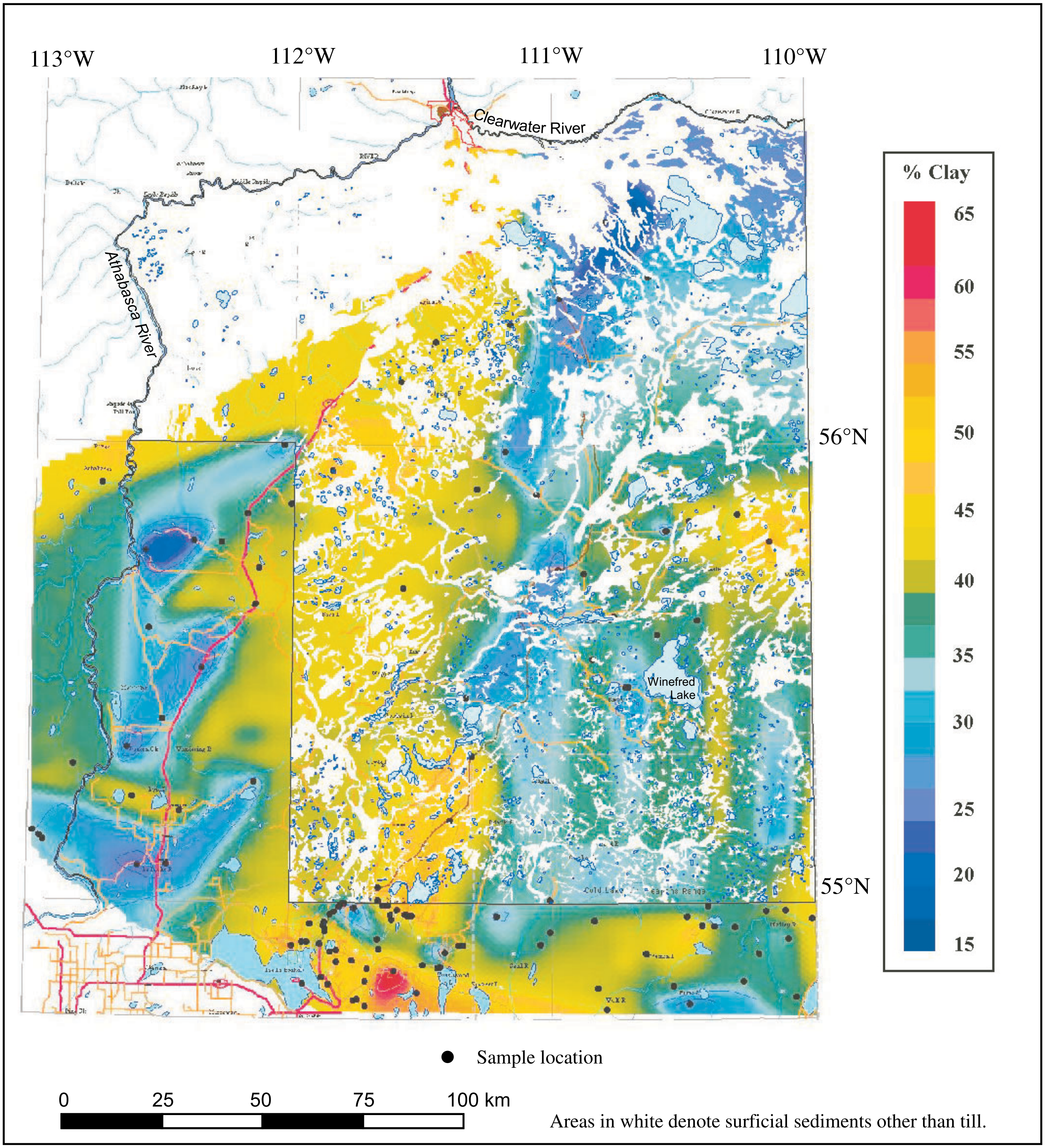


Figure 57. Percentage of clay in the matrix of surface tills.

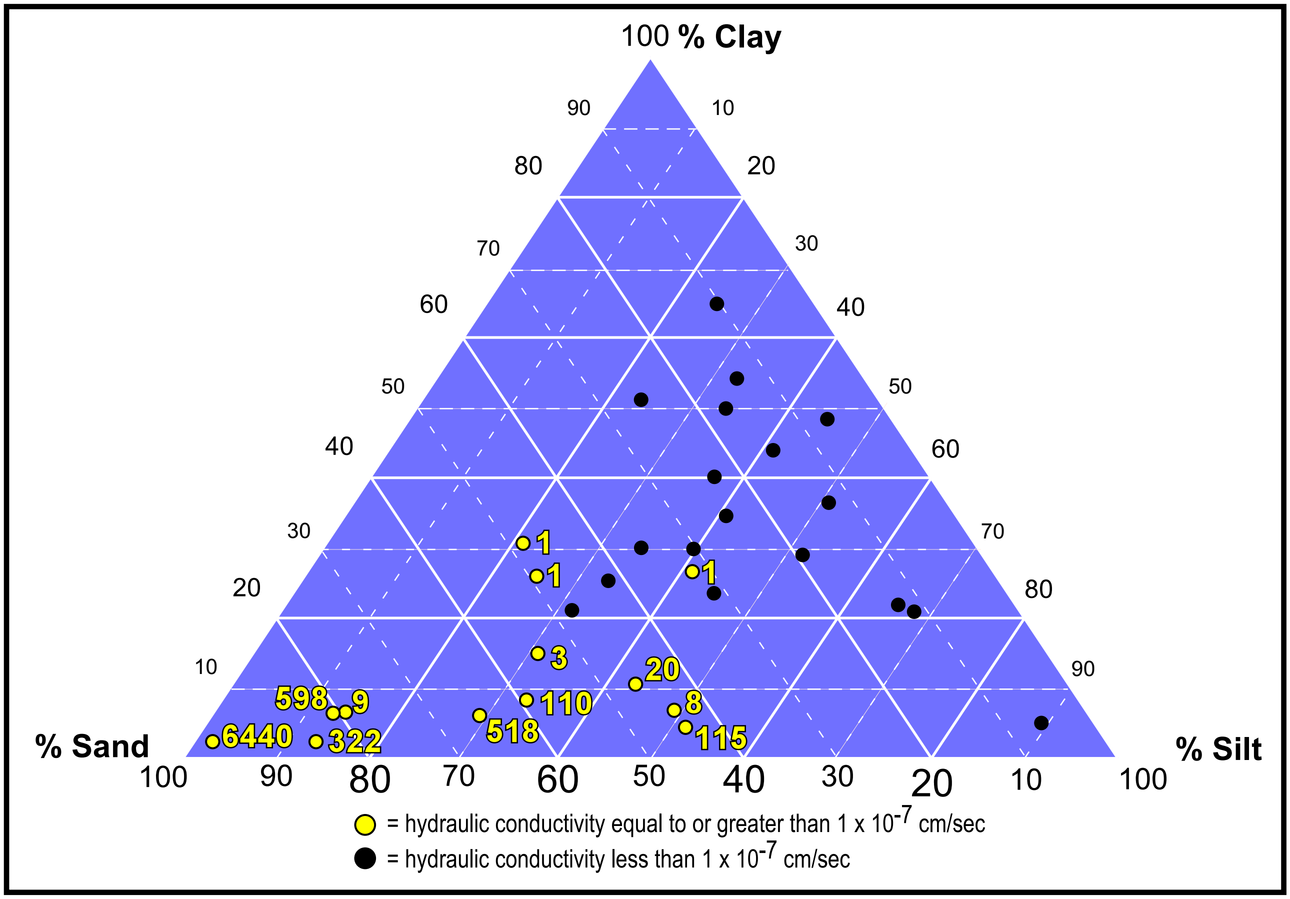


Figure 58. Relationship between hydraulic conductivity and till-matrix grain size.

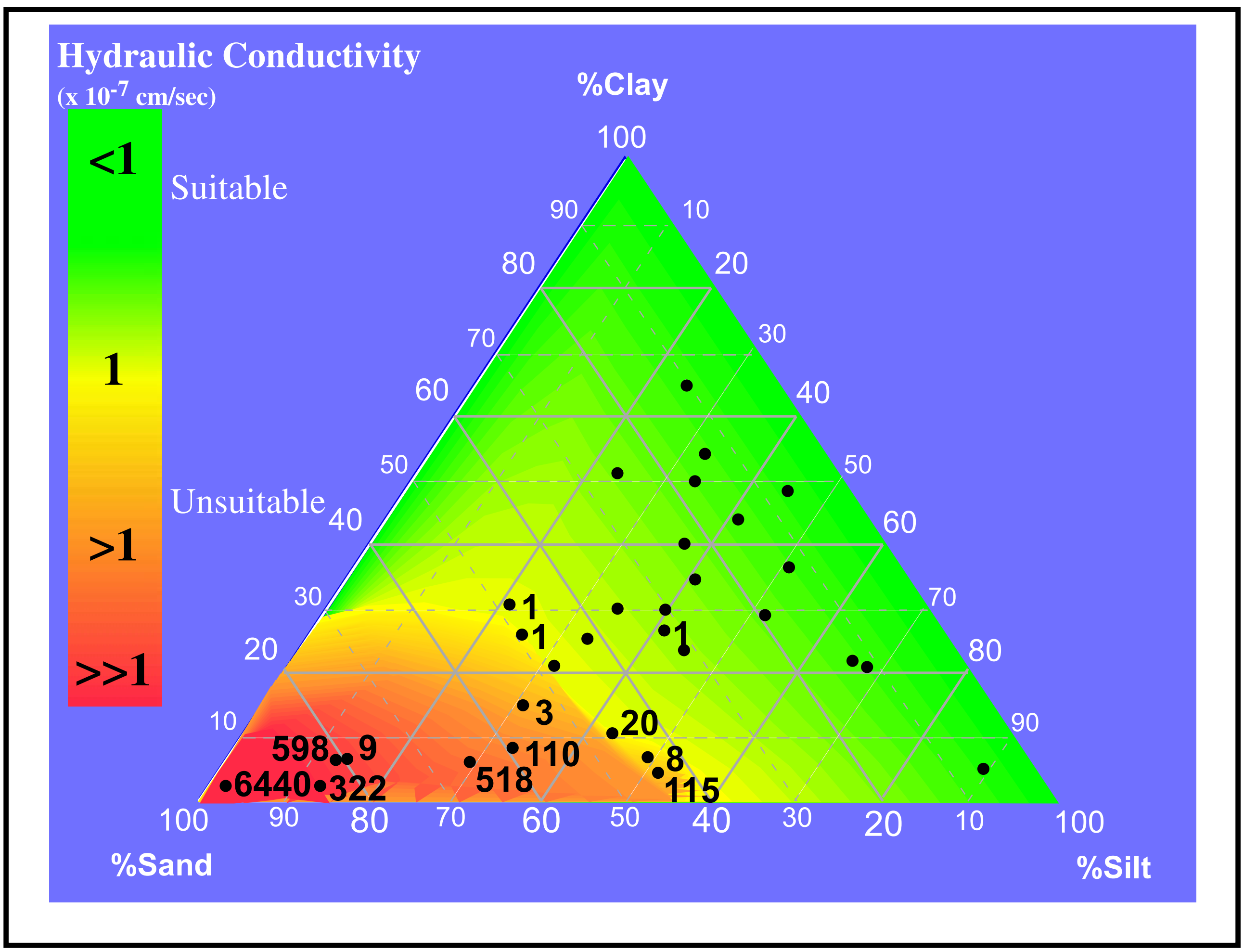


Figure 59. Suitability of till for clay-liner construction.

Figure 60. Poorly sorted outwash sand and sandy diamicton complex, Christina Lake area.

Figure 61. Sharp-crested ridges on hummocky, sandy moraine on the Mostoos Upland.

Figure 62. Sinuous-ridged hummocky, sandy moraine, on the Mostoos Upland.

differentiation between moraine and glaciofluvial outwash can be difficult from aerial photograph analysis (Figure 62).

Although there are local exceptions, in general the grain-size composition of the surface till becomes progressively more clayey in a westward direction, with roughly equal amounts of sand, silt and clay (clay loam) on top of the Crow Lake Upland (Figures 5 and 54). In the northern part of the upland Bayrock and Reimchen (1973) refer to the till as the 'Kinosis Till', and describe it as loamy textured with an abundance of rounded quartzite clasts derived from Tertiary gravel, which the authors believed may still overlie the bedrock surface in the upland. The abundance of small lakes and widespread organic deposits on the surface of the Crow Lake Upland (Figure 54) leads to the speculation that, in part, a till with a higher percentage of clay retards the downward percolation of surface water. Regionally, the surface till with the most clay, referred to as the 'Horse River Till' (Bayrock and Reimchen, 1973), occurs within the Wabasca Lowland physiographic unit along the western flank of the Stony Mountain Uplands (Figures 5 and 54). The till is described as generally thin with a clay- and silt-rich matrix containing very few stones.

5.2.2 Glaciofluvial Landforms and Deposits

During the last stages of deglaciation, glaciofluvial outwash sand and gravel ('FG' map unit) was deposited on the ice surface in the form of kames and eskers (eskers depicted by a symbol on Figure 54), or in meltwater channels eroded on the moraine surface (map unit 'FG'). Glaciofluvial deposits are differentiated on the basis of two grain-size categories: sandy deposits, denoted by map unit 'FG', and gravelly deposits, shown by map unit 'gFG'. Major outwash deposits are associated with meltwater channels that are found in a complex of channels in the southwest part of the area, in an east-trending meltwater channel system that is currently occupied by Christina Lake in the centre of the study area (Figure 63), in a north-trending channel system east of Winefred Lake, and along the margins of the present-day Christina and Athabasca rivers. In addition to isolated kames and small eskers that occur from place to place within the hummocky moraine complexes, extensive ice-contact and glacial meltwater-channel complexes occur along the upper margins of the Stony Mountain Uplands, southwest of Willow Lake (Figure 54). A number of these deposits are mined as sources of aggregate (Figure 64).

5.2.3 Glaciolacustrine Landforms and Deposits

Glaciolacustrine landforms and materials generally have a subdued appearance and cannot be easily mapped from aerial photographs. Glaciolacustrine sediments are absent in most of the study area, the exception being those deposits mapped by Bayrock and Reimchen (1973) within the Wabasca and McMurray lowlands, and the northern part of the Methy Portage Plains (Figures 4 and 54). Glaciolacustrine map units are subdivided on the basis of dominant grain size and include: bedded silt and clay deposits, denoted by the map unit 'cLG'; sandy deposits, denoted by the map unit 'sLG'; pebbly, clayey diamicts, denoted by the map 'pbGL'; and undifferentiated deposits, map unit 'LG'. There is little information to indicate the range in thickness of glacial lake sediments, though observations along the Athabasca River indicate a thickness of about 1 to 2 m (J. Pawlowicz, pers. comm., 2001).

5.2.4 Eolian Landforms and Deposits

Immediately following deglaciation, and prior to stabilization of the landscape by vegetation, strong winds reworked and modified many of the exposed glaciofluvial sand deposits. Dominant wind direction at that time appears to have been from the northwest, forming sheet sand or eolian dunes along the southeast, or downwind, margins of meltwater channels and glaciofluvial outwash deposits. Sporadic, but distinct, sand dunes are depicted by a red dune symbol on the terrain analysis maps (Figure 54), but large dune fields are mapped as separate units, as is the case along the south and east flanks of the Athabasca and Christina river valleys (Figure 54). Most eolian features are confined to the northeast part of the map

Figure 63. Ice-contact glaciofluvial sand and gravel pit, east of Christina Lake, Christina Lake Plain.

Figure 64. Glaciofluvial sand and gravel pit on Stony Mountain Upland.

area where glacial meltwater deposits overlie sandy till of the Gipsy moraine. It is probable that small isolated dunes occur elsewhere than depicted on the terrain analysis maps, but they are too small to identify or map at the 1:60 000 scale of the aerial photographs.

5.2.5 Colluvial Landforms and Deposits

Colluvial deposits are found predominantly in areas of high local relief, and within the study area three colluvial map units are defined: eroded colluvial landforms (map unit 'CE') consisting of colluvial veneers found on steeply eroded slopes such as along major river valleys; colluvial slump deposits (map unit 'CS') formed by large, unstable slump blocks of undifferentiated glacial and bedrock material, commonly forming a series of subparallel arcuate ridges; and undifferentiated colluvial deposits (map unit 'C') which includes material mapped as colluviated ground moraine in the 1:250 000 scale surficial geology map of NTS map area 74D (Bayrock and Reimchen, 1973). The largest areas of colluvial slump deposits are found along the northern perimeter of the Stony Mountain Uplands in Twp. 81 to 83, Rge. 7 to 8, W 4th Mer. and in Twp. 84 to 86, Rge. 7 to 9, W 4th Mer., where unstable bedrock shale is exposed or lies near the surface along the flanks of the upland (Figure 54). Eroded colluvial deposits are confined primarily to the steep valley walls of the major rivers including the Athabasca, Christina and Clearwater rivers.

5.2.6 Recent Fluvial and Lacustrine Deposits

Recent fluvial deposits are found along present-day stream and river channels and floodplains. Sediments include a wide range in grain sizes from cobbles and boulders along streambeds of major rivers, to poorly sorted muds along small, slow-moving streams. Where thick and coarse, recent fluvial deposits can be a potential source of aggregate.

Recent lacustrine deposits are found along the margins of the larger lakes. They are interpreted to consist of coarse, waved-washed beach sediment, such as sand, to poorly sorted, organic-rich muds. Recent lacustrine deposits are likely to be less than 1 m in thickness.

5.2.7 Organic Deposits

Organic deposits are possibly the most widespread surficial material, covering an estimated 65% of the study area (Figure 65).

Organic deposits can be easily recognized on aerial photographs, and because they are hydrogeologically and geotechnically significant in terms of moisture retention on the landscape, an attempt has been made to show their distribution even if they are not the primary surficial geological unit. Organic deposits are depicted in three ways on the 1:250 000 scale surficial materials map: areas interpreted to be dominantly thick organic deposits (>1 m thick, map unit ‘O’); thick organic deposits in association with other surficial materials (depicted by swamp or marsh symbol overlying a coloured map unit); and thin organic veneers on top of, or in conjunction with, other surficial materials (<1 m thick, depicted by the ‘^’ symbol overlying coloured map units).

Organic deposits occur in a number of different terrain settings. As mentioned, they are an integral part of hummocky morainal landscapes, filling in the circular depressions within stagnant ice collapse hummocks or depressions between neighbouring hummocks (Figure 61). The areas interpreted to have the most widespread, continuous and thick organic sediments are: much of the top of the Stony Mountain Uplands, the area defined by the Algar and Dover plains, the area between the Athabasca River and the Stony Mountain Uplands, the area around Clyde and Bohan lakes in the Mostoos Upland, much of the area within the Christina Lake Plain, and the area around Gordon and Gipsy lakes in the Methy Portage Plains (Figures 4 and 65).

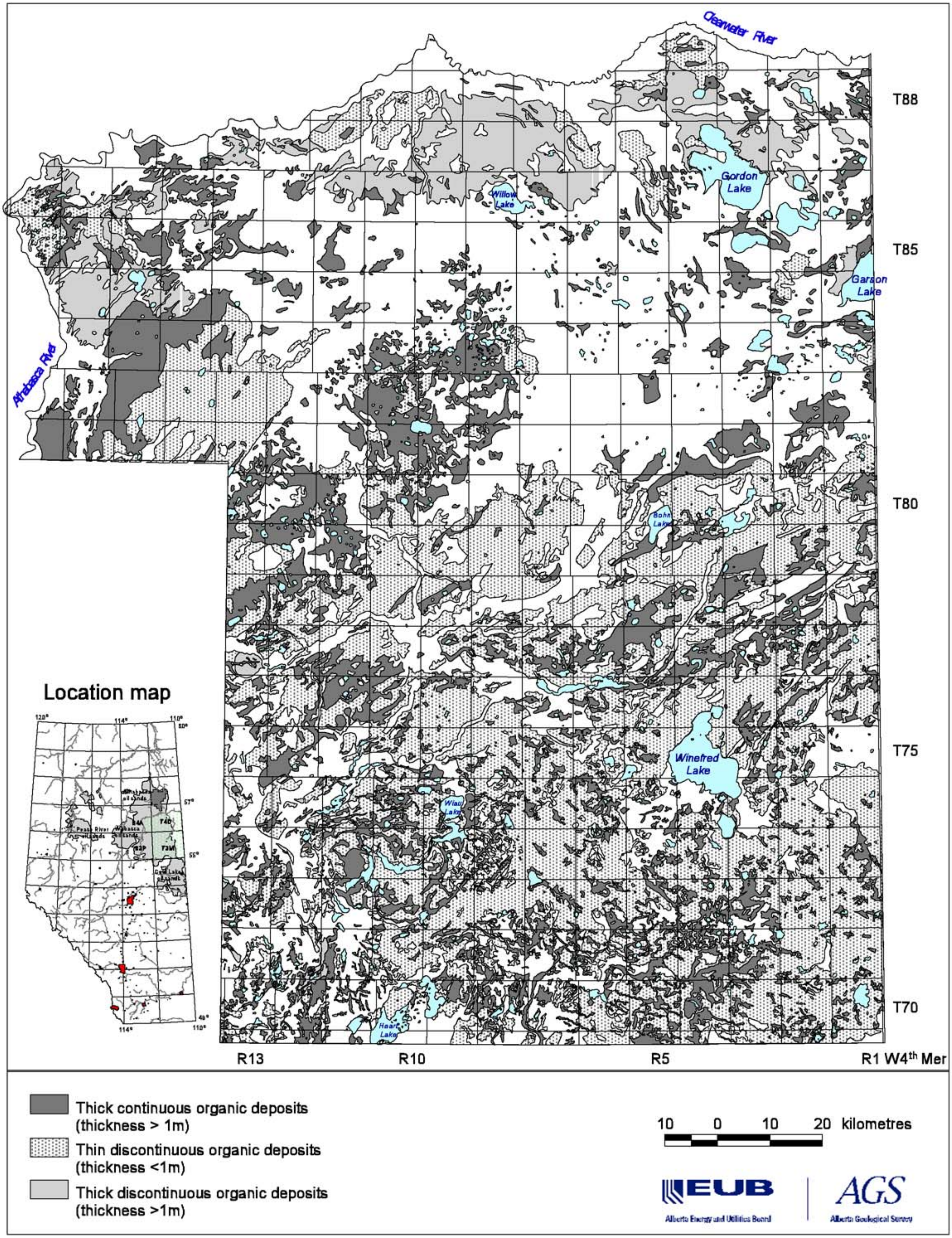


Figure 65. Distribution of organic deposits in the study area.

6 Summary

The report describes the geological framework of the bedrock topography and glacial stratigraphy in a region above the Athabasca Oil Sands that in places is covered by more than 300 m of unconsolidated Tertiary and Quaternary sediment.

The base of the unconsolidated drift sequence is defined by an erosional landscape on the surface of the underlying Cretaceous bedrock. Major physiographic elements on the bedrock surface consist of remnants of erosional uplands dissected by regionally extensive fluvial channel systems formed prior to the onset of the first glaciation in the area. The most prominent of the preglacial channel systems are the Wiau and adjacent Christina channels, which form a broad valley trending roughly eastwards through the south-central part of the study area. At its greatest, the valley is about 30 km wide and in places is covered by more than 320 m of drift. Secondary channels, though still regionally extensive, include the Amesbury, Imperial Mills and Leismer channels, formed at different times throughout the Late Tertiary. Thick, extensive deposits of quartzite-rich sand or sand and gravel, which are interpreted to have a Cordilleran source from the west, cover the floors of all of the above channels. Smaller-scale features on the bedrock surface are characterized by relatively local-scale, narrow and truncated channels formed by catastrophic releases of glacial meltwater. These deeply incised channels commonly contain thick sequences of sand and gravel with granitic clasts of a Canadian Shield composition, indicating a source from the northeast. The deposits of coarse fluvial sediment on the floors of these bedrock channels make them ideal targets for sources of fresh, potable water.

The onset of the first glaciation in the study area is recorded by an abrupt change from sand and gravel to silt and clay in the stratigraphic record of the major preglacial channel sediments. The fine-grained sediments are interpreted to have been deposited in glacial lakes that formed as a result of blockage of drainage in the channels as the first Laurentide glacier advanced from the northeast. These lacustrine sediments in turn are overlain by glacial outwash sand and gravel deposited during the advance of the first glaciation. Collectively, this sequence of stratified fluvial and lacustrine deposits constitute the Empress Formation, which underlies the lowermost and oldest glacial sediment (till) in the stratigraphic record, the Bronson Formation.

An abundance of petroleum exploration petrophysical logs, supplemented with petrophysical logs from the water-well industry and a few coreholes drilled by the Alberta Geological Survey, enable the construction of a lithostratigraphic framework for about the lower two-thirds of the drift succession. Steel surface casing prevents the upper third of the drift succession from being logged. Well-defined cyclic patterns in the electric logs of thick drift sequences permit the differentiation of at least three, and possibly four, major till packages. Correlation of these cyclic patterns on petrophysical logs with field sample descriptions and geochemical analyses of core samples, establish that these till packages can also be differentiated on the basis of mineralogy. The presences of paleoweathered horizons preserved in places on the surfaces of buried tills also establish that these tills represent separate glacial events, separated by lengthy interglacial weathering intervals. On the basis of petrophysical log characteristics, mineralogy and stratigraphic position, the tills are tentatively correlated with those defined in previous studies done in the Cold Lake area, south of the study area (Andriashek and Fenton, 1989). From oldest to youngest these are: the Bronson Formation, the Bonnyville Formation (Units 1 and 2), the diagnostic high-carbonate Marie Creek Formation and the uppermost Grand Centre Formation.

Because of their great extent and different mineralogies, the tills are analogous to widespread flood events in a marine sequence, and as such, they provide the architectural framework for establishing the regional extent and correlation of sand and gravel deposits that occur within the drift succession. The current level of interpretation only permits the bottommost of these aquifer systems, the Empress Formation, to be mapped in the subsurface. Other sand and gravel aquifer units are depicted in a series of geological cross-sections constructed through the thickest parts of the drift succession in the study area. These include: the

Muriel Lake Formation, the Bonnyville Formation Unit 1, the Ethel Lake Formation, and the Sand River Formation, as first recognized in the Cold Lake area, south of the study area. The cross-sections illustrate that some of these drift aquifer units have regional extent, and in places are directly superposed on lower aquifer units. Additional stratigraphic investigations are required to increase the density of data required to more accurately map each of the stratigraphic units within the glacial drift sequence.

The present-day land surface dominantly reflects geological processes, landforms and sediment related to the last glaciation during the Late Wisconisin. A series of 1:50 000 scale terrain analysis maps have been constructed primarily from aerial photographic interpretations to illustrate the primary geological sediments and aspects of the morphology and relief of the surficial landscape. These maps were prepared in a geographic information system (GIS) format and have been combined to construct a 1:250 000 scale regional surficial materials map. A minor amount of field checking and ground truthing was conducted by road and helicopter traverses to verify the major landscape elements depicted on the maps.

The terrain analysis maps are useful for a number of land-use panning purposes, one of which is selecting areas of geological sediment with suitable hydraulic conductivity values for siting petroleum industry facilities such as containment ponds and other surface waste-storage facilities. As an outcome of the mapping, it is evident that for large parts of the east half of the study area the surface materials have a very sandy composition, making them less than suitable for constructing earth-built structures such as clay liners and containment ponds.

7 References

Alberta Energy and Utilities Board (2001): Guide 55: Storage requirements for the upstream petroleum industry (December 2001); Alberta Energy and Utilities Board, 68 p.

Andriashek, L.D. (2000): Geochemistry of selected glacial and bedrock geological units, Cold Lake area, Alberta; Alberta Energy and Utilities Board, EUB/AGS Earth Sciences Report 2000-10, 26 p.

Andriashek, L.D. and Pawlowicz, J. (2002): Observations of naturally occurring hydrocarbons (bitumen) in Quaternary sediments, Athabasca Oil Sands Area and areas west, Alberta; Alberta Energy and Utilities Board, EUB/AGS Geonote 2002-01, 21 p.

Andriashek. L.D. and Fenton, M.M. (1989): Quaternary stratigraphy and surficial geology of the Sand River area, 73L; Alberta Research Council, Alberta Geological Survey, Bulletin 57, 154 p.

Bayrock, L. (1971): Surficial geology Bitumount, NTS 74E; Alberta Research Council, Alberta Geological Survey, Map 34, scale 1:250 000.

Bayrock, L. and Reimchen, T. (1973): Surficial geology of the Waterways map area, NTS74D; Alberta Research Council, Alberta Geological Survey, scale 1:250 000.

Bleuer, N.K. (1999): A "genetic-stratigraphic" basis for glacial-terrain characterization; Geological Society of America Annual Meeting, Denver, Colorado, 1999, Abstract 01990, p. A-4.

Bridge, J.S. and Leeder, M.R. (1979): A simulation model of alluvial stratigraphy; Sedimentology, v. 26, p. 617–644.

Canadian Discovery Digest (2001): Exploration Review - Quaternary gas in buried channels in the Sousa area, NW Alberta; Canadian Discovery Digest, January 2001, p. 25–39.

Christiansen, E.A. (1992): Pleistocene stratigraphy of the Saskatoon Area, Saskatchewan, Canada: an update; Canadian Journal of Earth Sciences, v. 29, no. 8, p. 1767–1178.

Christiansen, E.A., Padbury, G.A. and Long, R.J. (1975): Meadow Lake geology; Saskatchewan Department of Tourism and Renewable Resources, Museum Branch, 51 p.

Farvolden, R.N. (1963): Bedrock channels of southern Alberta; *in* Early Contributions to the Groundwater Hydrology of Alberta, Alberta Research Council, Bulletin 12, p. 63–75.

Galloway, W.E. (1989): Genetic stratigraphic sequences in basin analysis 1: Architecture and genesis of flooding-surface bounded depositional units; The American Association of Petroleum Geologists Bulletin, v. 73, p. 125–142.

Gold, C.M. (1983): Tertiary drainage in the Western Canadian Sedimentary Basin; Geological Association of Canada Annual Meeting 1983, Victoria, British Columbia, Program with Abstracts, p. A28.

Gold, C.M., Andriashek, L.D. and Fenton, M.M. (1985): Bedrock topography of the Sand River area, NTS73L; Alberta Research Council, Alberta Geological Survey, scale 1:250 000.

Mossop, G.D. and Shetsen I., comp. (1994): Geological atlas of the Western Canada Sedimentary Basin; Canadian Society of Petroleum Geologists and Alberta Research Council, Calgary, Alberta, 510 p.

Pettapiece, W.W. (1986): Physiographic subdivision of Alberta; Agriculture Canada, scale 1:500 000.

Richard, S. (1981): Surficial geology Dapp Creek, NTS 83I (9, 10, 15, 16); Geological Survey of Canada, Map 1-1979, scale 1:100 000.

Schreiner, B. (1990): Lithostratigraphic correlation of Saskatchewan tills – a mirror image of Cretaceous bedrock; Saskatchewan Research Council, Publication No. R-1210-3-E-90, Report Volume 1, 114 p.

Stephenson, D.A., Fleming, A.H. and Mickelson, D.M. (1988): Glacial deposits; Chapter 35 *in* Hydrogeology, W. Back, J. Rosenshein and P. Seaber (ed.), The Geological Society of America, p. 301–314.

Stein, R., Andriashek, L.D., Thomson, D., Stewart, S.A. and Fenton M.M. (1993): Evaluation of basal drift aquifers associated with the buried Wiau Channel: stratigraphy, aquifer occurrence, dimensions, and capability for groundwater production; unpublished report to Alberta Energy Company, Alberta Research Council, 41 p.

Stein, R. and Andriashek L.D. (1998): Evaluation of basal drift aquifers associated with the buried Wiau Channel: stratigraphy, aquifer occurrence, dimensions, and capability for groundwater production; Alberta Energy and Utilities Board, EUB/AGS Open File Report 1998-05, 5 maps at 1:250 000 and 11 cross-sections.

Tokarsky, O. and Epp, A.P. (1986): Regional hydrogeological cross-sections in Alberta; unpublished cross-sections A-A' Winefred Lake 73M, B-B' Winefred Lake 73M, C-C' Pelican 83P, V-V' Winefred Lake 73M, V-V' Pelican 83P, W-W' Winefred Lake 73M, W-W' Pelican 83P, Alberta Environment, Earth Sciences Division.

Weber, K.J. and van Geuns, L.C. (1990): Framework for constructing clastic reservoir simulation models; Journal of Petroleum Technology, October 1990, p. 1248–1253, 1296–1297.

Whitaker, S.H. and Christiansen, E.A. (1972): The Empress Group in Saskatchewan; Canadian Journal of Earth Sciences, v. 9, p. 353–360.

Appendix 1 – Surficial Geology Site Descriptions

NEQ96-Sec1 Longitude 110.62367 Latitude 56.367838

30 m high section on west side Christina River, July 29, 1996.

Unit 1: about 6m	Sand: upper 0.5m silty sand, massive; middle 1.5m medium grained, cross bedded; lower 2.5m horizontal bedded medium grained sand with 5cm thick silty clay beds; about 300 m north along section 1.5m horizontally bedded fine sand to silt and a few pebbles, well bedded over bank sediment overlying more than 1m of crossbedded medium sand.
Unit 2: > 3m	Till; clay loam texture; very dark grey to black; few pebbles or granules; unoxidized; friable; iron staining along fracture surfaces; weak reaction to HCL acid; at outcrop overlain by 20 cm thick very dark grey clay bed which also fractured and friable.
Unit 3: >5m	Grand Rapids Sandstone; fluvial sediment consisting of interbedded clayey silt and sand; well stratified, cross to planar bedded; hard iron cementing; weathers light grey; abundant muscovite flakes on weathered surface; abundant iron staining and some muscovite flakes along fracture and bedding planes; ironstone nodules in crossbedded sand.

NEQ96-Sec3 Longitude 110.69412 Latitude 56.414323

Fly stop along east side Christina River, July 29, 1996; DLS: 09-34-85-05W4; 10m high section above slump block to river level. 2 photos taken:

Unit 1: 2-2.5m	Diamicton (till-like); upper 1m uncertain; horizontal bedding or layers visible with sand layers about 10-30cm thick; numerous stones; grades downward into unoxidized till, with wavy contact defined by discontinuous sand layer.
Unit 2: 3m	Till; very dark grey exposed color; numerous stones; faint bitumen odor; greenish-grey colored bands near base of unit; thin wavy sand lenses and partings in horizontal wavy joints in till; moderate reaction to HCL acid.
Unit 3: 0.75m	Sand and silt; interbedded, well-sorted, glacial origin, silt reacts strongly to HCL acid.
Unit 4: >5m	Silt; uncertain origin; strongly jointed with strong iron staining along fractures; very dark grey; difficult to sample with hand pick; massive, no visible bedding; upper part of unit has bedrock appearance; interbedded with black silty clay beds (2-4 cm thick) about 0.5 m down from top of unit; strong groundwater discharge springs at base of slump face; mostly likely origin is Grand Rapids Formation bedrock.

NEQ96-Sec4 Longitude 110.792004 Latitude 56.489172

Fly stop along east side Christina River, July 29/96 DLS12-30-86-05W4; helicopter view indicates the following sequence:

1-2m Diamicton
5m Till
10m Glacial sand and gravel

NEQ96-Sec17 Longitude 110.354836 Latitude 56.668664

Fly view along east Edwin Creek, July 28/96 Numerous outcrops visible on east and west side of Edwin Creek Site 1: Crest of river valley; site described from helicopter only

Unit 1: 1m	Laminated lacustrine silt and clay; buff dark brown - no pink
Unit 2: 5-6 m	Till; columnar to massive till, has yellow brown oxidized color, but with grey veneer from overlying lacustrine colluvial veneer; wet stratified lenses and layers visible; a boulder pavement occurs at base of unit, one boulder thick, horizontal
Unit 3: 5-6m	Till; appears to have a less yellow brown and more grey brown color; at base is exposed a 1m thick deformed stratified unit; gradational contact between till and deformed stratified sediment
Unit 4: Colluvium	Bedrock not exposed; entire section appears to be drift, which is twice as thick as the drift in the outcrop to the north, towards the Clearwater River. 11 photos taken by LDA, photos RF96-1 #2-18 by M. Fenton. Site 1 is located at crest of river valley and is not excessively eroded. Sections exposed north of site 1.

1. Laminated silt and clay visible in adjacent outcrops but absent in subsequent outcrops to north.
2. The top 2-3 m of till is a layered sequence, which is gradational with underlying till.
3. At a couple of outcrops some indication of a boulder pavement; lenses of darker, coarser material within layered sequences (o.6-1m thick, 1-4m long).
4. Bedrock is visible in lower 1/2 of outcrop.
5. Large inclusions or blocks of what appear to be bedrock sandstone in the till unit - some are rounded, some angular.
6. The best outcrop to map is site 1. We did not see any intertill stratified sediment but the lower part of site 1 was colluviated; therefore the major difference is that the drift is much thicker to the south and multiple tills are indicated.
7. Laminated silt and clay are present on the west side at northernmost end of Edwin Valley but not across valley on east side.
8. One outcrop on west side (south end of tributary) has what appears to be stratified sediment (massive to poorly sorted) at base of till sequence (till is about 4-5 m thick), which correlates in elevation to the boulder concentration at site 1.

Section Revisited and sampled September 19, 1996.

Unit 1: 1m — Lacustrine silt and clay; light and dark grey rhythmites, each layer about 1cm thick, lighter silty layers and darker clayey layers.

Unit 2: 4m — Till; clayey-sand, soft, friable, very few clasts, some local sandstone cobbles, no iron staining, sharp upper and lower contact; boulder pavement directly below the lower contact; does not form shards; looking at a vertical cliff face one sees weakly developed horizontal joints with 2-5cm spacing. This unit 2 looks like the upper till at the OSLO site. Color grey brown.

	%MtxCO3	CO_2(ml/g)	%Sand	%Silt	%Clay
NAG96-660-2m	6.3	15.1	55	26	19
NAG96-661-4m	4.9	11.6	60	19	21

Unit 3: 6m — Till; silty sand; moderately hard, forms shards, non to very slight HCL reactions (however, cool day); more clasts than upper till; distinctly different from the upper till (harder, forms shards); medium to fine grained sand lenses which thicken to the top with 30 cm thick sand near the top; boulder horizon about 1/2 way down; grey color; till weathers a lighter color than above till even though fresh sample is grey and not grey brown as above unit 1.

.

	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
NAG96-662-6m	5.2	12.5	58	34	8
NAG96-663-10m	4.2	9.9	62	28	10

Unit 4: >6m — Grand Rapids Sandstone?; fine sand to silt; some deformed 1mm to 1cm dark grey laminae; 2-4cm size ironstone nodules suggest that this is weathered bedrock; origin of sediment uncertain.

NEQ96-Sec22 Longitude 110.846948 Latitude 56.46861

Fly stop along Gregoire River, September 22, 1996.

Thick till section, difficult to land, check at lower water stage, Note! Most sections between here and the Christina River have about 4-6m of drift on bedrock; this section appears to have in excess of 20-25m of drift, but this is not confirmed.

Appendix 1 – Surficial Geology Site Descriptions

LA98-1 Longitude 110.51 Latitude 55.603336

Winefred River Section.

Unit 1: 0.5m Colluvium, roots .5 -

Unit 2: 1 - 1.5m Sand, stratified; well bedded .

Unit 3: 1.5m Till; soft structureless, well oxidized olive brown, iron staining; sandy silt texture (loam); highly calcareous; manganese staining; 1% pebbles (some dolostone, granite); some high angle sand stringers; sample NATMAP 98-1 2.75m.

Unit 4: 0.15m Sand; subhorizontal, weakly bedded.

Unit 5: 0.1 m Sand and diamicton (till).

Unit 6: 0.65m Gravel with black diamicton; dirty, poorly sorted.

Unit 7: 2m Till; very dark grey, iron stained along fractures; moderately calcareous; 1% pebbles; clayey-sandy silt (sandy clay loam); bottom 0.5 m more clayey (heavy clay loam); black; weak to noncalcareous; till samples NATMAP 98-1 4.75m and NATMAP 98-1 6m.

Unit 8: 1.5m Shale; black, gypsum crystals; ironstone beds; block of displaced bedrock in till; sample collected.

Unit 9: 1.5m Till; similar to above till, sandy clay loam; strongly iron stained along fractures; moderately calcareous; faint bitumen odor; sample NATMAP 98-1 9m.

LA99-1 Longitude 111.6637 Latitude 55.036501

Approximately 15m outcrop on west side of Hwy 881.

Unit 1: 15 m Till; 3 till samples collected

LA99-1 3 m sample - clay loam; estimate 30% clay, 35% silt, 35% sand; moderate to strong reaction to HCL acid; color
2.5Y 3/2 very dark grey brown.

%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
6.3	15	33.1	30.8	36.1

LA99-1 6 m sample - clay loam; 35% clay, 35% silt, 30% sand; siltier and less sand than above; weak to moderate reaction to HCL acid; color 10YR 3/2 very dark grey brown.

%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
6	14.4	34.4	32.6	33

LA99-1 13m sample - clay loam; estimate 35-40% clay, 35% silt, 25-30% sand; clay (shale?) inclusions smeared within matrix; color 5Y 2.5/1 black to very dark olive grey; numerous Shield clasts throughout; some minor very rounded black chert and quartzite pebbles and cobbles.

%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
4.6	11	44.6	24.5	30.9

Comments: Generally decreasing amount of carbonates in matrix with depth. About 50 m north of site is a 3 to 4m thick silty sand bed below the till. Silty sand bed undulates in north direction; a suggestion that this may be a block of sand incorporated within thrust moraine. If so, roadside stratigraphy is likely to be highly variable here due to thrust masses.

LA99-2 Longitude 111.635333 Latitude 55.042276

Unit 1: 3 to 4 m, Fine sand in roadcut through hummock; high relief topography in this area; sand almost has a preglacial appearance.

LA99-3 Longitude 111.453817 Latitude 55.159952

Unit 1**:** 3 m Gravelly sand in hummock along northwest side of Hwy 881; glacial origin, mostly granitic rock fragments.

LA99-4 Longitude 111.320533 Latitude 55.276967

Unit 1: 2.5 m Stony sand; hummock; collapse stagnant ice features around here may be composed of outwash/ice-contact glaciofluvial sediment .

LA99-5 Longitude 111.307467 Latitude 55.324454

Appendix 1 – Surficial Geology Site Descriptions

East side of Hwy 881, next to DND Air Weapons Range.

Unit 1: Till; silty-clay texture, very little coarse sand; amorphous, iron-stained along joints; moderately calcareous; 1-2% pebbles, very few granules; estimate 20-25% sand, 40% silt, 30-35% clay; color 10YR 3/2 very dark grey brown; Note! This till is different from till at site LA99-1; it is similar to the Reita Lake till in Cold Lake, except it is more calcareous.

Sample LA99-5 2.5m.	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	15.2	36.5	24.5	36.6	38.0

LA99-6 Longitude 111.09891 Latitude 55.471701

Fresh road cut on west side of Hwy 881.

Unit 1: About 13 m of gravelly, stony sand; high relief hummock; ice-contact kame; a number of high relief knobs in area may also be kames; another kame sand outcrop at Longitude 111.09708 Latitude 55.479933 and at Longitude 111.0959 Latitude 55.5014; till outcrop about 400m north of site on east of Hwy 881.

LA99-7 Longitude 111.1247 Latitude 55.619729

Christina Creek Crossing.

Unit 1: 3 m Pebbly Sand, stratified, fine to medium grained, glacial, brown to grey-brown.

Unit 2: 12 m, Till; clayey sand loam texture, estimate 45-50% sand, 35% silt, 15% clay; abundant medium to coarse
sand, hard, brittle, fractured, numerous pebbles, moderate to highly calcareous; looks like Marie Creek till without the abundance of 1-2mm sand and granules; upper 3 m slightly oxidized, becoming very dark grey to black at about 7 - 8 m down from top of section.

Sample LA99-7 4.5m Oxidized dark grey brown (2.5Y 3/2 very dark grey brown), very sandy and highly calcareous;

%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
9.8	23.5	44.9	29.8	25.3

Sample LA99-7 6.5m Very sandy, oxidized 10YR3/4, highly calcareous, brittle, jointed, collapses when crushed between fingers.

%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
11.7	28.1	50.4	29.7	19.9

Sample LA99-7 7m	%MtxCO3	CO2(ml/g)	%Sand	%Silt	%Clay
	10.6	25.4	41.7	31.6	26.7

Sample LA99-7 9m Sandy clay loam, more clay than above, stiffer, black (5Y 3/1), highly calcareous, not too many granules or very coarse sand; dolostones on outcrop surface; iron staining along joints.

%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
11.2	26.8	42.4	39.7	17.9

Sample LA99-7 11m Sandy clay loam, as above, with less clay; very brittle, jointed, black (5Y 3/1), slight iron-staining along joints; unoxidized sand lenses in till from 9 to 11 m.

%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
11.6	27.7	42.2	38.3	19.5

Sample LA99-7 13m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	11.8	28	41	42.8	16.2

View across the road to the east shows wet, wavy silty sand beds in till, about 0.5 m thick; 5 photos taken of the outcrop and view on both sides of Hwy 881;
2 samples taken on east side of 881 at about 8.5 m and 11 m;
Sample LA99-7 8.5m

(East) till is highly calcareous; 2.5Y 4/4 olive brown

	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	10	23.9	49.8	28.8	21.4

Sample LA99-7 11m
(East) till is highly calcareous; 2.5Y 4/4 olive brown

	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	11.5	27.5	43.4	29.4	27.2

Comments: This appears to be a thick section of highly calcareous Marie Creek till, with abundant carbonates on the surface of the outcrop.

LA99-8 Longitude 110.976967 Latitude 55.730083

Unit 1: 1.5 m Section of till near well site; sample at 1.3 m is silty-sand texture; loose, not much coarse sand or pebbles; sample in the C horizon is highly calcareous; soft, easy to dig, not indurated or consolidated like till at Christina Crossing outcrop; color 2.5Y 4/4 to 4/2, olive brown to dark grey brown.

	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
Sample LA99-8 1.3m	9.1	21.7	48.9	30.7	20.4

LA99-9 Longitude 110.713383 Latitude 55.815596

Cowper Lake Road; high relief, east bank of 1.5 km wide meltwater channel, south side of road.

Unit 1: 2 - 3 m Till; silty-clayey sand texture, hard, brittle, iron-stained, very similar to till at Christina River crossing, but no reaction to HCL acid.

	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
Sample LA99-9 2.75m	0.3	73.9	25.8		

Unit 2: >1m Black shale exposed in ditch on south side of road, 2 photos taken.

LA99-10 Longitude 110.46645 Latitude 55.836279

Unit 1: Till; clay loam, sticky, not jointed or brittle, oxidized; not many pebbles, coarse sand or granules; non calcareous; mainly granite, quartzite, Athabasca Sandstone, no local rock types, very few carbonate rock types.

	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
Sample LA99-10 1.3m	1.1	2.5	48.1	18.2	33.7

SS1999-8 Longitude 111.09470 Latitude55.62036

Sand excavation pit; Aspen on edges of pit area.

SS1999-15 Longitude 112.37525 Latitude 55.48468

Clearing on west side of road; sandy-silty surface; small sand pit about 200 m from site.

SS1999-20 Longitude 112.14644 Latitude 55.65214

Sand pit along east side of road on the northern side of the House River crossing.

LA2000-1 Longitude 111.4653 Latitude 55.15233

Shallow road cut on the west side of Hwy 881, facing east. Hummocky to rolling, low to moderate relief; dominantly Black Spruce, minor Aspen, numerous organic depressions adjacent to hummocks.

Unit 1: 3m Clayey-silt, little to no sand, no pebbles or granules in matrix; fissile to weakly bedded, bedding defined by dark clayey layers about 0.5cm thick; some cobbles and boulders on surface of roadcut; very moist; color 2.5Y4/4, olive brown; on north side of hummock a 0.3m thick fine sand bed overlies a 0.2m thick till bed, which overlies >0.1m thick clean, medium sand; 2 digital photos taken; unit interpreted as glaciofluvial or glaciolacustrine origin.

LA2000-2 Longitude 111.3882 Latitude 55.18478

Appendix 1 – Surficial Geology Site Descriptions

Road cut on the east side of Hwy 881, facing west; mixed spruce and Aspen, about 15m high; hummocky to rolling, low relief.

Unit 1: >2m Till; clay loam (clayey silt), little to no coarse sand or granules, cobbles on surface, <1% pebbles dominantly quartzite with some granites.

Sample LA2000-02 2m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	16.2	38.6	17.6	41.0	41.4

LA2000-3 Longitude 111.2233 Latitude 55.36358

Road cut on east side of Hwy 881; numerous pines, 6-10m high; rolling, low relief.

Unit 1: >3m Till; clay loam, estimate 30-35% fine sand, 40% silt, 25-30% clay; rilling on surface; 1% pebbles, metaquartzites; color 10YR3/3 dark brown; very weak reaction to HCL acid.

LA2000-4 Longitude 110.8433 Latitude 55.535

Helicopter stop on intersection of cut lines; hummocky, low relief; dominantly Jack Pine, minor spruce, abundant Caribou moss; wetlands cover about 50% of area; surface looks sandy; hand auger sampling.

Unit 1: 0.2m Ae soil horizon; loamy sand.

Unit 2: 0.4m Sandy loam; faint beds of clean, medium sand; estimate 65% sand, 30% silt, 5-8% clay; numerous cobbles in auger hole, Athabasca Sandstone, granite; material looks like very poorly sorted glaciofluvial sediment, with a till-like appearance (loamy sand diamicton); color 10YR5/4 yellow brown.

Sample LA2000-04 0.2 – 0.6m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	1.5	3.4	57.7	14.7	27.6

LA2000-5 Longitude 110.5943 Latitude 55.58902

Helicopter stop on edge of drill pad near gas well collector site; mix of spruce, Aspen, pine, and Labrador tea; hummocky moderate relief (5-6m), well drained with wetland depressions about 200m distance.

Unit 1: 0.4m Ae soil horizon; loamy sand with a few stones

Unit 2: >05m Sandy diamicton (till); estimate 50-60% sand, 30% silt, 10% clay; stiffer, more cohesive with depth; <1% pebbles; numerous Athabasca Sandstone boulders on surface, a few granites; color 10YR4/4 dark yellow brown.

Sample LA2000-05 0.6-0.9m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	0.9	2.2	46.6	20.7	32.7

LA2000-6 Longitude 110.4386 Latitude 55.61855 DLS 14-29-76-3W4

Helicopter stop at gas well site; mixed spruce and Aspen, 10-15m high; undulating, low relief; numerous Athabasca Sandstone boulders on surface, some granites.

Unit 1: 0.1m Moss.

Unit 2: 0.2m Ae soil horizon; loamy sand.

Unit 3: 0.55m Till; sandy loam, estimate 40-50% sand, 30-35% silt, 20-25% clay; 1-2% pebbles, very weakly calcareous at 0.8m from land surface; numerous white sand partings in till sample (these may be fracture infills with white loamy sand from Ae horizon above); color 10YR ¾ dark yellow brown.

Sample LA2000-06 0.5-0.9m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	0.9	2.2	44.8	20.9	34.3

LA2000-7 Longitude 110.2782 Latitude 55.59218

Helicopter stop on edge of north-south cut line; mix of Sphagnum moss, Black Spruce, and Labrador tea, with Caribou moss on surface; undulating low relief.

Unit 1: 0.1m Peat and organic soil.

Unit 2: 0.15m Ae soil horizon; loamy sand.

Unit 3: 0.65m Till; a few iron oxide blebs; some clay or shale clasts; more clayey than till at sites LA2000-5 and LA2000-6; no reaction to HCL acid at 0.75m from land surface; color 2.5Y4/2 dark grey brown.

Relocate to site 10m to east
Unit 1: 0.1m Peat.
Unit 2: 0.6m Pebbly silt; minor sand; glaciofluvial origin.
Unit 3: >0.1m Till.
Discontinuous veneer of glaciofluvial sediment on till.

LA2000-8 Longitude 110.1082 Latitude 55.5268
Helicopter stop on old burn site; hummocky, moderate to high relief; 15-20 year-old Jack pine.
Unit 1: 0.15m Ae soil horizon; loamy sand, ashy white; oxidized rusty red at 0.15-0.2m down; boulder in auger hole.
Unit 2: 0.75m Silty to clayey-silt loam; 10YR4/4 dark yellow brown.

Sample	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
Sample LA2000-8a 0.7-0.9m	1.3	3	16.2	46.2	37.6

Unit 3: 0.2m Silty clay; clay rip-up clasts; no stones; color 2.5Y3/2 dark grey brown.
Unit 4: 0.25m Till; sandy clay loam, estimate 40-45% sand, 30-40% silt, 15-20% clay; some rusty iron oxide blebs, black carbonaceous blebs; 1-2% pebbles.

Sample	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
Sample LA2000-8b 1.1-1.25m	9.1	21.8	41.3	31.7	27

Comments: About 1m of glaciolacustrine or glaciofluvial sediment on till.

LA2000-9 Longitude 110.0775 Latitude 55.64543
Helicopter stop; shows evidence of old fire burn; undulating whaleback, low relief; pines on ridge and spruce in low areas; well drained site, Caribou moss on surface.
Unit 1: 0.2m Ae soil horizon; Sand; color 7.5Y7/2 pinkish grey.
Unit 2: 0.2m Bm soil horizon; Sand; medium to coarse, pebbly with cobbles.
Unit 3: 0.2m Sand; pebbly, medium to coarse sand; auger stopped on stones at 0.6m from surface; color 2.5YR4/6 red.
Comments: Augured three times and stopped on stones each time at about 0.7m down. Glaciofluvial deposit.

LA2000-10 Longitude 110.1589 Latitude 55.79065
Helicopter stop at a logged burn site; undulating to rolling, low to moderate relief; dominantly Aspen with minor spruce and pine.
Unit 1: 0.05m LFH soil horizon.
Unit 2: 0.2m Ae soil horizon; sand, fine to medium, boulders at base of Ae horizon.
Unit 3: 0.95m Sand, fine, very well sorted, no pebbles, color 10YR6/4 light yellow brown.

Relocated 10m north and augured new hole.
Unit 1: Ae soil horizon, sand, fine.
Unit 2: Bm1 soil horizon, sand.
Unit 3: 0.2m Bm2 soil horizon (0.5m from surface); fine sandy silt.
Unit 4: 0.1m Bm3 soil horizon, medium sand.
Unit 5: 0.1m Bm4 soil horizon, clayey diamictons.
Unit 6: 0.25m Bm5 soil horizon, fine to medium sand.

Relocated 100m west on edge of logged area.
Unit 1: 0.05m LFH soil horizon.
Unit 2: 0.25m Ae soil horizon; stony loamy sand.
Unit 3: 0.5m Till; clay loam, with inclusions of fine to medium sand, clay clasts, and clay layers
Unit 4: >0.1m Till; mostly clay, looks like shale incorporated into till; mottled; a few pebbles; see site LA98-1 north of Winefred Lake along Winefred River).

Appendix 1 – Surficial Geology Site Descriptions

Sample LA2000-10 0.3-0.8m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	1.5	3.4	43	12.9	44.1

LA2000-11 Longitude 110.2305 Latitude 55.98373

Helicopter stop in Black Spruce bog adjacent to pine-covered hummock, flat to very low relief, Labrador tea and Caribou moss.

Unit 1: 0.07m LFH soil horizon.
Unit 2: .63m Clayey silt with rounded black clay clasts 1-3mm in size; brown colored; 1 or 2 pebbles; no coarse sand or granules
Unit 3: 0.4m Clay; black; numerous rounded clay clasts.

Sample LA2000-11

Comments: This is either a lacustrine silty clay deposit with debris flow rip-up clasts of clay, or it is till derived from black shale with comminuted rounded clasts of shale and a few sandstone, quartzite and granite pebbles.

Relocated to nearby bog.

Unit 1: 0.5m Of soil horizon; fibrous peat.
Unit 2: 0.1m Sandy clay loam; lacustrine sediment?

LA2000-12 Longitude 110.501 Latitude 55.95375

Helicopter stop at the Cowper Tower air strip; elevation 546m; high point on major upland ridge

Unit 1: 0.2m Ae soil horizon; sand, fine to medium.
Unit 2: 0.3m Bm soil horizon; sand, fine, color reddish-brown.
Unit 3: 0.7m BC soil horizon; sand, fine, well sorted, color light yellow brown.

Comments: Glaciofluvial deposit

LA2000-13 Longitude 110.5094 Latitude 55.88207

Helicopter stop at cleared gas well site; Black Spruce, flat to low relief, boulders at surface.

Unit 1: 0.2m Ae soil horizon; fine sand.
Unit 2: 0.7m Sand; fine, grading to loamy sand with depth.
Unit 3: >0.1m Till; sandy clay loam; soft and very sandy.

Comments: Glaciofluvial veneer on till.

LA2000-14 Longitude 110.5568 Latitude 55.77337

Helicopter stop at recent burn site; flat to undulating low relief; numerous boulders on surface (lag?), Athabasca Sandstone, gneisses

Unit 1: 0.07m LFH soil horizon.
Unit 2: 0.13m Ae soil horizon; medium sand, cobble concentrations at base of Ae.
Unit 3: 0.8m Sand, pebbly, medium, moderately well sorted; wet at bottom of hole.

Comments: Glaciofluvial deposit.

LA2000-15 Longitude 110.7464 Latitude 55.77563

Helicopter stop along pipeline; hummocky to rolling, low to moderate relief, mixed Aspen and spruce.

Unit 1: 0.07m LFH soil horizon.
Unit 2: 0.28m Ae soil horizon; sand, color pinkish light grey.
Unit 3:).55m Bm soil horizon; sand, medium, very well sorted, color yellow brown; no pebbles or granules

Comments: Glaciofluvial? Aeolian?

LA2000-16 Longitude 110.8775 Latitude 55.72173

Helicopter stop along right-of-way on road to gas plant; hummocky moderate relief.

Unit 1: 0.05m LFH soil horizon.
Unit 2: 0.3m Ae soil horizon; sand, medium, one or two pebbles.

Unit 3: 0.25m B horizon; sand, medium well sorted, a few pebbles.
Unit 4: >0.4m Till; sand loam to sandy clay loam; crumbles when crushed between fingers; estimate 60-70% sand, 20-30% silt, 10% clay; <1% pebbles.

Sample LA2000-16 0.7-1.0m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	0.9	2.1	35.5	32.7	31.8

LA2000-17 Longitude 111.2518 Latitude 55.84347

Helicopter stop on very sharp relief ridge, 3-4m high, with organic bog to east and west of site; 6m drop-off on east side of ridge; lowland on west side of ridge may be a glacial meltwater channel; spruce in lowland, Aspen on slopes, pine on ridge.

Unit 1: 1m Sand; fine, silty, no granules or pebbles; color 10YR5/6 yellow brown.
Unit 2: 0.25m Till; sandy clay loam; estimate 45% sand, 30% silt, 25% clay; brittle; abundant coarse sand and limestone and dolostone granules; calcareous matrix, with moderate to strong HCL reaction; iron oxide blebs; color 2.5Y4/3 olive brown; looks like till at Christina River crossing on Hwy 881 (see LA99-7); similar to Marie Creek till in Cold Lake area.
Sample LA2000-17

Relocated to bog east of site
Unit 1: 0.5m Of soil horizon; fibrisol.
Unit 2: 0.7m Silty loam; recent lacustrine deposit; black organic rich zone (Ohg) from 0.5 to 1m down from surface; sand lenses in bottom 0.2m of hole.

LA2000-18 Longitude 111.2929 Latitude 55.90562

Helicopter stop at a cleared well site; site is a poorly drained flat Sphagnum-Black Spruce bog with Caribou moss and minor Aspen

Unit 1: 0.15m Peat.
Unit 2: 0.4m Sand; silty, medium, grading to fine with depth; a few pebbles and cobbles (gneiss); gleyed, iron oxide blebs.
Unit 3: 0.45m Till; sandy clay loam, estimate 45% sand, 35% silt, 20-25% clay; very moist, soft; 1% pebbles; a few local bedrock siltstone clasts; iron oxide and black carbonaceous (manganese?) staining; no reaction to HCL acid; color 2.5Y4/2 dark grey brown.

Sample LA2000-18 0.55m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	0.9	2.1	43.5	22.6	33.9

Comments: Glaciofluvial veneer on till.

LA2000-19 Longitude 111.1825 Latitude 55.9881

Helicopter stop at gas well lease site; undulating to rolling, low relief; moderately well drained; dominantly spruce, minor birch, pine, Aspen; Caribou moss at surface; auger hole at edge of lease, in trees.

Unit 1: 0.07m LFH soil horizon.
Unit 2: 0.68m Silty loam to very fine sandy loam; a few pebbles; color 10YR4/4 dark yellow brown; interpreted as a fluvial or lacustrine unit.

Sample LA2000-19a 0.07-0.75m	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	0.9	2.1	52.8	25.4	21.8

Unit 3: 0.45m Till; sandy loam, estimate 70% sand, 20% silt, 10% clay; abundant 1-2mm thick sand lenses giving unit a stratified appearance; <1% pebbles; iron oxide blebs; color 2.5Y4/2 dark grey brown; extremely sandy till (Gipsy till?).

Sample LA2000-19b 0.75-1.2m	%MtxCO_3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	0.9	2.1	56.3	19.6	24.1

Relocated 40 m east of site.

Appendix 1 – Surficial Geology Site Descriptions

Unit 1: 0.6m Sand, pebbly, loamy, massive; looks like till; Athabasca Sandstone, granite boulders on surface of lease.

LA2000-20 Longitude 111.1365 Latitude 56.07765

Helicopter stop at gas well lease site; flat, wet, poor drainage; dominantly Black Spruce and Sphagnum.

Unit 1: 0.75m Of; fibric organic soil profile.
Unit 2: 0.25m Oh; humic organic soil profile.
Unit 3: 0.25m Silty clay; gleyed, noncalcareous; sticky; recent lacustine sediment.

LA2000-21 Longitude 111.003 Latitude 56.14838

Helicopter stop at abandoned gravel pit, excavated at least 5m deep; hummocky moderate to high relief; 12-15m high pine, some Aspen Labrador tea on ground surface; auger site is about 40m west of gravel pit on side of hummock; well drained.

Unit 1: 1m Silty loam; faint bedding on auger-flyte samples; 1 or 2 pebbles near top of unit; glaciofluvial deposit

Unit 2: Till; Silty clay loam; very soft, sticky; not much coarse sand; some iron and manganese oxide blebs; <<1% pebbles; color 2.5Y 4/3 olive brown; appears to be gradational contact between silty loam and till.

Gravel Pit Description

Unit 1: 2-3m Sand; well stratified; fine to medium; normal faulting visible in horizontal beds, some deformed beds; dark beds of loamy sand with iron oxide concretions
Unit 2: >3m Gravel, coarse; digital photo taken, 5 35mm slides.
Comments: Ice-contact glaciofluvial kame deposit

LA2000-22 Longitude 111.1611 Latitude 56.26458

Helicopter stop at gas well site; hummocky, moderate to high relief; dominantly Aspen; many large boulders on surface, some limestone; well drained, with mossy ferns on surface.

Unit 1: 0.1m LFH soil horizon.
Unit 2: 0.55m Till; sandy loam; stony layer at the Ae-Bm soil contact

Sample LA2000-22 0-0.65m	%MtxCO_3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	0.9	2.1	36.4	28.1	35.5

Unit 3: 0.5m Sand; medium, well sorted, 1 to 2 pebbles.
Unit 4: >0.1m Till; sandy loam; estimate 70% sand, 20% silt, 10% clay, 1% pebbles; Ck soil horizon, strongly calcareous; color 2.5Y4/3 olive brown.

Comments: Sandy gravelly surface of lease site and nearby pipeline suggests this area may be an ice-contact glaciofluvial map unit.

Relocate 100m west of lease along pipeline.

Unit 1: >1m Sand, medium, pebbly; granite clasts; interpreted as ice-contact glaciofluvial kame complex.

LA2000-23 Longitude 111.4535 Latitude 56.22528

Helicopter stop at gas well lease site; undulating, low relief; mainly spruce; moderately well drained, creek to west.

Unit 1: 0.1m Peat.
Unit 2: 0.55m Silty loam; clast free; soft, color 2.5Y5/4 light olive brown.
Unit 3: 0.25m Silty clay; mottled, color dark grey brown to olive brown; clay clasts in clay matrix.
Unit 4: 0.15m Till; sandy clay loam, estimate 50-60% sand, 25% silt, 15% clay; <1% pebbles; iron oxide blebs; color 2.5Y4/3 olive brown.

Sample LA2000-23 0.9m	%MtxCO_3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	0.9	2.1	36.4	28.1	35.5

Unit 5: 0.15m Silty clay; stratified, well defined, finely bedded layers, eigen shaped clay lenses 2mm thick.

Comments: Complex looks like water-laid sediments including diamicton (till); interpreted as a glaciolacustrine sedimentary complex.

Appendix 1 – Surficial Geology Site Descriptions

LA2000-24 Longitude 111.5858 Latitude 56.13798

Helicopter stop at gas well lease site; old burn site; undulating, low relief, shallow hummock (4m relief) about 100m to east; stones on surface, new growth pine, Black Spruce; poorly drained site.

Unit 1: 0.08m LFH soil horizon

Unit 2: 0.27m Bm soil horizon; silty loam; no pebbles, color yellow brown

Unit 3: 0.65m Till; silty clay loam, estimate 50% sand, 25-30% silt, 15-20% clay; numerous sand lenses, abundant clay (shale?) clasts; <1% indurated pebbles; iron and manganese oxide blebs; very moist, soft.

Sample LA2000-24 0.5-1m	%MtxCO_3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	1.1	2.6	33.7	31.2	35.1

Comments: Glaciolacustrine veneer on till.

LA2000-25 Longitude 111.6072 Latitude 56.03908

Helicopter stop in a naturally cleared old burn site; 2-3m tall pines, spruce in wetlands nearby; shallow hummock about 1-1.3m high, surrounded by Black Spruce bog, numerous cobbles and boulders at surface.

Unit 1: 0.45m Sand; medium, with 1 or 2 pebbles; bedded; iron oxide concretions; color 10YR5/8 yellowish brown

Unit 2: 0.15m Sandy clay loam; diamicton; dark grey brown; iron oxide nodules in upper part; 1% pebbles and granules.

Unit 3: 0.65m Sand; coarse, glacial, very well sorted, some clayey silt lenses 0.5cm thick; wet; oxidized to bottom of interval.

Comments: Glaciofluvial deposit, possibly near glacier source (diamicton layer)

LA2000-26 Longitude 111.8526 Latitude 55.94457

Helicopter stop at logged burn site; rolling low relief.

Unit 1: 0.03m LFH soil horizon.

Unit 2: 0.3m Aeg soil horizon; gleyed silty sand.

Unit 3: 0.25m Btj soil horizon; silty loam; a few coarse clasts.

Unit 4: 0.4m Till; clay loam, estimate 30-35% sand, 30-35% silt, 25-30% clay; dense, stiff; abundant local siltstone fragments, some clay (shale?)-rich clasts; iron and manganese oxide blebs; 1-2% pebbles and granules, some granite, local bedrock; color dark grey brown.

Sample LA2000-26 0.5-0.9m	%MtxCO_3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	1.1	2.6	35.9	26.4	37.7

Comments: Glaciolacustrine veneer on till.

Relocate 150m east of site along logging trail.

Unit 1: 0.4m Silty loam; some pebbles and cobbles at base of unit; color olive brown

Unit 2: 0.1m Till; clay loam; stiff.

Comments: Glaciolacustrine veneer on till.

LA2000-27 Longitude 111.7134 Latitude 55.83442

Helicopter stop at well site; rolling, low relief; mix of Aspen, spruce, pine, some Birch

Unit 1: 0.25m Peat, thin (3-5cm) Ae soil horizon at base of interval

Unit 2: 0.4m Silty sand; till?; a few pebbles; possibly a transition between soil horizons A&B; no Bt horizon observed.

Unit 3: 0.2m Till; sandy clay loam; sandier than till at site LA2000-26; 1-2% pebbles; a few thin sand lenses; iron oxide blebs.

LA2000-28 Longitude 111.7745 Latitude 55.73723

Helicopter stop at north end of well site; undulating to hummocky, moderate relief, dominantly spruce and pine; well drained

Unit 1: 0.03m LFH soil horizon.

Unit 2: 0.03m Ae soil horizon.

Appendix 1 – Surficial Geology Site Descriptions

Unit 3: 0.59m Bm soil horizon; sand; fine to medium, some silt; compact structure; iron oxide concretions; color 10YR5/8 yellow brown.
Unit 4: 0.5m BC soil horizon; sand; well sorted, fine to medium, no pebbles or granules
Comments: Well sorted medium sand – glaciofluvial? aeolian?

LA2000-29 Longitude 111.5751 Latitude 55.68902
Helicopter stop at intersection of pipeline and well site; flat; Black Spruce bog; wet
Unit 1: 0.6m Peat
Unit 2: 0.1m Aeg soil horizon; sandy loam
Unit 3: 0.3m Till; sandy clay loam; 1% pebbles; abundant sand in matrix; stiff, plastic; gleyed

Sample	%MtxCO3	CO_2 (ml/g)	%Sand	%Silt	%Clay
LA2000-29 0.7-1m	1.3	3	47.4	19.6	33

LA2000-30 Longitude 111.5234 Latitude 55.58447
Helicopter stop at intersection of cut lines; flat, poorly drained; mix of Black and White Spruce, Larch, some pine, and Caribou moss on ground.
Unit 1: 0.1m Peat.
Unit 2: 0.1m Ae soil horizon; sandy loam, pebbles at contact with B horizon.
Unit 3: 0.6m Btjg soil horizon developed on till, silty-clay loam texture, estimate 70% sand, 20% silt, 10% clay; some stones; manganese oxide blebs.
Unit 4: 0.3m Sand; medium to coarse, silty, gritty.
Comments: Till veneer on glaciofluvial outwash.

LA2000-31 Longitude 111.6918 Latitude 55.142083
Roadside outcrop.
Unit 1: 5m Sand; medium to coarse, cobble horizon 2.5m down from top of unit
Comments: Glaciofluvial deposit.

LA2000-32 Longitude 111.714917 Latitude 55.1514333
Abandoned gravel pit; ridged to hummocky topography.
Unit 1: >6m Sand and gravel; 1cm to 4cm sized gravel; medium to coarse sand, some granules
Comments: Looks like an esker ridge, ice-contact glaciofluvial deposit.

LA2000-33 Longitude 111.00611 Latitude 55.6004
Road cut exposure; 2-3 m high Aspen and pine growth; 1 photo taken.
Unit 1: >2.5m Sandy diamicton and sand; poorly sorted, dirty glaciofluvial deposit with well sorted sand lenses.

LA2000-34 Longitude 110.98249 Latitude 55.5957
Road stop at old drill site; clover covered; hand auger sample description.
Unit 1: 0.4m Silty sand; pebbly; glaciofluvial deposit.

LA2000-35 Longitude 110.97531 Latitude 55.58727
Road stop at large cleared well site; hand auger sample description; 1 digital, 1- 35mm photo.
Unit 1: 0.4m Till; sandy loam, estimate 60% sand, 30% silt, 10% clay.

LA2000-36 Longitude 110.87767 Latitude 55.51328
Clover-covered site, Aspen and spruce nearby; hand auger sample description; 1- 35mm photo
Unit 1: 0.5m Sand, fine, pebbly, loose, soft; glaciofluvial deposit

LA2000-37 Longitude 110.8434 Latitude 55.45875
Abandoned sand pit on south side of road; very well drained; 1- 35mm photo; looks like ice-contact glaciofluvial kame deposit.

Appendix 1 – Surficial Geology Site Descriptions

LA2000-38 Longitude 110.727933 Latitude 55.464467
Outcrop along east side of road; organic areas nearby.
Unit 1: 5m Sand, silty, grading to silty coarse sand at base of unit; glaciofluvial deposit.

LA2000-39 Longitude 110.719917 Latitude 55.473483
Outcrop on east side of road, about 400m north of Kirby Gas Plant, at junction with east-west road.
Unit 1: 3.5m Till; sandy loam, estimate 70% sand, 20% silt, 10% clay; a few sand lenses about 0.5-1cm thick.

Sample LA2000-39 1.3m	%MtxCO_3	CO_2 (ml/g)	%Sand	%Silt	%Clay
	10	23.9	50.8	24.7	24.5

LA2000-40 Longitude 110.70645 Latitude 55.472433
Abandoned drill site on northeast side of road; alfalfa and clover covered; 1- 35mm photo.
Unit 1: Gravelly sand exposed in outcrop on southwest side road; pebbly medium sand; glaciofluvial deposit.

LA2000-41 Longitude 110.6459 Latitude 55.455583
Outcrop along east side of road.
Unit 1: 1m Clayey silt; weathers buff brown; glaciolacustrine deposit.
Unit 2: 0.15m Silty clay; very dark grey brown to black; glaciolacustrine.
Unit 3: 1.35m Till; sandy loam, estimate 70% sand, 20% silt, 10% clay, 1% pebbles.
Comments: Glaciolacustrine veneer on till.

LA2000-42 Longitude 110.6097 Latitude 55.364933
Clearing on south side of road; 2-3m Aspen and pine growth; hand auger sample description
Unit 1: 0.3-0.4m Loamy sand; cobbles.
Unit 2: 0.2m Till; sandy clay loam; coarse lag veneer on till surface.

LA2000-43 Longitude 111.039767 Latitude 55.7275
At approach west of Hwy 881, along a logging trail adjacent to the Christina River; 15-20m tall Aspen; hummocky, moderate relief.

LA2000-44 Longitude 110.917233 Latitude 55.746883
Aggregate stockpile site 60m east of Hwy 881, on Talisman Road (North Winefred); 1- 35mm photo; looks like till in outcrops.

LA2000-45 Longitude 110.761 Latitude 55.627433
Gravel stockpile site and pit along the north flank of the Christina meltwater channel complex; digital photo taken.

LA2000-48 Longitude 111.2772 Latitude 55.66806
Grassy, clover clearing on east side of road; gentle incline to north, low relief; silty sand exposed at surface; 1 digital photo, 1- 35mm slide.

LA2000-49 Longitude 111.41625 Latitude 55.598383
Hummocky, low relief; spruce and pine on hummocks.
Unit 1: 0.7m Sand; silty, medium grained, stony
Unit 2: 0.2m Diamicton and sand; sandy clay diamictons (till?) bed.
Unit 3: 0.2m Sand; medium grained.
Comments: Ice-contact glaciofluvial deposit.
.
LA2000-50 Longitude 111.361333 Latitude 55.6981
Gas lease site; 6m high outcrop on southwest side of lease, along meltwater channel.
Unit 1: 6m Silty clay with iron oxide nodules.
Comments: Interpreted as glacially displaced block of shale

Appendix 1 – Surficial Geology Site Descriptions

Relocate to outcrop about 300m east along road; Longitude 111.3576 Latitude 55.6979

Unit 1: 5m — Shale; bedded, dark brown to black silty clay with pale olive (5Y 6/4) layers (0.5cm) of bentonite; beds are discontinuous in outcrop, mostly horizontal; a few pebbles and cobbles on surface of fresh outcrop (rounded quartzite, quartz sandstone); 2 digital photos, 3- 35mm photos.

Sample LA2000-50 3m	%MtxCO$_3$	CO_2 (ml/g)	%Sand	%Silt	%Clay
	1.1	2.6	1.7	80.8	17.5

Comments: Interpreted as glacially displaced block of shale bedrock.

LA2000-51 Longitude 111.239033 Latitude 55.683983

2m high outcrop along east side of road.

Unit 1: 2m — Till; clay loam; dark grey brown; much more clayey and darker colored than the till east of Conklin community; possibly enriched with shale and siltstone on the top of Stony Mountain.

LA2000-52 Longitude 111.32955 Latitude 55.450966

Adjacent to abandoned railroad siding at Margie; well drained, undulating to hummocky, low relief, clover covered.

LA2000-53 Longitude 111.324266 Latitude 55.446683

Road side outcrop

Unit 1: 1.5m — Till; clay loam to loam; numerous sand lenses; olive brown; less clayey and more olive brown colored than till at LA2000-51.

LA2000-58 Longitude 110.796867 Latitude 55.8157

Road side outcrop; 1- 35mm photo.

Unit 1: 0.3m — Discontinuous boulder lag on surface.

Unit 2: 1.1m — Sand, well bedded, pebbly, moderately well sorted, medium grained; oxidized.

Unit 3: 0.15m — Sand; fine, darker grey than above, bedded.

Unit 3: 0.65m — Sand; medium grained, bedded as above, fining with depth.

Unit 4: 0.4m — Sand; medium to coarse, pebbly, stony; oxidized; poorly bedded; some boulders.

Unit 5: 0.4m — Till; fine sandy loam; wavy, irregular contact with overlying sand; abundant lenses and inclusions of fine sand and silt; very weakly calcareous; 1% pebbles; possibly thick sand bed beneath till, but covered by colluvium.

Comments: Interpreted as ice-contact glaciofluvial and morainal complex (kame-moraine).

LA2000-59 Longitude 110.697433 Latitude 55.820666

Outcrop on north side of road; rolling, moderate relief; Aspen.

Unit 1: 0.6-2.5m — Till; loam to fine sandy clay loam; 2.5Y 4/2 dark grey brown; irregular contact with underlying sand.

Unit 2: 0-2.2m — Sand; medium grained, a few stones.

LA2000-60 Longitude 110.6615 Latitude 55.815633

Observation along logging trail.

Unit 1: 0.6m — Sand; fine to medium grained.

LA2000-61 Longitude 110.556167 Latitude 55.815633

Abandoned construction camp; sandy surface; well drained, slopes to the east; 2 digital photos

Unit 1: 0.6m — Boulders, sand, cobbles

Unit 2: 0.8m — Till; sandy clay loam; soft moist, sticky; <1% pebbles and granules; color 2.5Y4/2 dark grey brown

Sample LA2000-61 0.6-1.4m	%MtxCO$_3$	CO_2 (ml/g)	%Sand	%Silt	%Clay
	1.3	3	44.8	27.3	27.9

LA2000-62 Longitude 110.415167 Latitude 55.8596

Observation of outcrop along south side of newly constructed road

Unit 1: 3-4m — Sand, stony.

Appendix 1 – Surficial Geology Site Descriptions

LA2000-63 Longitude 110.34265 Latitude 55.866767

Observation of outcrop on north side of newly constructed extension of Cowper Road.

Unit 1: 10m Gravelly sand; outcrop dressed with till with prevent erosion of underlying sand.

LA2000-64 Longitude 110.3194 Latitude 55.860233

Borrow pit on north side of road.

Unit 1: 3-4m Till; no sand visible.

LA2000-65 Longitude 110.28035 Latitude 55.850583

Undulating to rolling, low relief; dominantly spruce; large boulders on surface.

Unit 1: 0.45m Ae soil horizon; sandy loam to loamy sand.

Unit 2: 0.4m Till; fine sandy clay loam; color 2.5Y4/2 very dark grey brown; mottled, gleyed; pebbles <1%; sticky, plastic, moist; abundant clay in matrix.

	%MtxCO_3	CO_2 (ml/g)	%Sand	%Silt	%Clay
Sample LA2000-65 0.85m	1.1	2.6	47.6	17.1	35.5

Comments: Not like the sandy Gipsy till that L. Bayrock described in the region in the early 1970's.

LA2000-67 Longitude 110.999183 Latitude 56.091483

Gravel pit exposed in hummock on the north side of road; 1 digital photo.

Unit 1: 4-5m Gravel; cobbly.

LA2000-68 Longitude 111.033167 Latitude 56.0991

Observation along road; hummocky; 1 digital photo.

Unit 1: Gravel; boulders; poorly sorted; glaciofluvial deposit.

Comments: Glaciofluvial gravel observed along road from LA2000-67 to 68.

LA2000-69 Longitude 111.0514666 Latitude 56.10425

Gravel pit and stockpile; 2 digital photos, 5- 35mm photos.

Unit 1: 8-10m Sand and grave; boulders.

Comments: Similar to site LA2000-21 to the north of this site; ice-contact glaciofluvial deposit.

LA2000-70 Longitude 110.875017 Latitude 56.150583

Reclaimed sand pit, flat to rolling; well drained; glaciofluvial deposit.

LA2000-71 Longitude 111.0269 Latitude 56.38615

Borrow pit on east side of Hwy 881; 1 digital photo.

Unit 1: 3m Shale; Clearwater Formation?; black, silty clay; fissile; olive brown to grey silt partings; locally capped by 1m thick indurated silty sand (sandstone?) which forms 'mini hoodoos'; some granite pebbles on surface suggest unit may be glacially modified, or possibly displaced, shale and sandstone.

LA2000-72 Longitude 110.966883 Latitude 56.318117

Recently cleared construction staging site on west side of Hwy 881; flat; poor to moderate drainage; 1 digital photo; looks like clayey till at surface.

LA2000-73 Longitude 110.955967 Latitude 56.30245

Gravel stockpile on west side of Hwy 881; well drained, flat; 1 digital photo; no visible geology.

LA2000-74 Longitude 110.921383 Latitude 56.245283

Small clearing on north side of road; clover, small Aspen; 1 digital photo; sandy surface.

Appendix 1 – Surficial Geology Site Descriptions

LA2000-76 Longitude 110.95875 Latitude 56.228567
About 10 hectare gravel pit and stockpile area; 1 digital photo.
Comments: Looks like same glaciofluvial sand and gravel complex as seen at LA2000-21, and LA2000-68.

LA2000-77 Longitude 110.8863 Latitude 55.567467
Outcrop section along south side of lease road.
Unit 1: 4m Silty sand; medium grained; bedded with sandy diamicton layers; very poorly stratified to massive outcrop appearance.
Comments: Interpreted as either very poorly sorted glaciofluvial outwash deposit, or very sandy till.

LA2000-78 Longitude 110.9079 Latitude 55.55555
Outcrop along west side of road; described from mid point of section
Unit 1: 5-6m Till; sandy clay loam, estimate 45-50% sand, 30% silt, 20% clay; fractured with iron staining along fracture faces;

LA2000-79 Longitude 110.8544 Latitude 55.462417
Outcrop on north side of road; pine, spruce, minor Aspen.
Unit 1: 2.5m Till; sandy loam to sandy clay loam, estimate 50% sand, 25-30% silt, 15-20% clay; soft, easy to dig.

LA2000-80 Longitude 110.737117 Latitude 55.458817
Outcrop along road.
Unit 1: 2.5m Sand; gravelly with large inclusions of very dark grey brown sandy loam diamicton (till?); ice-contact glaciofluvial deposit.

LA2000-81 Longitude 111.28765 Latitude 55.761667
Outcrop on west side of road; mixed Aspen and spruce.
Unit 1: 1.5m Silty clay; very dark brown to black with beds of very dark brown clayey silt; discontinuous beds overlying till(?).
Comments: Site interpreted as glacially displaced shale and siltstone (see site LA2000-50).

LA2000-82 Longitude 111.315417 Latitude 55.8039
Outcrop along east side of road
Unit 1: 2.3m Gravelly sand; till inclusion at base of unit (sandy clay loam, estimate 50-60% sand, 25-30% silt, 10-15% clay)

LA2000-83 Longitude 110.7619 Latitude 55.627533
Esker ridge oriented parallel to Christina Lake meltwater channel complex; about 20 digital and 35mm slide photos taken.
Unit 1: 10-12m Gravel; collapse structures in flanks of esker gravel indicate ice-contact glaciofluvial origin.

LL2000-1 Longitude 111.46675 Latitude 55.1519
Shallow outcrop on west side of road; flat to rolling, low to moderate relief; dominantly Black Spruce, minor Aspen.
Unit 1: 2-3m Clayey silt; faintly bedded; color 2.5Y4/4 olive brown.
Comments: North part of outcrop displays beds of sand, fine to medium grained, well sorted, as well as blocks of diamicton (till) with very few granules or pebbles. Site interpreted as ice-contact glaciofluvial deposit.

LL2000-2 Longitude 111.08665 Latitude 55.616267
South flank of meltwater channel directly west of Christina Lake; 3-4 m relief; mixed Aspen and spruce, with sedges and Black Spruce in floor of channel.
Unit 1: 3-4m Sand; medium to fine, massive, oxidized; <1% pebbles to granule size clasts; glaciofluvial deposit.

Appendix 1 – Surficial Geology Site Descriptions

LL2000-3 Longitude 111.046667 Latitude 55.6123

Outcrop on south side of road, on upper part of meltwater channel near site LL2000-2; mixed Aspen and spruce; gently undulating, low relief.

Unit 1: 2.5m Sand; fine to medium, massive; unoxidized; moist; very few stones; rare cobble and boulder.

Unit 2: Till; sandy loam; very few stones (<1% granules, pebbles); some limestone and sandstone boulders; pebbles include Athabasca Sandstone, limestone, granite, gneiss.

Comments: Glaciofluvial outwash on till.

LL2000-4 Longitude 110.956983 Latitude 55.5821

Site along road side; flat, low relief; mainly spruce, some pine.

Unit 1: Sand; medium grained, massive; slightly oxidized; no pebbles or granules; glaciofluvial deposit.

LL2000-5 Longitude 110.908983 Latitude 55.556683

Site along road side; gently undulating to rolling, low relief; mix of Aspen, spruce, some pine.

Unit 1: Till; sandy loam; color 2.5Y4/4 olive brown; 1-2% granules; pebbles and cobbles on surface (sandstone, granite, some limestone, rounded to sub angular).

LL2000-6 Longitude 110.886183 Latitude 55.5091

Site on northwest side of road; rolling, low to moderate relief; mostly Aspen, some spruce.

Unit 1: Till; sandy loam; 1-2% granules; pebbles and cobbles on weathered surface.

LL2000-7 Longitude 110.8747 Latitude 55.478816

Observation along road side; hummocky, moderate relief (5-6m).

LL2000-8 Longitude 110.901383 Latitude 55.473433

Observation on west side of road; flat to gently undulating, low relief; mostly spruce, some pine and Aspen; located on small knob that lies above adjacent organic area.

Unit 1: Sand; medium to coarse, trace of silt, no pebbles; glaciofluvial deposit.

LL2000-9 Longitude 110.7357 Latitude 55.3753

Observation on southwest side of road; rolling to hummocky; open pine forest with patchy Caribou moss; pines up to 10m high.

Unit 1: Sand; medium; oxidized, color 10YR5/8 yellowish brown; no stones; glaciofluvial deposit.

LL2000-10 Longitude 110.515683 Latitude 55.432833

Near shoreline of Winefred Lake; rolling topography; mostly spruce, some Aspen; shovel pit.

Unit 1: Sand; fine to medium, some silt, no pebbles; glaciofluvial deposit.

LL2000-11 Longitude 110.455033 Latitude 55.39295

North shore of Grist Lake; flat to rolling; mix of spruce, pine, Aspen, birch.

Unit 1: Sand; medium with discontinuous lenses of black (charcoal?) and more oxidized sand; glaciofluvial deposit.

LL2000-12 Longitude 110.456133 Latitude 55.393783

Auger sample description at base of small hummock, northeast side of road; rolling to hummocky, low relief (<3m); spruce, pine, a few Aspen, some willow and birch.

Unit 1: 1m Sand; medium; glaciofluvial deposit.

LL2000-13 Longitude 110.459433 Latitude 55.396117

North side of road on 6-8m high ridge, trending 247^0, steep side on north face; mix of Aspen and spruce.

Unit 1: 6-8m Till; loam; 1-2% coarse fragments; a few pebble-size clasts; color 2.5Y4/4 olive brown.

Comments: Sand excavated in flank of ridge, medium grained, massive, no stones. Feature looks like esker ridge.

Appendix 1 – Surficial Geology Site Descriptions

LL2000-14 Longitude 110.5107 Latitude 55.41025

Observation on north side of road; undulating to rolling, low to moderate relief; mix of Aspen and spruce.

Unit 1: 0.3m Sand; medium to coarse, massive; slightly oxidized; a few large pebbles; sharp, undulating contact with underlying till.

Unit 2: 0.7m Till; loam; 1-2% pebbles.

Comments: Glaciofluvial veneer on till.

LL2000-15 Longitude 110.581667 Latitude 55.3728666

South facing exposure, hummocky to rolling moderate relief; burned area, pine and spruce about 8-10m high.

Unit 1: 0.25m Till; loam; <1% pebbles, massive

Unit 2: 0.25m Sand; coarse to gravelly, fining with depth; glaciofluvial origin.

Comments: Other shovel pits dug into hummock show sand at surface in some places and till in others.

Comments: Interpreted as till and sand morainal complex.

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

PROJECT: **WEPA Hydrogeology**	DATA NO: **WEPA99-1**	LOGGED BY: S. Stewart	DATE: Sept.17, 1999
DRILLER: Layne- Christiansen	TYPE DRILL: Wet Rotary	DRILL METHOD: Wireline Core	SURFACE ELEVATION: 660.92 m
LOCATION: LSD 03 SEC 08 TP 77 R 14 W4	LATITUDE: 55.6517371°	LONGITUDE: 112.1468557°	Source: Surveyed
COMMENTS ON LOCATION: Alberta Transportation sand pit on east side of HWY 63, against the trees on south side of clearing.			

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
0.0	1.5	cuttings	0.60	Sand	Med. Sand.
		cuttings	0.30	Sand	Silty med. Sand.
		cuttings	0.10	Silty sand	Silty sand, poorly sorted, dark brown (10YR4/3).
		cuttings	0.50	Sandy silt	Clayey loamy sand 5% clay, quartz pebbles.
1.5	3.0	0.00		Sandy silt	No recovery.
3.0	3.6	0.15	0.15	Silty sand	Possible reclaimed material, organic stain, rootlets, dark grey brown (2.5Y4/4).
3.6	4.3	0.23	0.23	Silty sand	Fine silty sand, bedded, dark carbon flecks, some iron staining, dark grey brown (10YR3/2), fine low-angle bedding planes.
4.3	4.9	0.00		Silty sand	No recovery.
4.9	5.5	0.40	0.40	Silty sand	Interbedded clay layer (6 cm), fine silty sand; 12cm silty sand; 6cm clayey silt; fine sand-silty fine sand unoxidized base of clay layer (5Y3/1) very dark grey.
5.5	7.0	0.00			No recovery.
7.0	8.5	0.90	0.90	Sand	10cm coarse sand, coal flakes, mottled, iron staining, unoxidized, massive to weakly bedded, bedding planes 5-10° , differential oxidation on bedding planes, med-coarse grained with coarser beds more oxidized, rusty brown.
8.5	10.3	0.30	0.30	Silty sand	Interbedded clay, sand beneath clay zone; mottled with oxidized and unoxidized zones, poorly sorted deformed bedding planes, mottled silty clay.
10.3	11.9	0.36	0.36	Sand	Poorly sorted medium sand, some carbon flecks (10YR4/3) dark brown, dirty sand.
11.9	15.8	0.40	0.40	Sand	Poorly sorted medium sand, weakly bedded 1 cm silt beds, iron oxide precipitation at sand contact (siderite); coal flecks, dark brown matrix; grey clay clasts.
15.8	18.9	1.65	1.65	Sand	Medium to coarse poorly sorted sand, dark brown, weakly stratified; carbonaceous streaks along bedding planes, fairly uniform from top to bottom (10YR4/3) dark brown.
18.9	21.9	0.15	0.06	Sand	Fine-medium sand (6 cm thick) mottled, iron oxide staining.
			0.01	Siderite	1 cm thick siderite zone at sand/till contact.
			0.08	Till	Very dark grey till, non-calcareous, 30% clay, 35% silt, 35% sand, pebbles, 7cm sandstone cobble in ???, pebbles <1%.

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
21.9	25.0	0.70	0.06	Sand	Recovery from bottom 70 cm of cored interval (from 24.3 m to 25 m depth); medium sand lense; sharp contact with till below; 50% sand, 15% clay, 35% silt, brittle, gritty Iron oxide stained; 5% coarse sand granules.
			0.64	Till	Dark grey till, 35% clay, 45% silt, 20% sand; Iron oxide staining at base of sample; 1-2 cm thick dark olive grey silt at base of sample.
25.0	25.9	0.35	0.20	Till	Bedding planes, iron oxide cementing (1-1.5 cm thick) rusty brown; dark olive grey weakly bedded iron oxide along partings.
			0.15	Stones	Base- well rounded granites and dolostones.
25.9	26.2	0.30	0.30	Gravel	Large sandstone boulder, granitic rocks; small amount of till, non calcareous, slight Fe stain, very dark grey/brown, 2.5Y 3/2; gravel contains quartz, feldspar (very angular), 3-4mm.
26.2	27.4	0.00		Cobbles	Large cobbles, quart and igneous .
26.8	27.4	0.60	0.60	Gravel	Very angular, igneous and quart (grab sample).
27.4	28.0	0.60	0.60	Cobbles	Igneous and dolostone.
28.0	28.3			Cobbles	Sandstone cobbles, trip out- rock bit, catch samples.
28.3	29.2	cuttings		Cobbles/ boulders	Poor cuttings from rock bit, ~1cm size, no sample, igneous, quartzite, angular.
29.2	29.5	cuttings	0.30	Till	Poor cuttings from rock bit, ~1cm size, no sample. Ream hole to 30.5m.
30.5	33.5	0.95	0.95	Till	No recovery of upper 2m. Drilled like till, granite boulder at top of hole, weak HCl reaction, sandy clayey silt, 2-3cm pebbles of granite, sandstone and carbonates 5Y2.5/1 black. 40%silt, 35%clay, 25% sand, ~5-2% pebbles.
33.5	36.2	0.00		?	No recovery, driller says rock stuck in bit-trip out. Driller unsure about material.
36.2	36.5	0.20	0.20	Till?	No recovery, some till stuck to bit, plastic, stiff, clayey silt, some sand, black, very little coarse material.
36.5	37.4	0.00		Till	Large sandstone rock in shoe.
37.4	39.3	0.00		Till	Boulder in shoe- no recovery.
39.3	39.9	0.57	0.15	Till	Silty, clayey, 2% pebbles, stiff, black, non-calcareous, 5Y2.5/1.
			0.42	Till	Sandy, silty, clayey, 2% pebbles, stiff, black, noncalcareous, 5Y2.5/1.
39.9	41.4	0.80	0.80	Till	Sandy silty clay till, very fine sandy partings, stiff, black (5Y2.5/1), 2% pebbles, some organic flecks, 35%silt, 30%sand, 35%clay, 2cm twig.
41.4	42.7	1.22	1.22	Till	Weakly calcareous, sandy silty clay, 2% pebbles 5Y2.5/1, black, 40% clay, 35% silt, 25% sand, less plastic than previous till.
42.7	44.2	1.55	1.30	Till	Black, sandy silty clay, <1% pebbles 5Y2.5/1, apparent washouts, 40%silt, 25% sand, 35% clay, limestone clasts, weakly calcareous, very stiff.
			0.20	Till	45% clay, 35% silt, 20% sand, black..
			0.05	Till	40% silt, 25% sand, 35% clay.

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
44.2	45.7	0.66	0.66	Till	Black, silty, sandy clay, with sand partings, weak to noncalcareous, 40%clay, 35%silt, 25%sand, o.5cm sand enrichment, <1%coarse/ pebbles.
45.7	47.2	0.00		Sand?	No recovery.
47.2	48.0	1.25	0.45	Till	This section from previous run- clay till, mottled, very stiff, waxy, black, 55%clay, 30%silt, 10-15%sand, section goes from 10cm clay rich to heavy clay till back into clay.
			0.90	Till	Alternating clay and heavy clay till, dry, brittle, siltstone?, ~3cm thick inclusion or bed, noncalcareous, some sand.
48.0	48.7	1.22	0.90	Till	Silty clay till, sandy zones ~2cm thick, coarse sand partings, shale clast inclusions, very faint oil odour, waxy black, 10%sand, 30%silt, 55-60%clay alternating clay/silt contents, 15%sand, 45-50%clay, 35%silt.
			0.32	Till	Sandy clay till, 25%sand, 35-40%clay, 35%silt.
48.7	50.2	1.35	1.35	Till	Sandy clay till, 40% sand, 40%silt, 20%clay, oxidation zones @20cm, noncalcareous, 2% pebbles, medium grained sand partings @22cm, oxidation colour = 10YR 3/6, dark yellow brown, at 80cm there are siltstone clasts.
50.2	51.8	1.76	1.76	Till	Clayey, sandy, silt till, very dark grey, noncalcareous, 3-4% pebbles, 45-50%sand, 35%silt, 10% clay. Munsell colour= 5Y2.5/1, black, some shale clasts.
51.8	54.8	3.00	3.00	Till	Black, silty sandy clay till, mostly same as above, 1-2% pebbles, 4cm thick calcareous cemented brecciaed mudstone? @2.15m, gypsum nodule? @2.95m.
54.8	57.9	2.80	2.80	Till	Clay sandy silt, 40%sand, 40% silt, 20%clay, 1-2% pebbles, evidence of local bedrock fragments, @80cm, a 5cm thick zone of clay enrichment in matrix (35%sand, 35%silt, 30%clay, <1% pebbles).
57.9	61.0	0.80	0.80	Till	Stone in shoe (poor recovery), black, 35%sand, 35%silt, 30%clay, <1% pebbles.
61.0	64.0	2.95	0.90	Till	Black clay sand silt till, 35% sand, 35%silt, 30%clay, 1-2% pebbles, large stone @ 50cm (sandstone).
			1.15	Bonneville till?	New till, sharp contact, 5Y4/3 olive oxidation pervasive entire matrix, sandier, bedrock clast inclusions, coal flecks, non-weakly calcareous, 5% pebbles, 45-50%sand, 35-40%silt, 15-20%clay.
			0.80	Till	Oxidation following paleo fractures, 45-50% sand, 15-20%clay, 25-30% silt, noncalcareous, coal flecks.
64.0	67.0	---		Till	Rock in bit, likely still in till.
67.0	68.6	1.40	0.80	Till	3-4% pebbles, oxidation fractures, 45-50% silt, 40%sand, 20%clay, 2cm granite clast on oxidation zone, matrix very dark grey to black, very sandy along fracture planes, abundant granules.
			0.60	Till	Lose oxidation completely, ~5% pebbles, very weakly calcareous.
68.6	70.1	1.75	1.75	Till	5% pebbles, 2-3% coarse sand and granules, 40-45%silt, 45%sand, 15%clay, clayey sandy silt till, very dark grey to black, very weakly calcareous, 5Y2.5/1.
70.1	73.2	2.60	2.00	Till	As above, weak-moderately calcareous, sand partings, shale clasts, silt clasts.
			0.60	Till	>% fine sand, ~50% increase in sand in bottom 60cm, clay-silt sand.
73.2	76.2	3.02	0.12	Till	As above, >% clay , <sand, clayey silt till, shale and silt clasts.
			0.83	Till	Clayey sandy silt till, abundant granules, weak to moderately calcareous.

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.13	Very fine sand	Fine silty sand.
			1.94	Till	4cm stones, abundant pebbles, clayey sandy silt till, weak to moderately calcareous, very dark grey to black.
76.2	79.2	2.60	2.60	Till	Weak to moderately calcareous, clayey sandy silt till, abundant pebbles and granules, very dark grey to black, 45-50% silt, 40%sand, 15% clay , ironstone granules, shale clasts, granites, sandstone pebbles (3cm).
79.2	82.3	2.15	0.45	Till	45-50%sand, 40-45%silt, 10-15%clay, abundant pebbles, no bedrock clasts, driller hit stone, possibly sand: 'water sand'.
			1.65	Till	Vuggy (wash out sand?), moderately calcareous, bedrock clasts, black, quartz and granite pebbles.
82.3	84.3	0.10	0.10	Till and stones	Driller says rocks and gravel, only drilled 2.0m @82.3m-84.3m, coarse gravel, limestones, granites, very angular, some till (5cm) recovered at bottom of bit, clay sandy silt till, weakly calcareous, abundant pebbles.
					Last 2.0m, drill chatter all the way down, felt like stones and rocks.
84.3	84.9			Boulders	Driller says 'very rocky 60cm', trip out and put on rock bit, rocks are very angular, granitic, Athabasca sandstone.
84.9	86.5	bag sample	0.70	Boulders and gravel	Rocks, very angular, as above, sandstone, granite, chert.
		cuttings	0.90	Till	No sample, described from small rock bit cuttings, clayey sandy silt.
86.5	87.0	---	---	Till	Driller says stone in bit.
87.0	88.3			Till	Clayey sandy silt till, shale clasts, 2-3% pebbles, weakly calcareous, 40% silt, 35-40% sand ,20-25% clay, 5Y2.5/2, abundant coarse granules.
88.3	89.6	0.03		Till	Hit rock, disturbed core, stiff, black, sandy clayey silt, weakly calcareous, abundant granules and coarse sand, 1-2% pebbles, 40%silt, 30-35%clay, 25-30%sand.
89.6	90.6	1.17	0.60	Till	Hit boulder, 3% pebbles, clayey sandy silt till, 45% silt, 30-35% sand, 30-35% clay, black, 2-3% granules, some coarse sand (2%), weakly calcareous, unoxidized, stiff.
			0.10	Silt and till	0-10cm of silt inclusion (not a bed) same as above.
			0.47	Till	Same as above, 3-4 large pebbles.
90.6	92.6	1.26	1.26	Till	Black, clayey sandy silty till, same as above, 3-5% pebbles (sandstone and granite), large shale clast @91m, very weakly calcareous, 5Y2.5/1, abundant granules (coarse sand), stiff (cracks when broken), siltstone inclusions.
92.6	94.8	0.75	0.75	Till	Black, clayey, sand, silty till, as above, rock at 75cm, no more recovery to 94.8m, rocks (granite and athabasca sandstone), some sandstone inclusions, very small and minor.
94.8	96.6	1.33	1.00	Till	Black, as above, very weakly calcareous, rock at contact with below.
			0.06	Till	Dark olive grey, 5Y3/2, clayey sandy silt till ,stiff, 3-5% pebbles, weakly calcareous, 40% silt, 35% clay, 25% sand.

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.27	Till	Black, weak to moderately calcareous, 40% silt, 35-40% clay, 20-25% sand, chert pebble, 3-5% pebbles, more CaCo3, more clayey.
96.6	98.1	1.71	1.71	Till	Black, sandy clay silt till, more bedrock clasts, siltstone, sandstone, shale, chert, >5% pebbles, moderately calcareous, interval enriched with local bedrock.
98.1	98.7	0.25	0.25	Till	Black, sandy clay silt till, bedrock clasts, moderately calcareous, dense, stiff, ~5% pebbles, abundant shale, siltstone, rock @98.1m (gneiss).
98.7	100.3	1.70	1.70	Till	Black (5Y2.5/1) clay sandy silt till, enriched with local bedrock, >5% pebbles, 2-3% granules/ coarse sand, moderately calcareous, very stiff, abundant quartz sand (2-3%).
100.3	103.0	2.49	1.03	Till	Black, moderately to strongly calcareous, abundant local bedrock clasts, 5% pebbles, sandy clayey silt, 30% clay, 35-40% sand, 35-40%silt.
			0.94	Till	Interbedded clay till and sand clay silt till with inclusions of clay silt ~10-15cm thick @60cm, highly calcareous zone- silt lense, higher silt= >CaCo3, bottom 30cm is noncalcareous (below silt lense).
			0.52	Clayey silt	Black, clayey silt, silt partings <<1% pebbles, angular clay clasts, non calcareous, sharp contact with clayey sandy silt till above, a few coarse sand and granule clasts (quartz).
103.0	106.0	2.13	0.70	Clayey silt	Black, silt to clayey silt, as above, increasing granules with depth, lignite inclusion, high angle contact of clay silt with unit (clay sandy silt till) below, noncalcareous.
			0.94	Till and silt	Black, clayey sand, silt, moderately calcareous, lots of dolomite pebbles, 8% pebbles, abundant carbonate pebble clasts.
			0.38		Interbedded clay sand, silty till and clay silt. clay silt has high angle, vertical bedding.
106.0	106.5	1.43	1.43	Till and silt	Recovered core lost from previous run. Clayey sandy silt till with inclusions of weakly calcareous silt at high angle, abundance of calcareous pebbles, moderately calcareous matrix, black, silt inclusions from 5-15cm thick.
106.5	109.6	1.11	1.11	Till	Driller said drilled easy, like sand to 108.8m, clayey sandy silt with inclusions of clay (5-15cm), weakly calcareous, sandy inclusions (5Y2.5/1), black, 3-5% pebbles, local bedrock, pebbles abundant, 40%silt, 30-35%sand, 25-30%clay.
109.6	111.3	1.10	1.10	Till	Sandy clay silt, abundant pebbles (3-4%), gritty, 35%sand, 25-30%clay, 40%silt, numerous local bedrock clasts (black shale), very weak to noncalcareous, dense, 2-3% coarse sand, 5cm quartzite cobble at bottom of core.
111.3	112.5	1.33	1.33	Till	Sandy clay silt, very gritty, as above but more pebbles (4-5%), 1-1.5cm shale clasts, no inclusions or beds, siltstone, igneous, local sandstone, shale, very weakly calcareous, a few fine sand partings 20cm from top of core, large cobble at end of run.

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
112.5	115.2	2.85	2.85	Till	As above, silty clay inclusion at 36-41cm, waxy, sandy silty clay, more clay in matrix, abundant shale clasts up to 1-1.5cm, occasional fine sand partings, 20%of clasts are local bedrock, mostly black clay stone, very weakly calcareous, 5% pebbles increase in pebbles in bottom 0.5-0.75m of core, gritty till, 30-35%sand, 35%clay, 35-40%silt.
115.2	116.4	0.85	0.85	Till	Sandy clay silt, about 5% more clay in matrix, very stiff, numerous shale clasts, fewer pebbles than above core interval, 3% pebbles, 30%sand, 35%clay, 35%silt, lignite clast (rusty brown), very weakly calcareous.
116.4	118.5	1.66	1.26	Till	Sandy silty clay, clay enrichment due to shale clast inclusions, 6cm shale clast at 12cm from top, very weak to noncalcareous, 35-40%clay, 35%silt, 25-30%sand, large shale clast orientation vertically on long axis.
			0.40	Till	Sandy clay silt, more silty, fine sand, less clay in matrix, fewer shale clasts, very weakly calcareous, 1-2%pebbles, gritty when cut with knife, 30-35%clay, 35%sand, 35-40%silt.
118.5	121.6	3.00	1.70	Till	Sandy silty clay, dense, abundant shale inclusions, 1-2% pebbles, weak to noncalcareous.
			0.02	Sand	Coarse sand lense in till.
			1.28	Till	More pebbles than above 1.7m, more silty, sandy clay silt, weak to noncalcareous, 3% pebbles, (large limestone cobble at 30cm from top of core, Athabasca sandstone cobble in core), gritty till, till still contains abundant coarse sand and granules/pebbles equal% sand and clay, silt dominant, fewer shale clasts in bottom1.28m of core.
121.6	123.7	2.20	0.55	Till	Sandy clay silt, 3% pebbles, gritty , 30%sand, 30-35%clay, 35%silt, stiff, dense, noncalcareous.
			0.75	Silty clay	Sharp contact with above till, irregular wavy silt partings, nearly vertical, some silty partings throughout, black clay (shale?) clasts (3mm), about 45° angle contact with till below, sharp contact, 80° angle deformed, dark black clay streaks, possibly block of mudstone in till.
			0.90	Till, minor sand lenses	Sandy clayey silt, some fine sand lenses near base of interval, 10cm interval of fine sand at about 60-70cm down in the interval, 4-5% pebbles, sandstone, shale, quartzite, gritty till when cut, 35-40%silt, 30%sand, 30%clay, weak to noncalcareous.
			0.90	Till, minor sand lenses	Sandy clayey silt, some fine sand lenses near base of interval, 10cm interval of fine sand at about 60-70cm down in the interval, 4-5% pebbles, sandstone, shale, quartzite, gritty till when cut, 35-40%silt, 30%sand, 30%clay, weak to noncalcareous.
			0.90	Till, minor sand lenses	Sandy clayey silt, some fine sand lenses near base of interval, 10cm interval of fine sand at about 60-70cm down in the interval, 4-5% pebbles, sandstone, shale, quartzite, gritty till when cut, 35-40%silt, 30%sand, 30%clay, weak to noncalcareous.
123.7	124.7	0.72	0.72	Till	Sandy clayey silt, 30-35%sand, 30-35%clay, 35-40%silt, 2-3% pebbles, weak to noncalcareous, fine sand parting @45cm from top, rotten sandstone pebble.
124.7	127.7	2.97	2.97	Till	Sandy clay silt, same texture as above, 3% pebbles, gritty abundant coarse sand and granules, some 2cm, shale clasts (2cm), sandstone, noncalcareous, numerous Athabasca sandstone pebbles, particularly the larger pebbles.

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
127.7	130.8	2.50	2.50	Till	As above, 2-3% pebbles, amount of clay in matrix varies as the amount of shale clasts in the till, numerous shale pebbles, sandy clay silt texture, gritty, very weak to noncalcareous, very dense and hard till, 1 chert pebble, abundant local siltstone, sandstone, core breaks on very thin discontinuous sand partings (2 breaks).
130.8	133.8	2.77	2.25	Till	As above, sandy clay silt, 2-3% pebbles, enrichment of sand in matrix @ 95-110cm from top of core, possibly incorporation of sand, noncalcareous.
			0.10	Sand	Fine sand, soft, unoxidized, no bedding visible, 60cm thick unit, driller said soft, easy from 132.9m to 133.5m.
			0.42	Till	As above, sandy clayey silt (30-35%sand, 30-35%clay, 35-40% silt), abundant local pebbles.
133.8	136.9	2.55	1.00	Till	Sandy clayey silt, as above, very dense, 2-3% pebbles, noncalcareous.
			0.55	Till? (sand)	Very sandy, soft till (?), silty sand with pebbles, easy drilling, very poorly sorted diamicton.
			1.00	Till	Two sand partings, each about 3cm thick, fine to medium @ 160cm from top of core @175cm from top of core, sandy clay silt till, numerous bedrock fragments, very weakly calcareous @ 190cm from top, 7cm thick Athabasca sandstone boulder cored @136.6m.
136.9	139.9	3.20	3.20	Till	As above, sandy clay till, 3-4% pebbles, gritty, very sandy diamicton inclusion @ 25-25cm from top core, dense, weakly calcareous (more than @ 120-135m), estimate 30-50% of pebbles are local bedrock clasts, core breaks on very thin discontinuous fine sand and silt partings (occasional, not common).
139.9	143.0	3.14	3.14	Till	Sandy clay silt, as above, 3-4% pebbles, ~50-60% pebbles are local bedrock clasts, no carbonate clasts evident (haven't seen carbonate clasts for last 15-20m), Athabasca sandstone and granites present, weakly calcareous, fine sand partings @ 55cm of top core.
143.0	146.0	2.45	2.45	Till	Sandy clay silt, 30%sand, 25-30% clay, 40-45% silt, 3-4% pebbles, 6-7cm calcite-cemented sandstone boulder @ 140cm from top of core, white calcite vein about 1cm thick in grey sandstone (grand Rapids sandstone?), weakly calcareous, abundant local bedrock.
146.0	148.4	2.95	2.95	Till	As above, gritty, sandy clay silt, 3-4% pebbles and granules, abundant local bedrock clasts (4cm black shale clast), weak to moderately calcareous, increase in carbonate in matrix, local bedrock clasts ~60-70% of pebbles, very fine sand parting @55cm from top of core, clay % varies with amount of shale clasts.
148.4	149.0	0.47	0.47	Till	Increase in clay in the matrix, sandy silty clay, (30%sand, 35%silt, 30-35%clay), a few granite pebbles, 70% of pebbles of local bedrock origin - shale, siltstone, Ironstone, weak to moderately calcareous, 4-5% pebbles and granules, gritty till.
149.0	150.3	1.25	0.86	Till	As above, sandy clay silt, dense, abundant pebbles, local bedrock, weak to moderately calcareous.
			0.20	Silty sand	Poorly sorted silty sand, massive to poorly bedded with discontinuous fine sand partings, weak to moderately calcareous, dense, stiff.
			0.19	Sand and silty sand	Medium sand interbedded with dense silty sand, ~4-6cm thick, unoxidized, weak to moderately calcareous.

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
150.3	152.7	2.30	2.30	Till	Sandy silty clay, 70-80% local bedrock clasts, some round chert, few igneous shield clasts, gritty ~5% pebbles, moderate to strongly calcareous along cut surfaces, no visible limestone or dolostone, black, stiff, dense, 30-35%sand, 30-35%clay, 35-40%silt.
152.7	153.8	1.45	1.08	Till	Sandy silty clay, 5% pebbles, siltstone, Athabasca sandstone, igneous, more shale clasts, moderate to strongly calcareous, siltstone.
			0.37	Silty clay	Discontinuous silt partings, high angle, almost vertical, silt partings are very weakly calcareous, claystone appearance, possibly displaced block, 10cm block of till within half diameter of core, weak slickensides.
153.8	154.5	0.00		Till?	Till at end of core barrel, thin cutting sand clay silt, gritty, lost core.
154.5	155.1	0.00		Bedrock? shale?	Lost core, changing core catcher, driller says he can feel the core at the bottom of the hole, tripped down again, but nothing in the core barrel again.
155.1	156.2	1.67	1.67	Mudstone (shale) (shell fragments)	Silty clay, claystone, weakly bedded with silt partings along bedding planes, clam shell (fossils (2-3cm) @ depth of 156m (147cm from top of core), recovered 60 cm of core from above drill interval as well as 1.1m of core in this drill interval, shell fragments along bedding plane, possibly dark brown fish scales (8mm) at about 155.5m depth (100cm from top of run).
156.2	158.2	2.00	0.50	Claystone	Bedded clay silt and silty clay, bedding interval from 3mm to15mm spacing, calcite crystals (Aragonite?) needle-form, along bedding plane, calcite veins along fracture.
			0.05	Bentonite	2.5Y 4.5/0 grey to dark grey, pyrite nodules, 1cm in size, micro crystals.
			1.45	Claystone	Mudstone to claystone, well bedded as above bentonite layer, very dark (black) with lighter coloured bedding, silt partings in lighter layers, looks like dark brown fish scales? along partings, unsure if shell fragments or carbonate deposition from groundwater. Aragonite crystals suggest these.
158.2	160.5	3.10	3.10	Mudstone (silt and silty clay)	Bedded, 1-2cm thick beds of alternating black and very dark grey beds, white calcium carbonate in fill along bedding planes @ 305cm from top of core (160m depth), high angle fractures in core result of too much core jammed in barrel, barrel expanded as core sheared inside and jammed barrel inside core tube - 1 hour to pull out core, calcite smells like H2S with 10% HCl, too much core, have to adjust above depths to account for the 75 cm of core lost at 154.5m to 156.2m. This run captured lost 75 cm of core. Elongated dendritic black patterns on silt parting faces - common on a number of faces.
160.5	161.2	0.00	0.00		Core remained in hole (0.5m).
161.2	162.8	0.68	0.68	Mudstone (or claystone?)	Drilled 1.5m, but only recovered 69 cm, weakly bedded mudstone or claystone?, moderate to strongly calcareous (only on light coloured silt? partings), presence of entire shells (2-3cm) possibly some fish scales present as well.
162.8	164.3	1.90	1.90	Claystone or mudstone	Numerous silt partings, shell fragments perhaps recrystallized to aragonite, weekly bedded, moderately calcareous (on silt partings), fish scales present on partings, photos taken.
164.3	165.8	0.00	0.00		

Appendix 2-A – Lithologic Description of Corehole WEPA99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
165.8	166.4	1.64	1.64	Mudstone	Well-bedded and regularly bedded spacing from 3 to 10mm, core breaks easily along the silt partings, 115cm from top of core Inoceramus (sp?) (shell), frequent occurrence of shells in the lower portion of the core, especially high HCl reaction, moderate on silt partings, offset in bedding at 156cm from top of core, 3 photos taken (of this offset).
166.4	167.3	0.00	0.00		No recovery ~3m of core left at the bottom of the hole. Depth to core ~164.2m. TD = 167.3m.

Appendix 2-B – Lithologic Description of Corehole WEPA99-2.

PROJECT: **WEPA Hydrogeology**	DATA NO: **WEPA99-2**	LOGGED BY: T. Lemay	DATE: Sept.23, 1999
DRILLER: Layne- Christiansen	TYPE DRILL: Wet Rotary	DRILL METHOD: Wireline Core	SURFACE ELEVATION: 583.07m
LOCATION: LSD 13 SEC 12 TP 74 R 17 W4	LATITUDE: 55.3985831°	LONGITUDE: 112.4932875°	Source: Surveyed
COMMENTS ON LOCATION: Flat area adjacent to bog and next to the access road.			

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
0	3.1	0	0		1.8 m of sand 1.25 m of harder material to drill based on driller's comments. In 1.8 m soil profile, 1.5 m of sand with clay beds and 0.3 m of clayey till from soil survey done 30 m NW of hole.
3.1	4.0	0.26	0.6	Till	Zone of mottled 10YR - dark yellow brown and 2.5Y 4/2 dark greyish brown clayey silt till with trace sand, massive, sharp contact with the till below, soft and plastic.
			0.20	Till	2.5Y 4 to 5/2 greyish brown to dark greyish brown clayey silt till with trace sand, silt component may be greater than in the above till, no reaction with HCl, Fe-oxidized irregular fractures and granules, hard and non plastic.
4.0	4.6	0.16	0.16	Till	Dark grey brown clayey silt till with some sand and mudstone and sandstone (Athabasca?) pebbles, pebbles range in size from 1cm to 3 cm along the long axis, zones of Fe-oxidation present in fractures and partings, material is brittle and stiff, quartzite.
4.6	4.9	0.20	0.20	Till	5Y 3/1 to 2.5/1 very dark grey to black, very dark brown, clayey silt till, Fe-oxidized with an irregular pattern to the oxidation, granule fraction appears to be less than in the above till, pebble content less than 1%, no reaction to HCl.
4.9	5.8	0.45	0.45	Till	Very dark grey clayey silt till, signs of Fe-oxidation, weak HCl reaction, presence of shale clasts, granule poor, pebbles make up 2 to 3%, most pebbles shale and sandstone, smaller percentage of igneous, metamorphic and limestone pebbles.
5.8	7.31	0.75	0.75	Till	Very dark grey to black clayey silt till, 3% pebbles predominantly shale, lesser amount of igneous, metamorphic and sandstone pebbles, also present a sand stringer 23 cm from top of core, sand was medium fray and fine textured, coal fragments found, till massive and rigid.
7.3	8.8	1.15	0.80	Till	Same as above.
			0.25	Silt	Dark grey silt, massive, soft, may be coarsening upwards, presence of trace pebbles.
			0.10	Silt	Dark grey sandy silt to a mud, massive, firm and rigid, trace pebbles.
8.8	9.4	0.50	0.50	Till	5Y 3/1 to 2.5/1 very dark grey to black, very dark brown, clayey silt till, local bedrock pebbles make up the greatest fraction, pebbles 3%, HCl reaction very weak, shale clast 7.6 cm in diameter at bottom of core interval.
9.4	11	1.00	1.00	Till	Same as above.
11	12.5	0.82	0.20	Till	Same as above but moderately calcareous.
			0.06	Silt till	Same as above but with greater clay content.

Appendix 2-B – Lithologic Description of Corehole WEPA99-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.56	Till	5Y 3/1 to 2.5/1 very dark grey to black, very dark brown, clayey silt till, local bedrock pebbles make up the greatest fraction, pebbles 3%, HCl reaction moderate, large igneous and quartzite cobbles at 40 cm from top of core and 82 cm from top of core.
12.5	14	1.05	0.20	Till	Same as above.
			0.10	Gravel and sand	Made up predominantly of local bedrock fragments, also contains igneous, quartzite and chert pebbles, largest pebble size 3 cm, smallest 0.20 cm, sand is poorly sorted.
			0.75	Till	5Y 3/1 very dark grey, sandy silt till, pebble content 3% predominantly local bedrock, some oxidized granules, in the lower 20 cm several horizontal sand stringers and lenses were found, two of which are oxidized, the lens of sand is coarse-grained, presence of green sandstone pebbles, some clasts and granules react moderately to HCl.
14	15.5	1.07	0.83	Till	Same as above, but no sand stringers, lenses or green sandstones observed.
			0.24	Silt	5Y 3/1 very dark grey silt with some pebbles and perhaps trace granules, no HCl reaction.
15.5	18.6	1.15	0.58	Silt	Same as above, but with some wavy bedforms?, non calcareous, some fine sand or silty streaks.
			0.10	Till	5Y 3/1 very dark grey, sandy silt till, pebble content 3% predominantly local bedrock, some oxidized granules, some clasts and granules react moderately to HCl, irregular high angle contact with the silt below.
			0.10	Silt	5Y 3/1 very dark grey silt with some pebbles and perhaps trace granules, no HCl reaction, gradational contact with the till below.
			0.37	Till	5Y 3/1 very dark grey, clayey sandy silt till, coarse sand fraction has increased over previous tills, non calcareous, pebble content 1% predominantly local bedrock, soft and easy to cut, limestone clast near the bottom of the core interval.
18.6	20.1	0.60	0.60	Till	Same as above with a sand lense near the top the of the core interval in the split section, large quartzite cobbles prominent especially at the base of the core interval.
20.1	21.6	0.17	0.17	Till	Same as above, three large cobbles/pebbles found, largest 7cm along the long axis possibly granite, mid sized pebble 3cm possibly diorite, smallest 2cm possibly quartzite.
21.6	22.3	0.32	0.32	Till	Same as above, with less local bedrock in the pebble fraction, ironstones found, fewer of the large pebbles found.
22.3	22.7	0.62	0.62	Till	Same as above with slight increase in pebble content.
22.7	23.6	0.76	0.76	Till	Same as above, local bedrock content continues to decrease.
23.6	24.7	0.28	0.28	Till	Same as above, Athabasca sandstone cobble at the base of the cored interval, cobble the diameter of the core.
24.7	25.5	0	0		
25.5	25.6	0	0		
25.6	26.5	0	0		Till cutting recovered Same as above.
26.5	27.1	0	0		

Appendix 2-B – Lithologic Description of Corehole WEPA99-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
27.1	27.7	0	0		
27.7	28.3	0.28	0.28	Till	Same as above, sand fraction decreased to where sand and clay appear equal.
28.3	29.2	0.59	0.59	Till	Same as above, igneous, metamorphic pebbles range in size from 1cm to 3cm, clay content variation of about 5% occurs in the upper portion of the core for about 10 to 15cm.
29.2	30	0.92	0.92	Till	Same as above, HCl reaction moderate, silt still dominant with sand and clay fighting it out for second place.
30	31.1	0.84	0.84	Till	Same as above, silt fraction may be increasing slightly, weakly moderate HCl reaction.
31.1	31.7	0.23	0.7	Sand	2.5Y 4/0 dark grey, medium to fine grained sand, no reaction to HCl.
			0.16	Till	Same as above with flat tabular coal striated on both flat surfaces.
31.7	32.8	0.90	0.90	Till	Same as above, coarse sand fraction increasing, silt still dominant, glacial sand lenses, shale pebbles found along with cherts, igneous and metamorphic pebbles, pebble content 1 to 2%.
32.8	33.8	0.90	0.90	Till	Same as above, lower 7cm of the cored interval a silty sand till, shale pebble found.
33.8	35.4	0.70	0.70	Till and sand	Till becoming lighter in colour 5Y 4/1 dark grey, sand fraction increasing, clay down to about 10%, silty sand till and silty sand have a strong to moderate reaction with HCl.
35.4	36.1	0.46	0.46	Till and sand	Same as above with some coarser sand lenses.
36.1	36.9	0.15	0.15	Till and sand	Same as above but siltier, sand lenses contain finer sand than above.
36.9	37.8	0.54	0.54	Till and sand	Same as above sand lenses and partings may be coarser than above.
37.8	38.6	0.41	0.10	Till and sand	Same as above.
			0.21	Sand	Medium to light grey brown fine-grained sand.
			0.10	Silt	5Y 3/1 very dark grey clayey silt, presence of some pebbles, sand lenses and partings, bedding in convoluted and possibly deformed, contact with the sand above is at an angle of approximately 45^{o}.
38.6	39.9	1.00	0.12	Silt	Same as above, convoluted bedding ends 8cm from the top of the core, weakly bedded below 8cm.
			0.10	Sand	Medium to light grey brown fine-grained sand.
			0.56	Till	5Y 4/1 dark grey silty sand till, shale, chert, igneous and metamorphic pebbles found, pebble content 1 to 2%, moderate HCl reaction.
			0.10	Sand	Dark grey silty sand with clay.
			0.12	Silt	Grey brown massive silt with faint bedding, moderate reaction with HCl.
39.9	40.8	0.94	0.08	Gravel	Glacial gravel, pebbles from 2mm to 1.5cm, presence of silt and sand within the gravel.
			0.42	Silt	Dark grey silt, clay content high, faint contorted bedding in the lower halt of the interval, no pebbles or granules, strong reaction to HCl.
			0.44	Silt	Very dark grey to black silt, faint contorted bedding, pure quartz pebbles found, quartzite and granite pebbles found in the lower 2cm.
40.8	41.5	0.47	0.14	Silt	Very dark grey massive clayey silt.
			0.33	Till	5Y 4/1 dark grey silty sand till, shale, chert, igneous and metamorphic pebbles found, pebble content 1to 2%, concentration of pebbles found 30cm from top of core interval, moderately weak HCl reaction.

Appendix 2-B – Lithologic Description of Corehole WEPA99-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
41.5	42.1	0.75	0.75	Till	Same as above with weak reaction to HCl.
42.1	43.3	1.12	0.32	Till	Same as above with greater pebble 2 to 3% and granule content, slow weak reaction to HCl.
			0.90	Till	Same as above, possible increase of silt may make this till a sandy silt till rather than a silty sand till, few pebbles, some shale clasts, weak reaction to HCl, green sandstone found.
43.3	46	2.82	2.82	Till	Same as above, upper 50cm has more pebbles than the lower 232cm, stiff and rigid, shale pebble content may be increasing.
46	49.1	3.10	3.10	Till	Same as above, zone from 50cm to 104cm from top of core may be more pebble rich than above or below, sand lense at 40cm from top of core, presence of Fe-oxidized sandstone and siltstone.
49.1	52.1	2.87	2.87	Till	Same as above, presence of large quartzite and Athabasca sandstone pebbles within the till
52.1	52.7	0.95	0.08	Till	Same as above, contact with unit below is distinct.
			0.08	Till	Colour as above, clayey silt till, shale fragments, no reaction to HCl, some igneous pebbles, contact with unit below distinct.
			0.10	Till	Lighter brown than above, sandy silt till, reaction to HCl moderate, contact with unit below distinct.
			0.69	Till	5Y 4/1 dark grey clayey silt till, appears to have a greater clay content than the first clayey silt till in this cored interval, pebble content and HCl reaction similar.
52.7	53.6	0	0		
53.6	53.9	0	0		
53.9	54.6	1.77	0.79	Till	Same as above, but with some bands of clay rich material.
			0.28	Till	Dark brown to black, silty clay till, no reaction to HCl, pebbles of sandstone present, massive.
			0.70	Till	Same as above, with Fe-oxidized pebbles.
54.6	56.1	0.79	0.79	Till	Same as above, but clay and sand contents seem to vary throughout the cored interval, generally more clay rich near the top and sandier near the bottom.
56.1	57	1.55	1.55	Till	Same as above, clay content varies throughout the cored interval making zones of clay rich and clay poorer till, coal fragment 1cm across found in the lower portion of the cored interval.
57	58.2	1.37	0.05	Till	Same as above, perhaps grading (?) into a finer till below.
			1.17	Till/Silt	Very dark brown to black, convoluted bedding with and alternation of light and dark beds (?), no HCl reaction, pebbles present and large granite cobble near the top of the interval, grain size may be getting finer near the bottom.
			0.15	Silt	Dark grey , massive silt, no pebbles present, no HCl reaction.
58.2	61.3	2.26	2.26	Silt	Same as above with zones of fine sand that show regular bedding, at the base of the sand rich areas clay content appears to increase to almost equal the silt content, more sand rich to more clay rich areas almost appear to alternate, this trend especially visible in the lower portion of the silt.
61.3	64.3	2.81	1.65	Silt	Same as above, spectacular convoluted bedding of fine sand, 15cm of sand silt till near the middle of the silt unit, some of the beds appear to be truncated by upper beds, photos taken.
			1.16	Till	Same as above 5Y 4/1 dark grey clayey silt till.

Appendix 2-B – Lithologic Description of Corehole WEPA99-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
64.3	67.4	3.10	3.10	Till	2.5Y 3/2 very dark greyish brown sandy silt till, 2 to 3% pebbles, igneous, quartzite and green sandstone pebbles found, weak to moderate HCl reaction, sand and silt partings found.
67.4	70.4	3.26	3.26	Till	Same as above, Fe-oxidized sandstone pebbles, green siltstones, pebble content may be increasing slightly, large limestone cobble found.
70.4	73.5	0.90	0.90	Till	Same as above, some shale clasts, weak reaction to HCl.
73.5	76.5	2.90	2.90	Till	Same as above, some sand and silt partings, the large pebble (2 to 5cm) fraction appears to be increasing as does the silt content.
76.5	78	1.89	1.89	Till	Same as above, silt content appears to be fluctuating, large clasts still present, clasts composed of sandstone and quartzite, plate of purple material 3mm by 2mm noted and location indicated on the core box.
78	79.6	1.44	1.44	Till	Same as above, starting to lose the larger clasts.
79.6	81.1	1.48	1.48	Till	Same as above.
81.1	82.6	1.55	1.55	Till	Same as above, with at least one shale clast, no HCl reaction, sand content appears to have increased, continued trend of less large pebbles.
82.6	85.6	2.81	2.81	Till	Same as above, sand still seems to be increasing, shale clasts found, large pebble size fraction content remaining constant.
85.6	88.7	3.10	3.10	Till	Same as above, numerous Fe-oxidized 10YR 6/8 brownish yellow sandstone clasts, weak reaction to HCl near the top of the interval increasing to a moderate reaction depth, more abundant shale clasts, limestone clast noted, presence of green siltstone, large pebbles still present (2-3cm long axis).
88.7	91.7	0.31	0.31	Till	Same as above, silt content may be increasing slightly, small shale clasts, moderate reaction to HCl.
91.7	94.8	3.02	3.02	Till	Same as above, dolostone pebble with an iron-stained rind, shale clasts more common, chert pebble found.
94.8	97.8	2.82	2.82	Till	Same as above, shale clasts more common, large clasts content increasing, silt content may be increasing near the top, sand lenses located near the core top, sulphide coated pebble located 20cm from the base of the core, limestone pebble found.
97.8	100.9	3.15	3.15	Till	Same as above, silt content appears to be increasing, may even be a sandy silt till now, 3cm thick clayey silt bed (?) at 130cm from the top of the core reacts strongly with HCl, cobble sized quartzite and igneous fragments found.
100.9	103.9	2.12	2.12	Till	Same as above, harder to split and break.
103.9	105.5	2.80	2.80	Till	Same as above.
105.5	107	1.28	1.28	Till	Same as above, large shale or clayey silt clast near the bottom of the cored interval had a strong reaction to HCl, pebble content may be decreasing.
107	110	3.00	3.00	Till	Same as above, recovered an 8cm diameter quartzite cobble near the bottom of the cored interval, igneous pebble content appears to have decreased, pebble content has remained at about 2%.

Appendix 2-B – Lithologic Description of Corehole WEPA99-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
110	113.1	2.84	2.84	Till	Same as above, HCl reaction increasing with depth, shale clasts varying in size from 2mm to 2cm, green sandstone found.
113.1	116.1	3.10	3.10	Till	Same as above, numerous clasts of quartzite, sandstone and igneous rocks, shale content may have decreased slightly, sand content appears to have increased.
116.1	119.2	2..80	2.80	Till	Same as above, dolostone clast found, pure quartz pebbles found, larger shale clasts found near the base of the cored interval, sand content does appear to have increased.
119.2	122.2	3.05	3.05	Till	Same as above, 2 to 3cm wide silty medium-grained sand lenses, pebble content has decreased to 1 to 2%, sand lenses react moderately to strongly with HCl.
122.2	125.3	2.97	2.97	Till	Same as above, greater concentration of shale clasts, clasts 1 to 3cm in length, greatest concentration of clasts near the bottom of the interval, bottom 20cm looks like a mixture of clayey silt and till units, sand partings present and non reactive to HCl.
125.3	128.3	2.51	2.51	Till	Same as above, sand lens present, shale clasts more abundant in the upper portion of the till, clayey silt lenses present, strong to moderate reaction to HCl, easier to break.
128.3	129.8	1.12	1.12	Till	Same as above, pebble content continues to drop 1%, clayey silt zone ends 10cm from top of core, definitely cuts more easily, sandier.
129.8	131.4	0.85	0.85	Till	5Y 3/1 very dark grey, sandy silt till. Moderate reaction to HCl, pebble content less than 1%, mainly local bedrock, some chert, sand stringers found within the till, contact with till above not well observed, looks like sand was lost at the bottom of the core.
131.4	132.9	2.75	2.75	Till	Same as above, pebble content increasing 225cm from top of core, abundant clayey silt beds, some seem to show weak bedding, HCl reaction increases from moderate near the top to strong near the base, sand lenses present, shale clasts, core breaking along silt parting
132.9	134.4	1.32	0.87	Till	Same as above.
			0.10	Sand	Dark grey fine to medium grained sand, strong reaction to HCl.
			0.35	Till	As till above.
134.4	137.5	2.85	1.10	Till	Same as above with a clayey silt rich zone 73cm from the top of the core, weak bedding present with the clayey silt.
			0.75	Sand	5Y 3/2 dark olive grey fine to medium sand, reacts moderately to HCl, presence of a massive 5cm wide clayey silt bed that reacted moderately with HCl, massive silt and clay also present.
			0.18	Silt	Very dark grey to black clayey silt with high angled contorted bedding, moderate reaction to HCl.
			0.82	Sand	5Y 3/2 dark olive grey fine to medium sand, reacts strongly to HCl, massive silt and clay also present.
137.5	140.5	2.20	0.36	Sand	Same as above.
			0.25	Silt	Clayey silt as above, highly deformed bedding.
			1.10	Silt	Very dark grey to black clayey silt with highly contorted bedding, moderate reaction to HCl
			0.49	Silt	5Y 3/2 dark olive grey fine grained sandy silt, massive, hint of low angled bedding, weak reaction to HCl.

Appendix 2-B – Lithologic Description of Corehole WEPA99-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
140.5	142.3	2.40	0.60	Silt	Same as above, clayey silt with convoluted bedding marks the base, coal fragment found 60cm from the top of the core.
			1.80	Silt	5Y 3/2 dark olive grey fine grained sandy silt, massive, hint of low angled bedding, weak reaction to HCl, presence of irregular polygons of sand on some of the ends of the broken core.
142.3	143.6	1.45	0.53	Silt	5Y 3/2 dark olive grey clayey silt with high angled contorted bedding, moderate reaction to HCl abundant slickensides.
			0.92	Silt	5Y 3/2 dark olive grey fine grained sandy silt, massive, weak reaction to HCl.
143.6	146.6	2.82	0.90	Silt	5Y 3/2 dark olive grey clayey silt with contorted bedding, moderate reaction to HCl, slickensides.
			0.52	Sand	2.5Y 3/2 very dark greyish brown, medium to fine grained silty sand, abundant coal fragments and what looks like a coal stringer or bed (?), moderate reaction to HCl.
			1.40	Silt	5Y 3/2 dark olive grey clayey silt with contorted bedding, moderate reaction to HCl, slickensides.
146.6	148.7	0.94	0.26	Silt	Same as above with a 5cm thick 2.5Y 3/2 very dark greyish brown medium to fine grained sand 15cm from the top of the core.
			0.45	Silt	5Y 3/2 dark olive grey sandy silt with clayey silt beds that show contorted bedding, moderate reaction to HCl.
			0.23	Silt	2.5Y 3/2/1 very dark greyish brown to very dark grey, clayey silt, slickensides very prominent, contorted bedding very distinct, moderate reaction to HCl.
148.7	149.7	1.64	1.18	Silt	2.5Y 3/1 very dark grey clayey silt, contorted bedding very noticeable, clasts of shale present, clay does not react with HCl, silt appears to react moderately, slickensides prominent.
			0.46	Silt	2.5Y 3/1 very dark grey, clayey silt, extremely contorted bedding that shows offsets and dislocations (photos taken), silt seems to react to HCl moderately, clay no reaction.
149.7	152.7	2.50	0.60	Silt	Same as above but only the top 15cm shows convoluted bedding, remainder is more massive and perhaps contains more silt, top portion reacts moderately to HCl, lower portion (below 15cm) reacts moderately to strongly to HCl.
			1.02	Till	5Y 3/1 very dark grey clayey sandy silt till, weak HCl reaction, local bedrock clasts and igneous pebbles make up 1%, clayey silt blocks within the till from 4 to 9cm wide, 2cm of dark grey medium to fine grained silty sand at the base of the till, coarse to medium grained sand lenses present in till.
			0.88	Silt	2.5Y 3/1 very dark grey clayey silt, some evidence of bedding, strong reaction to HCl, shale clasts found as individual clasts within 0.5cm to 1cm thick beds (?), lower 35cm appears to be more silt rich, bottom 10cm contains shale partings (?).
152.7	155.4	3.20	2.30	Silt	Same as above, till partings, 10cm thick till bed found 123cm from the top of the core, till is a 5Y 3/1 very dark grey clayey sandy silt till, weak HCl reaction, local bedrock clasts and igneous pebbles make up 1%, fine to medium grained sand with silt found 175cm.
			0.90	Till	5Y 3/1 very dark grey clayey sandy silt till, moderate HCl reaction, local bedrock clasts and igneous pebbles make up 1%.

Appendix 2-B – Lithologic Description of Corehole WEPA99-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
155.4	158.2	1.42	1.42	Till	Same as above, with limestone clasts and coal.
158.2	159.4	0	0		
159.4	160	0	0		
160	160.5	3.23	0.91	Till	Same as above.
			2.32	Mudstone	5Y 3 to 2.5/1 very dark grey to black mudstone, irregular bedding in the upper 160 cm of the interval, regular bedding begins 200 cm from the top of the interval, deformed bedding present in the lower 72 cm of the interval, HCl reacts only with the silt? in the mudstone; What may be bentonite found 124 cm from top of interval; colour 5Y 6/2, light olive grey; more regular bedding found ~2 m from the top of the interval.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

PROJECT: **WEPA Hydrogeology**	DATA NO: **WR99-1**	LOGGED BY: J. Pawlowicz, L. Andriashek	DATE: Dec. 7th, 1999
DRILLER: Layne- Christiansen	TYPE DRILL: Wet Rotary	DRILL METHOD: Wireline Core	SURFACE ELEVATION: 663.76 m
LOCATION: LSD 7 SEC 36 TP 77 R 15 W 4	LATITUDE: 55.7143976°	LONGITUDE: 112.1878725°	Source: Surveyed
COMMENTS ON LOCATION: Abandoned well site west side of HWY 63, 30km south of Marianna Lake. Use 14.3 cm (5 5/8") insert bit, 20.7m casing depth.			

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
0	1.8	Bag sample		Fill	Sandy clay till, fill.
				Peat	Peat- organic; fibrisol, wood fragments, black (5Y2.5/2).
1.8	3.4	Bag sample		Silt	Lacustrine, sandy-clayey silt; unoxidized, some coarse sand and pebbles at 4m, rig chatter.
3.4	4.9	Bag sample		Till?	Strong- either a very sandy soft till, or clayey fine gravel; some cuttings of sandy-clay till.
4.9	6.4	Bag sample		Sand	Mainly coarse, pebbly, dirty sand; pebbles <1cm. Sand in last 60cm of drill run (5.8m) glacial, unoxidized, limestone clasts.
6.4	7.9	Bag sample		Sand	Poorly sorted, more silty-clay in matrix; some sandy-clay till cuttings in pan, no HCL reaction.
7.9	9.4	Bag sample		Till	Good cuttings; sandy-clay loam; unoxidized; no HCL reaction; till contact @ 7.6m; black (5Y 2.5/1).
9.4	11	Bag sample		Till	As above; sandy clay loam; not many granules; abundant pebbles in pan; black (5Y 2.5/1).
11	12.5	Bag sample		Till	Stone- boulder @11.9m; as above; no HCL reaction; si-cl sand texture.
12.5	14	Bag sample		Till	Silty-clayey sand; soft, plastic; no HCL reaction; as above.
14	15.5	Bag sample		Till	As above; no change; a few stones in this interval.
15.5	17.1	Bag sample		Till	Rocky, hard drilling from 15.8m - 16.6m; granite rock cuttings in pan; till is more stiff; @16.6m.
17.1	18.6	Bag sample		Till	Stiffer, more consolidated, little change from above; no HCL reaction; angular rock fragments; peat fragments likely from above.
18.6	20.1	Bag sample		Till	Driller says stiff drilling; poor cuttings (very small); hit boulder @19.8m; some black rounded shale fragments; feldspar, quartz.
20.1	20.7	Bag sample		Till	Some well-rounded pebbles (0.5cm) suggests gravel layer, but driller says stiff till; a few limestone clasts; quartzite; crystalline; no HCL reaction, sa-clay till; moderately soft, plastic; few stones.
					End of rotary hole, set casing and cement, set up BOP and rig substructure.
					Rig set-up on substructure with BOP. Casing set to 20.7m and cemented.
20.7	22.6	---		Till	Drilled out with rock bit, same till as above.
22.6	25.6	1.40	0.70	Till	Black (5Y 2.5/1), stiff and plastic sandy clay loam, unoxidized, moderately pebbly, non-calcareous, shale clasts present.
			0.22	Silt	Black (5Y 2.5/1), clayey, massive, few pebbles, very soft, recovery likely lost in this unit.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.48	Till	Same till as above, 2cm silt bed 10cm from top, massive.
25.6	28.7	0.90	0.90	Till	Black, sandy clay loam, massive, unoxidized, stiff, quartzite, igneous, limestone, lost recovery probably due to large quartzite cobble at top of run.
28.7	31.7	1.72	1.72	Till	Same as before, very slightly calcareous, minor very fine grained sand lense, poorly bedded silt, moderately pebbly, well rounded quartzite pebbles to angular granites, minor black shale, greenish-grey siltstone, carbonaceous shale.
31.7	34.7	1.25	1.25	Till	Large rock @ 34.4m; 6-7cm dolostone pebble; 6-8cm Athabasca sandstone; 10cm quartz sandstone cobble; cl-si sand; soft, easy to cut; 1% pebbles, few granules; weak to very weak HCL reaction; a few dolostone pebbles; black (5Y 2.5/1); cobbles mostly at 0-15cm part of core; quartz sandstone cobble in shoe.
34.7	37.8	2.85	2.85	Till	As above; si-cl sand; few pebbles; some cobbles- Athabasca sandstone at top of core (from 34.4m); a few greenish sandstone clasts; no HCL reaction; moderately stiff; easy to split (breaks along apparent fracture planes), weak HCL reaction @ 2.6m (0.9-1.8m wrapped up in plastic for pore water sample).
37.8	40.8	2.7	2.7	Till	Rocks @ 39.3m, 40.2m; same as above; a few black rounded shale clasts; no HCL reaction at 2.4m; very minor reaction @ 1.5m.
40.8	43.9	3.1	0.70	Till	As above becoming much more clayey in texture at contact with lacustrine.
			2.40	Silt and clay	Lacustrine, rhythmically bedded; clay laminae ~4-5mm thick, silt laminae 12-20mm thick; silty beds are extremely finely laminated (0.25-0.5mm thick), noncalcareous, from 2.9-3.1m finely bedded, loosing rhythmite structure (about 25-30mm between clay beds); very dark grey to black (5Y2.5/2).
43.9	46.9	2.87	2.44	Cl-silt and clay	As above, but becoming more clayey; clay laminae 3-5mm; silty layers 15-35mm thickness; not as well finely laminated as above; dropstones.
			0.43	Diamicton	Very clayey beds with till beds (poorly defined), more stones; non calcareous; becoming more till like from 2.6m-2.87m.
				Till and Clay	Oxidized bleb @ 2.6m, ~5mm size; mostly till with 20mm thick clay layer, till cl-si sand like above; noncalcareous; 3 photos taken, photos of bedded lacustrine sediments, some brown siltstone/ very fine sandstone clasts in till.
46.9	50.0	2.4	0.30	Till and Clay	As above, some clay beds mixed with till.
			2.10	Till	Clayey silty sand, similar texture to till above; appears to have more local bedrock fragments, mostly soft sandstone; pebbles ~1%, a few dolostone, chert clasts; granules 2-3%; very weak to no HCl reaction, calcareous limestone nodule reacted strongly; black (5Y 2.5/1); Athabasca sandstone clasts, rocky from 49.1m-50.0m Athabasca sandstone boulder.
50.0	53.0	2.93	2.93	Till	Athabasca sandstone boulder at top of core; silty clay sand; 2% granules; 1-2% pebbles; no change from above; no HCL reaction; some gneissic cobbles; not any significant amount of local bedrock clasts.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
53.0	56.1	1.52	1.52	Till	Hit rock at 54.6m- only 1.5m core recovery (53.0m-54.5?); stiffer drilling at 55.2m; granite at 53.0m at top of core; till same as above, few more pebbles (2%); 10cm quartzite cobble at 1.0m; clayey silty sand.
56.1	59.1	1.0		Till	No core but driller said ~30cm-60cm till then hit sand.
				Sand	No sample in core; driller said hit at least 1.5m sand.
			0.20	Till	As above; siltstone cobble- buff coloured.
			0.10	Silty sand	Dirty, poorly sorted lense in till.
			0.70	Till	Large buff coloured siltstone cobble at top of core; granite cobble at top of this interval; numerous iron oxide blebs in this interval; lost core 56.1m-58.1m.
59.1	62.2	2.57	2.57	Sandy till	Athabasca sandstone cobble at top of core; granite cobbles at 1.7m-1.8m interval; this run appears to have more granitic rock fragments than previous runs; silt parting at 0.45m; texture same as above, clay silty sand; becoming more consolidated; some local sandstone clasts; no HCL reaction at 1m, no HCl reaction at 2.3m; bottom 0.5m very sandy, fewer granules.
62.2	65.2	1.47	1.47	Sandy till	Core recovered from 62.2m-63.7m; sandstone boulder at 63.7m; lost core from 63.7m to 65.2m; slightly clayey silty sand texture, very sandy; no HCL reaction; driller says slightly harder drilling, less clay in matrix (>15%); brittle; silt content also higher.
65.2	68.3	1.25	1.25	Till	Poor recovery- numerous stones in hole; cobble partially filling shoe but some curls of till squeezing by; granite cobbles at 0.9m in core; clay silty sand; more clay in matrix than previous runs (5% or more); granite cobble in shoe at 1.25m.
68.3	71.3	2.72	2.72	Till	As above; abundant granite clasts; granules 2%; coarse sand 2-3%; no HCL reaction; some limestone clasts; clayey silty sand texture; more consolidated; sample fractures when core split; medium sand parting at 1.3m.
71.3	74.4	3.0	3.0	Till	Boulder at 72.8m; softer drilling 72.8m-73.5m; Athabasca sandstone boulder at 72.8m in core; till same as above; pebble % increase 2-3%; clayey silty sand; core much stiffer, harder to break; more silt in matrix; clayey sandy silt, a few limestone clasts, numerous granite.
74.4	77.4	0.55	0.55	Till	Lost core from 75m to 77.4m (sand at 75.9m- no core recovery), as above.
				Sand	Sand at 75.9m; fine sand in sieve; glacial; a few carbonaceous shale (coal?) fragments (2mm).
77.4	80.5	0.07	0.07	Till and clay	Till in bottom of core shoe; large silty clay clast in till (8cm); silt parting in clay is non-calcareous, looks like shale clast but could be lacustrine clay inclusion; ~60cm of this according to driller.
80.5	83.5	0.42	0.15	Clay	Silt partings, massive to very weakly bedded.
			0.18	Till	Same till as above.
			0.09	Clay	Clay, massive, rounded clay clasts; some pebbles - clay diamicton.
				Sand	Glacial, medium to coarse in 60 mesh sieve; granitic fragments, some black coal- carbonaceous shale clasts.
83.5	86.6	1.0		Sand	Sand drilled from 83.5m to 85.0m.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			1.0	Clay (shale?)	Bedded silty clay, almost rhythmically; noncalcareous; almost has shale appearance; hard; light silty partings (highly calcareous); black clayey partings and fragments; clay sample from 85.0m- 86.0m.
				Sand	Driller says sand from 86.0m to 86.6m.
86.6	89.6	0.55		Sand	86.6m to 87.5m- no sample.
			0.25	Silt	Massive; brittle; moderately dense.
			0.30	Cl-si sand	Sand, diamicton; very poorly sorted, muddy glacio-fluvial deposit; pebbles; has sandy till-like appearance; can be cored.
				Sand	Sand at 88.1m- 90.5m.
89.6	92.7	0.55	0.15	Till (?)	Till at 90.5m, ~15cm thick; sandstone boulder at 90.8m (Athabasca sandstone).
			0.15	Boulder	13cm thick in core; Athabasca sandstone.
			0.25	Till and sand	~30cm sandy till and sandy diamicton (fluvial) mixed; gneiss, granite rock fragment at 0.4m down in core; could be sand from 91.1m-92.4m.
					Bag sample of fine to medium sand from 91.1m-92.7m; rock at 92.4m (till).
92.7	95.7	2.7	2.7	Till	Pore water core sample from 93.0m-93.7m; much more silty till than tills above; cl-sa silt; dense; stiff; breaks brittle; very weak HCl reaction; some local siltstone/ sandstone clasts; more sandy with depth around 2.3m; no HCL reaction at 2.6m; 1-2% pebbles and granules.
95.7	98.8	3.18	0.65	Till	Sandy clay silt till.
			0.10	Fine sand	10cm of silty fine sand.
			0.55	Silt	Massive, with rip up clasts of finely bedded silt ~3-4cm size.
			0.20	Silt	Finely bedded silt and clayey silt with highly deformed, contorted bedding suggesting dewatering structures; noncalcareous.
			0.60	Silt	Massive, with occasional bedded silty clay and silt layers (~5cm thick); noncalcareous.
			1.08	Silt and clay	Bedded silt and clay with increasing clay bed thickness at bottom 40cm; noncalcareous; clay is black, silt is very dark grey; finely laminated, fissile.
98.8	101.8	0.93	0.93	Clay	Lost 3m of core down hole- ran back down and retrieved 0.9m, running back down hole to retrieve remainder of core. Minor silt laminae, moderately well bedded; at 0.1-0.4m, high angle (10°) and some deformed silt beds; dark black clay beds from 2-5cm thick; noncalcareous; bottom 30cm finely bedded clay with silt partings (~1-2mm thickness of laminae).
101.8	103.6	0.65			Hard drilling at 100.6m, 101.8m- drilled 1.8m, only recovered 0.9m.
			0.15	Clay	Weakly bedded clay, poor sample.
			0.15	Clay and silt	Well-bedded clay with silt laminae.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.35	Clay	Weakly bedded clay with occasional 3mm thick silt laminae; still chasing 3m of core; driller says some of the missing 3m has been ground up by the bit and is cuttings in the tank; some of this missing core may show up in the next run.
103.6	104.9	0.52			Driller indicated sand at 104.5m to 104.9m.
			0.22	Clay	Black (5Y 2.5/2), same as above, weakly bedded; massive appearing; stiff; waxy; upper 10cm disturbed by redrilling; noncalcareous; pictures: R2/23-25.
			0.30	Clay	Same as above but well bedded; abundant fine silt/ very fine-grained sand laminae ~1mm thick; noncalcareous.
				Sand and gravel	104.5m-104.9m - no recovery-driller comment. Sample collected from mud tank flow; medium to coarse grained sand; abundant angular black grains.
104.9	106.4	0.10			Lost recovery; drillers comment sand and gravel.
			0.10	Clay	Black; highly broken and deformed; clay or shale (?) clasts; minor fine-grained sand (grey); noncalcareous; possibly deformed bedrock.
106.4	107.9	0.3	0.13	Silt	Very dark grey; soft, clayey; deformed; noncalcareous.
			0.12	Clay	Black; massive; faintly mottled; deformed with slickensides; noncalcareous.
			0.05	Silt	Very dark grey with black clay laminae; highly contorted and deformed; noncalcareous.
107.9	109.4	0.48	0.48	Clay	Black; deformed clay with silt; stiff; noncalcareous; silt beds deformed, also appears fractured throughout.
109.4	110.9	0.89	0.89	Clay	As above with slickensides; fewer silt beds; upper 50cm highly fractured; lower 39cm hard and very stiff; driller is thinning drilling mud to try and improve recovery.
110.9	114	0.53	0.53	Clay	As above; less hard and stiff; massive; waxy in appearance; very few granules, quartzite and granite; minor silt; noncalcareous.
114	115.5	1.38	1.38	Clay and silt	Very prominent rhythmic bedding; very dark grey silt and black clay interbeds (varved?); occasional pebbles; top 20cm: 2-3cm silt beds, 0.5cm clay beds; horizontal bedding, undeformed; noncalcareous; next 60cm: undeformed, 1cm silt, 0.5cm clay couplets, one 10cm silt bed, noncalcareous; next 20cm: same rhythmic bedding; some deformation with fractures and minor offsets, noncalcareous; next 38cm: undeformed; 0.5cm silt, 0.5cm clay; bottom of core: contains sand beds; slightly calcareous (photos R2/ 31-34).
115.5	117	1.53	1.53	Clay and silt	As above; rhythmic bedding; most silt beds ~1cm wide; dark grey in colour; 0.5cm black clay beds; horizontally bedded, undeformed; some of the thicker silt beds seem to show cross bedding; only the top 10cm is slightly calcareous; fairly stiff; presence of some pebbles, some bedding planes are sandy.
117	120.1	0.23	0.05	Clay and silt	As above.
			0.18	Silt	Number of bedded, very dark grey and black silts; slightly calcareous; darker beds contain more clay than lighter silt beds.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
120.1	123.1	0.92	0.10	Silt	Dark grey; same as above.
			0.10	Silt	Dark grey; massive; saturated; soft and loose; water bearing; possible loss of recovery.
			0.72	Silt	Minor clay interbeds and laminae; slightly deformed bands; stiff; noncalcareous.
			bag sample	Sand	Drillers comment: hit about 1.5m of water bearing sands from base of run; sand and fine gravel (igneous pebbles).
123.1	124.7	0.04	0.04	Clay	Black; massive; silty; hard; stiff; thin clay interbeds.
124.7	126.2	0.00			No recovery- likely sand.
126.2	129.2	0.35		Boulders and cobbles	Drillers comment: hit rock about 4' from bottom, chased it down the rest of the way.
			0.05	Silt	Black; massive; plastic; noncalcareous.
			0.10	Silt and cobbles	Chert, granite; sub angular to sub rounded; up to 5cm in diameter.
			0.20	Boulders	Dark grey and green igneous rock; cut with a diamond bit.
129.2	132.3	0.35	0.35	Sand	Dark grey; very fine to coarse-grained sand; disturbed from drilling, drilling through a number of stones; 10cm quartzite cobble at top; *faint olive grey oxidation bands ~ 1cm thick; finer grained sands show some bedding and become more prominent near the base.
132.3	133.8	0.00	Bag sample	Sand	Fine grained-very coarse grained; igneous, quartz, chert grains; rounded to sub angular; few pebbles.
133.8	135.3	0.00			Driller comment: still in sand.
135.3	138.3	0.45	0.45	Sand	Very dark grey; silty; very fine grained; silty clay interbeds; fine, wavy carbonaceous laminae (minor); light grey calcareous lense 3cm x 0.5cm.
138.3	141.4	0.60	0.60	Sand/ silt	Very fine grained; same as before; lower portion of core recovery shows minor deformation of the laminae; soft; slightly calcareous.
141.4	144.5	0.00		Sand	Sieve sample in bag- mostly fine grained.
144.5	147.5	1.00	0.70	Clay	Silty; very dark grey; grey silt laminae, horizontal; stiff; broken up from drilling; noncalcareous.
			0.15	Clay	Silty; massive; dark grey; stiff.
			0.15	Silt	Sub horizontal clayey interbeds; slightly calcareous. NOTE: drilling mud very sandy. Fines circulating and possibly contaminating screened samples. Need to empty mud tank. Also, likely affecting core recovery.
147.5	149	0.60	0.60	Sand	Grey- dark grey; fine to medium; loose; water bearing; clean; some dark silt interbeds; presence of some pink, angular igneous fragments, mostly well rounded quartz, some well rounded cherts.
149	152.1	0.90			Drillers comment: seem to be drilling through alternating beds of sand and clay.
			0.05	Sand	Same as above.
			0.08	Clay	Silty; very stiff; slightly calcareous; very dark grey.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.12	Silt	Massive; saturated; loose.
			0.55	Sand	Brownish grey; fining up water from coarse to very fine grained; saturated; loose; some well rounded quartzite pebbles up to 2cm.
			0.10	Diamicton	Clayey sand; massive with pebbles up to 4cm, noncalcareous.
152.1	153.6	0.00			Drillers comment: still in sand, most likely.
153.6	156.4	0.00		Gravel	Driller says 2.7m gravel; rig chatter; pan sample of angular fragments of mudstone (green-grey), local sandstone, crystalline gneiss, quartzite; bag sample (core box 20); 4 cobbles at bottom of core shoe, 7cm across, broken, 3 gneissic, 1 pink quartz sandstone; bag sample in core box 21.
156.4	159.7	0.00		Pebbly sand	Driller says stones in sand; sand is medium grained; quartz sand with feldspar; black grains- possibly rock fragments or chert(?); well rounded, carbonaceous shale clasts, bag sample in core box 21.
159.7	162.2	0.00		Gravelly sand	Driller reports rocks all the way down; sand is medium grained; quartz with 25% dark fragments, tabular shale fragments; bag sample in core box 21. Change to rock bit.
162.2	165.2	0.00		Sand	Medium grained; angular, tabular; dark grains (shale?); rounded quartz grains; moderately well sorted; some pink fragments (feldspar?); some tabular, light collared grains; very coarse fraction as caught in hand strainer absent; sample taken.
165.2	168.2	0.00		Sand	As above; 2 samples taken, finer fraction #1, coarser fraction #2; abundant local bedrock present (siltstone, shale).
168.2	171.3	0.00		Sand	As above; 2 samples taken: #1, #2; abundant local bedrock present (siltstone, shale).
171.3	174.3	0.00		Sand	Dominantly quartz; 10% igneous, 10% black, local bedrock, greenish igneous; quartz- well rounded to angular, frosted and clear; Ironstone.
174.3	177.4	0.00		Sand	As above.
177.4	180.4	0.00		Sand	As above.
180.4	183.5	0.00		Sand or till?	Sand fraction as above but now contains noticeable clay balls with grains at 182.9 m; possibly till; clay smeared onto granules; clay not seen alone.
183.5	186.5	0.00		Sand or till?	Same as before.
186.5	189.6	0.00		Sand or till?	As before- drilling with tricone rock bit. Driller comments: softer drilling since 180.4m.
189.6	192.6	0.00		Clay/ silt/ sand	Likely interbeds of clay silt and sand; soft drilling; very few larger clasts and granules; glacial sand; 2% pink feldspar, abundant pink quartz, 10% black mafics and cherts; angular, fine grained sand; clay ball still present; number may be increasing in coarse fraction.
192.6	195.7	0.00		Sand/ clay?	Same as before; but less clay balls; drilling change: harder, more coarse and fine fraction- likely interbeds; abundant pink, green igneous clasts, minor sulphides, some local bedrock, mostly quartz; 10% black grains.
195.7	198.7	0.00		Sand	Same as before; minor clay balls; fine grain sample- mostly quartz with increasing black grains; green grains; very few pink coarse fraction- quartz, black grains, few igneous, pink.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
198.7	201.8	0.00		Sand	Same as before; minor clay; mostly quartz; angular to rounded grains; fine to coarse grained; 10% igneous, 10% black mafics; Fine grain fraction: 30% black grains, few pink coarse fraction: minor sulphide rods.
201.8	204.8	0.00		Sand	Fine to coarse grained; fine grain- salt and pepper, mostly quartz, 30% black, green, few pink grains, minor yellow coarse grain fraction; quartz, igneous grains, 10% black, minor siltstone, minor brown tabular grains fossil? or Ironstone?; minor mica.
204.8	207.9	Bag sample		Sand	Little sample recovered; likely fine grained; same sand as above.
207.9	210.9	Bag sample		Gravel	Moderate sized; rock bit is chattering but still going down; no sample recovered; loss of circulation; mixing 9 more bags of mud.
210.9	214	Bag sample		Gravel	Cobble size (?); mostly quartzites; white, yellow, grey; abundant black chert- well rounded; minor igneous; very few pink igneous clasts; some crystalline quartz- rose, white; minor sandstone clast; limestone clast (HCl reaction).
214	217	Bag sample		Gravel	Same gravel as above.
		Bag sample		Sand	Driller note: out of gravel at 214.6m; drilling like same sand as above gravel.
217	220.1	Bag sample		Sand and gravel	Fine gravel with sand; mostly quartz, quartzite, white, grey, and yellow-brown; 20% black chert, >1% pink igneous- might be circulating from above; few larger stones.
220.1	223.1	Bag sample		Sand and gravel	As above; presence of clay/silt balls? make up less than 1% of sample.
		Bag sample		Sand and gravel	As above; no clay/silt balls.
		Bag sample		Sand and gravel	As above; finer gravel fraction increasing.
		Bag sample		Sand and gravel	As above; occasional large stone.
232.3	235.3	Bag sample		Gravel	Coarse; slow drilling. Driller reports clean mud; still drilling through rocks (233.2m-234.1m); sample wash fines from bottom of sample wash bucket; sample bag in box 21; driller reports finer gravel 234.1m; sample returns improving; driller reports back into rocks at 234.4m; drill break out of rocks, into hard drilling; driller suspects sandstone; first appearance of soft, white tabular cuttings.
232.3	235.3	Bag sample		Sand and gravel	Fine gravel with sand; rock fragments, quartz, abundant well-rounded black chert pebbles, white and smoky yellow quartz, rare green and rare pink igneous rock fragments, rare calcareous rock fragments, rare cemented quartz sandstone (medium grained, brown), very rare and very soft white tabular platy fragments, no HCL reaction, (anhydrite?).

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
235.3	236.8	Bag sample		Sandstone with bentonite interbeds	Drilling break; hard smooth drilling; 4100 kgs on bit ; metal shavings starting to appear in cuttings; at 236.2m, hard drilling for 15cm, driller says may be fracture bit; at 236.5m seeing more sandstone; rare bentonite (grey, tabular, soft, smearing- greasy) fragments in cuttings; at 236.7m, hard chatter. Lower medium to upper fine grained; medium brown to greenish brown; well sorted; quartoze with minor chert grains (sub rounded to sub angular); quartz cemented; porosity>5%. Bentonite- small; tabular; white-grey; greasy, soft cuttings; black and grey chert pebbles and fragments abundant in sample but origin unknown. Core point chosen at 236.8m. *NOTE: Driller called break at 235.3m but he was not at the drill; K.P and G.J and drillers helpers noted break at about 234.7m; plus, first sandstone and bentonite appeared in samples 232.3m-235.3m.
236.8	238.4	1.45	0.15	Sandstone	Upper fine grained to lower medium grained; well rounded; well sorted; light brown; silica content; quartz with 10% well rounded black chert pebbles (0.5cm), elongate; possible low angle cross bedding; tight (no porosity) [Sandstone].
			1.30	Shale	Black; soft; moderately fissile; non-calcareous with abundant light grey, wispy silt laminae, partings and blebs; occasional fine quartz sand on partings, non-calcareous; pyrite; recognizable horizontal burrows (planolites?) infilled with silt; one fossil ~3mm long found in place on a shale parting, not identified, light grey-brown [Bioturbidated Silty Shale].
238.9	240.8	2.4	2.4	Shale	As above but with 1-3cm interbeds of dark green to grey very fine grained quartz sandstone; very soft to unconsolidated sand with parallel to low angle fine cross lamination (glauconite?) and minor chert; sub rounded grains [Bioturbidated Silty Shale with glauconitic very fine sand/sandstone interbeds].
240.8	243.5	2.54	2.54	Shale	As above but with rare greenish very fine grained sandstone interbeds; still silty but silt becoming perhaps more interbedded or interlaminated with shale as opposed to wispy, bioturbated with occasional horizontal burrows in upper half of core; returning to more bioturbated silty shale in bottom; very fine green sandstone in burrows observed as well as silt.
243.5	245.1	1.64	1.64	Shale	As above; bioturbated silty shale with very fine grained, green sandstone.
245.1	248.1	1.93	1.93	Shale	Black; blocky; with minor silt partings (less than above unit); orange brown concretion (15cm) below top of core (BTOC), siderite?; subhorizontal fractures, 30° from horizontal; 60, 94, 110, 140 cm BTOC; may be slickensided but muddy- too hard to tell; incipient concretion at bottom of core, jammed in shoe, and twisted off; assume core below fell out; sandstone- 3cm at base of core, medium to coarse grained, moderately hard.
248.1	249.6	0.27	0.27	Shale	Black; hard; solid; numerous tight intersecting fractures, 30° angle clay filled fracture; tried to retrieve 1.2m of core from last run, but unsuccessful.
249.6	249.9	0			Tried to recover shale core in hole; different core catcher- finger; core slipping out.

Appendix 2-C – Lithologic Description of Corehole WR99-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
249.9	250.2	0			Different core catcher- spring toggle; no luck, core still slipping out.
250.2	250.7	2.54	2.54	Shale	As above; 2cm sandstone bed 62cm from base of core, depth might be 250.1m; sample is very hard and makes a dull ringing sound when struck; low angle bedding (5-10°) planes; few burrows are sand filled; minor sulphide nodules, occasional dark red-brown fish scales?
250.7	253.4	1.43	1.43	Shale	As above; parting planes appear to be subhorizontal; tight fractures; sulphides present as nodules and along fractures; bioturbation has decreased.
253.4	253.7	0.45	0.45	Shale	As above; drilled 30cm, and was only able to recover a portion of 1.2m core down the hole; broken up from drilling; end in Joli Fou Shale.
					T.D. at 253.7m. -Finished coring at 1:00am, Dec. 12/99. -Circulating for 30min. -Hole in good condition for logging. -Century logger on site. -Run 4 tools: 1st. Magnetic Susceptibility. 2nd. Sonic. 3rd. Density Combination. 4th. Neutron Combination.

Appendix 2-D – Lithologic Description of Corehole WEPA00-1.

PROJECT: **WEPA Hydrogeology**	DATA NO: **WEPA00-1**	LOGGED BY: T. Lemay	DATE: Sept 28, 2000
DRILLER: McAuley Drilling Ltd.	TYPE DRILL: Wet Rotary	DRILL METHOD: Wireline Core	SURFACE ELEVATION: 667.64 m
LOCATION: LSD 06 SEC 33 TP 74 R 09 W4	LATITUDE: 55.4514162°	LONGITUDE: 111.3298313°	Source: Surveyed
COMMENTS ON LOCATION: At Margie railroad crossing, north end of clearing, east side of tracks, west of hwy 881.			

DRILLED DEPTH (m) from	DRILLED DEPTH (m) to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
0.0	0.8	0		Till	Sandy silt till, (from cuttings)
0.8	1.8	0.18	0.18	Till	Sandy silt till, 2.5Y 4/3, granite clasts and some quartzite clasts, unoxidized grey blebs, thin sand partings, oxidation occurring along the partings, soft.
1.8	2.8	0		Till	No recovery.
2.8	3.7	0.50	0.50	Till	Sandy clay loam, abundant iron oxide blebs and lenses along fractures, iron oxide halos, clay content increasing, 2.5Y4/2, large clasts absent, granules 1%, very weak to weak HCl reaction, soft, moderate HCl reaction with iron oxides.
3.7	4.6	0.98	0.98	Till	Sandy clay loam, iron oxidation, present along medium sand beds, 2.5Y 4/2, and fractures, fracture angles about 10° from horizontal, clay or shale clasts present, coal carbonates, matrix has a weak HCl reaction, iron oxides have a weak to moderate HCl reaction, halos also present around some of the iron oxide blebs, soft. (4 photos taken).
4.6	5.3	0.18	0.18	Till	Till, as above, large clasts of igneous and sedimentary (clay and dolomite origin), oxidation decreasing, soft.
5.3	6.3	1.00	0.90	Till	Sandy clay loam, streaks of oxidation, some vertical, some horizontal, presence of unoxidized zones, some with unoxidized cores at the center of oxidized haloes, large clasts absent, soft.
			0.10	Till	Sandy clay loam, 5Y 3/1, moderate HCl reaction, granules 1%, large granite clasts at base of recovered core.
6.3	7.8	1.03	0.74	Till	Sandy clay loam, oxidation along sand lenses, moderate to weak HCl reaction, siltstone and clay clasts, large metamorphic clast at the top of the recovered core, soft, oxidation streaks at high angle with moderate HCl reaction.
			0.10	Sand	Silty sand, fine grained, abundant oxidation.
			0.19	Till	Silty sand, fine grained, 5Y 4/3, weak to no HCl reaction, oxidation at the base of this run, soft, till as above.
7.8	9.4	0.30	0.30	Till	Clay loam, 5Y 3/1, very dark grey, moderate to strong HCl reaction, sand parting about 25° from horizontal, fine sand 10cm from top of the recovered core, soft, large clasts present but not abundant, massive, shale clasts observed.
9.4	10.5	1.75	1.75	Till	Collected additional 60cm from previous run, Sandy clay loam, 5Y 3/1, moderate HCl reaction, granules 1%, massive, soft, presence of sand particles.
10.5	11.5	0.75	0.75	Till	Till, as above, medium grained sand partings.
11.5	13.5	1.70	1.70	Till	Till, as above, high angled fine grained sand partings, weak HCl reaction, few large clasts found, some dolostone clasts, pebbles <1%, granules <1%.

Appendix 2-D – Lithologic Description of Corehole WEPA00-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
13.5	15.5	1.90	1.90	Till	Till, as above, sandy, high angle (45°) sand partings still abundant, wear HCl reaction periodic, sand rich zone from 0.7m to 0.85m from top of recovered core, sand partings have moderate HCl reaction, core breaks along partings, till becoming firmer, bedding (?) planes of sandy diamictons up to 3.0cm thick, irregular, very calcareous, alternation between light and dark bedding, bottom 10cm -20cm clayey sand.
15.5	17.5	0		Sand	Sand content increasing with depth in the till above, could be causing the recovery problem.
17.5	18.5	0		Sand	Drill break at 20.5m, driller indicated we are out of the sand.
18.5	20.5	0		Sand	No recovery.
20.5	21.5	0.36	0.19	Slough	Mix of material from above the current material.
			0.17	Clay	Clay with silt beds, *rip-up clasts* present, alternation of light and dark beds, irregular in shape, weak reaction with HCl, 3 photos taken, firmer than above tills.
21.5	22.5	0.85	0.23	Silt	Clayey silt, frequent irregularly bedded silt and clay, weak to moderate HCl reaction.
			0.57	Silt	Clayey silt, massively bedded, evidence of some vertical bedding, weak to moderate HCl reaction.
			0.05	Sand	Silty (dirty) sand.
22.5	23.5	0.46	0.46	Till	Sandy clay loam, dark grey, very weak HCl reaction, thick sand bed about 10cm thick, 20cm from top of core recovered, large clasts forming a bed (?) near top of the interval, firm, zone of oxidation (dark olive color 2.5Y 3/2) 5cm from base of interval.
23.5	24.9	1.5	1.5	Till	Sandy clay loam, 0.6m to 0.65m zone of oxidation, very dark grey, oxidation appears to occur along fractures, pebbles 1%, granules 1%, weak to very weak HCl reaction, coloration of oxidized zones changes with depth from rust to olive brown, moisture content appears to have decreased.
24.9	26.1	1.2	1.2	Till	Till, as above, 0.2m from top of core contains more signs of oxidation, carbonaceous shale clasts noted, weak HCl reaction, large sandstone clast about 40cm from top of recovered core, occasional fine grained sand lenses
26.1	27.6	0.58	0.58	Till	Till, as above, with siltstone clasts, weak HCl reaction, large sandstone clast at the base of the recovered core, more massive till.
27.6	29.6	1.86	1.86	Till	Clay loam, stiff, very weak HCl reaction, large gneiss clast 20cm from top of recovered core.
29.6	31.9	0.15	0.15	Till	Sandy loam, fine grained, very weak HCl reaction, poor recovery due to rocks in the shoe, large igneous and metamorphic clasts present.
31.9	32.5	0.40	0.10	Till	Sandy loam, as above, fine grained.
			0.30	Till (#3?)	Clayey silt till, weak to moderate HCl reaction, dense and stiff, very dark grey, sulphur smell evident, igneous clasts, bitumen smell also present in core (sulphur smell noted after the addition of acid).
32.5	33.7	0.34	0.34	Till	Till, as above, bitumen smell still present in core, large clast of Athabasca sandstone, some very reactive particles present within the matrix, occurrence of shale or clay near the base of the recovered core. Oil emulsion in mud tank.
33.7	35.7	1.60	1.40	Till	Till, as above, 5Y 3/1 very dark grey, bitumen odour in core getting stronger, very stiff, large clasts of igneous rocks near the base of recovered core.

Appendix 2-D – Lithologic Description of Corehole WEPA00-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.20	Till	Sandy clay loam, 5Y 3/2, bitumen odour still apparent in core, stiff and massive, very weak HCl reaction, pebbles and clasts <1%.
35.7	37.7	Bag sample		Sand	Driller reported hitting rocks at the top of the run and then hit 2m of Sand (medium grained, glacial).
37.7	39.8	Bag sample		Sand	Sand, as above, poorly sorted, predominantly well rounded quartz grains with a minor mafic component.
39.8	41.1	0		Silt or sand	Material hit at 40.3m most likely a Clayey Silt (driller noted hitting harder beds), otherwise sand.
41.1	45.9	0.67	0.67	Sand and till	Sand is sorted with well rounded quartz grains, tabular and angular feldspars, some igneous rock fragments and some mafic minerals, medium grained, grey in color, sandy clay loam, weak to moderate HCl reaction, medium grained light colored sand lenses or blebs, brittle and firm, bitumen smell present but fainter than in above core, sand partings present. Losing water at about 43m (75 gallons). Drill break at 45.1m (harder).
45.9	48.0	0.60	0.60	Till	Sandy clay loam, as above, large igneous clast at the base, sample taken for hydrocarbon analysis from 46.1-46.25m. Driller reported sand from 46.6m to 46.8m and from 47.2 to end of run. Base of recovered core is becoming siltier.
48.0	51.0	1.0	1.0	Sand	Fine to medium grained sand growing finer towards the base into a firmer silt. Sand has rounded quartz grains, some angular feldspars and quartz grains with some mafic grains and rock fragments.
51.0	52.0	0		Sand	Driller thinks were back into that same grey sand.
52.0	55.0	0		Sand	Driller indicated this interval drilled like sand, but was easier drilling than the light grey sand.
55.0	58.1	0		Sand	Sand, as above.
58.1	61.3	Bag sample		Sand	Glacial sand, rich in coal, rounded quartz, igneous rock fragments.
61.3	64.2	Bag sample		Gravel	Glacial gravel, driller called it pea gravel, variety of components, rounded and angular cherts, sub rounded to angular quartz and dolomite fragments, angular igneous rock fragments, poorly sorted.
64.2	64.5	Bag sample		Gravel	Gravel, as above.
64.5	69.2	Bag sample		Sand	Sand, as above, hit a large rock (Athabasca sandstone & chlorite garnet gneiss) at 68.5m with interbeds of silt.
69.2	70.0	Bag sample		Gravel	Gravel, as above.
70.0	72.5	Bag sample		Gravel	Glacial gravel, poorly sorted, coarse grained, angular to sub rounded components, gravel components consist of cherts, dolomite, igneous and metamorphic rocks, sandstone, coal. Rock bit used to get through gravels.
72.5	75.6	Bag sample		Gravel	Gravel, as above.
75.6	78.6	Bag sample		Gravel	Gravel, as above, soft light grey material present, similar to unmixed bentonite powder, chips of white rock fragment, no HCl reaction for soft material or chips.
78.6	79.2	Bag sample		Gravel	Gravel, for upper part of interval. Bubbles noted in the mud at top of drill hole after mud tank emptied.
79.2	79.9	Bag sample		Silt (?)	Silt (?), softer interval.
79.9	80.2	Bag sample		Gravel	Back into gravel.
80.2	81.7	Bag sample		Till (#5?)	Clay loam, very dark grey (5Y 3/1), no HCl reaction, granules <1%.

Appendix 2-D – Lithologic Description of Corehole WEPA00-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
81.7	82.5	0.93	0.93	Till	Clay loam, as above, (clayey sandy silt till), 1-2% pebble content, lithology of pebbles includes sandstone, siltstone, granites, large siltstone clast about 25cm from base of recovered core, large sandstone clast at the top of the interval, bitumen odour in core.
82.5	85.5	2.85	2.85	Till	Sandy clay loam, large clasts at 1.18m from top, 1.88m from top and 2.13m from top, very brittle, very firm, very dark grey, rock fragments within the matrix react with HCl, matrix does not, faint bitumen odour in core, pebble content 1%.
85.5	88.6	1.86	1.86	Till	Silty sand loam, large sandstone clast at the base of run, very dark grey (5Y3/1), carbonate, chert, igneous, sedimentary pebbles, very weak HCl reaction, pebble content 2-3%.
88.6	91.7	2.46	2.46	Till	Silty sand loam, as above, granite cobble at the top of the interval, presence of medium to coarse sand lenses and partings, sand concentrations infrequent, pebble content increased to 3-4%, weak bitumen odour still prevalent in core.
91.7	94.8	2.18	1.13	Till	Sandy silt till, as above, large clasts of sandstone and granite, bitumen odour in core.
			0.66	Till	Sandy silt till, as above, silt content increasing, large clasts of granite, no bitumen odour in core.
			0.29	Till	Sandy silt till, as above, very dark grey (5Y 3/1), no HCl reaction, large clasts of sandstone, pebbles and granules <1% each.
			0.10	Silt	Silt, very dark grey, no HCl reaction, soft and brittle, massive.
94.8	96.7	1.38	1.38	Till	Clay silt till, very weak to no HCl reaction, pebble and granules content <1% each, siltstone pebble 20cm from base of recovered interval, breaks easily, some fine sand (?), competent, no bitumen odour in core.
96.7	98.4	1.99	1.99	Till	Clay silt till with some sand, very dark grey, no HCl reaction, large siltstone pebble 40cm from top of recovered interval, pebbles of dolomite and granite also observed, firm but easy to cut, competent and massive, some fine sand partings. Recovered additional 0.29 m core from above.
98.4	101.5	3.10	3.10	Till	Sandy silt till with some clay, abundant rock clasts, including several large granite, siltstone, sandstone, chert and metamorphic rock, very dark grey (5Y 3/1), some breaks along 45° planes with sand partings common, coal fragment 73cm from top of core.
101.5	104.5	1.13	1.13	Till	Sandy silt till with some clay, as above, sand content appears to be increasing from till above, no HCl reaction, sand partings present, clasts of granite, limestone, sandstone, bitumen odour debatable in core.
104.5	107.6	2.80	2.80	Till	Sandy silt till, as above, large rock at top of cored interval, silt body at 50cm from top with rip up clasts of silt, bitumen odour present in core, rock at top encountered in previous run and is most likely the cause of the poor recovery in the last run.
107.6	110.6	1.21	1.21	Till	Sandy silt till, as above, large Athabasca sandstone clast near the base of the recovered core likely the cause of the lost core.
110.6	113.4	0.5	0.5	Till	Driller reported hitting a large rock at 113.3m depth, slow drilling during that time, large sandstone clast at the base of cored interval likely the cause of the loss of core between 111.1m and 113.3m, large rock at the top of the cored interval (sandstone), no HCl reaction, very much like the till above, clay content appears to be increasing.

Appendix 2-D – Lithologic Description of Corehole WEPA00-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
113.4	114.0	Bag sample		Boulders	Fragments of Boulders, granites.
114.0	114.3	Bag sample		Gravel	Glacial Gravel, poorly sorted, dolomite, granite, sandstone, rounded quartz grains.
114.3	115.3	Bag sample		Till	Sandy silt till, very dark grey (5Y 3/1), no HCl reaction.
115.3	116.6	1.0	0.33	Till	Sandy silt till, granule and pebble content 3-4%, no HCl reaction, hard to split.
			0.18	Sand	Silty Sand, very dark grey (5Y 3/1), no HCl reaction.
			0.49	Till	Sandy silt till, as above, large sandstone clast at the base of the recovered interval.
116.6	119.7	2.86	0.43	Sand	Silty sand, no HCl reaction, olive grey (5Y 4/2), moderately sorted, sub rounded to rounded. Driller noted one foot of sand starting at 116.6m.
			0.40	Till	Sandy silt till with some clay, pebble content 3-4%, no HCl reaction, black (5Y 2.5/1), granite and igneous pebbles dominant, hard.
			1.84	Till	Sandy silt till, very dark grey (5Y 2.5/1), no HCl reaction, large igneous and sandstone rock fragments throughout, soft and brittle, large sandstone clast 49cm from the base of the recovered core.
			0.19	Sand	Silty sand, no HCl reaction, olive grey (5Y 4/2), massive and soft.
119.7	122.7	2.74	0.19	Sand	Silty sand, as above, large sandstone clast at top of run. Driller reported hitting that rock near the top of the run. One pebble thick gravel bed marks the base, moderately sorted rounded to sub rounded.
			2.21	Till	Sandy silt till with minor clay, black, very weak HCl reaction, numerous sandstone pebbles, pebble content 3-4%, very hard.
			0.34	Sand	Silty sand, olive grey (5Y 4/2), no HCl reaction, rocks and pebbles about 1%, sandstone predominantly, medium to fine grained sand, sub rounded to rounded, moderately well sorted.
122.7	125.8	2.28	2.28	Till	Sandy silt till, as above, numerous large pebbles along the outside of the core, very large granodioritic clast 62cm from the base of the recovered core, pebbles: siltstone, chert, sandstone, some granite, and sand content increasing downward.
125.8	127.2	1.50	1.40	Till	Silty sand till, very weak HCl reaction, clasts of granite, sandstone, siltstone, and other igneous clasts, pebbles 3-4%, granules 1-2%, firm and hard to break, massive, numerous large clasts.
			0.10	Sand	Silty fine grained sand, sub rounded to rounded, moderately well sorted, very dark grey, dominantly quartz with some feldspar and igneous rock fragments.
127.2	128.6	Bag sample		Till	Drilled like the silty sand till, Clayey Sand Till material recovered, abundant rocks hit. Hit rock at 127.2m and change to rock bit. Rock about 22cm thick, no HCl reaction.
128.6	129.8	Bag sample		Till	Drilled as above run, Clayey Sand Till recovered, still hitting abundant rocks, no HCl reaction.
129.8	130.5	Bag sample		Till	Clayey sand till, black, clay pieces noted in the recovered material, abundant rocks hit, no HCl reaction.
130.5	131.0	Bag sample		Till	Drilling harder for 10cm, then softer, Silty sand till, very dark grey to black clay, sample probably taken at 130.5m -130.6m, no HCl reaction.
131.0	133.5	Bag sample		Till	Drilling like the silty sand till above, hit rock at 133.2m, rock fragments, look like the rock is granite, no HCl reaction.

Appendix 2-D – Lithologic Description of Corehole WEPA00-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
133.5	134.4	Bag sample		Gravel (?)	Glacial gravel, igneous, coal and quartz fragments, oxidized till fragments, olive grey (5Y 4/2), no HCl reaction.
134.4	134.5	Bag sample		Till (?)	drilling like sandy till, clayey silt till in recovered material, no HCl reaction.
134.5	136.5	Bag sample		Till	Clayey silt till, very dark grey, no HCl reaction.
136.5	138.4	Bag sample		Till	Rock at 137.5m, probably sandstone, numerous other rocks.
138.4	139.3	Bag sample		Till	Sandy silt till, very dark grey, no HCl reaction.
139.3	139.6	Bag sample		Till	Sandy silt till with minor clay, very dark grey, no HCl reaction.
139.6	139.9	Bag sample		Till	Sandy silt till with minor clay, as above.
139.9	140.2	Bag sample		Till	Sandy silt till, as above.
140.2	140.5	Bag sample		Till	Sandy silt till with minor clay.
140.5	143.6	Bag sample		Till	Sandy silt till (possibly with minor clay)
143.6	144.3	Bag sample		Till	Sandy silt till with minor clay in the matrix, granite rock fragments.
144.3	145.7	Bag sample		Till	Sandy silt till, as above, more clay, stiffer drilling at 144.8m.
145.7	146.5	Bag sample		Till	Sandy silt till, with minor clay, very dark grey.
146.5	147.2	Bag sample		Till	Sandy silt till, with minor clay, as above.
147.2	147.7	Bag sample		Till	Silty clay till with minor sand.
147.7	149.0	Bag sample		Till (or clay)	Silty clay till, or clayey silt, very poor cuttings.
149.0	149.3	Bag sample		Till (or clay)	Silty clay till, or clayey silt, very poor cuttings.
149.3	152.2	Bag sample		Till (or clay)	Silty clay till or clayey silt.
152.2	153.2	0.75	0.75	Till	Till, hit a rock and lost most of the core.
153.2	155.2	1.50	1.50	Till	Clayey silt till with sand, black to very dark grey (5Y 2.5/1), first occurrence of shale clasts, siltstone, granite, sandstone, no HCl reaction, pebble content 3-4%, shale clasts up to 3cm long by 2cm wide, some sand lenses of fine to medium grained sand, no bitumen odour in core, 50% of the clasts appear to be local bedrock, hydrocarbon streaks and gas bubbles coming up in the mud.
155.2	157.2	1.12	1.12	Till	Clayey silt till with some sand, very dark grey to black, 2-3% pebbles, brittle, clasts of shale, siltstone, sandstone, large quartzite clast near the base of the recovered core, no HCl reaction.
157.2	159.3	2.1	2.1	Till	As described below.
159.3	162.1	0.9	0.9	Silt	Driller indicated the core recovered from this run was likely from the previous run, hit sand at 160.3m, Sandy Clayey Silt, very dark grey to black, very weak HCl reaction, abundant local bedrock clasts, very few igneous clasts, variation with depth in clay content, some sand partings and lenses, sand content increasing towards the base of the recovered interval, large shale clast 50cm from the base of the interval, easy to break.
162.1	164.3	1.58	0.68	Till	Sandy silt till with clay, black, very weak HCl reaction, siltstone and sandstone clasts, fine sand lenses and partings throughout, minor igneous rock fragments, 2-3% pebbles.

Appendix 2-D – Lithologic Description of Corehole WEPA00-1.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.90	Sand	Silty sand, light grey, poor to moderately sorted, subangular to rounded clasts, glacial origin, made up predominantly of quartz, igneous rock fragments, massive, medium to coarse grained, presence of some local bedrock clasts (namely shale and siltstone).
164.3	167.6	2.74	2.74	Till	Sandy silt till, black (5Y2.5/1), very weak to no HCl reaction, shale, siltstone, some igneous clasts, silt and fine to coarse grained sand partings and lenses, 2-3% pebbles, firm but brittle.
167.6	173.5	5.6	1.8	Till	Sandy silt till, as above, large metamorphic rock at base of recovered core, stiff and brittle, absence of limestone.
			1.8	Till	Sandy silt till, as above, quartzite, granites, local bedrock clasts, coarse sand in the matrix, 4-5% pebbles and granules, hydrocarbons noted in mud tank, core in this run contains material from last run.
			2.0	Till	Sandy silt till, as above, core in this run contains some material from the previous run, abundant coarse sand, faint bitumen odour in core, few (if any) granite clasts.
		0	0.30	Till	Drilled 30cm into till TD 173.5m.

Appendix 2-E – Lithologic Description of Corehole WEPA00-2.

PROJECT: **WEPA Hydrogeology**	DATA NO: **WEPA00-2**	LOGGED BY: T. Lemay	DATE: Oct 3, 2000
DRILLER: McAuley Drilling Ltd.	TYPE DRILL: Wet Rotary	DRILL METHOD: Wireline Core	SURFACE ELEVATION: 570.83 m
LOCATION: LSD 07 SEC 31 TP 76 R 05 W4	LATITUDE: 55.6275339°	LONGITUDE: 110.7614465°	Source: Surveyed
COMMENTS ON LOCATION: Located 50 m from turn in gravel pit along Alta Gas road.			

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
0.0	1.6	0	1.20	Gravel and sand	Most likely fill material.
			0.40	Clay	Buff colour till or clay.
1.6	3.4	1.02	0.48	Clay	Upper 48cm likely the clay encountered in the previous run, 2.5Y 4/2 dark grey-brown mottled with grey, rusty brown mottling, no HCl reaction, soft.
			0.54	Diamicton	Sandy diamicton, sand, silt, pebbles of igneous rocks, sandstone, no HCl reaction, iron oxidation and iron staining, soft, enough clay to bind it together, 2.5Y 4/2.
3.4	4.7	0.35	0.35	Diamicton or till (?)	Clayey silty sand, 2.5Y 4/2, driller hit rocks on run from 3.4m to 4.7m, iron oxide staining forming lenses or bands along fractures (?), weak to moderate HCl reaction, 70%sand, 22% silt, 8% clay, consolidated large clasts of granite, gneiss, sandstone (most greater than 3cm by 3cm).
4.7	5.8	0.30	0.30	Till	5Y 3/2 dark olive grey, clayey silty sand till, weak to moderate HCl reaction, firm, fine sand partings, remnants from the oxidation above, pebbles and granules about 1%. Driller felt that the core recovered came from the bottom of the run.
5.8	7.8	0.69	0.69	Till	5Y 3/2 very dark grey, clayey silty sand till, moderate to strong HCl reaction, several large sandstone clasts with some minor quartzite, 1% granules and pebbles, silt content increasing, coarse sand fraction decreasing, presence of some sand stringers.
7.8	8.8	0.35	0.35	Till	5Y 3/1 very dark grey, same till as above, organic matter observed, could be peat or lignite, firm and massive.
8.8	10.7	0.79	0.79	Till	Till, as above, what look like roots (?) found. Mostly sand at 9.5 m.
10.7	12.1	0.22	0.22	Till	Till, as above, large gneiss clast at top of recovered interval, no organic material.
12.1	12.8	0.15	0.15	Till	Till, as above, large granite clast hit, dolomite pebble present, no organic material.
12.8	13.9	0.86	0.86	Till	Till, as above, very large boulder core of granite about 10cm from the base of recovered interval, also present large clasts of sandstone, no organic material.
13.9	16.0	2.08	2.08	Till	Till, as above, no organic material.
16.0	16.5	0.35	0.35	Till	5Y 3/1 very dark grey, clayey silty sand till, weak to moderate HCl reaction, about 1% pebbles and granules, clasts of sandstone about 5cm from the base of the recovered interval, firm and difficult to split, no organic material.
16.5	18.2	0.39	0.39	Till	Till, as above, moderate HCl reaction, pebbles 1%, large sandstone clast at the base of the recovered interval, no organic material.

Appendix 2-E – Lithologic Description of Corehole WEPA00-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
18.2	20.2	2.00	2.00	Till	Till, as above, several large sandstone clasts, no organic material.
20.2	22.3	2.20	2.20	Till	Till, as above, no organic material
22.3	24.3	0.97	0.97	Till	Till, as above, no organic material; quartzite, sandstone, igneous, limestone clasts, glacial sand and gravel depth (23.6m) from drillers comments.
24.3	25.2	Bag sample	0.60	Sand and gravel	Depth from driller's comments.
25.2	27.5	1.48	1.48	Till	5Y 3/1 very dark grey, clayey sandy silt till, moderate to strong HCl reaction, large granite clast near top of recovered interval, also present are siltstone, sandstone and other igneous rock clasts, bitumen odour noted.
27.5	30.4	2.93	2.93	Till	Till, as above, sandstone clast at the top, shale or clay clast about 30cm from base of recovered interval, interesting rock about 60cm from base of run.
30.4	33.4	2.38	1.90	Till	Till, as above.
			0.14	Clay and sand	Two fining upward cycles from clay to coarse sand.
			0.24	Sand	Silty sand, very dark grey, no reaction with HCl, clasts are sub angular to sub rounded, grains of quartz dominate. Driller noted that from 32.5m to 33.2m drilled like sand.
			0.10	Till	Till, as above.
33.4	36.5	1.29	1.29	Silt and clay	Alternation of dark clay bands with light silty sandy bands, bedding appears deformed and contorted, silt reacts strongly with HCl, clay has no reaction to HCl, top of interval is clay rich grading into more silty and sand rich at the bottom, clay is slickensided, presence of some large pebbles but generally pebble free.
36.5	39.6	1.56	0.14	Till	Till, as above.
			0.90	Silt, clay and sand	Fining upwards from interbedded sand, silt and clay, signs of deformation in the bedding and in the rip up clasts.
			0.32	Sand	Silty sand with some silt and clay clasts, moderate HCl reaction.
			0.20	Silt and clay	Silt and clay, as above.
39.6	42.6	0.60	0.10	Clay	Light grey brown, massive, silty clay, no HCl reaction.
			0.06	Gravel	Sandstone pebble horizon.
			0.09	Clay	Silt clay, light grey brown, massive, no HCl reaction.
			0.05	Sand	Fine-grained sand with minor silt.
			0.02	Clay	Light grey-brown, massive silty clay, moderate reaction of silt with HCl.
			0.14	Till	Sandy silty clay till, 2.5Y 3/1 very dark grey, weak to moderate HCl reaction.
			0.06	Clay	Clay with minor silt, light grey-brown, massive no HCl reaction.
			0.08	Till	Clayey silty sand till, 2.5Y 3/1 very dark grey, weak to moderate HCl reaction.
42.6	45.7	1.42	1.42	Clay and silt	Silty clay with some fine-grained sand, irregular bedding of light silt, sand, dark silt, and clay, only the light colour material reacts to HCl, breaks along silt and sand partings.

Appendix 2-E – Lithologic Description of Corehole WEPA00-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
45.7	46.4	0.70	0.70	Clay and silt	Silty clay with regular bedding of silt and clay with some fine sand beds, bedding appears rhythmic, only the light colour material reacts with HCl.
46.4	48.7	1.42	0.10	Clay, silt and sand	Interbedded and contorted and deformed clay, silt and sand beds, weak HCl reaction, maximum bed width approx. 1cm.
			0.18	Clay and silt	Massive silty clay with blebs or rip up clasts of silt, no HCl reaction.
			0.12	Clay and silt	Interbedded and deformed, laminated silty clay, rhythmically bedded with some blebs of silt, weak HCl reaction, 2 photos taken.
			0.03	Clay and silt	Silty clay, massive, with blebs or rip up clasts of silt, no HCl reaction.
			0.55	Clay and silt	Silty clay, highly deformed and contorted, weak HCl reaction.
			0.07	Clay and silt	Silty clay, massive, with blebs or rip up clasts of silt, no HCl reaction.
			0.10	Clay and silt	Silty clay, deformed, weak HCl reaction, rhythmic bedding.
			0.27	Clay and silt	Silty clay, massive, with blebs or rip up clasts of silt, no HCl reaction.
48.7	51.7	0	0.00	Sand or clay	Clay (?), drilled very soft, cuttings didn't reveal if it was sand or clay, from the residue left in the core shoe it appears to be clay, very dark grey, no HCL reaction.
51.7	54.8	0.25	0.25	Silt	Silt, drilling like a soft clay or sand, very dark grey, clayey silt, clay is minor, weak to moderate HCl reaction, some regular bedding of light and dark colour silt, abundant coal fragments recovered in cuttings.
54.8	56.8	0.18	0.18	Silt	Clayey silt, drilling the same as above, very soft, clay content increasing from that recovered above (about 25%), minor deformation of bedding, weak to moderate HCl reaction, very easy to cut.
56.8	58.8	0	0.00	?	Drills very easily.
58.8	60.9	0	0.00	?	Drills very easily.
60.9	64.0	Bag sample	0.00	Sand	Glacial sand, feldspar, granite, quartz, igneous rock fragments, moderately to poorly sorted, round to sub angular, grey-brown colour, last 1m of drilling was firmer.
64.0	67.0	0.12	0.12	Silt	Clayey silt, drilling very easy like sand or silt, no cuttings, very dark grey, massive, weak HCl reaction. The drill hole is taking on water.
67.0	69.4	1.62	0.57	Sand	Sand, dark grey, fine to medium grained, fully saturated, well sorted, dominantly quartz with some granite and igneous rock fragments, well rounded, no HCl reaction, very soft.
			0.05	Clay	Silty clay, dark grey, massive, no HCl reaction, very soft.
			0.08	Sand	Sand, as above.
			0.04	Clay	Clay, as above, gradational contact.
			0.03	Sand	Sand, as above.
			0.03	Clay	Clay, as above, gradational contact.
			0.20	Sand	Sand, as above.
			0.10	Clay	Clay, as above, sharp contact.

Appendix 2-E – Lithologic Description of Corehole WEPA00-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.30	Sand	Sand, as above.
			0.22	Clay	Clay, as above.
69.4	71.5	0.40	0.40	Sand	Silty sand, dark grey, fine to medium grained, dominantly quartz with black flecks of coal or chert and some minor igneous rock fragments, well sorted, well rounded, no HCl reaction.
71.5	73.1	0.07	0.07	Sand	Clayey silty sand, dark grey, massive, weak HCl reaction.
73.1	79.2	0.07	0.07	Sand	Clayey silty sand, no cuttings being captured, all fine grained, what little could be captured looked like glacial sand, driller noted 70cm of gravel at 78.0m, dark grey, weak to no HCl reaction, large granite clast at base of recovered interval, glacial.
79.2	80.8	0.77	0.77	Sand	Silty sand, regularly bedded, subhorizontal alternating beds of dark and light material, some appear to be deformed, no HCl reaction, predominantly quartz with some igneous rock fragments, sub rounded to rounded, very soft, glacial.
80.8	83.2	0.02	0.02	Silt	Clayey silt, dark grey, massive, some fine sand lenses, very weak to no HCl reaction, interval drilled very softly.
83.2	85.3	0.65	0.09	Sand	Silty sand, dark grey, fine-grained, massive, dominantly quartz, well rounded and well sorted, glacial.
			0.18	Till	Clayey sandy silt till, 5Y 3/1 very dark grey, weak to no HCl reaction, fine sand or silt partings and sand lenses, pebbles less than 1%, clasts of coal, sandstone, and igneous.
			0.03	Sand	Sand, as above.
			0.35	Till	Till, as above.
85.3	87.6	1.35	0.08	Sand	Silty sand, dark grey, fine-grained, massive, dominantly quartz, well rounded and well sorted, glacial.
			0.10	Silt	Clayey silt, very dark grey, massive, weak HCl reaction, some fine sand or silt lenses or partings.
			0.46	Sand	Sand, as above.
			0.20	Clay	Silty clay, very dark grey, irregular bedding of silt and clay, clay clasts in the silt beds on occasion, no HCl reaction.
			0.51	Silt	Clayey silt with some sand beds and lenses, very dark grey, no HCl reaction.
87.6	89.0	0.93	0.07	Silt	Silt, as above.
			0.86	Till	Clayey silty sand till, very dark grey, weak to moderate HCl reaction, some fine sand or silt partings, pebble content less than 1%, clasts of granite and sandstone.
89.0	92.0	3.01	3.01	Till	Till, as above, limestone clasts observed.
92.0	95.0	2.07	2.07	Till	Till, as above, some clay or shale clasts.
95.0	98.1	3.05	3.05	Till	Till, as above, some fine sand or silt partings, absence of clay or shale clasts, pebbles 1-2%.
98.1	101.2	3.18	3.18	Till	Till, as above, moderate to strong HCl reaction, 2-3% pebbles, massive, driller indicated this interval was harder drilling.
101.2	104.2	2.98	2.98	Till	Till, as above, local bedrock clasts dominant, silt or fine sand partings.

Appendix 2-E – Lithologic Description of Corehole WEPA00-2.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
104.2	107.3	2.06	2.06	Till	Till, as above, with signs of oxidation, 56cm from top of recovered core is rusty in colour, in the same general location is a light grey lens of clayey silt 4cm by 2cm, other signs of oxidation but not as concentrated as at 56cm. Driller indicated that the last 1m drilled softer than the above.
107.3	110.3	3.00	0.28	Till	Till, as above.
			0.30	Till	Till, as above, but 5Y 4/3 olive grey, contact is gradational at the top but sharp at the bottom, mottling of olive grey and very dark grey, large shale clast.
			2.02	Till	Till, as above, unoxidized, large brown shale clast present (1.5m from the top of recovered core).
			0.40	Silt and clay	Silt and clay, rhythmically bedded dark clay beds and light grey silt and fine sand beds, irregular contact at the top with the till, clay beds between 0.5cm to 1.5cm, silt beds 0.5cm to 1cm thick, silt reacts moderately to HCl, clay no reaction, rip up clasts (?) visible at the top contact, beds near the base are deformed and contorted.
110.3	112.5	1.96	0.42	Silt and clay	Silt and clay, as above, some carbonaceous material, some fine sand, photos taken.
			0.60	Clay	Clay, with thin laminates of silt, upper contact gradational with the silt and clay above, silt has a moderate HCl reaction, very soft, clay is massive, dark grey, some carbonaceous material.
			0.63	Silt and clay	Silt and clay, as above, but with silt beds becoming thicker, and clay beds becoming fewer and thinner, some fine sand.
			0.25	Silt	Silt, dark grey with laminae of clay with some carbonaceous material and fine sand, silt react moderately to strongly to HCl.
			0.06	Sand	Silty sand, dark grey, fine grained, moderate to strong HCl reaction, predominantly well rounded quartz, well sorted, some pink grains either feldspar, granite, or possibly a contaminant.
112.5	115.0	2.14	2.14	Sand	Silty sand, fine grained, predominantly quartz grains, well rounded and well sorted, moderately regular bedding, and some cross bedding (?), carbonaceous (?) black material, presence of some medium grained sand beds 1-3cm thick in lower half of the recovered core, moderate to strong HCl reaction.

Appendix 2-F – Lithologic Description of Corehole WEPA00-3.

PROJECT: **WEPA Hydrogeology**	DATA NO: **WEPA00-3**	LOGGED BY: T. Lemay	DATE: Oct. 11, 2000
DRILLER: McAuley Drilling Ltd.	TYPE DRILL: Wet Rotary	DRILL METHOD: Wireline Core	SURFACE ELEVATION: 648.78 m
LOCATION: LSD 16 SEC 04 TP 75 R 05 W4	LATITUDE: 55.4730401°	LONGITUDE: 110.7072983°	Source: Surveyed
COMMENTS ON LOCATION: Approximately 20 m from the road near the tree line on the southwest side of clearing.			

DRILLED DEPTH (m) from	DRILLED DEPTH (m) to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
0.0	1.7	0.36	0.36	Till	Silty sand till, moderate to strong HCL reaction, some dark mottling, 4cm by 5cm pink-red sandstone clast near the top of recovered interval, dark greyish-brown (2.5Y 4/2), presence of roots, 1% pebbles.
1.7	3.1	0	0.00	Till	Silty sand till, as above from drillers' comments and cuttings.
3.1	3.7	0	0.00	Till	Silty sand till, as above from drillers' comments and cuttings, clay cutting detected in cuttings from this run.
3.7	4.4	0.20	0.20	Till	Silty sand till, as above, orange mottling, metal steak removed from hole, many oxidized grains and pebbles.
4.4	5.3	0.20	0.20	Till	Silty sand till, as above, medium sized sandstone boulder from above retrieved with this run, slight HCl reaction.
5.3	6.3	0.40	0.22	Till	Silty sand till, as above.
			0.10	Silt and clay	Interbedded silt and clay, between beds some occurrences of sand, mottled dark grey and oxidized brown, sand and silt partings or beds react strongly with HCl, some shale or clay clasts.
			0.08	Till	Silty clay till, massive, very dark grey (2.5Y 3/1), delayed moderate HCl reaction, <1% granules and <1% pebbles.
6.3	7.9	1.1	0.41	Till	Silty clay till, as above.
			0.61	Till	Silty sand till with clay, moderate to strong HCl reaction, oxidized and grey mottling, dolostone and shale clasts, sand lenses show stronger signs of oxidation, contact with upper till sharp but with lower till more gradual, matrix is dark grey-brown.
			0.09	Till	Silty clay till, as above, with minor sand.
7.9	8.9	0.22	0.15	Till	Poor recovery due to rock in shoe (sandstone), silty sand till, as above, rocks moderate HCl reaction.
			0.07	Till	Silty sand till, oxidized, silt and sand lenses, olive brown (2.5Y 4/4), strong HCl reaction.
8.9	10.0	0.96	0.96	Sand	Silty sand, fine grained, moderately well sorted, subrounded to subangular, predominantly quartz with some feldspar and igneous rock fragments, moderate HCl reaction, sandstone, dolostone, some granite, brown with zones of rust colour sand.
10.0	12.4	0.46	0.46	Sand	Drilled like sand, a few rocks but no gravel. Clayey sand, massive, very dark grey, weak HCl reaction, granite, dolostone and sandstone clasts, a zone of oxidization is observed at the base of the recovered core.

Appendix 2-F – Lithologic Description of Corehole WEPA00-3.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
12.4	14.4	0.43	0.22	Sand and clay	Silty sand and clay, recovered material almost appears to be vertically bedded, silty reddish brown sand in one half and very dark grey clay on the other, sand has a moderate HCl reaction, clay has no reaction, both are massive, coarse sand lenses near the base, clean, clay content increasing towards the base.
			0.21	Sand	Silty sand, vertically bedded with reddish brown fine sand in half with more clay clasts and very dark grey fine sand in the other, both sands appear to be rounded to subrounded, predominantly quartz with some feldspar and rock fragments, reddish brown sand reacts moderate to strongly with HCl, very dark grey sand reacts weak to moderate to HCl.
14.4	16.4	0.35	0.27	Sand	Silty sand, as above.
			0.08	Sand and till	Interbedding of sand and Sandy clay till, change is gradual, reacts moderately to HCl, clasts of sandstone and dolostone, along clasts there is a fine parting of medium sand, till expanded rapidly once removed from the core tube.
16.4	17.5	0.29	0.05	Boulders	Sandstone, igneous (gneiss) rocks.
			0.24	Till	Sandy clay till, massive, dark grey, weak to moderate HCl reaction, oxidized clasts, medium to coarse-grained sand partings, metamorphic and sandstone clasts.
17.5	18.5	0.44	0.44	Till	Sandy clay till, as above.
18.5	19.8	1.40	1.40	Till	Sandy clay till, as above, with slight bitumen odour in core.
19.8	22.0	0.76	0.40	Till	Silty clay till, massive, no HCl reaction, <1% pebbles and granules, soft, very dark grey, slight bitumen odour in core, pebble of sandstone identified.
			0.36	Till	Sandy clay till, as above.
22.0	23.2	0.93	0.93	Till	Sandy clay till, as above, pebble and granule content may be increasing.
23.2	24.6	0.90	0.90	Till	Sandy clay till, as above, decreased reaction to HCl (weak reaction).
24.6	26.6	0.10	0.10	Till	Sandy clay till, as above, drilling the same based on drillers comments, schist at the base of the recovered interval was hit at 23.5m, according to the driller, and must have fallen into the hole before this run.
26.6	27.6	0.96	0.20	Till	Sandy clay till, as above, large rock hit at the start of this run.
			0.76	Till	Transition from sandy clay till into a sandier till, weak HCl reaction, very dark grey (5Y 3/1), bitumen odour in core noted, 1-2% pebbles and granules.
27.6	28.8	1.09	1.09	Till	Silty sand till with minor clay, massive, firm, very dark grey (5Y 3/1), weak to moderate HCl reaction, sandstone clasts dominate, some igneous, more clasts than in above till, 1-2% granule content, 2% pebble content, bitumen odour present in core.
28.8	30.7	1.88	1.88	Till	Silty sand till with minor clay, as above, moderate HCl reaction, bitumen odour noted in core.
30.7	32.7	1.14	1.14	Till	Silty sand till with minor clay, as above, large igneous clast 45cm from top of cored interval.
32.7	34.4	1.72	1.50	Till	Silty sand till with minor clay, as above, driller indicated he is hitting many rocks, large dolostone clast at 35cm from the top of the recovered core.

Appendix 2-F – Lithologic Description of Corehole WEPA00-3.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.05	Sand	Fine grained silty sand, very dark grey, weak HCl reaction, predominantly quartz, rounded to subrounded, well sorted.
			0.17	Till	Silty sand till, as above, moderate HCl reaction, coarse sand parting near base.
34.4	35.6	0.95	0.95	Till	Silty sand till, as above, 0.3m to 0.45m from the top of the recovered core the till becomes siltier with less clay than before, the change is abrupt at the top and bottom of this interval, bitumen odour noted in core.
35.6	36.8	1.20	1.20	Till	Sandy silt till, very dark grey (5Y 3/1), moderate to strong HCl reaction, limestone, sandstone, granite (igneous) clasts, 1-2% pebbles and granules, soft, sand lense of silty sand found at top of run.
36.8	38.8	0.82	0.82	Till	Clayey silt till, changes from a slow moderate HCl reaction at the top of run to a quick moderate to strong reaction at base, oxidized siltstone grains, percentages of sand and clay are about the same (clay increasing at base of run).
38.8	40.8	1.54	1.54	Till	Clayey silt till, as above, clay content has increased slightly, moderate HCl reaction, 1-2% pebbles, not as many large clasts, faint bitumen odour in core.
40.8	42.9	0.45	0.45	Till	Clayey silt till, as above, black (2.5Y 3/1), moderate HCl reaction, faint bitumen odour, clasts of limestone, sandstone, granite, gneiss, 1% pebbles, 1% granules, massive and firm.
42.9	44.5	1.58	1.58	Till	Clayey silt till, as above, faint bitumen odour in core.
44.5	46.6	2.15	2.15	Till	Clayey silt till, as above.
46.6	49.0	2.40	2.40	Till	Clayey silt till, as above.
49.0	51.0	1.90	1.90	Till	Clayey silt till, as above, with some oxidized clasts and bitumen odour.
51.0	53.0	1.88	1.88	Till	Clayey silt till, as above, large sandstone clast near the base of the recovered interval (in shoe).
53.0	55.1	2.05	2.05	Till	Clayey silt till, as above.
55.1	57.1	2.00	2.00	Till	Clayey silt till, as above, till becoming richer in clay towards the base of the recovered interval.
57.1	59.1	1.6	0.80	Till	Clayey silt till, as above, but gradually becoming more clay rich.
			0.10	Till	Clayey silt till, as above, massive, very dark grey, moderate HCl reaction, gradually becoming more clay rich, (transition zone?).
			0.70	Till	Silt or clay till, percentages of silt and clay very close, very dark grey, moderate HCl reaction, 1% pebbles, 1% granules, appear to be slickensides.
59.1	61.2	2.16	1.50	Till	Clay till, very dark grey, moderate HCl reaction, 1% pebbles, 1% granules.
			0.15	Till	Clayey silt till, massive, very dark grey, moderate HCl reaction, 1% each pebbles and granules.
			0.10	Till	Clay till, as above.
			0.41	Till	Clayey silt till.
61.2	63.2	2.00	1.60	Till	Clay till, as above.
			0.40	Till	Clayey silt till, as above.
63.2	63.2	1.41	0.20	Till	Clayey silt till

Appendix 2-F – Lithologic Description of Corehole WEPA00-3.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
63.2	65.2		1.21	Till	Sandy silt till, very dark grey, gradual increase in sand over clay with depth, moderate HCl reaction, 1% pebbles and granules, clasts of limestone, sandstone, and granite, large sandstone clast 10cm from the base of the recovered interval.
65.2	67.3	2.05	1.00	Till	Silty clay till, massive, 5Y 3/1, very dark grey, moderate HCl reaction, limestone, sandstone, granites, 1% pebbles, 1% granules, hard, slickensides present.
			1.05	Till	Sandy silt till, massive, moderate to strong HCl reaction, same clast lithology as above till.
67.3	69.3	1.45	1.45	Till	Sandy silt till grading into a clayey silt till, both are very dark grey, massive, 1% each pebbles and granules, weak HCl reaction (due to cold temp.?), clasts of sandstone, limestone and granite noted, large sandstone clast at the base of recovered core.
69.3	71.3	0.60	0.60	Till	Silt till, very dark grey, weak to moderate HCl reaction, massive, sand fraction increasing. (at 69.6m, driller indicated drilled like sand.)
71.3	73.4	0.80	0.80	Till	Driller noted that first 1.5m drilled like sand with some stiff bands, bottom portion drilled like till above, examination revealed that the till is indeed the Clay silt till, as above, sand content is high, some coarse sand partings noted.
73.4	75.8	1.55	1.55	Till	Clayey silt till, as above, sand content is increasing, possibly a sand till, coarse-grained clean sand partings, pebble and granule content decreasing.
75.8	77.8	2.00	1.50	Till	Hit sand and maybe some gravel during this run, clayey silt till, as before, sand content fluctuating.
			0.10	Clay	Massive clay with silt partings and rip-up clasts.
			0.08	Till	Clay silt till, as above.
			0.32	Till and clay	Interbedded clay (as above) and clay silt till (as above).
77.8	79.5	1.57	1.57	Till	Driller reported the upper 0.1m drilled like sand, silty sand till, massive, oxidized, orange-brown colour (10YR 4/3) mottled with patches of strongly oxidized (7.5YR 4/6) and unoxidized (5Y 3/1) till, weak HCl reaction, 1-2% pebbles and granules, easily cut, soft, clay clasts noted, some coal flecks, 3 photos taken, gradual transition from oxidized to unoxidized till.
79.5	82.5	1.40	1.40	Till	Unoxidized silty sand till, as above, granule content may be increasing, several large sandstone and igneous clasts at the base of the recovered interval, coal noted.
82.5	84.8	2.38	2.38	Till	Driller reported hitting a large rock at 84.8m, silty sand till, as above.
84.8	88.3	0	0.00	Till	Till, based on drillers comments and cuttings.
88.3	89.5	0	0.00	Till and sand	Stiffer zones then easier drilling zones, one easier drilling zone at 0.1m another at 0.4m depth.
89.5	92.0	0	0.00	Till and sand	Driller reported hitting sand in this interval 82.9m to 91.4m, lower portion appears to be silty sand till, very dark grey, no HCl reaction, no pebbles or granules noted in cuttings.
92.0	92.3	0.30	0.30	Till	Silty sand till, very dark grey, massive, no HCl reaction, bitumen odour noted in core, pebbles and granules 1% each, clasts of granite and quartzite noted, hit a rock at near the end of the last run.

Appendix 2-F – Lithologic Description of Corehole WEPA00-3.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
92.3	94.3	2.05	2.05	Till	Silty sand till, very dark grey, no HCl reaction, igneous clasts, siltstone, sandstone, oxidized siltstone, shale, stratified sulphide bearing rock 0.2m from top of recovered interval, pebble content 2-3%, numerous large clasts, faint bitumen odour in core.
94.3	96.0	Bag sample	0.00	Till	Silty sand till, very dark grey, rock hit was 0.2m thick, frock fragments suggest the rock was a granite.
96.0	97.5	Bag sample	0.00	Till	Silty sand till, as above, some siltier and clayier cuttings present, firmer drilling at 96.0m.
97.5	99.0	Bag sample	0.00	Till	Silty sand till, as above.
99.0	100.5	Bag sample	0.00	Till	Silty sand till, as above.
100.5	101.5	Bag sample	0.00	Till	Silty sand till, as above, numerous rocks hit.
101.5	103.6	Bag sample	0.00	Till	Silty sand till, as above, numerous rocks hit, rock fragments of sandstone and quartzite noted.
103.6	105.1	Bag sample	0.00	Till	Drilling stiffer like there is more clay, still appears to be silty sand till.
105.1	106.6	Bag sample	0.00	Till	Silty sand till, as above.
106.6	108.1	Bag sample	0.00	Till	Silty sand till, as above.
108.1	109.4	Bag sample	0.00	Till	Silty sand till, as above, hit a rock at 109.4m depth.
109.4	110.5	0.95	0.55	Till	Clayey sand till, massive, black, very weak HCl reaction, granules 1%, pebbles 3-4%, clasts of siltstone, granite, dolostone, bitumen odour present in core.
			0.15	Till	Silty sand till, massive, brown-black, strong bitumen odour in core, weak to no HCl reaction, sandstone, siltstone, shale, igneous clasts.
			0.25	Till	Clayey sand till, as above with coarse sand beds.
110.5	113.6	2.96	1.50	Till	Interbedded clayey sand till (as above) and silty sand till (as above), limestone clasts, sandstones, siltstones, some coarse sand partings.
			1.46	Till	Clayey sand till, as above, some silty zones with coarse sand, hit large gneiss clast 0.1m from base of run, grading into more silty sand till.
113.6	116.6	2.72	2.72	Till	Silty sand till, black, very weak HCl reaction, sandstone, shale, siltstone, granite, metamorphic clasts, many large clasts mainly sandstone, coarse sand partings and lenses near the top, granules 3-4%, pebbles 4-5%.
116.6	119.6	2.71	2.71	Till	Silty sand till, as above, large clasts throughout, large sandstone cobble 1m from top of recovered interval.
119.6	122.7	2.30	0.60	Till	Driller reported hitting sand and gravel from 121.0m to 122.0m (grab sample- glacial sand and gravel), silty sand till, as above, bitumen odour in core.
			0.33	Silt and clay	Clayey silt, irregular bedding, no HCl reaction, black, sand bed 0.65m from top, sharp contact at top and base.
			0.76	Till	Silty sand till, as above, grading into silty sand near the base, bitumen odour in core.
			0.07	Sand and gravel	Glacial sand and gravel, granite, quartzite, igneous rocks.

Appendix 2-F – Lithologic Description of Corehole WEPA00-3.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.56	Sand diamicton	Glacial sand, very dark grey, no HCl reaction, poorly sorted, subrounded to subangular, large granite clast 7cm from base of recovered interval.
122.7	125.7	1.75	0.95	Sand	Glacial sand, as above, ironstone clast found, dirty (silty) sand.
			0.80	Till	Silty sand till, as above, metamorphic clast 1.45m depth, driller indicated that he hit many stones, bitumen odour noted in core.
125.7	128.8	2.17	0.45	Till	Silty sand till, as above, bitumen odour still present in core.
			0.05	Sand	Glacial sand, poorly sorted silty sand, no HCl reaction, subrounded to subangular, predominantly quartz.
			0.35	Till	Silty sand till, as above.
			0.20	Sand	Glacial sand, as above, very wet, core is flowing out of core tube.
			0.15	Till	Silty sand till, as above.
			0.10	Sand	Glacial sand, as above, very wet, core is flowing out of core tube.
			0.87	Till	Silty sand till, as above, very large granite cobble 1.35m from top of the recovered core, several large sandstone clasts near the base of the run.
128.8	131.8	2.45	1.10	Till	Silty sand till, as above, some carbonaceous material, fine sand partings noted.
			0.50	Sand	Medium grained, well sorted, rounded to subrounded glacial sand with minor silt, no HCl reaction, very wet, flowing out of core tube.
			0.10	Till	Silty sand till, as above.
			0.60	Sand	Sand, as above, grading into a fine-grained, moderately well sorted, subrounded to subangular glacial silty sand, no HCl reaction.
			0.15	Till	Silty sand till, as above.
131.8	134.9	2.77	2.77	Till	Silty sand till, as above, large granite clast 1m from top of core, large sandstone clast 0.7m from top of core.
134.9	137.9	2.55	0.24	Till	Sandy silt till, with clayey silt bed 7cm thick, grading into the silty sand till as above, shale clast near the top of this interval, no HCl reaction.
			1.61	Till	Silty sand till, as above, becoming sandier with depth.
			0.35	Sand	Medium grained, moderately well sorted, rounded to subrounded, glacial sand grading into a fine grained silty sand, neither show a reaction with HCl.
			0.35	Till	Silty sand till, as above, silt content appears to be increasing.
137.9	141.0	2.87	2.87	Till	Silty sand till, as above, zones of medium to coarse-grained sand occur occasionally, maximum thickness 2-3cm, sand and silt partings common.
141.0	144.1	2.70	2.70	Till	Silty sand till, as above, massive, black, weak to moderate HCl reaction, clasts of siltstone, sandstone, granite, quartzite, shale, some oxidized clasts, pebble content 3-4%, granules 4-5%, some sand and silt partings.
144.1	146.8	1.80	0.95	Till	Silty sand till, as above.

Appendix 2-F – Lithologic Description of Corehole WEPA00-3.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			0.85	Till	Silty sand till, as above, moderate to strong HCl reaction, abundant shale clasts (dominant clast type), pebbles 2-3%, granules 3-4%.
146.8	149.1	1.63	1.63	Till	Silty sand till, as above, one silt bed 5cm wide 1 m from top of recovered core, massive sulphide noted, abundant shale, abundant large sandstone clasts.
149.1	150.8	0.80	0.80	Till	Silty sand till, as above, sandstone clasts very brittle, shale clasts, medium grained sand partings, moderate HCl reaction.
150.8	153.1	1.45	1.45	Till	Silty sand till, as above, driller's comments: last 2m of run were sand.
153.1	156.2	0.33	0.33	Silt	Silt, black, no pebbles, irregular clay beds, one sandstone clast, sand partings (fine grained, silty), no HCl reaction.
156.2	157.4	0		Sand	Driller reported hitting 1m of sand, with 2 large rocks after the sand.
157.4	161.9	Bag sample	1.50	Till	No recovery, silty sand till, from cuttings.
		Bag sample	3.00	Sand	No recovery, olive grey, fine to medium grained, moderately well sorted glacial sand, sub rounded to subangular, predominantly quartz with black chert (?) and minor feldspar.
161.9	162.9	Bag sample		Sand	Olive grey glacial sand, as above.
162.9	164.4	Bag sample		Sand	Glacial sand, as above.
164.4	165.9	Bag sample		Sand	Glacial sand, as above with some very dark grey sand.
165.9	167.4	Bag sample		Sand	Glacial sand, as above, sand appears more oxidized (?).
167.4	168.4	Bag sample		Sand	Glacial sand, as above.
168.4	169.9	Bag sample		Sand	Glacial sand, as above.
169.9	172.5	Bag sample		Sand	Glacial sand, as above, some sand very light grey in colour with similar characteristics.
172.5	172.5		0.05	Sand	No recovery, glacial sand, as above.
172.5	174.0		1.45	Sand and gravel	No recovery, glacial sand and gravel.
174.0	175.8			Sand and gravel	No recovery, glacial sand and gravel, as above.
175.8	177.5			Sand and gravel	No recovery, glacial sand and gravel, as above.
177.5	182.0	Bag sample		Shale or clay	Very dark grey shale or clay, poor cuttings return. TD = 182.0m

Appendix 2-G – Stratigraphic Description of Corehole WEPA00-4.

PROJECT: **WEPA Hydrogeology**	DATA NO: **WEPA00-4**	LOGGED BY: T. Lemay	DATE: Oct. 17, 2000
DRILLER: McAuley Drilling Ltd.	TYPE DRILL: Wet Rotary	DRILL METHOD: Wireline Core	SURFACE ELEVATION: 569.35 m
LOCATION: LSD 08 SEC 04 TP 79 R 04 W4	LATITUDE: 55.8156450°	LONGITUDE: 110.5576402°	Source: Surveyed
COMMENTS ON LOCATION: Approximately 20 m from the road near the tree line on the southwest side of clearing.			

DRILLED DEPTH (m)		CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
from	to				
0.0	2.1	1.32	1.32	Diamicton (fill?)	Silty sand diamicton, mottled strong brown and grey brown, strongly oxidized with nodules of clayey silty sand almost olive in colour on the outside but dark grey on the inside, clasts of quartzite and siltstone, roots, no reaction with HCl, some carbonaceous material. Driller reported bottom 30cm drilled like sand.
2.1	3.1	0.14	0.14	Diamicton	Till, as above, large clast of a mafic igneous rock.
3.1	4.6	Bag sample	0.00	Sand	Poorly sorted sand (glacial), olive grey, oxidized.
4.6	6.3	0.29	0.29	Sand	Driller reported sand for first 1m, harder band for about 10cm, sand then lower 30cm harder.
6.3	7.8	1.1	0.08	Clay	Silty clay, highly irregular bedding, mottled grey-brown and strong brown, no HCl reaction.
			0.13	Sand	Fine grained, silty sand, oxidized brown, no HCl reaction.
			0.69	Silt and clay	Interbedded silt and clay, clay beds between 1-3cm thick, silt beds 1-10cm thick, no HCl reaction, silt predominantly oxidized, clay shows slickensides.
			0.08	Sand	Sand, as above.
			0.12	Silt and clay	Silt and clay, as above.
7.8	9.7	0.92	0.22	Silt and clay	Driller reported first 30cm drilled hard, next 1m drilled soft, next 10cm may have been gravel. Silt and clay, as above.
			0.08	Clay	Very dark grey, massive, no HCl reaction
			0.22	Sand	Very dark grey, medium grained, sub angular to angular clasts, moderately well sorted, massive, no HCl reaction.
9.7	12.4	2.58	0.13	Sand	Sand, as above.
			2.45	Till	Silty sand till, very dark grey, no HCl reaction, clasts of sandstone, siltstone, quartzite, granite and other igneous rock fragments, abundant fine sand and silt partings, pebbles about 1%, granules 2-3%.
12.4	14.3	1.02	1.02	Till	Till, as above, large granite clast about 10cm from top of interval, rock at 14.3m.
14.3	16.0	Bag sample	0.00	Till	Till, as above, fragments of rock in cuttings suggest rock was sandstone or granite, maybe becoming more clay rich.
16.0	18.5	1.79	1.79	Till	Driller indicated last 0.5m likely sand in grab sample. Sand clay till, plastic, very dark grey, no HCL reaction, pebble content 1-2%, granules 1-2%, clasts of sandstone and some granite, medium to coarse grained sand partings, some bands of pure clay.
18.5	18.9	Bag sample		Sand	Glacial sand.

Appendix 2-G – Stratigraphic Description of Corehole WEPA00-4.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
18.9	19.9	Bag sample		Gravel	Glacial gravel.
19.9	23.0	Bag sample		Sand	Glacial sand with beds of till, about 30cm thick (according to the driller).
23.0	23.6	0.22	0.22	Till	Sandy clay till, as above, large clast of sandstone at the base of the recovered interval.
23.6	24.2	Bag sample		Sand	Rock at top of run, granite, glacial sand beneath.
24.2	25.7	Bag sample		Sand and till	Glacial sand and sand clay till as above.
25.7	27.2	Bag sample		Till	Sandy clay till, as above.
27.2	29.0	Bag sample		Till	Till, as above.
29.0	30.7	0	0.00	Till	Driller indicated material drilled like till, encountered a rock.
30.7	32.1	Bag sample		Till	Till, as above.
32.1	33.9	0	0.00	Till	Till, as above.
33.9	35.5	1.10	1.10	Till	Till, as above.
35.5	36.8	0.61	0.20	Till	Till, as above, silt content may be increasing.
			0.28	Clay	Massive clay, blocky, mottled very dark grey and dark grey, some silt no HCl reaction.
			0.13	Till	Sandy silt till, as above, (driller indicated that the last 1m of this run drilled very softly).
36.8	39.8	0	0.00	Sand	Driller indicated this interval drilled like sand.
39.8	42.9	1.90	0.05	Clay and silt	Driller indicated upper 70cm sand, black clay and light grey silt, irregularly interbedded, no HCl reaction.
			1.85	Till	Till, as above, silt content may be increasing.
42.9	44.9	2.12	0.40	Till	Till, as above.
			1.72	Till	Sandy clay till, weak HCl reaction, very dark grey, pebbles about 1%, granules about 1%, granite, sandstone, coal clasts, large granite clast at the base of the recovered interval.
44.9	46.9	1.84	0.90	Sand	Fine- medium grained sand, becoming coarser towards the bottom of the interval, clay content decreasing, silt content increasing towards bottom of run, no HCl reaction.
			0.05	Clay	Massive clay, black, no HCl reaction.
44.9	46.9		0.89	Silt and clay	Irregularly bedded, deformed silt and clay, silt beds between 1-3cm thick, clay beds between 1-2cm thick, silt beds light olive grey, clay black, silt has a moderate HCl reaction, clay has no HCl reaction.
46.9	49.0	0	0.00	Silt and clay (?)	Drilling like clay (core slipped out of core barrel on the way to the surface).
49.0	49.0	1.03	0.40	Silt and clay	Interbedded silt and clay, irregularly bedded, silt beds between 1-2cm thick, clay between 0.5-1cm thick slightly deformed, very weak HCl reaction, very dark grey clay and light grey silt.
49.0	50.0		0.63	Clay	Massive clay with minor silt beds, very dark grey, no HCl reaction.
50.0	52.6	0.73	0.73	Clay	As above clay, silt beds slightly more predominant, driller indicated that upper 1.6m drilled like clay and lower 1m drilled softer.

Appendix 2-G – Stratigraphic Description of Corehole WEPA00-4.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
52.6	53.7	0.72	0.72	Till	Sandy silt till, very dark grey, very weak HCl reaction, clasts of sandstone, granite and siltstone, pebbles about 1%, granules about 1%, silt content increasing in the lower 0.25m, lighter and darker bands visible in that interval.
53.7	55.1	1.0	0.60	Till	As above till, about 15cm from top is a zone of silt or fine sand about 7cm wide.
			0.10	Clay and silt	High angle contact at top and base of clay, high angle, irregular bedding of silt and clay, no HCl reaction.
			0.30	Till	Silty sand till, very dark grey, no HCl reaction, pebbles about 5%, granules 2-3%, clasts of sandstone, granite, siltstone and other igneous rocks.
55.1	57.1	1.57	1.02	Silt and sand	Silt with fine grained silty sand beds, sand beds between 1-5cm thick, fine silty sand at base of interval, light grey to grey, no HCl reaction, sharp contact with till below.
			0.55	Till	Sandy silt till, very dark grey, no HCl reaction, clasts of granite and sandstone, pebble content about 1%, granules about 1%, sand and silt partings throughout (more so near base of interval), some partings show deformation.
57.1	59.1	1.77	1.77	Till	Sandy silt till, no HCl reaction, upper 1.5m very dark grey, lower 20 cm black, present in upper 80cm of interval: clasts of sandstone, siltstone, and calcareous siltstone as well as abundant sand and silt partings, abundant shale clasts in lower 97cm, at 80cm large sandstone clast, at base of interval a clast of gneiss, from 70-80cm are bands of fine grained sand.
59.1	61.2	2.03	2.03	Till	Till, as above, shale clasts increasing, pebbles 3-4%, granules 2-3%, coal fragments observed.
61.2	63.2	2.40	2.40	Till	Till, as above.
63.2	65.2	1.54	1.29	Till	Till, as above.
			0.25	Sand	Fine grained silty sand, well sorted, light to medium grey, no HCL reaction, lower 10cm includes regularly bedded clay bands, upper 25cm less well bedded, grains are subrounded to rounded, dominantly quartz, low angle contact with till (sharp contact).
65.2	67.3	0.70	0.70	Sand	Fine to medium grained glacial sand, minor silt and clay, evidence of cross bedding and 2 (possibly 3) coarsening upwards cycles, no HCl reaction, grains are moderately well sorted, sub angular to surrounded, quartz and feldspar dominant.
67.3	69.9	0	0.00	Sand	Driller indicated 2.2m drilled like sand and 0.4m drilled like clay.
69.9	71.2	1.29	1.29	Till	Sandy silt till, as above, no shale clasts observed.
71.2	73.5	2.23	2.23	Till	Till, as above, becoming more clay rich towards the base, 5cm thick bed of silt and clay with deformed bedding about 25cm from base of run.
73.5	76.5	2.93	0.57	Clay and silt	Interbedded and deformed clay and silt, no HCl reaction, silt beds 0.5-1cm thick, clay beds 0.5-2cm thick becoming more silty towards the base, clay very dark grey to black, silt light grey to pale white yellow.
			0.35	Sand, Silt and Clay	Interbedded fine-medium grained sand, silt and clay, no HCl reaction, irregular bedding, silt and clay more prominent at top of interval and gradually decreasing, overall colour medium grey.

Appendix 2-G – Stratigraphic Description of Corehole WEPA00-4.

DRILLED DEPTH (m) from	to	CORE RECOVERY (m)	DESCRIBED INTERVAL (m)	LITHOLOGY	COMMENTS
			2.01	Till	Silty sand till, very dark grey, no HCl reaction, clasts of shale, granite, sandstone, carbonaceous material and siltstone identified, pebbles about 1%, granules about 1%.
76.5	79.5	2.51	0.81	Till	Till, as above, at 81cm from top of interval is a silt wedge about 20cm long by 8cm wide, light grey, no HCl reaction, high angled contact, inclusion of till stringers within the silt, abundant shale clasts in the till
			0.20	Silt	Deformed medium bedding, abundant shale clasts.
			1.50	Till	Abundant silt partings plus inclusions, non-horizontal, irregular form.
79.5	82.6	3.09	3.09	Till	As above till, large sandstone clast about 70cm from top of interval, 75cm from base of run colour changes abruptly from dark grey to black and very dark grey (mottled), at 65cm from the base of run very hard black chert conglomerate (?) observed (or oolitic sandstone), no HCl reaction, sulphides observed.
82.6	85.6	2.35	2.35	Till	Till, as above, shale clasts increasing in number and size, presence of some fine- medium grained sand beds and some silt rich zones, clasts of sandstone, siltstone, granite and other igneous rocks.
85.6	88.7	2.48	2.48	Till	Till, as above.
88.7	90.0	1.14	0.74	Till	Till, as above.
			0.40	Silt and till	Sandy silt till, irregular bedding of light and dark coloured silt, signs of deformation, generally beds are high angled, no HCl reaction, clasts of shale, sandstone and siltstone, pebbles 1-2%, granules 1%.

Appendix 3 - Description of Geochemical Analytical Methods and Procedures

The till and bedrock samples were obtained by sub sampling cored intervals and submitting to the AGS lab for processing. 200 grams of raw sample for the Texture Analysis and 250 grams of raw sample for the Standard (Reference) Sample are placed into separate labelled bags. Each sample was dried, gently disaggregated to avoid the crushing of rock and mineral grains, and was screened using 2.00 mm, 1mm and 0.063 mm mesh stainless steel sieves. The <63µm fraction was then weighed into labelled vials. About 60 grams of the <63µm fraction were recovered from each sample. The <63µm fractions were then subdivided to provide a 30 gm subset for AGS Reserve and a 30 gm subset for Becquerel Laboratories Inc. Subsequent to drying, any dissolved metals in the water component of the sample remain within the matrix, adding to the total concentration of metals within the sample. Prior to submission of the samples to the laboratory, the sample order was randomized and both duplicate and standard samples were inserted. About five per cent of the samples which were submitted, are duplicates or standards.

Becquerel Laboratories Inc analyses package involves analyses from two different labs – Becquerel Labs conduct the Neutron Activation Analysis (NAA), a method based on nuclear reactions, and ALS Chemex conducts plasma analyses (ICPMS and ICPAES) and Cold Vapour Atomic Absorption (CVAA).

Procedure for Mercury Determination (CVAA) by ALS Chemex:

A prepared sample (0.50 grams) is digested with aqua regia for two hours in a hot water bath. After cooling, the resulting sample solution is transferred to a gas cylinder and mixed with stannous sulphate. The vapour generated is pumped through a tube that is located in the light path of an atomic absorption spectrometer. The absorbance is measured and compared to a standard series to determine the amount of mercury that is present.

Procedure for ICP Spectroscopy by ALS Chemex:

A prepared sample (usually 0.2 g) is digested using a mixture of hydrofluoric, perchloric and nitric acids. This will completely dissolve all but the most resistant minerals. Because of the use of hydrofluoric acid, silica and other more volatile elements such as arsenic and selenium, will be partially volatilized. These problems are identified by the element overlap from the various techniques.

The samples are initially analyzed using an inductively coupled atomic emission spectrometer (ICPAES). Following this analysis, the results are reviewed to ensure that base metal concentrations are less than 1%, with the exception of silver, bismuth, and tungsten which have upper analytical limits of 100, 500 and 1000 ppm, respectively. Samples that meet these criteria are then diluted and analyzed by ICPMS-MS. Samples that exceed the Upper Limits cannot be analyzed by ICPMS and they are treated as regular ICPAES analyses. The
analytical results are corrected for inter-element spectral interferences.

Procedure for Neutron Activation Analysis (NAA) by Becquerel:

The method for neutron activation analysis of rocks or mineralogenic sediments such as stream sediments or till, involves the transfer of about 15 grams of sample material to tared, plastic, watertight vials. Each vial is identified with a bar code and a flux monitor affixed to the base. These vials are stacked into one-foot long bundles for irradiation. The bundles contain randomly selected duplicate samples at the base of the bundle and standards inserted at random positions in the bundle. All bundles are treated in a similar manner. They are submitted for exposure to a flux of neutrons at a nuclear reactor.

These bundles are inserted into the core of a nuclear reactor for a short period of time. This irradiation causes many of the elements in the sample to become radioactive and begin to emit radiation in the form of penetrating gamma rays whose energies (or wavelengths) are characteristic of particular elements. After an appropriate decay period (usually six to seven days), the irradiated samples are loaded onto the counting system, a gamma-ray spectrometer with a high resolution, coaxial germanium detector. Gamma rays radiate continuously and the interaction of these with the detector lead to discrete voltage pulses proportional in height to the incident gamma-ray energies, producing a spectrum of gamma ray energies versus intensities. The counting time varies but it is between twenty and thirty minutes per sample. By comparing spectral peak positions and areas with library standards, the elements comprising the samples are qualitatively and quantitatively identified. If the standard values vary by more than two standard deviations from the mean, the vials are examined and recounted and the batch is reanalysed if the standard values are still unacceptable. Duplicate samples must also fall within our accepted range or recounting and/or reanalysis is done.

Appendix 3 - Table A3-1: List of Elements Analyzed and Method of Analysis.

Element	ICPMS
Al (%)	Aluminum
Ba (ppm)	Barium
Be (ppm)	Beryllium
Bi (ppm)	Bismuth
Cd (ppm)	Cadmium
Ca (%)	Calcium
Cr (ppm)	Chromium
Co (ppm)	Cobalt
Cu (ppm)	Copper
Ga (ppm)	Gallium
Ge (ppm)	Germanium
Pb (ppm)	Lead
Li (ppm)	Lithium
Mg (%)	Magnesium
Mn (ppm)	Manganese
Mo (ppm)	Molybdenum
Ni (ppm)	Nickel
Nb (ppm)	Niobium
P (ppm)	Phosphorus
K (%)	Potassium
Rb (ppm)	Rubidium
Ag (ppm)	Silver
Sr (ppm)	Strontium
Te (ppm)	Tellurium
Tl (ppm)	Thallium
Ti (%)	Titanium
W (ppm)	Tungsten
V (ppm)	Vanadium
Y (ppm)	Yttrium
Zn (ppm)	Zinc

Element	NAA
As (ppm)	Arsenic
Au (ppb)	Gold
Ba (ppm)	Barium
Br (ppm)	Bromium
Ce (ppm)	Cerium
Cs (ppm)	Cesium
Cr (ppm)	Chromium
Eu (ppm)	Europium
Hf (ppm)	Hafnium
Ir (ppm)	Iridium
Fe (%)	Iron
La (ppm)	Lanthanum
Lu (ppm)	Lutetium
Na (%)	Sodium
Sb (ppm)	Antimony
Sc (ppm)	Scandium
Se (ppm)	Selenium
Sm (ppm)	Samarium
Sn (ppm)	Tin
Ta (ppm)	Tantalum
Tb (ppm)	Terbium
Th (ppm)	Thorium
U (ppm)	Uranium
Yb (ppm)	Ytterbium
Zr (ppm)	Zirconium

Element	CVAA
Hg (ppb)	Mercury

Appendix 3 - Table A3-2: Detection Limits for Elements Analyzed, (Becquerel Laboratory Inc.)

Element	Detection limit	NAA	ICPMS
Aluminum	0.01 %		0.01
Antimony	0.1 ppm	0.1	0.1
Arsenic	0.5 ppm	0.5	1
Barium	10 ppm	50	10
Berylium	0.05 ppm		0.05
Bismuth	0.02 ppm		0.02
Bromine	0.5 ppm	0.5	
Cadmium	0.1 ppm	5	0.1
Calcium	0.01 %		0.01
Cerium	0.01 ppm	5	0.01
Cesium	0.05 ppm	0.5	0.05
Chromium*	1 ppm	20	1
Cobalt	0.2 ppm	5	0.2
Copper	1 ppm		1
Europium	1 ppm	1	
Gallium	0.1 ppm		0.1
Germanium	0.1 ppm		0.1
Gold	2 ppb	2	

Element	Detection limit	NAA	ICPMS
Hafnium	1 ppm	1	
Iridium	50 ppb	50	
Iron	0.01 %	0.2	0.01
Lanthanum	0.5 ppm	2	0.5
Lead	0.5 ppm		0.5
Lithium	0.2 ppm		0.2
Lutetium	0.2 ppm	0.2	
Magnesium	0.01 %		0.01
Manganese	5 ppm		5
Mercury	0.01 ppm		*
Molybdenum	1 ppm	1	1
Nickel*	0.2 ppm	10	0.2
Niobium	0.2 ppm		0.2
Phosphorus	10 ppm		10
Potassium	0.01 %		0.01
Rubidium	0.2 ppm	5	0.2
Samarium	0.1 ppm	0.1	
Scandium	0.2 ppm	0.2	

Element	Detection limit	NAA	ICPMS
Selenium	5 ppm	5	
Silver	0.05 ppm	2	0.05
Sodium	0.01 %	0.02	0.01
Strontium	0.2 ppm		0.2
Tantalum	0.2 ppm	0.5	0.2
Tellurium	0.1 ppm	10	0.1
Terbium	0.5 ppm	0.5	
Thallium	0.05 ppm		0.05
Thorium	0.2 ppm	0.2	0.2
Tin	100 ppm	100	
Titanium	0.01 %		0.01
Tungsten	0.2 ppm	2	0.2
Uranium	0.2 ppm	0.2	0.2
Vanadium	1 ppm		1
Ytterbium	2 ppm	2	
Yttrium	0.1 ppm		0.1
Zinc	2 ppm	100	2
Zirconium	200 ppm	200	

COMMENTS:

1. The package combines Inductivity Coupled Plasma Mass Spectrometry (ICPMS) (tri-acid) plus Hg Cold Vapour Atomic Adsorption (CVAA) with Nuetron Atomic Activation (NAA) on a 15 g. subsample.
2. The package is intended for unmineralized sediments. The samples are not run by ICPMS if they are mineralized - higher detection limits and fewer elements are available with this type of sample.
3. * denotes CVAA method of analysis.

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			NAA	NAA	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	IMS
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**	**Cr***
			grams	**ppb**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-22.4	Till	22.4	11.4	<2	1	11	590	590	2	0.29	2.4	0.56	1.04	82	5.2	84	69
W99-1-25.1	Till	25.1	13.7	<2	0.8	6.6	590	540	1.2	0.17	1.9	0.46	1.59	80	2.8	66	44
W99-1-32.6	Till	32.6	10.6	<2	0.8	12	670	610	2	0.26	2	0.32	1	72	6.3	80	70
W99-1-33.0	Till	33.0	12.7	<2	0.8	10	670	630	1.6	0.23	2.1	0.42	1	69	4.6	67	59
W99-1-39.5	Till	39.5	11.9	<2	0.8	11	660	610	1.8	0.27	1.6	0.4	1.01	77	6	67	71
W99-1-40.2	Till	40.2	11.9	<2	0.9	11	670	590	1.7	0.26	1.9	0.34	0.95	76	5.8	74	67
W99-1-41.4	Till	41.4	12.5	<2	0.8	10	600	580	1.7	0.25	1.9	0.34	1.1	72	5.6	81	65
W99-1-42.3	Till	42.3	10.8	<2	0.9	11	650	590	2.5	0.31	2.3	0.32	1	76	6.3	80	74
W99-1-43.3	Till	43.3	11.6	4	0.9	11	610	620	2	0.26	1.8	0.36	1.02	78	6.6	75	77
W99-1-44.7	Till	44.7	12.2	<2	0.9	11	560	580	1.5	0.27	1.8	0.52	0.8	76	5.9	60	68
W99-1-47.3	Till	47.3	11.4	<2	0.9	12	750	710	2.3	0.32	2.1	0.48	0.83	80	6.8	82	80
W99-1-48.3	Till	48.3	10.4	<2	0.8	10	620	550	2	0.28	2	0.48	0.77	80	6.9	82	76
W99-1-49.5	Till	49.5	12.2	<2	1	10	540	500	1.9	0.25	2.1	0.42	0.53	74	5	72	60
W99-1-50.4	Till	50.4	13.3	<2	1	10	620	550	1.6	0.27	2.1	0.44	0.67	79	5.1	80	60
W99-1-51.5	Till	51.5	13.0	<2	1	10	560	540	1.9	0.27	2	0.48	0.72	81	5.4	63	58
W99-1-52.5	Till	52.5	13.0	<2	1.1	11	690	660	1.6	0.25	2.8	0.48	0.74	78	4.6	62	60
W99-1-53.5	Till	53.5	12.3	<2	1	11	670	610	1.7	0.26	2.4	0.46	0.74	74	5	57	58
W99-1-54.4	Till	54.4	13.2	<2	1	11	590	550	1.8	0.27	2.3	0.48	0.75	75	4.9	65	59
* W99-1-54.4	Till	54.4	11.6	<2	1	11	610	550	1.8	0.24	2.4	0.44	0.76	74	4.7	62	60
W99-1-55.5	Till	55.5	11.8	<2	1	11	610	540	1.7	0.24	2.6	0.36	0.72	75	5.2	83	57
W99-1-56.4	Till	56.4	12.0	<2	1	12	620	560	1.6	0.26	2.7	0.46	0.76	75	5.1	78	58
W99-1-57.9	Till	57.9	11.8	5	1	11	610	550	1.8	0.27	2.3	1.18	0.75	82	4.3	75	59
W99-1-61.0	Till	61.0	11.8	<2	1.1	12	630	600	1.7	0.28	2.9	0.58	0.67	75	4.8	63	65
W99-1-61.7	Till	61.7	12.2	7	1.1	11	680	620	2	0.27	2.6	0.6	0.77	77	4.9	84	63
W99-1-62.1	Till	62.1	11.9	<2	0.7	16	820	780	1.8	0.26	0.8	0.1	0.62	94	4.4	70	61
W99-1-63.1	Till	63.1	11.4	<2	0.8	25	650	570	2.1	0.24	1.2	0.1	0.6	91	4.7	77	59
W99-1-63.9	Till	63.9	11.8	<2	0.8	10	570	500	1.8	0.24	0.9	0.66	0.61	88	4.7	68	59
W99-1-67.2	Till	67.2	12.7	<2	0.8	7.1	520	390	1.6	0.24	1.8	0.48	0.93	89	4.8	73	49
W99-1-68.2	Till	68.2	11.1	<2	0.8	7.9	540	470	1.6	0.24	2.1	0.32	1.31	83	4.7	61	57
W99-1-69.2	Till	69.2	11.5	<2	0.8	8.2	570	480	1.9	0.24	2.1	0.38	1.34	80	4.8	61	57
W99-1-70.0	Till	70.0	13.3	<2	0.9	8.4	590	500	1.7	0.23	2.2	0.34	1.42	80	4.8	81	57
W99-1-71.0	Till	71.0	12.7	<2	0.8	8.1	590	520	1.8	0.22	1.7	0.48	1.53	83	4.5	68	57

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS	CVAA
Sample #	**Material**	**Depth**	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**	**Hg**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppb**
W99-1-22.4	Till	22.4	14	23	<1	19.3	1.9	10	<50	3.3	39	24	58	0.3	0.89	450	40
W99-1-25.1	Till	25.1	9	14	1	11.9	1.4	17	<50	2.5	39	16	28	0.4	0.97	445	20
W99-1-32.6	Till	32.6	12	21	1	18	1.7	8	<50	3.5	40	18	55	0.3	0.91	370	30
W99-1-33.0	Till	33.0	12	16	2	16.2	1.6	10	<50	3.1	38	17	44	0.4	0.83	375	40
W99-1-39.5	Till	39.5	13	21	1	18.8	1.7	8	<50	3.4	40	20	55	0.3	0.94	370	40
W99-1-40.2	Till	40.2	13	19	<1	18.1	1.7	9	<50	3.3	40	19	51	0.4	0.87	355	60
W99-1-41.4	Till	41.4	12	18	1	16.7	1.6	9	<50	3.2	40	21	49	0.4	0.89	365	50
W99-1-42.3	Till	42.3	15	21	2	20.5	1.9	7	<50	3.5	39	21	61	0.4	0.95	380	40
W99-1-43.3	Till	43.3	14	22	<1	18.8	1.7	8	<50	3.5	40	19	55	0.4	0.99	395	30
W99-1-44.7	Till	44.7	13	22	2	18.3	1.7	8	<50	3.3	40	19	53	0.4	0.83	370	40
W99-1-47.3	Till	47.3	14	25	2	21.9	1.9	5	<50	3.9	44	20	62	0.4	0.97	420	40
W99-1-48.3	Till	48.3	15	20	3	19.6	1.7	6	<50	4.7	42	17	55	0.4	0.91	1035	30
W99-1-49.5	Till	49.5	14	19	2	16.1	1.7	11	<50	3	41	18	46	0.4	0.62	345	60
W99-1-50.4	Till	50.4	14	20	2	16.7	1.7	10	<50	3.1	42	18	46	0.5	0.71	390	40
W99-1-51.5	Till	51.5	13	19	<1	17.2	1.8	11	<50	3.2	40	18	51	0.5	0.74	385	50
W99-1-52.5	Till	52.5	13	19	1	16.4	1.8	10	<50	3.4	39	19	48	0.4	0.76	410	30
W99-1-53.5	Till	53.5	13	19	1	16.9	1.8	12	<50	3.1	40	19	50	0.4	0.74	375	40
W99-1-54.4	Till	54.4	13	19	1	16.4	1.7	10	<50	3.3	39	19	49	0.4	0.77	380	40
* W99-1-54.4	Till	54.4	11	19	<1	15.3	1.7	10	<50	3.2	39	17	44	0.4	0.78	390	40
W99-1-55.5	Till	55.5	12	18	1	15.9	1.6	11	<50	3.4	38	17	48	0.4	0.74	400	30
W99-1-56.4	Till	56.4	13	18	2	15.9	1.7	12	<50	3.5	41	18	50	0.4	0.76	385	40
W99-1-57.9	Till	57.9	12	22	<1	16	1.7	11	<50	3.3	41	20	48	0.4	0.73	360	60
W99-1-61.0	Till	61.0	13	22	2	17.6	1.9	10	<50	3.2	38	22	53	0.4	0.72	335	40
W99-1-61.7	Till	61.7	13	21	2	16.3	1.6	10	<50	3.2	38	18	42	0.4	0.74	380	40
W99-1-62.1	Till	62.1	12	17	2	17.2	1.7	12	<50	4	48	18	38	0.5	0.61	250	10
W99-1-63.1	Till	63.1	12	17	2	16.7	1.6	12	<50	3.7	48	18	37	0.5	0.61	260	10
W99-1-63.9	Till	63.9	13	19	1	17.1	1.7	13	<50	3.4	49	18	37	0.5	0.63	345	30
W99-1-67.2	Till	67.2	12	14	2	16	1.5	12	<50	3.2	46	16	36	0.5	0.77	1020	30
W99-1-68.2	Till	68.2	11	17	2	15.8	1.6	11	<50	3.1	45	16	37	0.4	0.9	610	30
W99-1-69.2	Till	69.2	12	17	2	16.3	1.6	11	<50	2.9	44	17	39	0.5	0.92	610	30
W99-1-70.0	Till	70.0	12	18	2	15.7	1.5	10	<50	3.1	42	17	38	0.4	0.92	550	30
W99-1-71.0	Till	71.0	12	17	<1	16.2	1.5	11	<50	3.1	42	17	38	0.4	0.95	545	40

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS	NAA
Sample #	**Material**	**Depth**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**	**Tb**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-22.4	Till	22.4	3.4	37	14	790	1.64	98	6.4	12	<5	0.8	0.43	141	1	0.05	1
W99-1-25.1	Till	25.1	1.6	21	10	700	1.38	62	6.5	9.4	<5	0.4	0.71	129	1.2	0.05	0.9
W99-1-32.6	Till	32.6	1.8	31	14	710	1.73	97	6.4	13	<5	0.45	0.51	133	1.3	0.05	1
W99-1-33.0	Till	33.0	2	28	14	720	1.6	88	6	11	<5	0.45	0.6	137	1.1	0.05	0.8
W99-1-39.5	Till	39.5	2	32	15	730	1.73	101	6.2	12	<5	0.45	0.53	140	1.4	0.05	0.8
W99-1-40.2	Till	40.2	1.6	31	14	690	1.65	97	6.2	13	<5	0.45	0.53	135	1.2	0.05	0.7
W99-1-41.4	Till	41.4	1.6	29	13	700	1.62	91	6.1	12	<5	0.4	0.56	134	1	0.05	0.9
W99-1-42.3	Till	42.3	2	36	15	730	1.78	111	6.1	13	<5	0.5	0.49	139	1.2	0.05	0.8
W99-1-43.3	Till	43.3	1.8	34	14	740	1.8	102	6.3	13	<5	0.45	0.5	138	1.1	0.05	0.6
W99-1-44.7	Till	44.7	2.4	32	15	700	1.7	100	6.3	13	<5	0.45	0.53	132	1	0.05	0.8
W99-1-47.3	Till	47.3	2.4	35	17	760	1.85	115	6.7	15	<5	0.45	0.45	139	1.1	0.05	0.6
W99-1-48.3	Till	48.3	1.8	32	14	720	1.73	100	6.4	14	<5	0.4	0.46	125	1.1	0.05	1.3
W99-1-49.5	Till	49.5	2.6	30	14	640	1.58	86	6.5	12	<5	0.45	0.52	124	1.4	0.05	0.9
W99-1-50.4	Till	50.4	3	30	14	650	1.52	88	6.4	12	<5	0.4	0.52	126	1.4	0.05	0.9
W99-1-51.5	Till	51.5	2.6	30	15	630	1.55	92	6.5	12	<5	0.45	0.52	129	1.2	0.05	1
W99-1-52.5	Till	52.5	2.8	29	14	680	1.56	88	6.5	12	<5	0.45	0.53	130	1	0.05	0.6
W99-1-53.5	Till	53.5	3	29	14	670	1.53	88	6.6	12	<5	0.4	0.53	130	1.2	0.05	0.9
W99-1-54.4	Till	54.4	3	29	14	660	1.54	88	6.6	12	<5	0.45	0.51	125	1.2	0.05	1
* W99-1-54.4	Till	54.4	2.8	26	12	690	1.57	83	6.4	12	<5	0.4	0.5	125	1.6	0.05	0.8
W99-1-55.5	Till	55.5	2.4	27	14	680	1.53	84	6.6	12	<5	0.4	0.5	123	1.4	0.05	0.8
W99-1-56.4	Till	56.4	2.6	28	14	680	1.53	84	6.4	12	<5	0.4	0.5	126	1.3	0.05	1.1
W99-1-57.9	Till	57.9	3.2	31	14	690	1.51	85	6.2	11	<5	1.85	0.55	127	1.2	10.05	<0.5
W99-1-61.0	Till	61.0	4.4	33	15	760	1.56	93	5.9	11	<5	0.5	0.44	130	1	0.05	0.9
W99-1-61.7	Till	61.7	3.4	30	12	680	1.54	86	6.1	11	<5	0.45	0.47	136	1.2	<0.05	0.9
W99-1-62.1	Till	62.1	2.6	29	14	1070	1.65	89	7.3	12	<5	0.45	0.59	147	1.6	<0.05	1
W99-1-63.1	Till	63.1	1.8	26	13	940	1.62	86	7.6	12	<5	0.4	0.61	139	1.5	0.05	0.9
W99-1-63.9	Till	63.9	2.4	28	13	960	1.64	89	7.7	12	<5	0.4	0.62	141	1	0.05	1.5
W99-1-67.2	Till	67.2	1.6	27	13	580	1.37	83	7.3	12	<5	0.35	0.61	121	1.3	<0.05	1.1
W99-1-68.2	Till	68.2	1.6	26	12	660	1.57	83	7	12	<5	0.35	0.57	135	1.7	0.05	0.8
W99-1-69.2	Till	69.2	1.6	26	13	650	1.58	83	7	11	<5	0.35	0.58	134	1.4	<0.05	1.1
W99-1-70.0	Till	70.0	1.8	26	12	660	1.55	81	6.6	11	<5	0.35	0.61	136	1.4	<0.05	0.9
W99-1-71.0	Till	71.0	1.8	26	12	670	1.6	84	6.6	11	<5	0.35	0.63	140	1.4	<0.05	0.8

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-22.4	Till	22.4	0.86	12	<100	0.33	2.9	4.2	143	3	23.5	88	360
W99-1-25.1	Till	25.1	0.56	11	<100	0.28	1.0	3.5	83	3	20.9	56	720
W99-1-32.6	Till	32.6	0.70	11	<100	0.33	1.3	3.7	132	2	21.2	76	<200
W99-1-33.0	Till	33.0	0.68	11	<100	0.32	1.3	3.6	108	3	22.4	70	400
W99-1-39.5	Till	39.5	0.72	11	<100	0.34	4.3	4.8	132	2	22.7	92	390
W99-1-40.2	Till	40.2	0.72	11	<100	0.32	1.8	3.9	123	2	22.4	78	380
W99-1-41.4	Till	41.4	0.66	11	<100	0.32	1.2	3.9	120	3	21.9	84	<200
W99-1-42.3	Till	42.3	0.78	11	<100	0.34	2.7	3.3	136	2	24.4	86	<200
W99-1-43.3	Till	43.3	0.76	12	<100	0.34	1.4	3.7	140	3	21.8	92	<200
W99-1-44.7	Till	44.7	0.76	11	<100	0.35	1.4	3.8	126	3	23.1	84	<200
W99-1-47.3	Till	47.3	0.80	12	<100	0.39	1.5	3.3	151	2	24.4	92	<200
W99-1-48.3	Till	48.3	0.70	11	<100	0.34	1.3	3.5	137	3	22.8	92	<200
W99-1-49.5	Till	49.5	0.74	10	<100	0.35	1.2	3.9	110	3	23.2	72	310
W99-1-50.4	Till	50.4	0.78	11	<100	0.33	1.4	4.1	115	3	22.7	72	370
W99-1-51.5	Till	51.5	0.78	10	<100	0.35	1.3	3.9	108	3	24.7	72	<200
W99-1-52.5	Till	52.5	0.78	11	<100	0.33	1.2	4.2	114	3	23.1	72	540
W99-1-53.5	Till	53.5	0.78	11	<100	0.32	1.3	3.8	112	3	23.4	70	<200
W99-1-54.4	Till	54.4	0.78	11	<100	0.33	1.4	3.8	111	3	23.2	68	420
* W99-1-54.4	Till	54.4	0.72	11	<100	0.33	1.3	3.8	115	3	21.8	70	510
W99-1-55.5	Till	55.5	0.70	11	<100	0.34	1.2	3.5	105	3	22.2	64	<200
W99-1-56.4	Till	56.4	0.74	10	<100	0.34	1.2	4.0	105	3	22.6	78	600
W99-1-57.9	Till	57.9	0.76	11	<100	0.33	7.4	3.9	108	2	22.5	72	<200
W99-1-61.0	Till	61.0	0.90	11	<100	0.34	1.7	3.7	141	2	23.8	76	<200
W99-1-61.7	Till	61.7	0.80	11	<100	0.32	1.3	3.9	127	2	22.2	76	<200
W99-1-62.1	Till	62.1	0.66	13	<100	0.36	1.5	3.2	101	3	25.1	76	600
W99-1-63.1	Till	63.1	0.64	13	<100	0.32	1.3	3.2	102	3	23.8	72	420
W99-1-63.9	Till	63.9	0.64	14	<100	0.32	1.5	3.3	104	3	24.0	76	740
W99-1-67.2	Till	67.2	0.64	13	<100	0.28	0.9	4.0	85	3	22.6	60	400
W99-1-68.2	Till	68.2	0.64	12	<100	0.32	1.4	4.3	100	3	22.3	68	310
W99-1-69.2	Till	69.2	0.60	12	<100	0.34	1.1	5.0	98	3	22.8	72	450
W99-1-70.0	Till	70.0	0.64	12	<100	0.31	1.0	5.1	102	3	21.9	76	<200
W99-1-71.0	Till	71.0	0.64	12	<100	0.32	1.3	5.7	100	3	22.2	76	440

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			NAA	NAA	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	IMS
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**	**Cr***
			grams	**ppb**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-72.0	Till	72.0	11.8	4	0.8	7.8	600	540	1.7	0.24	2	0.38	1.57	84	4.3	68	57
W99-1-73.3	Till	73.3	12.0	<2	0.6	5.7	530	470	1.9	0.21	2	0.24	2.02	89	3.9	75	56
W99-1-74.3	Till	74.3	11.4	<2	0.7	8.1	390	370	1.7	0.24	1.4	0.26	0.57	79	4.4	62	51
W99-1-75.3	Till	75.3	13.6	<2	0.7	6.4	550	500	1.7	0.2	2.4	0.34	2.61	83	4.1	68	57
W99-1-76.3	Till	76.3	13.0	<2	0.7	5.3	560	510	1.8	0.2	2.2	0.38	2.52	88	4.2	67	56
* W99-1-76.3	Till	76.3	11.3	<2	0.6	4.5	550	510	2	0.2	2.1	0.38	2.56	99	3.9	80	56
W99-1-77.3	Till	77.3	13.2	<2	0.6	5.2	590	480	1.7	0.21	1.6	0.34	2.05	84	4.4	67	57
W99-1-78.3	Till	78.3	12.1	<2	0.6	5.6	580	480	1.8	0.2	2	0.34	2.01	94	4	64	54
W99-1-79.3	Till	79.3	13.3	<2	0.7	5.3	600	510	1.7	0.2	1.7	0.4	2.69	81	4.1	53	58
W99-1-80.3	Till	80.3	13.5	<2	0.6	4.5	520	490	1.6	0.22	1.6	0.4	1.84	81	4.4	59	57
W99-1-80.7	Till	80.7	12.2	<2	0.7	6.7	610	500	1.7	0.21	2.1	0.38	2.22	88	4.4	78	60
W99-1-81.1	Till	81.1	11.3	<2	0.6	6.1	540	510	1.9	0.22	2	0.28	2.16	94	3.7	76	60
W99-1-87.1	Till	87.1	11.0	<2	0.8	10	1300	1190	1.8	0.28	2.4	0.46	1.16	83	4.4	73	60
W99-1-88.0	Till	88.0	9.5	<2	0.8	11	660	610	1.9	0.27	2.3	0.44	1.18	90	5.3	77	61
W99-1-89.7	Till	89.7	10.8	<2	0.8	10	560	490	1.8	0.24	2.2	0.4	1.07	76	4.8	68	55
W99-1-91.4	Till	91.4	12.0	<2	1	13	630	540	1.6	0.27	3	0.46	1.05	82	5.4	72	59
W99-1-92.4	Till	92.4	10.9	<2	0.9	13	630	570	2.2	0.29	3	0.56	1.03	86	5.2	79	59
W99-1-93.3	Till	93.3	12.3	<2	0.9	14	650	560	1.8	0.28	3.1	0.52	1.02	87	5.6	72	58
W99-1-95.1	Till	95.1	11.2	<2	0.9	11	620	550	2	0.28	2.6	0.46	1.2	84	5.2	76	61
W99-1-95.5	Till	95.5	11.3	7	1	11	700	590	1.7	0.24	2.6	0.62	1.14	85	5.4	76	62
W99-1-96.5	Till	96.5	10.7	5	1	8.3	640	570	2.1	0.3	2.5	0.54	1.79	83	5.7	77	77
W99-1-97.5	Till	97.5	9.6	<2	1	9	600	540	2	0.29	2.3	0.48	1.73	90	6.1	93	77
W99-1-98.1	Till	98.1	10.6	<2	1	9.1	720	650	2.4	0.3	2.9	1	1.74	89	5.3	83	76
W99-1-99.2	Till	99.2	11.1	<2	1	10	630	640	2.2	0.31	2.5	0.54	1.89	94	5.4	87	75
* W99-1-99.2	Till	99.2	11.5	5	1	9.2	650	630	2.6	0.29	2.4	0.5	1.87	89	5.6	94	75
W99-1-100.2	Till	100.2	10.6	<2	1	9.2	600	600	2.2	0.29	3.1	0.56	2.02	95	5.7	80	75
W99-1-101.3	Till	101.3	10.6	<2	1.1	72.5	750	710	2.7	0.35	3.6	0.44	1.47	88	7.5	110	91
W99-1-102.2	Till	102.2	11.5	<2	0.9	2.4	810	840	1.9	0.37	2.9	0.08	0.48	85	5	69	58
W99-1-103.4	Till	103.4	9.8	<2	1	14	620	590	1.9	0.32	2.9	0.64	0.68	74	4.5	57	53
W99-1-104.4	Till	104.4	9.9	<2	1	8.4	530	520	2	0.3	2.5	0.52	2.09	93	5.8	77	74
W99-1-105.4	Till	105.4	13.3	<2	1.1	9.4	630	570	1.7	0.25	1.6	0.48	1.47	86	5.1	82	65
W99-1-106.3	Till	106.3	12.4	<2	0.9	7	540	560	2.1	0.27	2.9	0.58	2.08	89	5.3	91	71

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS	CVAA
Sample #	**Material**	**Depth**	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**	**Hg**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppb**
W99-1-72.0	Till	72.0	12	17	1	16	1.6	11	<50	3.1	44	18	40	0.4	0.97	525	30
W99-1-73.3	Till	73.3	11	16	2	15.6	1.4	12	<50	3	45	16	38	0.4	1.11	635	30
W99-1-74.3	Till	74.3	19	16	2	15.1	1.8	13	<50	3.1	42	18	49	0.4	0.61	1000	40
W99-1-75.3	Till	75.3	11	16	2	15.7	1.4	11	<50	3	45	16	35	0.4	1.27	630	10
W99-1-76.3	Till	76.3	10	16	2	16	1.4	11	<50	3	47	16	37	0.5	1.24	595	20
* W99-1-76.3	Till	76.3	11	15	2	16.2	1.3	13	<50	2.9	45	16	36	0.3	1.25	615	20
W99-1-77.3	Till	77.3	12	14	2	16.7	1.4	11	<50	2.9	45	18	37	0.4	1.13	590	10
W99-1-78.3	Till	78.3	11	14	2	15.8	1.3	12	<50	3	47	16	35	0.4	1.07	585	10
W99-1-79.3	Till	79.3	11	16	1	15.8	1.3	11	<50	3.1	45	17	35	0.4	1.27	630	30
W99-1-80.3	Till	80.3	12	14	<1	16.9	1.4	10	<50	2.7	46	17	40	0.4	1.06	615	20
W99-1-80.7	Till	80.7	12	18	1	16.7	1.3	11	<50	3.2	48	16	39	0.4	1.21	650	20
W99-1-81.1	Till	81.1	12	16	2	17.9	1.5	11	<50	3.2	45	17	41	0.4	1.21	630	20
W99-1-87.1	Till	87.1	13	19	1	16.7	1.6	12	<50	2.9	40	18	41	0.4	0.83	460	30
W99-1-88.0	Till	88.0	13	19	2	17.2	1.6	11	<50	3.2	44	19	42	0.4	0.85	445	20
W99-1-89.7	Till	89.7	11	17	2	15.5	1.4	10	<50	3.2	42	16	38	0.4	0.76	405	20
W99-1-91.4	Till	91.4	12	20	2	15.8	1.5	11	<50	3.1	44	17	39	0.4	0.81	425	30
W99-1-92.4	Till	92.4	13	20	2	16.6	1.7	11	<50	3.2	45	21	42	0.4	0.77	415	30
W99-1-93.3	Till	93.3	13	21	2	16.6	1.6	11	<50	3.3	46	22	42	0.5	0.77	420	30
W99-1-95.1	Till	95.1	13	20	3	17.5	1.7	12	<50	3.2	46	20	43	0.5	0.86	450	20
W99-1-95.5	Till	95.5	12	19	2	15.9	1.5	11	<50	3.2	46	17	40	0.5	0.83	395	30
W99-1-96.5	Till	96.5	14	22	2	20.4	1.7	9	<50	3.4	47	20	52	0.3	1.07	630	60
W99-1-97.5	Till	97.5	14	23	1	21.1	1.7	10	<50	3.5	49	18	54	0.3	1.07	620	40
W99-1-98.1	Till	98.1	15	23	2	21.7	1.6	9	<50	3.6	49	19	57	0.4	1.05	620	40
W99-1-99.2	Till	99.2	15	25	2	22.3	1.8	10	<50	3.9	51	21	59	0.4	1.06	655	50
* W99-1-99.2	Till	99.2	14	24	2	21.4	1.8	9	<50	3.5	44	20	59	0.3	1.05	655	50
W99-1-100.2	Till	100.2	13	24	2	19.9	1.6	10	<50	3.7	49	17	53	0.4	1.11	620	40
W99-1-101.3	Till	101.3	17	28	2	24.2	1.8	7	<50	4.7	49	20	68	0.4	1.12	750	40
W99-1-102.2	Till	102.2	5	26	2	18.1	1.8	9	<50	2.5	48	20	46	0.4	0.56	105	50
W99-1-103.4	Till	103.4	14	24	1	17.3	1.9	9	<50	3.2	43	22	44	0.4	0.62	410	40
W99-1-104.4	Till	104.4	13	23	2	20.5	1.6	10	<50	3.4	50	19	56	0.4	1.09	595	30
W99-1-105.4	Till	105.4	11	20	1	16.4	1.7	12	<50	3	48	18	42	0.4	0.91	520	30
W99-1-106.3	Till	106.3	12	23	2	19	1.6	10	<50	3.3	50	20	53	0.4	1.09	635	40

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS	NAA
Sample #	**Material**	**Depth**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**	**Tb**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-72.0	Till	72.0	1.8	28	13	680	1.6	85	6.7	11	<5	0.45	0.62	141	1.6	0.05	0.7
W99-1-73.3	Till	73.3	1.2	26	12	670	1.71	84	6.9	12	<5	0.35	0.7	141	1.5	0.05	1
W99-1-74.3	Till	74.3	1.2	31	14	520	1.43	78	6.9	11	<5	0.35	0.41	90	1.7	<0.05	0.7
W99-1-75.3	Till	75.3	1.2	26	12	730	1.74	85	6.9	11	<5	0.3	0.74	153	1.3	<0.05	0.8
W99-1-76.3	Till	76.3	1.2	24	12	710	1.75	86	7	11	<5	0.35	0.7	151	1.3	0.05	0.6
* W99-1-76.3	Till	76.3	1.2	25	12	720	1.77	86	6.5	11	<5	0.4	0.66	153	1.1	<0.05	0.9
W99-1-77.3	Till	77.3	1.2	27	13	680	1.74	89	7.1	11	<5	0.35	0.7	144	1.5	<0.05	1.1
W99-1-78.3	Till	78.3	1	24	12	660	1.73	86	7.1	11	<5	0.3	0.71	145	1.1	<0.05	1.3
W99-1-79.3	Till	79.3	1.4	26	11	730	1.77	85	6.8	10	<5	0.35	0.72	156	1.2	<0.05	0.6
W99-1-80.3	Till	80.3	1.2	25	12	650	1.78	93	6.9	10	<5	0.4	0.68	146	1.2	<0.05	1.1
W99-1-80.7	Till	80.7	1.2	27	12	700	1.82	90	7.2	12	<5	0.35	0.74	153	1.1	0.05	0.7
W99-1-81.1	Till	81.1	1.2	26	14	710	1.88	99	7	11	<5	0.4	0.73	155	1	<0.05	0.9
W99-1-87.1	Till	87.1	2.2	28	13	730	1.55	86	6.2	11	<5	0.65	0.47	160	1.3	<0.05	0.9
W99-1-88.0	Till	88.0	2.4	29	14	730	1.57	88	6.7	12	<5	0.55	0.53	146	1.5	<0.05	1
W99-1-89.7	Till	89.7	2.4	26	12	680	1.43	78	6.5	12	<5	0.4	0.51	135	1.3	0.05	1
W99-1-91.4	Till	91.4	2.8	28	12	760	1.5	80	7.2	12	<5	0.4	0.51	141	1.4	0.05	1
W99-1-92.4	Till	92.4	3.2	30	13	780	1.52	86	7.1	12	<5	0.5	0.51	148	1.5	0.05	1.1
W99-1-93.3	Till	93.3	3.2	29	13	810	1.51	84	7.2	12	<5	0.4	0.53	145	1.2	0.05	0.9
W99-1-95.1	Till	95.1	2.6	30	13	730	1.59	89	6.9	12	<5	0.45	0.58	148	1.4	0.05	0.8
W99-1-95.5	Till	95.5	3	27	12	690	1.56	83	7	13	<5	0.45	0.56	148	1.3	0.05	1
W99-1-96.5	Till	96.5	2.6	34	13	690	1.72	99	6.8	14	<5	0.45	0.53	158	1.2	0.05	1.2
W99-1-97.5	Till	97.5	2.6	34	14	730	1.75	101	7.2	15	<5	0.45	0.5	153	1.2	<0.05	0.8
W99-1-98.1	Till	98.1	2.8	35	14	740	1.74	103	7.2	15	<5	0.4	0.52	155	1.2	<0.05	1
W99-1-99.2	Till	99.2	2.8	34	15	710	1.8	107	7.3	15	<5	0.45	0.5	164	1.2	0.05	0.7
* W99-1-99.2	Till	99.2	2.8	33	14	700	1.8	100	6.8	13	<5	0.4	0.47	157	1.3	0.05	1
W99-1-100.2	Till	100.2	2.4	31	13	680	1.79	97	7.1	15	<5	0.4	0.53	157	1.3	0.05	0.9
W99-1-101.3	Till	101.3	5.8	39	14	690	1.85	115	6.9	18	<5	0.4	0.46	161	1	0.05	1
W99-1-102.2	Till	102.2	1.8	14	15	500	1.55	88	6.5	12	<5	0.45	0.42	276	1.6	<0.05	0.7
W99-1-103.4	Till	103.4	4	31	14	680	1.53	88	6.5	11	<5	0.5	0.42	168	1.5	0.05	1.1
W99-1-104.4	Till	104.4	2.6	32	14	650	1.75	99	7.1	14	<5	0.35	0.54	165	1.1	0.1	0.9
W99-1-105.4	Till	105.4	2.6	27	11	600	1.63	83	6.9	13	<5	0.4	0.74	167	1.1	0.05	1
W99-1-106.3	Till	106.3	2.6	30	13	680	1.73	94	7.1	14	<5	0.4	0.61	166	1.6	<0.05	1.1

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-72.0	Till	72.0	0.68	12	<100	0.33	1.3	4.5	100	3	23.2	74	<200
W99-1-73.3	Till	73.3	0.56	13	<100	0.32	1.0	5.3	92	3	21.5	58	580
W99-1-74.3	Till	74.3	0.50	11	<100	0.38	1.3	7.7	79	3	21.9	96	690
W99-1-75.3	Till	75.3	0.58	13	<100	0.30	1.0	4.0	93	3	22.0	66	510
W99-1-76.3	Till	76.3	0.60	13	<100	0.31	0.9	3.9	93	3	22.4	66	<200
* W99-1-76.3	Till	76.3	0.60	13	<100	0.31	1.1	3.7	89	3	22.3	66	<200
W99-1-77.3	Till	77.3	0.58	13	<100	0.30	1.0	3.7	86	3	22.0	62	600
W99-1-78.3	Till	78.3	0.58	14	<100	0.30	1.0	4.0	97	3	22.0	68	440
W99-1-79.3	Till	79.3	0.60	13	<100	0.30	1.3	3.8	89	3	22.3	70	430
W99-1-80.3	Till	80.3	0.62	14	<100	0.31	1.3	3.7	98	2	21.9	68	<200
W99-1-80.7	Till	80.7	0.62	14	<100	0.32	1.2	3.7	98	3	24.1	68	630
W99-1-81.1	Till	81.1	0.66	14	<100	0.31	1.0	3.7	95	3	22.0	66	720
W99-1-87.1	Till	87.1	0.70	11	<100	0.33	1.3	3.8	108	2	23.6	72	520
W99-1-88.0	Till	88.0	0.70	12	<100	0.34	1.5	4.2	107	3	24.0	76	400
W99-1-89.7	Till	89.7	0.66	11	<100	0.31	1.2	3.8	97	3	21.6	68	440
W99-1-91.4	Till	91.4	0.74	12	<100	0.32	1.3	4.6	108	3	22.8	80	460
W99-1-92.4	Till	92.4	0.76	12	<100	0.32	1.8	4.5	107	3	24.6	78	320
W99-1-93.3	Till	93.3	0.80	12	<100	0.32	1.3	4.6	105	3	24.8	80	430
W99-1-95.1	Till	95.1	0.76	12	<100	0.33	1.4	4.4	110	3	23.5	98	<200
W99-1-95.5	Till	95.5	0.76	12	<100	0.31	1.3	4.5	122	3	21.3	78	440
W99-1-96.5	Till	96.5	0.76	12	<100	0.35	1.6	5.5	147	3	22.9	90	<200
W99-1-97.5	Till	97.5	0.74	13	<100	0.36	1.7	5.1	146	3	23.4	88	<200
W99-1-98.1	Till	98.1	0.76	13	<100	0.35	1.5	5.3	144	3	23.9	102	480
W99-1-99.2	Till	99.2	0.80	13	<100	0.36	2.0	4.7	156	3	24.5	94	<200
* W99-1-99.2	Till	99.2	0.80	13	<100	0.36	1.7	4.6	151	3	23.3	90	430
W99-1-100.2	Till	100.2	0.70	13	<100	0.36	1.4	4.4	157	3	22.3	98	610
W99-1-101.3	Till	101.3	0.84	13	<100	0.36	1.5	4.0	204	3	23.5	92	<200
W99-1-102.2	Till	102.2	0.70	12	<100	0.36	1.4	3.0	113	3	21.8	40	<200
W99-1-103.4	Till	103.4	0.96	11	<100	0.32	1.4	4.4	106	3	24.5	90	730
W99-1-104.4	Till	104.4	0.72	13	<100	0.35	1.4	4.1	146	3	23.5	86	500
W99-1-105.4	Till	105.4	0.68	13	<100	0.34	1.2	4.6	131	3	20.8	84	650
W99-1-106.3	Till	106.3	0.70	13	<100	0.35	1.8	4.7	145	3	23.5	88	<200

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			NAA	NAA	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	IMS
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**	**Cr***
			grams	**ppb**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-109.0	Till	109.0	11.9	<2	1	12	720	690	1.8	0.3	2.8	0.46	0.87	88	5.5	72	56
W99-1-110.0	Till	110.0	12.0	<2	0.9	11	540	530	2.2	0.31	3.1	0.5	0.72	84	5.2	78	60
W99-1-111.0	Till	111.0	11.8	<2	0.8	11	560	530	1.8	0.29	3.4	0.48	0.66	96	5.7	78	61
W99-1-112.0	Till	112.0	11.9	<2	0.9	11	520	530	2.2	0.3	2.8	0.6	0.69	90	5.2	75	60
W99-1-113.0	Till	113.0	13.0	<2	0.9	11	480	490	1.9	0.31	3.2	0.52	0.7	96	5.6	90	59
W99-1-114.0	Till	114.0	11.3	10	0.9	11	860	810	1.8	0.29	2.6	0.58	0.71	88	5.1	68	57
W99-1-115.0	Till	115.0	12.0	3	1	11	590	550	1.7	0.3	2.6	0.52	0.71	86	4.8	73	57
W99-1-116.0	Till	116.0	11.7	3	0.9	11	610	560	2.1	0.33	2.5	0.54	0.66	82	4.9	60	54
W99-1-117.0	Till	117.0	11.0	<2	0.9	10	490	480	2.6	0.31	2.5	0.46	0.63	83	5.3	67	61
W99-1-118.0	Till	118.0	12.8	<2	0.9	11	570	640	1.7	0.27	2.6	0.34	0.84	85	5.6	61	72
W99-1-119.0	Till	119.0	11.3	3	0.9	11	590	540	1.7	0.3	2.9	0.54	0.66	88	5.5	69	59
* W99-1-119.0	Till	119.0	11.4	3	0.9	11	590	540	2.2	0.31	2.7	0.58	0.66	88	5.3	67	59
W99-1-120.0	Till	120.0	11.2	3	0.9	11	510	460	2.5	0.32	2.6	0.46	0.64	81	5.1	66	60
W99-1-121.0	Till	121.0	10.5	<2	0.9	11	780	740	1.9	0.29	2.6	0.58	0.63	82	5	67	59
W99-1-121.9	Till	121.9	11.7	3	1	11	480	440	1.9	0.33	2.6	0.5	0.65	86	4.6	66	56
W99-1-122.4	Till	122.4	9.1	4	1	12	620	560	2.3	0.36	3	0.58	0.6	81	6.2	71	67
W99-1-123.1	Till	123.1	12.6	3	0.9	11	500	460	2	0.29	2.5	0.62	0.62	87	5.2	66	55
W99-1-124.1	Till	124.1	11.1	<2	0.9	11	530	480	2.1	0.28	2.7	0.64	0.63	86	5.1	70	58
W99-1-125.1	Till	125.1	11.1	<2	0.9	10	480	440	1.8	0.3	2.7	0.72	0.61	89	5.5	70	62
W99-1-126.1	Till	126.1	11.3	4	0.9	10	520	470	2.5	0.3	2.4	0.4	0.61	85	5.9	80	63
W99-1-127.1	Till	127.1	10.1	<2	0.9	10	510	440	2.1	0.32	2.2	0.48	0.61	92	5.7	70	65
W99-1-128.1	Till	128.1	10.7	<2	1	10	460	450	1.9	0.32	2.8	0.8	0.61	84	5.9	80	66
W99-1-129.1	Till	129.1	12.5	<2	0.9	10	440	430	2.1	0.3	2.6	0.68	0.59	83	5.8	70	63
W99-1-130.6	Till	130.6	9.6	<2	1	10	1500	1430	1.8	0.31	2.9	0.88	0.62	92	5.6	79	63
W99-1-131.6	Till	131.6	10.6	4	0.9	12	650	600	2	0.33	2.8	0.58	0.72	92	5.1	76	60
W99-1-132.5	Till	132.5	10.9	<2	0.9	11	500	460	1.8	0.31	2.2	0.62	0.69	86	5.2	72	59
W99-1-133.5	Till	133.5	13.2	3	0.8	10	640	590	2.1	0.3	2.4	0.58	0.64	87	4.6	63	58
W99-1-134.5	Till	134.5	11.5	3	0.9	11	560	520	1.8	0.29	2.5	0.54	0.65	97	4.9	85	59
W99-1-135.5	Till	135.5	13.1	<2	1	11	580	550	1.7	0.24	2	0.54	0.57	91	3.8	78	51
W99-1-137.0	Till	137.0	11.1	<2	1.3	14	660	550	2.1	0.3	2.8	0.72	0.69	83	5.4	81	64
* W99-1-137.0	Till	137.0	11.7	<2	1.3	14	640	540	2.2	0.33	3	0.88	0.68	89	5.4	65	66
W99-1-138.0	Till	138.0	11.5	3	1.4	13	620	550	1.6	0.28	3.1	0.82	0.8	85	5	76	64

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS	CVAA
Sample #	**Material**	**Depth**	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**	**Hg**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppb**
W99-1-109.0	Till	109.0	12	20	1	16.7	1.6	12	<50	3.2	48	19	41	0.5	0.62	440	40
W99-1-110.0	Till	110.0	13	21	2	17.4	1.6	11	<50	3.2	48	18	45	0.4	0.66	400	30
W99-1-111.0	Till	111.0	13	20	3	18.4	1.6	13	<50	3.6	55	19	48	0.4	0.66	410	50
W99-1-112.0	Till	112.0	13	20	1	17.4	1.8	13	<50	3.3	47	20	46	0.5	0.65	395	40
W99-1-113.0	Till	113.0	13	20	<1	17.7	1.6	14	<50	3.4	46	21	45	0.4	0.66	395	40
W99-1-114.0	Till	114.0	12	20	2	16.7	1.7	13	<50	2.8	40	18	43	0.3	0.63	380	40
W99-1-115.0	Till	115.0	13	20	2	16.7	1.8	13	<50	2.9	42	19	44	0.3	0.64	400	40
W99-1-116.0	Till	116.0	13	20	1	17.6	1.8	12	<50	2.8	41	20	46	0.3	0.6	385	30
W99-1-117.0	Till	117.0	13	19	2	19.4	1.8	11	<50	2.9	43	19	53	0.3	0.67	370	30
W99-1-118.0	Till	118.0	10	25	1	14	1.4	11	<50	3	42	15	38	0.3	0.79	480	30
W99-1-119.0	Till	119.0	15	19	2	18.6	1.8	12	<50	3	41	19	53	0.3	0.65	385	30
* W99-1-119.0	Till	119.0	14	20	2	18.7	1.8	12	<50	3	42	21	53	0.3	0.64	380	40
W99-1-120.0	Till	120.0	16	20	1	19.2	1.8	11	<50	3	43	20	55	0.3	0.65	380	40
W99-1-121.0	Till	121.0	14	21	2	17.3	1.8	11	<50	2.8	40	18	48	0.3	0.64	385	40
W99-1-121.9	Till	121.9	15	20	2	18.6	1.8	12	<50	3	42	21	52	0.3	0.61	380	40
W99-1-122.4	Till	122.4	16	25	2	20.9	2	7	<50	3.5	41	21	62	0.3	0.77	425	30
W99-1-123.1	Till	123.1	13	19	2	16.7	1.8	13	<50	2.8	43	22	48	0.3	0.61	435	50
W99-1-124.1	Till	124.1	14	20	2	17.3	1.7	12	<50	2.9	42	18	49	0.3	0.63	390	30
W99-1-125.1	Till	125.1	13	21	1	19.1	1.8	12	<50	3.2	43	19	53	0.4	0.68	390	40
W99-1-126.1	Till	126.1	15	20	2	19.6	1.8	12	<50	3	43	19	58	0.3	0.67	380	40
W99-1-127.1	Till	127.1	14	20	2	19.7	1.7	11	<50	3.2	44	18	58	0.3	0.7	365	40
W99-1-128.1	Till	128.1	15	20	3	20.3	1.8	12	<50	3.2	43	20	59	0.3	0.72	380	40
W99-1-129.1	Till	129.1	14	19	1	19.8	1.9	11	<50	3.1	42	20	58	0.3	0.68	360	30
W99-1-130.6	Till	130.6	13	19	1	18.9	1.8	11	<50	3.1	42	19	56	0.3	0.7	365	30
W99-1-131.6	Till	131.6	14	21	1	18.3	1.7	12	<50	3.4	44	21	53	0.3	0.67	435	40
W99-1-132.5	Till	132.5	14	21	2	17.9	1.8	12	<50	3.1	42	20	51	0.2	0.65	405	40
W99-1-133.5	Till	133.5	14	19	2	17.3	1.6	14	<50	3.1	41	18	52	<0.2	0.64	415	40
W99-1-134.5	Till	134.5	13	21	3	16.4	1.7	14	<50	3.3	42	17	49	0.2	0.63	395	50
W99-1-135.5	Till	135.5	13	20	1	14.7	1.7	15	<50	3	41	18	44	0.3	0.54	370	50
W99-1-137.0	Till	137.0	14	22	2	18	1.7	11	<50	3.3	45	19	55	0.3	0.69	390	50
* W99-1-137.0	Till	137.0	14	22	2	18.8	1.8	11	<50	3.3	46	20	58	0.3	0.71	395	40
W99-1-138.0	Till	138.0	12	21	2	15.9	1.5	13	<50	3.1	45	18	47	0.3	0.66	380	50

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS	NAA
Sample #	**Material**	**Depth**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**	**Tb**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-109.0	Till	109.0	3	27	13	650	1.46	82	7.2	12	<5	0.45	0.44	151	1.4	0.05	1
W99-1-110.0	Till	110.0	3.4	29	13	660	1.48	85	7.2	12	<5	0.45	0.42	148	1.6	0.05	1.1
W99-1-111.0	Till	111.0	3	31	13	600	1.55	92	7.5	13	<5	0.45	0.47	149	1.6	<0.05	0.9
W99-1-112.0	Till	112.0	3.2	30	14	640	1.52	88	6.9	13	<5	0.45	0.46	152	1.5	<0.05	0.8
W99-1-113.0	Till	113.0	3.2	29	13	650	1.5	88	6.7	12	<5	0.45	0.44	148	1.2	<0.05	1
W99-1-114.0	Till	114.0	3.2	28	12	670	1.48	83	6.4	10	<5	0.45	0.37	160	1.6	<0.05	0.9
W99-1-115.0	Till	115.0	3.4	29	13	660	1.46	85	6.6	11	<5	0.4	0.42	153	1.6	0.05	1.1
W99-1-116.0	Till	116.0	3.4	30	15	630	1.46	87	6.7	10	<5	0.5	0.41	155	1.4	0.05	0.8
W99-1-117.0	Till	117.0	3.2	29	14	580	1.52	95	6.5	11	<5	0.45	0.4	145	1.6	0.05	0.9
W99-1-118.0	Till	118.0	2.6	23	11	820	1.79	68	6.7	12	<5	0.35	0.4	147	1.5	0.05	0.9
W99-1-119.0	Till	119.0	3.2	31	13	620	1.49	91	6.6	11	<5	0.45	0.41	153	1.5	0.05	1.1
* W99-1-119.0	Till	119.0	3.2	29	14	630	1.49	88	6.6	11	<5	0.5	0.42	154	1.4	0.05	0.8
W99-1-120.0	Till	120.0	3.2	32	14	620	1.51	94	6.7	12	<5	0.5	0.41	150	1.5	0.05	1
W99-1-121.0	Till	121.0	2.8	29	12	620	1.46	83	6.4	11	<5	0.4	0.4	154	1.3	0.05	0.9
W99-1-121.9	Till	121.9	3.4	31	14	630	1.44	92	6.6	11	<5	0.5	0.41	151	1.6	0.05	1
W99-1-122.4	Till	122.4	3	31	14	570	1.64	101	6.3	13	<5	0.5	0.43	163	1.6	0.05	0.9
W99-1-123.1	Till	123.1	3	27	13	620	1.44	80	6.8	11	<5	0.45	0.44	148	1.3	0.05	1.1
W99-1-124.1	Till	124.1	3.2	28	13	640	1.5	81	6.7	11	<5	0.45	0.43	147	1.5	<0.05	0.9
W99-1-125.1	Till	125.1	3	28	14	610	1.53	88	6.8	12	<5	0.45	0.42	147	1.6	0.05	1
W99-1-126.1	Till	126.1	3.2	31	14	620	1.53	91	6.7	12	<5	0.45	0.41	147	1.3	0.05	1.1
W99-1-127.1	Till	127.1	3	30	14	600	1.55	90	6.8	13	<5	0.45	0.42	145	1.4	0.05	0.9
W99-1-128.1	Till	128.1	3	30	14	590	1.56	94	6.8	13	<5	0.45	0.41	146	1.6	0.05	1
W99-1-129.1	Till	129.1	3	28	14	580	1.55	94	6.6	12	<5	0.45	0.41	146	1.4	0.05	1.1
W99-1-130.6	Till	130.6	3	28	13	610	1.54	90	6.7	12	<5	0.45	0.42	171	1.6	0.05	0.8
W99-1-131.6	Till	131.6	3.4	29	14	800	1.47	84	6.9	12	<5	0.45	0.45	167	1.6	0.05	0.9
W99-1-132.5	Till	132.5	3.2	30	13	690	1.49	85	6.4	11	<5	0.45	0.46	159	1.5	0.05	1
W99-1-133.5	Till	133.5	2.8	29	13	630	1.5	80	6.2	11	<5	0.45	0.42	155	1.6	0.05	0.9
W99-1-134.5	Till	134.5	3.2	26	12	640	1.49	78	6.3	12	<5	0.4	0.48	152	1.5	0.05	1
W99-1-135.5	Till	135.5	3	27	12	560	1.4	69	6.4	11	<5	0.45	0.5	154	1.2	0.1	1.1
W99-1-137.0	Till	137.0	4.6	30	13	730	1.49	85	6.8	12	<5	0.45	0.46	155	1.3	0.05	0.9
* W99-1-137.0	Till	137.0	4.8	30	13	740	1.47	88	6.7	12	<5	0.45	0.47	158	1.4	0.05	0.9
W99-1-138.0	Till	138.0	5	28	12	820	1.46	75	6.8	12	<5	0.4	0.45	154	1.3	<0.05	1.1

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-109.0	Till	109.0	0.76	12	<100	0.33	1.4	4.3	114	4	23.5	70	590
W99-1-110.0	Till	110.0	0.80	13	<100	0.34	1.4	4.7	121	3	23.7	76	590
W99-1-111.0	Till	111.0	0.76	14	<100	0.33	1.3	4.4	114	4	23.6	76	450
W99-1-112.0	Till	112.0	0.82	13	<100	0.33	1.4	4.4	122	3	23.6	84	380
W99-1-113.0	Till	113.0	0.80	12	<100	0.32	1.5	4.1	123	3	23.6	78	390
W99-1-114.0	Till	114.0	0.80	12	<100	0.32	1.4	4.3	119	3	22.7	76	330
W99-1-115.0	Till	115.0	0.84	12	<100	0.33	1.4	4.5	119	3	23.2	82	380
W99-1-116.0	Till	116.0	0.82	12	<100	0.34	1.5	4.6	111	3	24.6	72	520
W99-1-117.0	Till	117.0	0.80	12	<100	0.34	1.5	4.1	126	3	23.8	72	380
W99-1-118.0	Till	118.0	0.64	12	<100	0.41	1.3	4.5	145	3	18.9	92	380
W99-1-119.0	Till	119.0	0.82	12	<100	0.33	1.6	4.4	122	3	23.8	84	460
* W99-1-119.0	Till	119.0	0.80	12	<100	0.35	1.7	4.4	119	4	23.9	80	230
W99-1-120.0	Till	120.0	0.88	12	<100	0.34	1.7	4.3	120	3	24.7	72	360
W99-1-121.0	Till	121.0	0.80	12	<100	0.33	1.5	4.3	120	3	22.8	80	370
W99-1-121.9	Till	121.9	0.88	12	<100	0.34	1.6	4.2	113	3	25.4	70	460
W99-1-122.4	Till	122.4	0.86	12	<100	0.36	1.6	3.9	137	3	21.1	82	<200
W99-1-123.1	Till	123.1	0.76	12	<100	0.33	1.4	4.7	112	4	22.7	84	400
W99-1-124.1	Till	124.1	0.78	12	<100	0.34	1.5	4.4	116	4	22.5	86	360
W99-1-125.1	Till	125.1	0.76	12	<100	0.35	1.4	4.1	126	3	22.7	72	530
W99-1-126.1	Till	126.1	0.82	13	<100	0.35	1.5	4.3	126	3	23.6	68	580
W99-1-127.1	Till	127.1	0.80	13	<100	0.36	1.5	4.3	135	3	22.9	72	400
W99-1-128.1	Till	128.1	0.84	13	<100	0.36	1.6	4.3	139	3	23.4	84	630
W99-1-129.1	Till	129.1	0.80	12	<100	0.34	1.5	4.7	132	3	22.5	106	400
W99-1-130.6	Till	130.6	0.80	13	<100	0.35	1.6	4.5	135	4	23.0	84	390
W99-1-131.6	Till	131.6	0.84	13	<100	0.34	1.6	4.8	123	4	25.1	78	400
W99-1-132.5	Till	132.5	0.80	12	<100	0.33	1.7	4.4	117	3	23.7	76	500
W99-1-133.5	Till	133.5	0.76	12	<100	0.35	1.7	4.3	117	3	22.0	78	500
W99-1-134.5	Till	134.5	0.76	12	<100	0.34	1.3	4.4	120	3	21.4	82	420
W99-1-135.5	Till	135.5	0.76	12	<100	0.35	1.5	4.3	103	4	21.3	66	470
W99-1-137.0	Till	137.0	0.94	13	<100	0.34	1.6	5.0	139	3	22.3	90	330
* W99-1-137.0	Till	137.0	1.02	13	<100	0.34	1.7	5.1	148	3	23.0	90	520
W99-1-138.0	Till	138.0	0.92	13	<100	0.34	1.4	5.2	139	4	22.1	88	390

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			NAA	NAA	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	IMS
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**	**Cr***
			grams	**ppb**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-139.0	Till	139.0	12.1	4	1.5	14	640	550	2.1	0.31	3.1	0.94	0.87	90	5.1	78	64
W99-1-140.0	Till	140.0	11.1	4	1.5	15	580	500	2	0.33	3.5	0.88	0.87	93	5.5	75	66
W99-1-141.0	Till	141.0	13.2	<2	1.5	14	540	460	1.6	0.32	3.2	0.88	0.87	87	5	84	63
W99-1-142.0	Till	142.0	13.1	<2	1.5	15	690	610	1.9	0.31	3.8	0.86	0.93	87	5.4	77	67
W99-1-143.0	Till	143.0	10.6	3	1.5	16	990	800	2.1	0.33	3.6	0.88	0.89	88	5.2	74	64
W99-1-144.0	Till	144.0	11.4	5	1.5	15	540	480	2.1	0.31	3.4	1.04	0.87	84	5.5	71	65
W99-1-145.0	Till	145.0	11.6	5	1.5	17	1000	770	1.6	0.33	3.4	1.14	0.87	89	5.2	72	60
W99-1-146.0	Till	146.0	11.7	<2	1.5	16	690	620	1.9	0.33	3.8	1.08	0.93	93	5.5	80	69
W99-1-147.0	Till	147.0	12.2	<2	2.3	20	720	600	2.3	0.35	5	1.68	1.3	87	5.2	82	69
W99-1-148.0	Till	148.0	12.0	<2	2.2	20	700	590	2.1	0.35	4.3	1.58	1.12	92	5.4	72	69
W99-1-149.0	Till	149.0	12.1	4	2.2	19	810	700	1.8	0.36	4.7	1.52	1.14	89	5.8	82	69
W99-1-150.0	Till	150.0	13.0	36	2.2	22	660	250	1.7	0.34	4	1.46	1.03	100	4.1	76	54
W99-1-151.0	Till	151.0	11.2	5	2.6	19	740	540	1.7	0.36	4.9	1.74	1.23	87	6.4	87	75
W99-1-152.0	Till	152.0	12.1	5	2.6	20	740	610	2.1	0.37	4.9	1.74	1.19	88	5.9	90	76
W99-1-153.0	Till	153.0	11.8	4	2.8	19	740	600	2.2	0.34	5.2	1.86	1.2	90	6.4	93	76
W99-1-153.4	Till	153.4	11.1	4	3.4	21	670	570	2.1	0.37	5.6	2.66	1.42	91	6.4	85	79
W99-1-153.6	Shale	153.6	8.8	4	0.7	13	920	740	2.4	0.32	4.5	0.36	0.72	75	8.1	110	108

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS	CVAA
Sample #	**Material**	**Depth**	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**	**Hg**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppb**
W99-1-139.0	Till	139.0	13	21	2	17.1	1.6	12	<50	3.2	44	19	50	0.3	0.67	360	30
W99-1-140.0	Till	140.0	13	23	1	17.8	1.7	11	<50	3.3	46	21	52	0.3	0.7	370	40
W99-1-141.0	Till	141.0	13	21	2	17.5	1.8	12	<50	3.2	45	20	51	0.4	0.68	350	40
W99-1-142.0	Till	142.0	13	23	2	17.2	1.7	11	<50	3.4	44	19	49	0.4	0.71	360	50
W99-1-143.0	Till	143.0	14	22	1	18.2	1.9	11	<50	3.3	45	19	52	0.2	0.69	365	60
W99-1-144.0	Till	144.0	13	23	2	17.4	1.7	11	<50	3.2	44	19	48	0.4	0.69	355	60
W99-1-145.0	Till	145.0	13	23	2	16.2	1.7	12	<50	3.5	44	18	48	0.3	0.67	370	60
W99-1-146.0	Till	146.0	14	25	2	18	1.8	11	<50	3.4	45	25	50	0.3	0.73	385	70
W99-1-147.0	Till	147.0	14	28	2	18.1	1.8	10	<50	3.7	46	20	50	0.3	0.74	360	80
W99-1-148.0	Till	148.0	14	29	2	17.6	1.6	10	<50	3.6	45	19	50	0.3	0.77	375	60
W99-1-149.0	Till	149.0	14	29	2	17.9	1.6	10	<50	3.5	46	19	50	0.3	0.76	380	60
W99-1-150.0	Till	150.0	13	28	2	13.8	1.5	17	<50	3.3	49	19	40	0.5	0.58	375	70
W99-1-151.0	Till	151.0	15	32	1	17.8	1.7	10	<50	3.6	45	19	53	0.2	0.86	395	60
W99-1-152.0	Till	152.0	15	32	2	18.8	1.7	9	<50	3.5	45	20	55	0.2	0.79	390	80
W99-1-153.0	Till	153.0	15	32	2	18	2.1	10	<50	3.7	45	19	52	0.3	0.77	365	60
W99-1-153.4	Till	153.4	16	33	2	18.9	1.8	10	<50	3.9	47	20	55	<0.2	0.78	365	70
W99-1-153.6	Shale	153.6	10	25	<1	20	2.1	6	<50	3.2	39	17	78	<0.2	0.72	115	90

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS	NAA
Sample #	**Material**	**Depth**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**	**Tb**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-139.0	Till	139.0	6	30	13	850	1.46	81	7	12	<5	0.45	0.48	160	1.5	0.05	1.1
W99-1-140.0	Till	140.0	5.8	32	14	870	1.51	86	6.9	12	<5	0.5	0.48	163	1.5	0.15	0.9
W99-1-141.0	Till	141.0	6.4	30	13	850	1.46	80	6.8	12	<5	0.45	0.48	157	1.3	0.05	1.1
W99-1-142.0	Till	142.0	5.6	31	13	950	1.52	81	6.9	12	<5	0.45	0.51	171	1.2	<0.05	1.1
W99-1-143.0	Till	143.0	5.8	32	13	890	1.47	87	6.7	12	<5	0.45	0.48	181	1.2	0.05	1
W99-1-144.0	Till	144.0	5.4	31	13	870	1.46	83	6.7	12	<5	0.45	0.47	165	1.3	0.05	1.1
W99-1-145.0	Till	145.0	5.6	31	13	900	1.4	78	6.8	12	<5	0.5	0.5	177	1.4	0.15	1.1
W99-1-146.0	Till	146.0	5.8	33	13	980	1.52	85	6.9	12	<5	0.6	0.5	179	1.3	0.05	1.1
W99-1-147.0	Till	147.0	9.8	37	13	1030	1.5	85	6.9	12	<5	0.5	0.52	185	1.4	0.15	0.9
W99-1-148.0	Till	148.0	8.4	36	12	1020	1.51	81	7	12	<5	0.5	0.51	184	1.5	0.1	1
W99-1-149.0	Till	149.0	8.6	36	13	1040	1.5	82	7	12	<5	0.5	0.53	192	1.3	0.05	1.2
W99-1-150.0	Till	150.0	7.4	33	11	1110	1.35	64	8	10	<5	0.5	0.57	169	1.3	0.15	1.2
W99-1-151.0	Till	151.0	9.4	39	13	1000	1.57	83	7	13	6	0.55	0.53	195	1.4	0.15	1.2
W99-1-152.0	Till	152.0	9.8	41	12	1000	1.58	87	6.9	13	<5	0.55	0.56	196	1.5	0.15	1
W99-1-153.0	Till	153.0	9.4	40	12	1020	1.59	85	6.8	14	<5	0.55	0.54	196	1.5	0.15	1.1
W99-1-153.4	Till	153.4	12.6	46	13	950	1.59	90	6.7	13	<5	0.6	0.59	201	1.4	0.15	1
W99-1-153.6	Shale	153.6	7.2	34	15	920	1.94	112	5.3	15	<5	0.45	0.45	143	1.3	<0.05	0.9

Appendix 3 - Table A3-3: Geochemical analysis of samples from corehole WEPA99-1

			IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-1-139.0	Till	139.0	1.02	13	<100	0.33	1.5	5.3	146	4	24.4	86	420
W99-1-140.0	Till	140.0	1.10	13	<100	0.34	1.9	5.3	153	4	24.9	90	430
W99-1-141.0	Till	141.0	1.08	13	<100	0.33	1.7	5.5	145	4	24.4	86	400
W99-1-142.0	Till	142.0	1.02	13	<100	0.34	1.8	5.5	151	4	24.5	90	380
W99-1-143.0	Till	143.0	1.10	12	<100	0.33	1.5	5.5	148	3	25.1	86	260
W99-1-144.0	Till	144.0	1.02	12	<100	0.33	1.5	5.7	149	4	24.1	100	390
W99-1-145.0	Till	145.0	1.02	13	<100	0.32	1.3	6.0	138	4	24.3	88	400
W99-1-146.0	Till	146.0	1.10	13	<100	0.34	1.8	5.6	154	3	24.7	90	400
W99-1-147.0	Till	147.0	1.44	13	<100	0.31	1.6	7.0	200	3	26.6	102	500
W99-1-148.0	Till	148.0	1.36	13	<100	0.32	2.1	6.8	190	4	25.7	100	460
W99-1-149.0	Till	149.0	1.38	13	<100	0.33	1.6	6.8	194	4	26.3	98	240
W99-1-150.0	Till	150.0	1.38	14	<100	0.31	1.7	7.6	137	5	27.8	90	690
W99-1-151.0	Till	151.0	1.48	13	<100	0.33	1.6	7.3	215	3	25.4	116	450
W99-1-152.0	Till	152.0	1.58	13	<100	0.32	1.5	6.9	217	3	24.9	108	340
W99-1-153.0	Till	153.0	1.54	13	<100	0.33	1.5	7.0	228	4	24.7	122	310
W99-1-153.4	Till	153.4	1.90	13	<100	0.32	2.1	7.3	269	3	25.5	136	<200
W99-1-153.6	Shale	153.6	1.08	11	<100	0.38	1.5	5.7	192	3	20.2	122	<200

Notes: < denotes less than
NAA denotes neutron activation analysis
CVAA denotes analysis by cold vapour atomic absorption
IMS denotes plasma-mass spectrometry analysis
All results are reported on a dry basis.
Ba* and Cr* denotes acid soluble portion
* W99-1-54.4 denotes sample duplicate of W99-1-54.4

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-7.5	Till	7.5	10.6	<2	5.97	0.9	12.0	740	720	1.5	0.25	1.9	0.42	1.12	61	4.2	64
W99-2-9.5	Till	9.5	10.3	<2	6.18	0.9	13.0	700	420	1.4	0.25	2.2	0.38	1.09	67	5.1	73
W99-2-12.0	Till	12.0	12.2	5	6.21	0.9	13.0	720	710	1.5	0.27	2.3	0.36	1.09	74	4.7	80
W99-2-14.0	Till	14.0	11.3	<2	5.95	0.9	13.0	670	480	1.5	0.22	2.5	0.44	1.18	68	4.1	74
W99-2-15.0	Till	15.0	10.0	<2	5.60	0.9	14.0	670	670	1.5	0.22	2.1	0.44	1.04	67	4.1	70
W99-2-17.0	Silt	17.0	10.6	6	5.88	0.9	13.0	690	440	1.1	0.22	2.1	0.38	1.22	73	4.5	69
W99-2-21.8	Till	21.8	11.0	<2	6.10	0.9	12.0	680	660	1.5	0.23	2.3	0.36	1.32	69	4.5	76
W99-2-22.7	Till	22.7	11.6	<2	5.93	1.0	12.0	670	660	1.3	0.21	2.1	0.34	1.27	68	4.3	73
W99-2-23.4	Till	23.4	11.8	5	6.06	0.9	12.0	660	630	1.4	0.23	2.4	0.36	1.26	70	4.2	73
W99-2-29.0	Till	29.0	12.7	<2	6.21	0.9	11.0	660	560	0.9	0.22	1.8	0.34	1.38	64	4.7	74
W99-2-30.5	Till	30.5	12.1	<2	6.31	0.9	11.0	740	730	1.1	0.16	1.7	0.30	2.28	64	4.0	73
W99-2-32.5	Till	32.5	12.7	<2	5.88	0.9	10.0	640	640	0.8	0.17	1.3	0.30	2.22	69	4.0	74
W99-2-33.4	Till	33.4	12.2	<2	6.01	0.9	10.0	710	620	1.3	0.19	1.6	0.30	1.97	69	4.1	80
W99-2-35.0	Till	35.0	16.5	<2	5.01	0.7	7.9	640	660	0.9	0.13	1.5	0.20	2.73	68	2.9	78
W99-2-35.7	Till	35.7	13.2	<2	6.48	0.8	9.5	670	740	1.2	0.13	1.7	0.32	2.90	71	3.4	77
W99-2-37.5	Till	37.5	12.2	5	6.06	0.8	10.0	660	660	1.1	0.17	1.7	0.32	1.94	70	4.4	81
W99-2-38.7	Till	38.7	12.0	<2	6.26	0.8	7.8	1100	1090	1.1	0.23	1.3	0.24	1.24	68	4.8	70
W99-2-40.0	Silt & clay	40.0	14.1	<2	5.89	0.8	6.1	710	670	1.4	0.22	1.5	0.34	1.72	90	3.9	86
* W99-2-40.0	Silt & clay	40.0	14.7	<2	5.81	0.8	6.0	670	650	0.9	0.18	1.3	0.38	1.71	80	4.2	87
W99-2-41.0	Silt & clay	41.0	13.3	<2	6.48	1.0	7.7	620	620	1.2	0.25	2.2	0.24	0.66	86	4.7	83
W99-2-42.0	Till	42.0	11.6	<2	6.15	0.7	12.0	460	520	1.3	0.25	1.8	0.46	0.90	83	4.7	71
W99-2-43.0	Till	43.0	14.2	5	5.92	0.7	12.0	580	620	1.2	0.23	1.6	0.28	0.85	76	4.1	82
W99-2-44.0	Till	44.0	12.7	<2	5.81	0.8	10.0	440	460	1.0	0.22	1.5	0.24	0.82	72	3.8	64
W99-2-45.0	Till	45.0	14.6	<2	5.90	0.8	11.0	460	500	1.1	0.22	1.6	0.32	0.86	79	4.2	61
W99-2-46.0	Till	46.0	16.3	<2	5.75	0.8	10.0	460	480	1.0	0.20	1.3	0.26	0.85	75	3.9	60
W99-2-47.0	Till	47.0	15.4	<2	5.63	0.8	11.0	480	450	1.1	0.19	1.6	0.24	0.82	73	3.6	59
W99-2-48.0	Till	48.0	12.1	<2	5.91	0.8	10.0	570	580	1.0	0.24	2.0	0.30	0.81	76	4.4	65
W99-2-49.0	Till	49.0	11.2	<2	6.05	0.8	14.0	550	570	1.0	0.23	1.5	0.34	0.74	73	4.9	72
W99-2-50.0	Till	50.0	13.0	<2	5.91	0.9	12.0	540	500	1.2	0.24	2.1	0.34	0.76	72	4.6	50
W99-2-51.0	Till	51.0	12.9	<2	5.96	0.8	12.0	520	490	1.4	0.27	1.7	0.32	0.77	70	3.9	61
W99-2-52.0	Till	52.0	12.9	<2	6.09	0.9	12.0	550	510	1.3	0.26	1.4	0.36	0.80	70	4.6	69
W99-2-54.0	Till	54.0	11.2	<2	6.66	1.0	12.0	560	750	1.3	0.28	2.4	0.58	0.87	72	5.4	72

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W99-2-7.5	Till	7.5	59	14	25	2	15.6	1.5	10	<50	3.10	32	18	52	0.3	0.80	395
W99-2-9.5	Till	9.5	63	13	25	2	15.6	1.5	9	<50	3.10	34	17	55	0.4	0.85	395
W99-2-12.0	Till	12.0	67	14	25	2	16.2	1.6	8	<50	3.40	33	18	56	0.4	0.87	405
W99-2-14.0	Till	14.0	61	14	25	2	15.4	1.6	9	<50	3.00	34	19	51	0.4	0.88	425
W99-2-15.0	Till	15.0	57	14	24	1	14.6	1.5	9	<50	3.10	34	19	47	0.3	0.80	370
W99-2-17.0	Silt	17.0	61	14	25	1	14.5	1.5	9	<50	3.10	35	17	47	0.4	0.88	410
W99-2-21.8	Till	21.8	59	14	24	2	15.3	1.5	10	<50	3.00	36	18	47	0.4	0.89	425
W99-2-22.7	Till	22.7	62	13	24	2	14.6	1.4	9	<50	3.30	37	17	44	0.4	0.88	420
W99-2-23.4	Till	23.4	61	15	23	1	15.2	1.6	9	<50	3.00	37	19	49	0.4	0.88	425
W99-2-29.0	Till	29.0	70	13	26	1	15.8	1.4	9	<50	3.40	35	17	48	0.3	0.95	410
W99-2-30.5	Till	30.5	64	12	22	1	14.4	1.3	8	<50	3.10	33	14	41	0.4	1.40	505
W99-2-32.5	Till	32.5	67	12	23	2	14.4	1.3	9	<50	3.10	35	16	40	0.3	1.23	515
W99-2-33.4	Till	33.4	61	13	21	2	14.9	1.4	8	<50	3.30	33	15	42	0.4	1.20	425
W99-2-35.0	Till	35.0	56	9	15	<1	11.2	1.2	13	<50	2.30	35	13	26	0.4	1.28	410
W99-2-35.7	Till	35.7	59	11	19	1	13.1	1.2	11	<50	2.70	34	15	33	0.4	1.50	505
W99-2-37.5	Till	37.5	63	12	22	2	13.6	1.3	9	<50	3.20	34	15	39	0.3	1.20	435
W99-2-38.7	Till	38.7	61	10	22	1	14.6	1.5	10	<50	3.00	36	21	40	0.4	0.98	275
W99-2-40.0	Silt & clay	40.0	54	11	19	1	14.4	1.4	12	<50	3.10	39	17	41	0.5	0.84	485
* W99-2-40.0	Silt & clay	40.0	63	10	21	2	13.9	1.3	12	<50	3.10	39	16	37	0.4	0.83	475
W99-2-41.0	Silt & clay	41.0	60	12	24	1	15.6	1.6	11	<50	2.80	38	19	49	0.5	0.71	270
W99-2-42.0	Till	42.0	57	14	22	2	15.1	1.5	10	<50	3.90	39	18	49	0.5	0.77	540
W99-2-43.0	Till	43.0	55	12	19	2	13.7	1.4	12	<50	3.10	36	16	46	0.4	0.78	435
W99-2-44.0	Till	44.0	56	12	19	2	13.8	1.5	12	<50	2.80	34	17	46	0.4	0.74	400
W99-2-45.0	Till	45.0	58	11	21	2	14.2	1.5	12	<50	3.20	37	16	45	0.4	0.80	415
W99-2-46.0	Till	46.0	53	11	19	2	13.4	1.5	12	<50	3.10	37	16	43	0.5	0.74	410
W99-2-47.0	Till	47.0	52	11	19	2	13.2	1.1	11	<50	3.00	37	16	43	0.4	0.74	400
W99-2-48.0	Till	48.0	55	12	26	1	14.3	1.4	11	<50	3.10	37	17	48	0.5	0.78	420
W99-2-49.0	Till	49.0	58	12	24	2	15.1	1.4	9	<50	3.20	37	18	46	0.4	0.77	390
W99-2-50.0	Till	50.0	56	13	20	2	14.8	1.5	10	<50	3.30	37	17	47	0.4	0.73	365
W99-2-51.0	Till	51.0	55	13	20	1	15.3	1.7	10	<50	3.00	36	18	49	0.4	0.74	395
W99-2-52.0	Till	52.0	58	13	22	2	15.0	1.6	10	<50	3.00	36	18	48	0.5	0.77	405
W99-2-54.0	Till	54.0	65	16	23	2	17.2	1.6	8	<50	3.30	36	19	51	0.4	0.84	480

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-7.5	Till	7.5	50	2.6	27	11	740	1.64	84	5.7	10	<5	0.50	0.55	174	0.9	0.10
W99-2-9.5	Till	9.5	60	2.4	27	11	730	1.68	84	5.9	12	<5	0.50	0.58	171	1.2	<0.05
W99-2-12.0	Till	12.0	60	2.6	29	12	740	1.70	89	5.9	12	<5	0.55	0.60	176	1.3	0.05
W99-2-14.0	Till	14.0	70	2.6	28	12	720	1.72	85	6.2	11	<5	0.50	0.58	162	1.3	0.05
W99-2-15.0	Till	15.0	60	2.6	28	12	710	1.64	81	6.0	11	<5	0.50	0.62	157	1.1	0.05
W99-2-17.0	Silt	17.0	50	2.6	28	12	720	1.73	85	6.4	11	<5	0.50	0.59	158	1.1	0.05
W99-2-21.8	Till	21.8	30	2.6	28	12	690	1.74	88	6.3	11	<5	0.50	0.62	161	1.0	0.05
W99-2-22.7	Till	22.7	30	2.4	26	12	710	1.69	81	6.3	12	<5	0.50	0.60	158	1.1	0.05
W99-2-23.4	Till	23.4	40	2.4	28	11	700	1.74	86	6.1	11	<5	0.55	0.60	156	1.2	<0.05
W99-2-29.0	Till	29.0	40	2.6	27	11	800	1.74	88	6.1	12	<5	0.50	0.67	163	1.3	<0.05
W99-2-30.5	Till	30.5	30	1.4	26	10	750	1.80	79	5.5	12	<5	0.50	0.86	177	0.9	0.05
W99-2-32.5	Till	32.5	50	1.2	27	10	770	1.76	77	5.8	12	<5	0.40	0.91	169	1.0	0.05
W99-2-33.4	Till	33.4	40	1.4	27	10	670	1.66	80	5.8	12	<5	0.45	0.85	163	0.9	0.05
W99-2-35.0	Till	35.0	40	0.8	21	9	820	1.75	61	6.0	9	<5	0.40	1.10	173	1.2	<0.05
W99-2-35.7	Till	35.7	30	1.0	23	9	780	2.05	70	6.1	11	<5	0.40	1.00	206	1.0	<0.05
W99-2-37.5	Till	37.5	40	1.2	25	10	770	1.74	77	5.9	12	<5	0.45	0.80	166	1.2	0.05
W99-2-38.7	Till	38.7	30	1.2	22	10	740	1.74	83	6.2	12	<5	0.50	0.71	161	1.0	0.05
W99-2-40.0	Silt & clay	40.0	30	1.2	23	11	500	1.57	78	6.8	12	<5	0.45	0.81	166	1.5	0.05
* W99-2-40.0	Silt & clay	40.0	10	1.0	20	10	560	1.60	74	6.7	11	<5	0.46	0.78	158	1.1	0.05
W99-2-41.0	Silt & clay	41.0	40	1.4	23	12	610	1.80	89	6.9	12	<5	0.55	0.56	136	0.9	0.10
W99-2-42.0	Till	42.0	30	1.8	23	12	680	1.73	84	6.6	12	<5	0.60	0.50	126	1.3	<0.05
W99-2-43.0	Till	43.0	30	1.6	19	11	650	1.56	74	6.1	11	<5	0.50	0.49	127	1.0	0.05
W99-2-44.0	Till	44.0	30	1.8	20	11	640	1.54	75	6.2	10	<5	0.45	0.47	120	1.4	0.10
W99-2-45.0	Till	45.0	30	1.8	20	12	680	1.70	79	6.4	11	<5	0.50	0.55	127	1.3	0.10
W99-2-46.0	Till	46.0	20	2.0	19	11	650	1.65	76	6.5	10	<5	0.50	0.55	123	1.4	0.05
W99-2-47.0	Till	47.0	30	1.8	19	10	600	1.40	69	6.5	11	<5	0.46	0.55	120	1.1	0.05
W99-2-48.0	Till	48.0	40	2.0	21	12	650	1.47	74	6.4	11	<5	0.60	0.53	135	1.4	0.05
W99-2-49.0	Till	49.0	40	2.4	21	12	650	1.52	79	6.5	11	<5	0.75	0.51	132	1.2	0.05
W99-2-50.0	Till	50.0	40	2.4	22	12	640	1.48	79	6.5	11	<5	0.55	0.54	128	1.2	0.05
W99-2-51.0	Till	51.0	40	2.2	22	12	640	1.49	79	6.4	11	<5	0.60	0.50	130	1.4	<0.05
W99-2-52.0	Till	52.0	50	3.2	23	12	650	1.50	80	6.5	12	<5	0.50	0.53	133	1.3	0.05
W99-2-54.0	Till	54.0	30	2.6	28	12	660	1.54	89	6.3	12	<5	0.50	0.53	142	1.6	0.10

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-2-7.5	Till	7.5	0.8	0.70	9.1	<100	0.30	1.2	3.5	119	<2	22.8	78	<100
W99-2-9.5	Till	9.5	0.8	0.68	10.0	<100	0.30	1.1	3.7	124	3	21.8	84	140
W99-2-12.0	Till	12.0	1.0	0.72	10.0	<100	0.31	1.1	3.8	126	3	22.9	86	<100
W99-2-14.0	Till	14.0	1.0	0.76	10.0	<100	0.31	2.8	3.9	123	2	22.9	84	<100
W99-2-15.0	Till	15.0	0.9	0.78	10.0	<100	0.30	1.1	3.7	113	3	22.4	84	<100
W99-2-17.0	Silt	17.0	1.1	0.78	10.0	<100	0.31	1.1	3.7	115	3	22.6	84	<100
W99-2-21.8	Till	21.8	0.6	0.78	10.0	<100	0.31	1.2	3.8	120	2	23.4	80	<100
W99-2-22.7	Till	22.7	0.8	0.76	10.0	<100	0.32	1.2	3.7	122	3	21.9	80	110
W99-2-23.4	Till	23.4	0.9	0.76	10.0	<100	0.30	1.1	3.8	121	3	24.0	82	100
W99-2-29.0	Till	29.0	0.9	0.74	10.0	<100	0.30	1.1	3.7	126	2	22.2	88	<100
W99-2-30.5	Till	30.5	0.8	0.60	8.9	<100	0.31	0.9	3.2	123	2	19.8	76	<100
W99-2-32.5	Till	32.5	0.8	0.60	10.0	<100	0.30	1.0	3.4	116	3	20.6	80	<100
W99-2-33.4	Till	33.4	0.9	0.60	10.0	<100	0.29	1.0	3.4	120	2	20.1	70	<100
W99-2-35.0	Till	35.0	0.7	0.50	10.0	<100	0.30	0.8	3.4	82	3	20.3	62	<100
W99-2-35.7	Till	35.7	0.9	0.54	10.0	<100	0.35	1.2	3.2	118	3	20.5	66	<100
W99-2-37.5	Till	37.5	<0.5	0.60	10.0	<100	0.30	1.0	3.2	120	3	19.5	74	110
W99-2-38.7	Till	38.7	0.6	0.70	10.0	<100	0.28	2.2	3.1	121	2	20.3	66	<100
W99-2-40.0	Silt & clay	40.0	1.2	0.70	12.0	<100	0.29	1.2	3.5	115	3	22.5	60	<100
* W99-2-40.0	Silt & clay	40.0	1.0	0.62	12.0	<100	0.31	0.9	3.4	113	3	20.7	68	110
W99-2-41.0	Silt & clay	41.0	0.6	0.74	11.0	<100	0.35	1.4	3.8	124	3	22.4	70	<100
W99-2-42.0	Till	42.0	0.9	0.66	11.0	<100	0.33	1.2	3.7	111	3	23.3	76	<100
W99-2-43.0	Till	43.0	0.8	0.58	10.0	<100	0.32	1.0	3.4	104	2	20.8	60	<100
W99-2-44.0	Till	44.0	0.9	0.64	10.0	<100	0.31	1.1	3.3	101	2	19.8	62	<100
W99-2-45.0	Till	45.0	0.8	0.62	10.0	<100	0.31	1.0	3.6	106	3	21.2	66	<100
W99-2-46.0	Till	46.0	0.7	0.66	10.0	<100	0.31	1.0	3.5	97	3	20.4	62	<100
W99-2-47.0	Till	47.0	0.9	0.56	10.0	<100	0.29	1.0	3.8	98	3	20.1	60	<100
W99-2-48.0	Till	48.0	0.5	0.60	10.0	<100	0.32	1.2	3.3	106	3	21.4	62	<100
W99-2-49.0	Till	49.0	0.8	0.66	10.0	<100	0.33	1.2	3.2	115	3	22.4	64	130
W99-2-50.0	Till	50.0	0.8	0.68	10.0	<100	0.33	1.3	3.3	106	3	21.9	64	<100
W99-2-51.0	Till	51.0	0.9	0.74	10.0	<100	0.33	1.4	3.3	106	3	22.2	62	<100
W99-2-52.0	Till	52.0	0.6	0.70	10.0	<100	0.34	1.2	3.2	110	3	22.3	66	110
W99-2-54.0	Till	54.0	0.9	0.74	11.0	<100	0.32	1.7	3.3	131	3	22.5	94	<100

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-55.0	Till	55.0	12.2	<2	6.10	1.0	12.0	550	540	1.3	0.25	2.2	0.46	0.80	76	4.6	66
W99-2-56.0	Till	56.0	11.0	<2	6.19	1.0	12.0	570	2140	1.1	0.25	2.1	0.50	0.75	74	4.8	64
W99-2-57.0	Till	57.0	10.5	<2	6.85	0.9	12.0	560	540	1.5	0.29	1.9	0.36	0.70	76	4.8	79
W99-2-58.0	Silt & Clay	58.0	9.3	<2	6.67	1.0	11.0	660	590	1.1	0.27	1.8	0.34	0.73	74	5.7	66
W99-2-59.0	Silt & Clay	59.0	14.5	<2	5.12	0.8	12.0	670	620	1.0	0.16	1.8	0.26	0.92	63	3.6	65
* W99-2-59.0	Silt & Clay	59.0	10.0	<2	5.34	0.8	12.0	630	680	1.0	0.18	1.0	0.32	0.93	59	3.8	60
W99-2-60.0	Silt & Clay	60.0	12.1	6	4.98	0.9	11.0	680	650	0.9	0.16	1.7	0.28	0.96	58	3.9	62
W99-2-61.0	Silt & Clay	61.0	13.4	<2	4.09	0.7	11.0	570	620	0.6	0.13	1.1	0.26	1.03	67	2.9	59
W99-2-62.0	Silt & Clay	62.0	13.4	<2	4.50	0.7	12.0	700	580	0.9	0.15	1.4	0.22	0.87	65	3.8	73
W99-2-63.0	Till	63.0	11.6	<2	5.55	1.0	13.0	600	530	0.8	0.22	1.9	0.40	0.93	73	4.0	63
W99-2-64.0	Till	64.0	13.2	<2	5.99	0.9	14.0	610	550	1.5	0.23	2.0	0.40	1.00	78	4.3	62
W99-2-65.0	Till	65.0	12.0	<2	5.97	1.0	11.0	580	560	1.1	0.25	1.8	0.40	0.96	84	4.1	75
W99-2-66.0	Till	66.0	11.9	<2	5.89	0.9	10.0	540	560	0.7	0.25	2.0	0.38	0.98	78	3.5	88
W99-2-67.0	Till	67.0	11.4	<2	5.67	0.9	11.0	530	520	1.4	0.26	1.6	0.44	1.00	74	3.7	64
W99-2-68.0	Till	68.0	11.2	5	5.43	0.9	12.0	560	500	1.3	0.28	1.8	0.42	0.98	80	4.2	71
W99-2-69.0	Till	69.0	10.9	<2	5.89	0.9	12.0	520	500	1.8	0.22	1.7	0.38	0.93	82	3.9	65
W99-2-70.1	Till	70.1	11.1	<2	5.84	0.9	14.0	540	500	1.1	0.20	2.3	0.36	0.91	79	4.8	69
W99-2-71.0	Till	71.0	11.7	<2	5.80	1.0	12.0	560	490	1.9	0.22	1.9	0.32	0.90	78	4.1	69
W99-2-74.0	Till	74.0	12.5	<2	5.62	0.9	12.0	550	530	1.4	0.21	2.1	0.44	0.84	79	3.9	67
W99-2-75.0	Till	75.0	12.4	<2	5.71	0.9	12.0	530	480	1.4	0.22	1.7	0.42	0.85	75	4.3	71
W99-2-76.0	Till	76.0	11.1	6	5.96	0.9	12.0	540	550	1.8	0.23	2.3	0.34	0.87	75	4.2	68
W99-2-77.0	Till	77.0	10.0	<2	5.77	1.0	12.0	540	550	1.6	0.23	2.4	0.42	0.88	75	4.7	73
W99-2-78.0	Till	78.0	11.8	<2	5.84	0.9	11.0	540	550	1.3	0.23	2.0	0.40	0.86	76	3.7	63
W99-2-79.0	Till	79.0	12.2	<2	5.56	0.9	13.0	550	520	1.5	0.20	1.8	0.36	0.85	75	4.4	86
* W99-2-79.0	Till	79.0	12.1	<2	5.59	0.9	12.0	550	530	1.5	0.21	1.8	0.38	0.86	78	4.5	63
W99-2-80.0	Till	80.0	10.5	5	5.93	0.9	14.0	560	540	1.5	0.23	2.3	0.38	0.89	77	4.2	57
W99-2-81.0	Till	81.0	11.2	<2	5.71	0.9	12.0	540	530	1.4	0.22	2.2	0.40	0.87	77	4.4	49
W99-2-82.0	Till	82.0	11.2	<2	5.72	1.0	12.0	570	540	1.2	0.23	1.5	0.38	0.83	76	4.3	67
W99-2-83.0	Till	83.0	11.5	<2	5.73	0.9	13.0	560	580	1.3	0.22	2.0	0.38	0.81	77	4.1	65
W99-2-84.0	Till	84.0	11.7	<2	5.50	1.0	13.0	550	540	1.5	0.22	2.5	0.42	0.77	70	4.1	67
W99-2-85.0	Till	85.0	13.7	<2	5.77	1.0	12.0	570	580	1.4	0.22	2.3	0.40	0.81	79	5.0	71
W99-2-86.0	Till	86.0	9.8	6	5.47	1.1	13.0	590	600	1.1	0.22	2.3	0.56	0.91	79	4.3	64

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W99-2-55.0	Till	55.0	59	13	22	2	14.8	1.4	9	<50	3.10	36	18	45	0.5	0.77	420
W99-2-56.0	Till	56.0	63	14	24	2	15.3	1.6	9	<50	3.40	37	19	47	0.4	0.77	430
W99-2-57.0	Till	57.0	64	13	23	1	16.3	1.5	8	<50	3.50	38	116	50	0.4	0.82	345
W99-2-58.0	Silt & Clay	58.0	65	14	27	2	15.6	1.6	6	<50	3.60	35	18	46	0.4	0.83	645
W99-2-59.0	Silt & Clay	59.0	50	10	19	2	11.3	1.3	9	<50	2.70	31	15	32	0.4	0.76	515
* W99-2-59.0	Silt & Clay	59.0	53	11	20	2	11.5	1.3	9	<50	2.70	28	16	33	0.4	0.79	540
W99-2-60.0	Silt & Clay	60.0	50	11	17	2	11.6	1.4	10	<50	2.60	29	16	32	0.4	0.79	465
W99-2-61.0	Silt & Clay	61.0	41	9	13	1	8.5	1.2	15	<50	2.20	31	15	25	0.5	0.71	375
W99-2-62.0	Silt & Clay	62.0	45	9	15	2	10.2	1.3	11	<50	2.50	31	14	31	0.4	0.68	375
W99-2-63.0	Till	63.0	51	11	20	2	11.5	1.2	11	<50	2.80	35	16	34	0.5	0.74	430
W99-2-64.0	Till	64.0	56	13	22	2	13.7	1.4	11	<50	3.70	37	19	42	0.5	0.83	505
W99-2-65.0	Till	65.0	56	12	21	2	13.0	1.3	13	<50	3.10	38	19	40	0.5	0.80	440
W99-2-66.0	Till	66.0	56	12	23	1	13.6	1.4	12	<50	3.10	36	19	39	0.5	0.82	450
W99-2-67.0	Till	67.0	55	13	20	1	13.9	1.4	12	<50	2.90	34	21	42	0.4	0.76	420
W99-2-68.0	Till	68.0	54	13	19	2	14.7	1.4	11	<50	3.10	36	19	44	0.5	0.72	400
W99-2-69.0	Till	69.0	55	14	22	1	15.7	1.4	12	<50	3.30	38	16	45	0.4	0.72	395
W99-2-70.1	Till	70.1	55	14	21	2	15.1	1.5	11	<50	3.10	37	16	45	0.4	0.74	400
W99-2-71.0	Till	71.0	55	14	21	2	15.8	1.5	11	<50	3.00	37	17	45	0.5	0.73	395
W99-2-74.0	Till	74.0	57	14	21	2	15.4	1.7	12	<50	3.00	37	16	43	0.4	0.75	420
W99-2-75.0	Till	75.0	51	13	19	2	15.1	1.5	12	<50	3.10	38	17	43	0.5	0.68	370
W99-2-76.0	Till	76.0	56	14	21	2	16.0	1.6	11	<50	2.90	36	16	45	0.5	0.77	420
W99-2-77.0	Till	77.0	56	14	20	2	15.2	1.5	11	<50	3.00	37	19	43	0.4	0.78	410
W99-2-78.0	Till	78.0	57	14	22	2	15.6	1.5	11	<50	3.00	36	17	43	0.4	0.75	425
W99-2-79.0	Till	79.0	56	14	22	2	15.5	1.5	11	<50	3.20	38	16	43	0.4	0.76	425
* W99-2-79.0	Till	79.0	55	13	20	2	15.6	1.6	11	<50	3.30	37	17	44	0.3	0.74	415
W99-2-80.0	Till	80.0	57	14	21	2	16.0	1.6	11	<50	3.00	36	18	46	0.5	0.75	410
W99-2-81.0	Till	81.0	55	13	21	1	14.9	1.6	11	<50	3.20	37	17	43	0.5	0.75	390
W99-2-82.0	Till	82.0	56	13	22	1	14.7	1.6	11	<50	3.10	37	17	40	0.4	0.72	395
W99-2-83.0	Till	83.0	58	13	23	2	14.0	1.5	11	<50	3.20	38	17	40	0.4	0.78	440
W99-2-84.0	Till	84.0	54	12	23	2	14.4	1.5	11	<50	3.10	37	17	41	0.5	0.71	385
W99-2-85.0	Till	85.0	61	13	24	2	14.9	1.4	12	<50	3.20	37	17	40	0.5	0.78	395
W99-2-86.0	Till	86.0	64	13	27	1	14.1	1.6	10	<50	3.00	35	16	39	0.4	0.84	375

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-55.0	Till	55.0	50	2.6	23	11	670	1.45	78	6.3	12	<5	0.55	0.53	135	1.5	<0.05
W99-2-56.0	Till	56.0	50	2.6	25	11	680	1.50	80	6.5	12	<5	0.55	0.52	158	1.2	0.05
W99-2-57.0	Till	57.0	40	2.6	24	12	660	1.73	91	6.7	13	<5	0.55	0.46	135	1.3	0.10
W99-2-58.0	Silt & Clay	58.0	40	1.8	25	11	680	1.59	83	6.4	13	<5	0.65	0.51	127	1.3	0.05
W99-2-59.0	Silt & Clay	59.0	40	1.2	20	9	690	1.47	63	5.6	10	<5	0.45	0.73	135	1.2	0.05
* W99-2-59.0	Silt & Clay	59.0	50	1.2	21	10	700	1.55	61	5.3	10	<5	0.50	0.68	143	1.2	<0.05
W99-2-60.0	Silt & Clay	60.0	60	1.2	21	10	730	1.33	63	5.6	10	<5	0.45	0.66	132	1.0	0.05
W99-2-61.0	Silt & Clay	61.0	50	1.0	17	9	730	1.21	52	5.7	8.3	<5	0.40	0.71	121	1.1	<0.05
W99-2-62.0	Silt & Clay	62.0	50	0.8	16	9	700	1.23	57	5.7	9.3	<5	0.45	0.69	165	1.3	0.05
W99-2-63.0	Till	63.0	30	1.8	19	10	640	1.40	63	6.5	11	<5	0.45	0.58	124	1.0	0.05
W99-2-64.0	Till	64.0	30	2.2	23	11	670	1.75	84	6.6	12	<5	0.55	0.61	144	1.0	0.05
W99-2-65.0	Till	65.0	40	2.2	22	10	670	1.72	77	6.6	11	<5	0.55	0.57	141	1.1	0.15
W99-2-66.0	Till	66.0	30	2.4	22	11	680	1.48	73	6.1	10	<5	0.60	0.51	141	1.2	0.05
W99-2-67.0	Till	67.0	30	2.4	24	12	660	1.55	78	6.2	10	<5	0.60	0.53	138	1.2	0.05
W99-2-68.0	Till	68.0	20	2.6	24	12	650	1.51	77	6.5	11	<5	0.55	0.55	135	1.1	0.05
W99-2-69.0	Till	69.0	30	2.4	25	12	690	1.59	76	6.7	11	<5	0.60	0.56	136	1.2	0.10
W99-2-70.1	Till	70.1	40	2.6	26	11	690	1.56	77	6.9	11	<5	0.55	0.55	139	1.3	0.05
W99-2-71.0	Till	71.0	30	2.4	26	11	670	1.46	76	6.9	11	<5	0.60	0.61	142	1.1	0.10
W99-2-74.0	Till	74.0	30	2.4	25	11	730	1.35	74	6.8	11	<5	0.50	0.56	146	1.3	0.05
W99-2-75.0	Till	75.0	30	2.6	25	11	610	1.42	73	6.8	11	<5	0.55	0.58	135	1.2	0.05
W99-2-76.0	Till	76.0	30	2.6	26	11	700	1.42	76	6.8	11	<5	0.60	0.58	149	1.2	0.15
W99-2-77.0	Till	77.0	40	2.6	26	12	690	1.65	81	6.6	11	<5	0.55	0.55	144	1.1	0.05
W99-2-78.0	Till	78.0	30	2.6	26	12	700	1.53	76	6.6	11	<5	0.65	0.56	146	0.9	0.05
W99-2-79.0	Till	79.0	40	2.6	25	11	680	1.41	73	6.7	11	<5	0.50	0.57	142	1.2	0.05
* W99-2-79.0	Till	79.0	40	2.6	24	12	670	1.55	77	6.5	11	<5	0.50	0.54	141	1.0	0.05
W99-2-80.0	Till	80.0	30	3.0	25	12	710	1.55	77	6.7	11	<5	0.55	0.57	145	1.2	0.15
W99-2-81.0	Till	81.0	40	3.0	25	11	700	1.45	73	6.6	11	<5	0.55	0.57	143	1.3	0.10
W99-2-82.0	Till	82.0	40	2.8	24	10	700	1.44	73	6.6	11	<5	0.55	0.57	143	1.2	0.05
W99-2-83.0	Till	83.0	40	2.6	24	11	750	1.51	71	6.7	11	<5	0.45	0.54	145	1.4	0.05
W99-2-84.0	Till	84.0	40	2.8	24	10	700	1.37	72	6.7	11	<5	0.65	0.57	141	1.3	0.05
W99-2-85.0	Till	85.0	50	2.8	24	10	780	1.47	74	6.7	12	<5	0.50	0.53	148	1.2	0.05
W99-2-86.0	Till	86.0	50	2.8	28	11	800	1.38	75	6.3	11	<5	0.25	0.54	131	1.2	0.05

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-2-55.0	Till	55.0	0.8	0.76	10.0	<100	0.30	1.2	3.4	122	3	21.4	72	<100
W99-2-56.0	Till	56.0	0.8	0.80	11.0	<100	0.31	1.2	3.0	122	3	21.6	72	<100
W99-2-57.0	Till	57.0	0.9	0.74	11.0	<100	0.33	1.2	3.8	132	3	21.4	68	120
W99-2-58.0	Silt & Clay	58.0	1.1	0.70	10.0	<100	0.33	1.2	3.2	127	<2	20.1	72	<100
W99-2-59.0	Silt & Clay	59.0	0.8	0.58	8.5	<100	0.30	0.9	2.9	100	2	18.2	66	<100
* W99-2-59.0	Silt & Clay	59.0	0.8	0.60	7.9	<100	0.33	1.0	2.8	105	2	18.7	68	<100
W99-2-60.0	Silt & Clay	60.0	0.8	0.64	8.5	<100	0.29	1.0	3.1	108	3	19.7	78	100
W99-2-61.0	Silt & Clay	61.0	0.8	0.50	9.0	<100	0.27	0.8	4.0	87	4	18.9	64	<100
W99-2-62.0	Silt & Clay	62.0	0.6	0.54	8.9	<100	0.28	1.0	3.5	94	3	17.9	60	<100
W99-2-63.0	Till	63.0	1.0	0.68	10.0	<100	0.30	1.0	3.9	99	3	19.5	74	<100
W99-2-64.0	Till	64.0	0.8	0.82	10.0	<100	0.29	1.5	4.2	110	3	22.3	74	<100
W99-2-65.0	Till	65.0	0.8	0.74	11.0	<100	0.30	1.2	3.9	113	3	21.9	74	<100
W99-2-66.0	Till	66.0	0.9	0.74	10.0	<100	0.32	1.5	3.7	112	2	21.7	70	120
W99-2-67.0	Till	67.0	0.7	0.80	10.0	<100	0.33	1.4	3.5	103	3	23.3	70	<100
W99-2-68.0	Till	68.0	0.9	0.76	10.0	<100	0.33	1.2	3.8	100	3	23.0	68	<100
W99-2-69.0	Till	69.0	0.9	0.62	10.0	<100	0.33	1.1	4.1	101	3	23.9	70	<100
W99-2-70.1	Till	70.1	1.0	0.64	11.0	<100	0.32	1.2	3.6	103	3	23.1	78	<100
W99-2-71.0	Till	71.0	0.7	0.64	11.0	<100	0.30	1.5	3.9	101	3	23.9	68	<100
W99-2-74.0	Till	74.0	1.0	0.60	11.0	<100	0.30	1.1	3.8	106	3	24.2	72	<100
W99-2-75.0	Till	75.0	0.8	0.62	11.0	<100	0.30	1.0	4.4	100	3	23.7	62	<100
W99-2-76.0	Till	76.0	0.9	0.62	11.0	<100	0.31	1.1	3.8	112	3	24.3	72	<100
W99-2-77.0	Till	77.0	1.0	0.66	11.0	<100	0.31	1.1	4.0	114	3	24.1	70	<100
W99-2-78.0	Till	78.0	0.9	0.64	11.0	<100	0.33	1.2	4.1	112	3	24.9	70	<100
W99-2-79.0	Till	79.0	0.8	0.62	11.0	<100	0.30	1.2	4.5	108	3	23.7	70	<100
* W99-2-79.0	Till	79.0	0.9	0.66	11.0	<100	0.32	1.3	4.4	105	3	21.4	68	<100
W99-2-80.0	Till	80.0	0.8	0.66	11.0	<100	0.32	1.1	3.8	107	3	21.3	74	<100
W99-2-81.0	Till	81.0	0.9	0.68	10.0	<100	0.31	1.1	3.7	109	3	20.6	70	<100
W99-2-82.0	Till	82.0	0.9	0.68	11.0	<100	0.29	1.1	4.1	106	3	20.7	70	<100
W99-2-83.0	Till	83.0	0.9	0.66	11.0	<100	0.30	1.0	3.8	119	3	19.8	76	<100
W99-2-84.0	Till	84.0	1.0	0.66	10.0	<100	0.28	1.1	4.0	111	3	19.8	70	<100
W99-2-85.0	Till	85.0	0.8	0.70	11.0	<100	0.29	1.0	3.9	123	3	19.2	74	<100
W99-2-86.0	Till	86.0	0.7	0.78	10.0	<100	0.30	1.1	3.9	135	3	20.6	88	100

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-87.0	Till	87.0	12.1	<2	6.43	1.4	14.0	670	650	1.7	0.28	2.9	0.80	1.17	80	5.5	69
W99-2-88.0	Till	88.0	11.5	<2	6.24	1.4	13.0	680	630	2.0	0.27	2.6	0.72	1.09	80	5.0	67
W99-2-92.7	Till	92.7	11.2	<2	5.76	1.4	15.0	620	640	1.5	0.23	2.7	0.68	1.13	77	4.5	85
W99-2-93.1	Till	93.1	12.2	<2	5.79	1.5	15.0	650	650	1.3	0.24	2.4	0.64	1.02	78	4.4	65
W99-2-94.0	Till	94.0	12.3	11	6.15	1.4	13.0	660	660	1.3	0.25	3.3	0.74	1.07	85	5.1	71
W99-2-95.0	Till	95.0	10.8	<2	6.19	1.4	14.0	700	680	1.8	0.24	2.3	0.66	1.14	82	5.0	88
W99-2-96.0	Till	96.0	12.1	3	5.63	1.5	17.0	760	690	1.9	0.24	2.4	0.78	1.05	78	5.1	94
W99-2-97.0	Till	97.0	11.3	<2	6.45	1.2	12.0	700	660	1.5	0.25	2.4	0.56	1.14	83	5.2	86
W99-2-98.0	Till	98.0	12.1	<2	6.04	1.2	12.0	700	620	1.4	0.25	2.7	0.62	1.14	78	5.0	84
W99-2-99.0	Till	99.0	12.1	<2	6.37	1.2	12.0	680	650	1.6	0.23	2.8	0.62	1.16	73	5.4	71
W99-2-100.0	Till	100.0	10.6	<2	6.08	1.1	13.0	680	580	1.3	0.24	2.8	0.52	0.90	77	5.4	71
* W99-2-100.0	Till	100.0	10.4	<2	6.33	1.1	13.0	650	620	1.7	0.25	2.7	0.56	0.94	72	5.6	76
W99-2-101.0	Till	101.0	10.7	4	6.41	1.2	13.0	660	490	1.5	0.26	3.0	0.58	1.02	71	5.6	73
W99-2-102.0	Till	102.0	10.9	<2	6.50	1.3	13.0	710	680	1.8	0.28	2.9	0.74	1.12	77	5.9	76
W99-2-103.0	Till	103.0	11.3	3	6.54	1.3	14.0	740	680	1.6	0.29	2.6	0.68	1.14	72	5.6	70
W99-2-104.0	Till	104.0	10.0	<2	6.32	1.3	14.0	740	680	2.1	0.26	3.1	0.64	1.08	75	5.3	94
W99-2-105.0	Till	105.0	10.8	<2	6.44	1.3	13.0	720	700	1.3	0.26	3.0	0.74	1.14	74	5.4	84
W99-2-106.0	Till	106.0	10.9	<2	6.39	1.3	14.0	710	680	1.6	0.26	3.4	0.80	0.95	78	6.1	72
W99-2-107.1	Till	107.1	8.8	<2	6.50	1.3	17.0	770	640	1.8	0.30	3.2	0.70	1.01	79	6.1	80
W99-2-108.0	Till	108.0	11.4	<2	6.65	1.4	15.0	740	730	2.0	0.28	3.1	0.74	0.97	77	6.1	70
W99-2-109.0	Till	109.0	11.8	<2	6.55	1.5	16.0	760	680	1.9	0.27	3.5	0.80	0.96	79	6.5	69
W99-2-110.1	Till	110.1	9.3	<2	6.28	1.2	14.0	750	710	1.9	0.29	3.3	0.66	0.89	77	5.4	79
W99-2-111.0	Till	111.0	11.2	3	6.25	1.1	13.0	910	870	1.8	0.25	2.6	0.64	1.02	78	5.7	69
W99-2-112.0	Till	112.0	12.4	4	5.96	1.2	15.0	760	690	1.5	0.22	2.2	0.44	1.30	76	4.8	76
W99-2-113.5	Till	113.5	9.9	<2	6.09	1.1	11.0	720	670	1.5	0.23	2.3	0.54	1.33	76	4.8	84
W99-2-114.3	Till	114.3	11.6	<2	6.13	1.0	11.0	620	650	1.6	0.23	2.1	0.50	1.27	75	4.6	67
W99-2-115.0	Till	115.0	10.5	3	5.81	1.0	12.0	660	620	1.3	0.22	1.7	0.46	1.23	62	4.2	80
W99-2-116.0	Till	116.0	10.4	<2	6.08	1.1	13.0	710	650	1.5	0.24	2.2	0.52	1.36	67	5.2	64
W99-2-117.0	Till	117.0	9.3	3	5.93	1.1	11.0	710	630	1.5	0.24	2.3	0.54	1.27	65	5.3	62
W99-2-118.0	Till	118.0	12.9	<2	6.25	1.1	12.0	720	650	1.6	0.21	2.3	0.56	1.41	67	5.4	68
* W99-2-118.0	Till	118.0	11.2	<2	6.24	1.1	12.0	720	650	1.7	0.24	2.4	0.48	1.40	79	5.3	74
W99-2-119.0	Till	119.0	11.0	3	6.29	1.1	10.0	730	670	1.6	0.22	1.7	0.44	1.48	70	5.1	73

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W99-2-87.0	Till	87.0	73	15	27	2	18.0	1.6	9	<50	3.20	37	19	47	0.4	0.84	375
W99-2-88.0	Till	88.0	65	15	26	2	18.0	1.6	9	<50	3.10	36	18	46	0.4	0.81	360
W99-2-92.7	Till	92.7	63	13	26	<1	15.2	1.4	10	<50	3.10	36	17	39	0.4	0.74	350
W99-2-93.1	Till	93.1	61	13	26	2	14.7	1.5	11	<50	3.30	35	16	39	0.4	0.77	355
W99-2-94.0	Till	94.0	66	14	25	1	15.9	1.6	10	<50	3.60	36	17	41	0.3	0.79	355
W99-2-95.0	Till	95.0	68	14	26	2	17.1	1.6	11	<50	3.40	35	18	45	0.3	0.82	360
W99-2-96.0	Till	96.0	62	14	25	2	15.2	1.6	11	<50	3.30	38	17	40	0.4	0.75	340
W99-2-97.0	Till	97.0	66	14	25	2	16.1	1.6	11	<50	3.40	38	17	44	0.4	0.85	380
W99-2-98.0	Till	98.0	63	14	24	1	16.8	1.7	10	<50	3.40	38	17	43	0.4	0.80	355
W99-2-99.0	Till	99.0	68	13	26	2	16.5	1.6	9	<50	3.40	37	17	42	0.4	0.84	380
W99-2-100.0	Till	100.0	63	13	24	<1	15.1	1.4	9	<50	3.40	39	16	42	0.4	0.77	360
* W99-2-100.0	Till	100.0	65	14	25	2	16.4	1.6	9	<50	3.40	39	18	48	0.4	0.81	380
W99-2-101.0	Till	101.0	67	14	25	2	17.2	1.6	9	<50	3.40	37	18	44	0.4	0.81	370
W99-2-102.0	Till	102.0	69	15	27	1	17.5	1.7	9	<50	3.40	38	19	44	0.3	0.79	335
W99-2-103.0	Till	103.0	70	14	28	2	17.5	1.7	9	<50	3.30	37	19	45	0.4	0.82	395
W99-2-104.0	Till	104.0	69	14	27	<1	16.9	1.7	9	<50	3.30	39	18	44	0.3	0.80	345
W99-2-105.0	Till	105.0	69	14	26	1	17.8	1.8	9	<50	3.30	38	18	46	0.3	0.82	355
W99-2-106.0	Till	106.0	69	14	27	2	16.5	1.7	10	<50	3.40	39	19	44	0.4	0.77	335
W99-2-107.1	Till	107.1	71	14	27	2	17.1	1.7	9	<50	3.40	39	18	45	0.4	0.78	330
W99-2-108.0	Till	108.0	73	14	26	2	17.4	1.7	10	<50	3.40	40	19	48	0.4	0.80	340
W99-2-109.0	Till	109.0	73	14	28	2	17.1	1.7	9	<50	3.50	40	19	45	0.4	0.75	330
W99-2-110.1	Till	110.1	68	14	26	1	17.3	1.6	10	<50	3.30	38	19	44	0.4	0.76	340
W99-2-111.0	Till	111.0	66	14	26	1	16.6	1.6	9	<50	3.20	38	18	41	0.4	0.79	325
W99-2-112.0	Till	112.0	61	14	24	1	15.3	1.6	10	<50	3.50	37	18	38	0.4	0.83	370
W99-2-113.5	Till	113.5	62	13	25	2	15.5	1.4	10	<50	3.50	36	16	38	0.3	0.85	385
W99-2-114.3	Till	114.3	63	12	25	1	15.0	1.5	11	<50	3.30	34	16	36	0.4	0.84	380
W99-2-115.0	Till	115.0	59	13	24	1	15.2	1.5	9	<50	2.90	30	17	38	<0.2	0.79	355
W99-2-116.0	Till	116.0	63	13	24	2	15.8	1.5	10	<50	3.00	32	17	39	0.3	0.85	380
W99-2-117.0	Till	117.0	63	13	24	2	15.3	1.5	9	<50	3.10	34	16	39	0.3	0.81	360
W99-2-118.0	Till	118.0	65	13	25	2	16.2	1.5	8	<50	3.10	34	17	38	0.3	0.87	375
* W99-2-118.0	Till	118.0	65	13	25	2	15.0	1.5	10	<50	3.50	36	17	36	0.4	0.86	365
W99-2-119.0	Till	119.0	67	13	25	<1	15.6	1.5	9	<50	3.10	34	17	35	0.3	0.88	380

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-87.0	Till	87.0	60	4.6	32	12	810	1.64	89	6.6	13	6	0.65	0.54	170	1.2	0.05
W99-2-88.0	Till	88.0	50	4.6	31	12	720	1.48	85	6.5	12	<5	0.65	0.57	162	1.2	0.05
W99-2-92.7	Till	92.7	50	4.6	30	11	760	1.59	79	6.5	11	<5	0.55	0.60	154	1.1	0.05
W99-2-93.1	Till	93.1	50	4.4	28	11	750	1.47	73	6.4	12	6	0.55	0.57	158	1.1	0.05
W99-2-94.0	Till	94.0	40	4.8	30	11	770	1.48	80	6.2	12	<5	0.55	0.58	159	1.0	0.10
W99-2-95.0	Till	95.0	70	4.4	33	11	780	1.55	83	5.5	12	<5	0.60	0.51	166	0.9	0.10
W99-2-96.0	Till	96.0	40	5.2	31	11	720	1.59	83	6.1	12	5	0.55	0.56	154	1.2	0.10
W99-2-97.0	Till	97.0	40	3.6	28	12	740	1.58	82	6.1	12	<5	0.60	0.54	163	1.1	0.05
W99-2-98.0	Till	98.0	50	3.8	30	12	700	1.58	83	6.2	12	<5	0.55	0.52	160	1.3	0.10
W99-2-99.0	Till	99.0	40	3.8	29	11	740	1.59	81	6.1	12	<5	0.55	0.53	161	1.1	0.05
W99-2-100.0	Till	100.0	40	3.4	26	11	720	1.54	77	6.4	12	<5	0.55	0.49	147	1.3	0.05
* W99-2-100.0	Till	100.0	40	4.0	28	13	760	1.63	84	6.4	12	<5	0.65	0.49	153	1.3	0.10
W99-2-101.0	Till	101.0	40	4.4	30	11	760	1.74	86	6.2	12	<5	0.55	0.49	158	1.0	0.05
W99-2-102.0	Till	102.0	50	5.2	33	13	800	1.66	91	6.2	12	<5	0.65	0.51	169	0.9	0.15
W99-2-103.0	Till	103.0	40	5.0	33	13	800	1.69	92	6.2	12	<5	0.65	0.54	170	1.0	0.10
W99-2-104.0	Till	104.0	50	5.2	30	12	770	1.61	84	6.3	12	<5	0.70	0.52	168	1.4	0.10
W99-2-105.0	Till	105.0	20	5.0	32	12	750	1.66	90	6.2	12	<5	0.65	0.55	174	1.2	0.15
W99-2-106.0	Till	106.0	40	5.6	31	12	840	1.63	87	6.4	13	<5	0.65	0.48	167	1.2	0.10
W99-2-107.1	Till	107.1	50	5.6	32	13	810	1.69	88	6.5	13	<5	0.65	0.49	169	1.4	0.15
W99-2-108.0	Till	108.0	50	6.0	32	13	820	1.73	92	6.4	13	<5	0.70	0.49	175	1.3	0.15
W99-2-109.0	Till	109.0	50	6.0	32	13	860	1.67	84	6.5	13	<5	0.65	0.49	167	1.4	0.10
W99-2-110.1	Till	110.1	40	4.8	30	13	820	1.74	92	6.5	12	<5	0.70	0.49	161	1.4	0.10
W99-2-111.0	Till	111.0	30	4.2	29	13	770	1.67	84	6.3	11	<5	0.65	0.54	167	1.3	0.10
W99-2-112.0	Till	112.0	40	3.0	29	12	690	1.64	78	5.9	12	<5	0.60	0.63	162	0.9	0.10
W99-2-113.5	Till	113.5	60	3.0	28	12	730	1.64	75	5.7	12	<5	0.55	0.61	162	1.5	0.05
W99-2-114.3	Till	114.3	60	2.8	27	11	740	1.63	77	5.5	11	6	0.50	0.56	155	1.2	0.10
W99-2-115.0	Till	115.0	50	2.8	28	12	710	1.60	75	5.6	9.1	<5	0.55	0.49	153	1.1	0.10
W99-2-116.0	Till	116.0	50	3.2	29	11	720	1.65	78	5.8	11	<5	0.60	0.53	158	1.2	0.10
W99-2-117.0	Till	117.0	40	3.2	28	12	720	1.62	76	6.1	11	<5	0.60	0.53	154	1.2	0.10
W99-2-118.0	Till	118.0	50	3.2	29	11	750	1.65	77	6.0	11	<5	0.50	0.53	159	1.2	0.10
* W99-2-118.0	Till	118.0	50	3.2	29	12	750	1.66	75	6.0	13	<5	0.60	0.61	158	1.2	0.10
W99-2-119.0	Till	119.0	30	3.0	28	11	760	1.66	76	6.0	11	<5	0.55	0.58	162	1.4	0.05

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-2-87.0	Till	87.0	0.6	0.98	11.0	<100	0.33	1.2	4.5	159	3	21.9	86	<100
W99-2-88.0	Till	88.0	1.0	0.88	11.0	<100	0.30	1.2	4.7	152	2	22.0	86	<100
W99-2-92.7	Till	92.7	0.8	0.84	10.0	<100	0.29	1.1	4.4	139	3	20.5	88	<100
W99-2-93.1	Till	93.1	0.8	0.82	11.0	<100	0.29	1.0	4.5	146	3	19.6	84	<100
W99-2-94.0	Till	94.0	0.9	0.84	11.0	<100	0.30	1.2	4.8	153	2	20.9	84	<100
W99-2-95.0	Till	95.0	0.6	0.86	10.0	<100	0.30	2.9	4.0	156	3	21.3	114	140
W99-2-96.0	Till	96.0	0.9	0.88	11.0	<100	0.29	1.2	4.5	143	3	21.4	82	110
W99-2-97.0	Till	97.0	0.9	0.80	11.0	<100	0.33	1.2	4.2	145	3	19.8	84	120
W99-2-98.0	Till	98.0	0.8	0.82	11.0	<100	0.32	1.6	4.3	141	3	20.6	86	100
W99-2-99.0	Till	99.0	0.7	0.78	11.0	<100	0.32	1.4	3.9	149	3	19.8	86	130
W99-2-100.0	Till	100.0	0.9	0.74	11.0	<100	0.32	1.0	4.2	138	3	19.1	80	<100
* W99-2-100.0	Till	100.0	1.0	0.82	11.0	<100	0.34	1.2	4.4	147	3	22.1	84	130
W99-2-101.0	Till	101.0	0.7	0.86	11.0	<100	0.29	1.3	4.2	150	3	21.1	86	100
W99-2-102.0	Till	102.0	0.7	1.00	11.0	<100	0.32	1.3	4.4	154	3	22.4	88	130
W99-2-103.0	Till	103.0	0.9	0.96	11.0	<100	0.32	2.3	4.6	158	3	23.1	90	160
W99-2-104.0	Till	104.0	0.7	0.92	11.0	<100	0.33	1.4	4.7	156	3	21.4	92	<100
W99-2-105.0	Till	105.0	0.9	0.94	11.0	170	0.32	1.3	5.0	159	3	22.5	90	110
W99-2-106.0	Till	106.0	1.1	0.96	11.0	<100	0.31	2.3	4.6	166	3	22.0	94	130
W99-2-107.1	Till	107.1	1.0	0.98	11.0	<100	0.34	1.4	5.0	162	3	22.6	94	130
W99-2-108.0	Till	108.0	0.8	1.00	11.0	<100	0.34	1.3	4.7	176	3	22.4	98	100
W99-2-109.0	Till	109.0	0.9	1.04	11.0	<100	0.34	1.4	5.0	171	3	22.9	96	130
W99-2-110.1	Till	110.1	0.8	1.00	11.0	<100	0.32	1.5	4.8	152	4	23.5	94	180
W99-2-111.0	Till	111.0	0.9	0.86	11.0	<100	0.33	1.4	4.3	141	3	22.9	90	160
W99-2-112.0	Till	112.0	0.7	0.78	11.0	<100	0.33	1.4	4.1	126	3	20.9	84	140
W99-2-113.5	Till	113.5	0.8	0.74	10.0	<100	0.33	1.2	4.0	127	3	20.2	82	120
W99-2-114.3	Till	114.3	0.6	0.74	10.0	<100	0.32	1.1	3.5	128	3	20.4	80	140
W99-2-115.0	Till	115.0	0.6	0.74	10.0	<100	0.32	1.2	3.7	120	2	19.7	74	<100
W99-2-116.0	Till	116.0	0.8	0.78	10.0	<100	0.32	1.1	3.9	125	3	20.4	80	<100
W99-2-117.0	Till	117.0	0.9	0.78	10.0	<100	0.32	1.3	3.9	130	3	20.3	78	<100
W99-2-118.0	Till	118.0	0.7	0.76	10.0	<100	0.32	1.2	4.0	136	3	20.0	80	<100
* W99-2-118.0	Till	118.0	0.9	0.76	11.0	<100	0.33	1.2	3.7	134	3	20.4	82	<100
W99-2-119.0	Till	119.0	0.9	0.76	11.0	<100	0.34	1.2	3.7	134	2	20.0	84	110

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-120.0	Till	120.0	12.3	3	6.12	1.1	13.0	730	680	1.6	0.23	2.0	0.56	1.42	63	5.0	70
W99-2-121.0	Till	121.0	9.7	4	6.17	1.1	12.0	720	770	1.2	0.24	2.1	0.44	1.32	68	4.7	70
W99-2-122.0	Till	122.0	9.8	3	6.18	1.1	11.0	680	670	1.6	0.25	2.4	0.54	1.11	72	5.1	69
W99-2-123.0	Till	123.0	10.1	<2	6.12	1.1	12.0	720	670	1.4	0.21	2.1	0.44	1.43	70	5.0	82
W99-2-124.0	Till	124.0	10.3	<2	6.24	1.1	10.0	750	690	1.5	0.20	1.7	0.38	1.75	70	5.1	81
W99-2-125.0	Till	125.0	12.2	3	6.23	1.0	12.0	780	730	1.3	0.20	1.5	0.48	1.64	71	5.1	80
W99-2-127.0	Till	127.0	11.1	3	6.49	0.9	12.0	770	740	1.7	0.23	1.5	0.42	1.87	70	4.9	83
W99-2-128.0	Till	128.0	11.4	3	6.20	1.0	11.0	740	690	1.4	0.21	1.7	0.40	1.57	70	4.8	80
W99-2-129.0	Till	129.0	11.3	<2	6.24	1.0	10.0	790	730	1.3	0.24	1.6	0.40	1.61	68	4.5	81
W99-2-130.0	Till	130.0	9.9	4	6.28	1.0	7.9	790	720	1.5	0.22	1.1	0.38	1.87	73	5.2	75
W99-2-131.0	Till	131.0	9.6	5	6.15	1.1	10.0	730	650	1.4	0.21	1.7	0.42	1.75	74	4.9	84
W99-2-132.0	Till	132.0	10.9	3	6.25	1.0	34.0	810	720	1.1	0.21	1.6	0.46	1.88	70	5.0	95
W99-2-133.0	Till	133.0	9.6	5	6.16	1.0	15.0	790	710	1.3	0.22	1.8	0.36	1.72	72	5.1	83
W99-2-134.2	Till	134.2	12.2	<2	6.62	1.0	11.0	860	790	1.4	0.24	1.7	0.38	1.83	73	5.3	83
W99-2-135.0	Till	135.0	9.8	5	6.49	1.1	40.0	860	750	1.1	0.22	2.1	0.40	1.96	78	4.8	100
W99-2-136.0	Till	136.0	11.6	<2	6.50	1.0	7.6	810	750	1.2	0.22	1.3	0.28	2.18	77	4.6	95
W99-2-137.0	Till	137.0	13.7	4	6.85	1.0	9.1	810	780	1.7	0.22	1.1	0.26	2.27	81	4.9	100
* W99-2-137.0	Till	137.0	11.1	7	6.42	1.0	8.4	870	770	1.7	0.23	1.2	0.24	2.32	73	5.0	98
W99-2-138.0	Silt & Clay	138.0	10.2	3	5.69	0.9	10.0	790	700	1.1	0.19	1.4	0.24	2.07	57	3.9	71
W99-2-139.0	Silt & Clay	139.0	11.9	<2	5.62	0.9	9.1	810	730	1.1	0.15	1.4	0.24	2.14	58	3.8	77
W99-2-140.0	Silt	140.0	10.6	4	5.93	0.9	11.0	830	770	1.3	0.17	1.3	0.24	2.24	57	4.0	73
W99-2-141.0	Silt	141.0	10.6	<2	5.71	1.0	10.0	940	840	1.3	0.20	1.2	0.26	2.03	63	4.3	92
W99-2-142.0	Silt	142.0	12.7	<2	6.27	1.1	11.0	890	800	1.4	0.21	1.4	0.26	1.99	70	5.1	97
W99-2-143.0	Silt	143.0	11.5	8	6.12	1.0	11.0	930	830	1.4	0.22	1.0	0.22	2.01	78	4.7	120
W99-2-144.0	Silt	144.0	14.2	<2	5.74	0.9	8.4	830	780	1.0	0.18	1.0	0.24	2.08	61	3.6	84
W99-2-145.0	Silt	145.0	12.5	4	6.95	1.0	22.0	780	730	1.8	0.29	1.3	0.28	2.05	61	5.5	92
W99-2-146.0	Silt	146.0	12.9	3	5.81	1.0	8.4	910	830	1.5	0.19	1.3	0.28	2.18	77	3.9	110
W99-2-148.1	Silt & Clay	148.1	12.3	3	5.79	1.0	8.0	790	750	1.2	0.15	1.2	0.32	2.12	69	3.6	79
W99-2-149.0	Till & Clay	149.0	12.7	<2	5.55	1.1	9.0	870	790	1.4	0.21	1.5	0.42	1.78	68	4.3	83
W99-2-149.9	Till & Clay	149.9	12.9	<2	5.43	0.9	9.5	840	800	1.1	0.19	1.4	0.32	2.06	74	4.1	88
W99-2-151.0	Till & Clay	151.0	12.5	7	6.59	1.0	12.0	760	680	1.2	0.27	1.6	0.42	1.91	71	5.4	79
W99-2-152.0	Till & Clay	152.0	12.5	<2	6.65	0.9	6.0	830	810	0.9	0.18	1.2	0.32	3.01	63	4.0	83

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W99-2-120.0	Till	120.0	66	13	25	1	15.7	1.5	10	<50	3.20	33	20	38	0.3	0.86	380
W99-2-121.0	Till	121.0	64	13	25	2	14.8	1.4	8	<50	3.20	32	16	36	0.4	0.85	370
W99-2-122.0	Till	122.0	66	13	25	2	15.6	1.6	10	<50	3.20	37	17	38	0.4	0.80	350
W99-2-123.0	Till	123.0	64	13	24	<1	15.1	1.5	9	<50	3.50	35	15	34	0.4	0.88	365
W99-2-124.0	Till	124.0	64	12	24	2	16.0	1.3	8	<50	3.30	33	15	35	0.3	0.95	390
W99-2-125.0	Till	125.0	65	13	24	1	15.5	1.2	9	<50	3.30	35	16	36	0.4	0.92	380
W99-2-127.0	Till	127.0	67	13	24	2	17.0	1.4	8	<50	3.10	35	16	36	0.4	1.00	400
W99-2-128.0	Till	128.0	63	13	23	2	15.9	1.4	9	<50	3.40	35	16	37	0.5	0.92	375
W99-2-129.0	Till	129.0	66	13	24	2	16.1	1.6	9	<50	3.30	34	17	38	0.4	0.93	375
W99-2-130.0	Till	130.0	68	13	26	1	16.1	1.4	8	<50	3.50	35	16	34	0.3	0.99	400
W99-2-131.0	Till	131.0	70	12	25	2	16.3	1.5	8	<50	3.80	36	17	33	0.3	0.95	395
W99-2-132.0	Till	132.0	68	14	25	2	16.0	1.3	8	<50	3.40	35	16	35	0.4	0.98	390
W99-2-133.0	Till	133.0	68	13	25	2	15.0	1.3	8	<50	3.30	35	16	33	0.3	0.94	375
W99-2-134.2	Till	134.2	69	14	26	2	16.6	1.4	9	<50	3.40	36	17	37	0.4	1.01	415
W99-2-135.0	Till	135.0	66	15	25	<1	15.4	1.3	9	<50	3.20	35	16	34	0.4	1.02	420
W99-2-136.0	Till	136.0	69	14	28	2	15.8	1.4	11	<50	5.00	34	18	32	0.4	1.08	555
W99-2-137.0	Till	137.0	73	14	28	2	16.1	1.4	11	<50	6.40	36	19	32	0.4	1.11	675
* W99-2-137.0	Till	137.0	76	15	29	1	16.3	1.4	11	<50	6.20	36	20	31	0.4	1.08	675
W99-2-138.0	Silt & Clay	138.0	59	12	21	1	13.7	1.2	9	<50	3.10	27	14	28	0.2	1.04	520
W99-2-139.0	Silt & Clay	139.0	58	11	21	1	13.3	1.2	9	<50	2.60	28	14	27	0.4	1.07	440
W99-2-140.0	Silt	140.0	63	12	22	1	13.8	1.3	7	<50	2.70	27	15	28	0.3	1.13	465
W99-2-141.0	Silt	141.0	64	12	22	1	12.9	1.3	11	<50	2.70	30	15	26	0.4	1.02	400
W99-2-142.0	Silt	142.0	72	13	27	2	15.1	1.3	11	<50	3.80	34	17	29	0.4	1.04	475
W99-2-143.0	Silt	143.0	71	13	25	2	15.2	1.3	17	<50	3.70	39	18	30	0.5	1.05	495
W99-2-144.0	Silt	144.0	59	11	20	2	13.1	1.3	10	<50	2.60	30	15	26	0.4	1.03	370
W99-2-145.0	Silt	145.0	76	15	32	1	17.1	1.4	6	<50	5.60	32	19	34	0.3	1.11	585
W99-2-146.0	Silt	146.0	62	12	21	2	13.8	1.3	14	<50	2.80	36	16	27	0.5	1.04	380
W99-2-148.1	Silt & Clay	148.1	58	11	21	1	13.1	1.3	11	<50	2.40	32	15	26	0.4	1.06	380
W99-2-149.0	Till & Clay	149.0	60	11	20	<1	13.1	1.2	10	<50	2.80	34	16	26	0.4	0.97	380
W99-2-149.9	Till & Clay	149.9	60	12	21	2	13.5	1.3	10	<50	3.10	34	16	27	0.5	1.04	395
W99-2-151.0	Till & Clay	151.0	69	14	26	2	15.7	1.4	8	<50	4.00	36	18	33	0.4	1.06	440
W99-2-152.0	Till & Clay	152.0	64	12	23	2	14.6	1.3	8	<50	2.80	31	16	26	0.4	1.28	425

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-120.0	Till	120.0	30	3.2	30	12	730	1.67	77	5.9	11	<5	0.60	0.58	163	0.9	0.15
W99-2-121.0	Till	121.0	40	2.8	27	11	740	1.65	75	5.9	11	<5	0.60	0.56	156	1.2	0.05
W99-2-122.0	Till	122.0	40	3.2	27	12	760	1.67	79	6.1	12	<5	0.60	0.53	155	1.2	0.10
W99-2-123.0	Till	123.0	40	2.6	29	11	720	1.66	72	5.7	12	<5	0.55	0.61	156	1.1	0.05
W99-2-124.0	Till	124.0	30	2.2	28	11	700	1.66	76	5.6	13	<5	0.50	0.65	163	1.2	0.05
W99-2-125.0	Till	125.0	30	2.0	28	11	710	1.69	75	5.6	12	<5	0.50	0.67	164	1.0	0.05
W99-2-127.0	Till	127.0	30	2.2	29	12	680	1.70	81	5.5	12	<5	0.55	0.71	174	1.0	0.05
W99-2-128.0	Till	128.0	30	2.2	29	11	710	1.57	77	5.7	13	<5	0.50	0.67	161	1.1	0.05
W99-2-129.0	Till	129.0	60	2.6	30	12	690	1.71	78	5.7	12	<5	0.55	0.69	163	0.9	0.05
W99-2-130.0	Till	130.0	60	2.0	29	11	710	1.73	69	5.5	13	<5	0.55	0.65	162	1.2	0.05
W99-2-131.0	Till	131.0	70	1.8	28	11	690	1.69	65	5.6	14	<5	0.55	0.63	156	1.0	0.05
W99-2-132.0	Till	132.0	40	4.2	31	11	660	1.68	67	5.6	14	<5	0.55	0.72	167	1.0	0.05
W99-2-133.0	Till	133.0	50	2.4	30	11	690	1.67	67	5.7	13	<5	0.50	0.67	164	1.1	0.05
W99-2-134.2	Till	134.2	40	2.4	31	11	700	1.77	81	5.8	13	<5	0.55	0.70	179	1.2	0.10
W99-2-135.0	Till	135.0	40	3.6	33	11	660	1.68	78	5.7	13	<5	0.55	0.75	175	0.7	0.10
W99-2-136.0	Till	136.0	40	1.0	31	9	770	1.69	77	5.6	14	<5	0.45	0.77	177	1.0	0.10
W99-2-137.0	Till	137.0	50	1.0	30	10	820	1.65	73	5.8	15	<5	0.50	0.71	179	0.7	0.10
* W99-2-137.0	Till	137.0	60	1.2	33	11	860	1.69	62	6.0	15	<5	0.55	0.71	179	1.0	0.05
W99-2-138.0	Silt & Clay	138.0	40	1.0	27	10	720	1.57	65	5.2	10	<5	0.40	0.64	164	0.9	0.10
W99-2-139.0	Silt & Clay	139.0	50	1.2	27	9	710	1.59	59	5.2	10	<5	0.50	0.77	175	0.9	0.05
W99-2-140.0	Silt	140.0	50	1.4	27	10	770	1.72	61	5.1	10	<5	0.45	0.81	184	0.9	0.05
W99-2-141.0	Silt	141.0	40	1.2	28	10	710	1.58	56	5.7	10	<5	0.50	0.78	186	1.1	0.15
W99-2-142.0	Silt	142.0	50	1.2	30	10	770	1.63	65	6.0	13	<5	0.50	0.70	175	1.2	0.10
W99-2-143.0	Silt	143.0	50	1.2	30	11	770	1.58	62	6.7	12	<5	0.55	0.74	183	1.0	0.15
W99-2-144.0	Silt	144.0	30	1.4	26	9	700	1.56	64	5.1	11	<5	0.40	0.84	181	0.9	0.05
W99-2-145.0	Silt	145.0	60	1.8	35	11	900	1.65	78	5.4	15	<5	0.50	0.57	165	0.8	0.05
W99-2-146.0	Silt	146.0	50	1.4	27	10	720	1.56	63	6.0	12	<5	0.50	0.86	183	1.1	0.05
W99-2-148.1	Silt & Clay	148.1	50	1.4	26	10	690	1.57	66	5.4	11	<5	0.45	0.88	180	0.9	0.10
W99-2-149.0	Till & Clay	149.0	40	1.2	27	10	670	1.62	61	5.6	11	<5	0.55	0.83	166	1.3	0.10
W99-2-149.9	Till & Clay	149.9	30	1.0	26	10	710	1.63	59	5.5	11	<5	0.55	0.87	173	0.9	0.05
W99-2-151.0	Till & Clay	151.0	40	1.6	32	11	750	1.75	83	5.7	14	<5	0.55	0.67	164	1.0	0.10
W99-2-152.0	Till & Clay	152.0	40	1.6	28	10	650	1.72	69	5.0	12	<5	0.50	1.00	206	0.7	0.05

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-2-120.0	Till	120.0	0.8	0.80	10.0	<100	0.34	2.0	4.1	131	3	21.2	88	<100
W99-2-121.0	Till	121.0	0.9	0.80	10.0	<100	0.33	1.1	4.0	135	3	19.7	80	110
W99-2-122.0	Till	122.0	1.0	0.76	11.0	<100	0.33	1.2	4.1	135	3	20.4	84	<100
W99-2-123.0	Till	123.0	0.9	0.68	10.0	<100	0.32	1.2	3.7	130	3	19.0	80	150
W99-2-124.0	Till	124.0	0.8	0.68	10.0	<100	0.32	1.0	3.4	124	3	19.1	78	120
W99-2-125.0	Till	125.0	0.9	0.66	10.0	<100	0.32	1.3	3.5	129	3	20.1	80	110
W99-2-127.0	Till	127.0	0.8	0.70	10.0	<100	0.33	1.2	3.6	130	3	19.4	78	110
W99-2-128.0	Till	128.0	0.7	0.70	10.0	<100	0.30	1.1	3.9	129	3	19.9	76	<100
W99-2-129.0	Till	129.0	0.9	0.76	10.0	<100	0.33	1.2	3.6	128	3	19.7	78	110
W99-2-130.0	Till	130.0	<0.5	0.72	10.0	<100	0.33	1.3	4.0	132	3	18.7	84	130
W99-2-131.0	Till	131.0	0.9	0.68	10.0	<100	0.32	1.1	4.0	132	3	17.6	86	140
W99-2-132.0	Till	132.0	0.7	0.64	11.0	<100	0.31	1.1	3.8	131	3	17.4	80	100
W99-2-133.0	Till	133.0	0.7	0.68	10.0	<100	0.31	1.2	3.7	134	3	17.5	80	<100
W99-2-134.2	Till	134.2	0.9	0.76	11.0	<100	0.33	1.2	3.9	138	3	19.7	82	130
W99-2-135.0	Till	135.0	0.6	0.74	10.0	<100	0.32	1.1	4.0	132	3	19.3	78	<100
W99-2-136.0	Till	136.0	0.6	0.62	10.0	<100	0.31	1.0	3.1	135	3	20.0	86	<100
W99-2-137.0	Till	137.0	0.8	0.58	11.0	<100	0.34	1.1	3.3	144	3	21.7	92	130
* W99-2-137.0	Till	137.0	0.9	0.62	10.0	<100	0.36	1.1	3.4	144	3	23.3	90	120
W99-2-138.0	Silt & Clay	138.0	0.9	0.54	8.9	<100	0.30	1.0	3.4	113	2	20.0	72	<100
W99-2-139.0	Silt & Clay	139.0	0.6	0.54	8.7	<100	0.30	0.9	3.0	108	2	18.7	66	<100
W99-2-140.0	Silt	140.0	0.8	0.62	8.6	<100	0.32	1.0	3.2	116	2	18.4	72	<100
W99-2-141.0	Silt	141.0	0.8	0.54	10.0	<100	0.32	0.9	3.7	112	3	18.9	72	<100
W99-2-142.0	Silt	142.0	1.0	0.60	11.0	<100	0.35	1.1	3.5	134	3	21.4	86	<100
W99-2-143.0	Silt	143.0	0.9	0.56	12.0	<100	0.38	1.1	4.2	131	3	23.7	80	110
W99-2-144.0	Silt	144.0	0.8	0.54	9.0	<100	0.30	0.9	3.2	109	3	18.5	66	<100
W99-2-145.0	Silt	145.0	0.7	0.64	9.4	<100	0.34	1.3	3.0	152	3	22.6	92	<100
W99-2-146.0	Silt	146.0	0.7	0.56	11.0	<100	0.34	1.0	3.8	114	3	20.9	68	<100
W99-2-148.1	Silt & Clay	148.1	0.9	0.56	9.3	<100	0.31	1.0	3.6	106	3	20.4	76	<100
W99-2-149.0	Till & Clay	149.0	0.8	0.64	10.0	<100	0.31	1.1	3.1	112	3	20.0	70	<100
W99-2-149.9	Till & Clay	149.9	0.8	0.62	9.3	<100	0.32	1.1	2.9	109	3	20.3	74	<100
W99-2-151.0	Till & Clay	151.0	0.7	0.78	10.0	<100	0.32	1.1	3.3	137	3	21.7	78	<100
W99-2-152.0	Till & Clay	152.0	0.6	0.58	9.2	<100	0.31	1.0	3.6	112	3	18.2	74	<100

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-153.0	Till & Clay	153.0	10.8	<2	6.47	1.1	11.0	720	660	1.5	0.24	1.8	0.42	1.77	70	5.0	82
W99-2-154.0	Till & Clay	154.0	11.3	<2	6.00	1.1	8.0	880	810	1.3	0.21	1.4	0.42	2.05	70	4.5	94
W99-2-155.0	Till & Clay	155.0	11.7	<2	6.54	1.0	11.0	890	810	1.4	0.21	1.3	0.38	2.62	66	4.6	84
W99-2-156.0	Till	156.0	12.5	<2	6.36	1.0	11.0	740	700	1.1	0.25	1.7	0.46	1.46	75	5.2	83
W99-2-157.0	Till	157.0	10.3	<2	6.22	1.1	12.0	740	690	1.5	0.25	2.3	0.52	1.36	66	5.1	76
W99-2-158.0	Till	158.0	11.5	<2	6.14	1.1	11.0	780	720	1.5	0.26	1.9	0.42	1.74	76	4.9	79
W99-2-159.0	Mudstone	159.0	11.1	<2	8.70	1.3	11.0	830	800	1.9	0.31	1.2	0.36	1.72	60	6.9	110
W99-2-160.0	Mudstone	160.0	10.4	<2	7.68	1.1	9.2	900	860	1.9	0.31	1.2	0.38	2.14	73	5.7	96

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W99-2-153.0	Till & Clay	153.0	68	14	25	2	15.8	1.5	7	<50	4.00	35	18	33	0.3	1.03	445
W99-2-154.0	Till & Clay	154.0	61	11	23	2	13.5	1.3	12	<50	2.70	33	17	28	0.4	1.00	385
W99-2-155.0	Till & Clay	155.0	66	13	25	1	14.5	1.3	8	<50	3.00	33	17	29	0.4	1.18	430
W99-2-156.0	Till	156.0	66	13	24	2	14.9	1.4	10	<50	3.40	38	19	33	0.5	0.94	425
W99-2-157.0	Till	157.0	64	14	24	1	15.6	1.5	10	<50	3.40	37	19	34	0.4	0.90	400
W99-2-158.0	Till	158.0	66	13	25	1	15.4	1.4	9	<50	3.50	36	18	32	0.4	0.98	420
W99-2-159.0	Mudstone	159.0	93	14	34	2	20.8	1.5	4	<50	4.70	29	20	32	0.3	1.26	295
W99-2-160.0	Mudstone	160.0	84	15	30	2	18.0	1.5	6	<50	3.80	32	19	36	0.4	1.25	365

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W99-2-153.0	Till & Clay	153.0	70	2.0	31	10	750	1.77	84	5.7	13	<5	0.55	0.67	158	0.9	0.05
W99-2-154.0	Till & Clay	154.0	50	2.0	27	10	690	1.73	72	5.6	12	<5	0.50	0.80	174	1.1	0.05
W99-2-155.0	Till & Clay	155.0	50	2.0	31	10	670	1.72	74	5.3	12	<5	0.50	0.88	193	0.9	0.10
W99-2-156.0	Till	156.0	50	2.6	28	11	770	1.67	78	6.1	12	<5	0.60	0.69	161	1.2	0.05
W99-2-157.0	Till	157.0	50	3.0	31	12	750	1.62	81	6.1	12	<5	0.60	0.68	155	1.0	0.20
W99-2-158.0	Till	158.0	50	2.4	29	11	700	1.74	69	5.9	13	<5	0.60	0.72	158	1.1	0.05
W99-2-159.0	Mudstone	159.0	110	1.4	36	11	630	1.79	81	4.9	19	<5	0.60	0.53	149	0.9	0.10
W99-2-160.0	Mudstone	160.0	60	1.4	35	12	650	1.88	88	5.0	16	<5	0.65	0.62	163	1.1	0.15

Appendix 3 - Table A3-4: Geochemical analysis of samples from corehole WEPA99-2

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W99-2-153.0	Till & Clay	153.0	0.8	0.76	10.0	<100	0.29	1.1	3.4	136	3	20.7	80	<100
W99-2-154.0	Till & Clay	154.0	0.7	0.66	10.0	<100	0.31	1.1	4.3	114	3	19.4	86	<100
W99-2-155.0	Till & Clay	155.0	0.9	0.68	10.0	<100	0.32	1.1	4.1	121	3	19.7	80	<100
W99-2-156.0	Till	156.0	0.8	0.84	11.0	<100	0.32	1.3	3.7	135	3	22.2	78	<100
W99-2-157.0	Till	157.0	0.8	0.80	10.0	<100	0.32	1.2	4.6	135	3	23.2	78	<100
W99-2-158.0	Till	158.0	0.8	0.78	10.0	<100	0.34	1.3	3.5	133	3	20.5	80	120
W99-2-159.0	Mudstone	159.0	0.6	0.78	10.0	<100	0.36	1.4	2.8	172	3	19.0	110	110
W99-2-160.0	Mudstone	160.0	0.7	0.82	10.0	<100	0.35	1.4	3.2	166	2	20.6	104	<100

Notes: < denotes less than
NAA denotes neutron activation analysis
CVAA denotes analysis by cold vapour atomic absorption
IMS denotes plasma-mass spectrometry analysis
All results are reported on a dry basis.
Ba* and Cr* denotes acid soluble portion
* W99-2-40.0 denotes sample duplicate of W99-2-40.0

Appendix 3 - Table A3-5: Geochemical analysis of samples from corehole WR99-1

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
WR99-1-26.0	Till	26.0	10.8	<2	5.96	1.0	12.0	570	580	1.5	0.31	2.1	0.52	0.97	83	4.5	62
WR99-1-28.9	Till	28.9	11.3	<2	5.86	1.0	12.0	560	590	1.6	0.30	2.2	0.58	0.89	84	4.6	70
WR99-1-30.6	Till	30.6	10.1	<2	5.42	0.7	10.0	560	490	1.3	0.43	1.9	0.42	1.01	73	4.1	68
WR99-1-31.6	Till	31.6	10.5	<2	5.78	1.0	13.0	560	550	1.6	0.27	2.1	0.54	0.86	73	4.5	77
WR99-1-34.8	Till	34.8	12.0	<2	6.37	1.0	13.0	580	580	1.5	0.28	2.6	0.48	0.87	75	5.1	86
WR99-1-35.0	Till	35.0	9.9	<2	5.67	1.2	13.0	610	530	1.4	0.27	2.6	0.58	0.83	78	4.8	78
WR99-1-35.9	Till	35.9	11.4	<2	6.16	1.0	13.0	660	580	1.6	0.29	2.2	0.48	0.79	81	5.3	83
WR99-1-36.6	Till	36.6	10.3	<2	6.10	1.0	13.0	570	570	1.7	0.27	2.3	0.50	0.83	75	4.8	71
WR99-1-37.7	Till	37.7	10.5	<2	6.10	1.1	12.0	600	590	1.5	0.27	2.6	0.54	0.90	72	4.9	76
WR99-1-38.6	Till	38.6	10.2	4.0	6.38	1.1	13.0	560	680	1.5	0.29	2.1	0.52	0.91	77	4.9	89
WR99-1-39.9	Till	39.9	9.8	3.0	6.18	1.0	12.0	590	560	1.7	0.28	2.6	0.52	0.83	85	4.6	68
WR99-1-40.9	Till	40.9	12.3	<2	6.40	1.0	11.0	600	600	1.8	0.27	1.9	0.44	0.87	77	5.0	89
WR99-1-43.0	Silt & Clay	43.0	10.5	<2	6.42	0.7	9.1	630	670	1.3	0.21	1.8	0.36	1.75	69	4.1	68
WR99-1-46.5	Silt & Clay	46.5	8.9	6.0	6.91	1.0	12.0	600	660	1.9	0.30	2.0	0.46	0.89	76	4.9	74
* WR99-1-46.5	Silt & Clay	46.5	8.1	6.0	6.73	1.0	11.0	630	610	1.9	0.29	2.2	0.42	0.87	77	5.4	94
WR99-1-47.5	Till	47.5	11.4	6.0	6.28	1.3	13.0	600	660	1.8	0.30	2.7	0.64	0.82	76	4.9	75
WR99-1-48.6	Till	48.6	10.9	<2	6.22	1.3	14.0	640	590	1.6	0.28	2.9	0.64	0.82	79	5.1	94
WR99-1-49.8	Till	49.8	10.0	<2	6.19	1.3	13.0	620	610	1.6	0.29	2.5	0.62	0.79	75	5.3	89
WR99-1-51.0	Till	51.0	10.9	<2	6.13	1.3	14.0	590	620	1.7	0.30	2.8	0.62	0.80	78	4.9	77
WR99-1-52.3	Till	52.3	9.5	<2	6.04	1.2	14.0	590	550	2.0	0.29	2.4	0.64	0.78	81	5.3	85
WR99-1-53.2	Till	53.2	10.8	<2	5.96	1.2	13.0	600	550	2.1	0.27	2.4	0.64	0.82	73	4.5	69
WR99-1-54.3	Till	54.3	9.5	<2	6.06	1.2	14.0	580	570	1.6	0.29	3.1	0.62	0.79	81	5.4	72
WR99-1-58.2	Till	58.2	9.8	<2	5.94	1.1	11.0	580	580	1.5	0.26	2.2	0.58	0.80	84	4.5	81
WR99-1-59.0	Till	59.0	10.4	<2	5.52	1.1	12.0	560	520	1.5	0.25	2.2	0.58	0.78	88	4.7	87
WR99-1-60.0	Till	60.0	10.9	<2	5.49	1.1	13.0	590	580	1.4	0.25	2.4	0.54	0.80	82	4.4	83
WR99-1-61.0	Till	61.0	10.9	<2	5.31	1.0	12.0	560	510	1.6	0.24	2.3	0.50	0.76	79	4.3	84
WR99-1-62.0	Till	62.0	11.0	<2	5.73	1.0	12.0	560	530	1.3	0.26	2.3	0.54	0.82	75	4.1	68
WR99-1-63.0	Till	63.0	11.6	<2	5.54	1.0	12.0	550	480	1.3	0.26	2.1	0.54	0.76	78	4.3	68
WR99-1-65.4	Till	65.4	11.1	<2	5.63	0.9	11.0	610	560	1.4	0.26	2.1	0.42	0.92	77	4.6	62
WR99-1-66.4	Till	66.4	11.5	<2	5.77	0.9	12.0	580	570	1.7	0.26	2.2	0.48	0.90	73	4.3	79
WR99-1-68.0	Till	68.0	12.1	<2	5.42	0.9	11.0	560	560	1.4	0.25	2.0	0.48	0.88	69	3.8	78
WR99-1-69.5	Till	69.5	11.7	<2	5.74	0.8	11.0	630	560	1.6	0.24	1.4	0.26	0.97	68	4.5	70

Appendix 3 - Table A3-5: Geochemical analysis of samples from corehole WR99-1

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
WR99-1-26.0	Till	26.0	57	14.0	22	2	15.3	1.5	13	<50	2.8	42	17.5	40	0.3	0.72	480
WR99-1-28.9	Till	28.9	55	13.8	24	2	14.9	1.5	12	<50	3.0	46	21.0	38	0.4	0.68	465
WR99-1-30.6	Till	30.6	52	13.6	20	2	15.5	1.5	10	<50	2.9	44	16.5	41	0.3	0.75	420
WR99-1-31.6	Till	31.6	55	14.2	24	2	14.5	1.6	11	<50	2.9	44	16.0	39	0.4	0.69	495
WR99-1-34.8	Till	34.8	63	13.8	26	2	15.5	1.6	10	<50	3.3	45	15.5	41	0.4	0.79	425
WR99-1-35.0	Till	35.0	55	14.0	25	1	14.2	1.5	11	<50	3.0	46	15.0	38	0.4	0.67	500
WR99-1-35.9	Till	35.9	59	14.2	25	1	15.6	1.6	10	<50	3.2	46	15.0	42	0.3	0.73	410
WR99-1-36.6	Till	36.6	59	13.4	25	2	15.0	1.6	10	<50	3.1	44	15.0	40	0.3	0.73	425
WR99-1-37.7	Till	37.7	59	13.8	25	1	14.8	1.5	11	<50	2.9	44	15.5	40	0.4	0.71	470
WR99-1-38.6	Till	38.6	61	14.6	26	1	15.3	1.6	10	<50	3.2	45	15.5	41	0.3	0.81	455
WR99-1-39.9	Till	39.9	62	14.4	26	<1	15.4	1.6	10	<50	3.2	43	15.0	42	0.3	0.73	440
WR99-1-40.9	Till	40.9	64	14.0	27	2	15.6	1.5	9	<50	3.3	46	15.0	40	0.3	0.78	435
WR99-1-43.0	Silt & Clay	43.0	59	12.6	23	1	14.2	1.3	6	<50	2.9	38	13.5	36	0.3	1.28	540
WR99-1-46.5	Silt & Clay	46.5	69	15.2	27	2	17.8	1.6	8	<50	3.2	44	16.5	49	0.3	0.91	460
* WR99-1-46.5	Silt & Clay	46.5	67	14.4	28	1	17.2	1.6	8	<50	3.3	43	15.5	48	0.3	0.90	440
WR99-1-47.5	Till	47.5	62	15.4	28	<1	15.2	1.6	10	<50	2.9	45	15.5	42	0.4	0.70	465
WR99-1-48.6	Till	48.6	63	14.2	27	2	14.8	1.6	10	<50	3.1	44	15.0	42	0.4	0.70	465
WR99-1-49.8	Till	49.8	61	14.6	27	2	14.9	1.5	10	<50	3.0	44	17.0	42	0.4	0.68	455
WR99-1-51.0	Till	51.0	62	15.0	26	2	15.8	1.6	10	<50	2.9	44	16.5	44	0.3	0.68	450
WR99-1-52.3	Till	52.3	61	14.8	26	2	15.6	1.6	10	<50	3.1	45	17.0	43	0.4	0.66	450
WR99-1-53.2	Till	53.2	58	14.0	26	2	14.6	1.5	10	<50	2.9	46	15.5	40	0.4	0.66	450
WR99-1-54.3	Till	54.3	58	14.8	26	<1	15.2	1.6	10	<50	3.1	45	15.5	41	0.4	0.65	450
WR99-1-58.2	Till	58.2	57	14.2	26	<1	14.7	1.6	11	<50	3.0	44	15.0	42	0.3	0.66	450
WR99-1-59.0	Till	59.0	53	13.6	24	2	13.8	1.5	14	<50	2.9	43	15.0	38	0.3	0.63	445
WR99-1-60.0	Till	60.0	53	13.0	24	2	13.5	1.5	12	<50	3.0	46	14.0	37	0.4	0.64	465
WR99-1-61.0	Till	61.0	54	12.8	26	2	13.2	1.5	12	<50	2.8	44	14.0	37	0.4	0.60	460
WR99-1-62.0	Till	62.0	51	13.4	23	1	13.6	1.5	11	<50	2.8	43	14.5	38	0.4	0.68	465
WR99-1-63.0	Till	63.0	51	14.0	24	2	14.2	1.6	11	<50	2.8	43	15.0	40	0.4	0.62	480
WR99-1-65.4	Till	65.4	53	13.6	22	1	15.1	1.6	11	<50	3.0	43	15.0	42	0.4	0.72	435
WR99-1-66.4	Till	66.4	57	13.6	24	2	14.9	1.5	10	<50	2.9	42	15.5	41	0.4	0.72	445
WR99-1-68.0	Till	68.0	53	12.8	23	2	13.6	1.5	11	<50	2.8	40	14.5	38	0.4	0.70	445
WR99-1-69.5	Till	69.5	57	12.2	22	2	14.2	1.5	10	<50	3.0	41	14.0	42	0.3	0.77	370

Appendix 3 - Table A3-5: Geochemical analysis of samples from corehole WR99-1

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
WR99-1-26.0	Till	26.0	50	3.4	33.2	13.6	760	1.65	93.6	6.3	11.0	<5	0.15	0.49	160	1.2	0.05
WR99-1-28.9	Till	28.9	70	3.8	31.2	13.2	740	1.60	93.2	6.7	12.0	<5	0.10	0.53	159	1.2	0.05
WR99-1-30.6	Till	30.6	70	2.8	31.4	13.4	610	1.53	93.8	6.2	11.0	<5	0.10	0.58	157	0.9	0.05
WR99-1-31.6	Till	31.6	70	3.6	31.8	10.4	730	1.41	85.6	6.6	11.0	<5	0.05	0.53	156	1.2	0.05
WR99-1-34.8	Till	34.8	100	3.6	32.6	10.8	760	1.47	88.6	6.5	13.0	<5	0.05	0.55	163	1.1	0.05
WR99-1-35.0	Till	35.0	50	3.8	33.0	10.8	720	1.31	78.4	6.7	12.0	<5	0.05	0.55	153	1.1	0.05
WR99-1-35.9	Till	35.9	40	3.8	33.6	11.2	720	1.44	90.4	6.6	13.0	<5	0.10	0.55	157	1.1	0.05
WR99-1-36.6	Till	36.6	30	3.6	31.6	11.4	740	1.41	85.0	6.5	12.0	<5	0.10	0.54	156	1.2	0.05
WR99-1-37.7	Till	37.7	40	4.0	32.4	11.6	740	1.58	90.0	6.4	12.0	<5	0.15	0.54	155	1.2	0.05
WR99-1-38.6	Till	38.6	50	4.0	37.2	11.8	790	1.48	94.8	6.7	13.0	<5	0.05	0.57	159	1.1	0.05
WR99-1-39.9	Till	39.9	40	4.0	34.2	11.8	750	1.39	88.4	6.5	13.0	<5	0.15	0.55	152	1.2	0.05
WR99-1-40.9	Till	40.9	40	3.4	32.4	11.6	750	1.47	87.0	6.5	13.0	<5	0.05	0.56	150	0.9	0.05
WR99-1-43.0	Silt & Clay	43.0	40	1.4	31.0	10.0	710	1.91	93.0	5.5	11.0	<5	<0.05	0.89	179	1.1	0.05
WR99-1-46.5	Silt & Clay	46.5	60	2.6	37.8	13.4	720	1.88	114.0	6.3	13.0	<5	0.10	0.63	166	1.3	0.05
* WR99-1-46.5	Silt & Clay	46.5	50	2.4	35.6	12.2	720	1.63	100.0	6.1	14.0	<5	0.10	0.65	159	1.1	0.05
WR99-1-47.5	Till	47.5	50	4.2	36.8	11.8	790	1.48	92.4	6.5	12.0	<5	0.05	0.50	151	1.2	0.10
WR99-1-48.6	Till	48.6	60	4.2	34.6	11.2	810	1.46	88.2	6.4	13.0	<5	0.10	0.48	154	1.3	0.05
WR99-1-49.8	Till	49.8	50	4.2	35.4	11.2	770	1.39	86.6	6.5	12.0	<5	0.15	0.47	152	1.4	0.05
WR99-1-51.0	Till	51.0	50	4.4	36.6	12.4	790	1.53	97.0	6.5	12.0	<5	0.20	0.50	159	1.3	0.05
WR99-1-52.3	Till	52.3	50	4.4	35.0	11.8	800	1.36	88.4	6.7	12.0	<5	0.10	0.50	165	1.2	0.10
WR99-1-53.2	Till	53.2	40	4.4	33.8	11.0	780	1.37	85.2	6.6	12.0	<5	0.10	0.49	159	1.2	0.05
WR99-1-54.3	Till	54.3	60	4.6	45.4	11.4	770	1.43	91.0	6.6	13.0	<5	0.05	0.52	156	1.2	0.05
WR99-1-58.2	Till	58.2	50	4.2	33.8	11.6	780	1.40	88.8	6.3	12.0	<5	0.05	0.48	157	1.1	0.05
WR99-1-59.0	Till	59.0	40	4.0	32.0	11.2	740	1.33	80.4	6.5	10.0	<5	<0.05	0.48	157	1.0	0.05
WR99-1-60.0	Till	60.0	50	4.0	30.2	11.2	750	1.36	79.8	6.7	12.0	<5	0.05	0.53	157	1.2	0.05
WR99-1-61.0	Till	61.0	40	3.6	32.0	10.2	680	1.30	77.2	6.5	11.0	<5	<0.05	0.55	143	1.3	0.05
WR99-1-62.0	Till	62.0	40	3.4	30.0	10.8	790	1.42	88.4	6.5	11.0	<5	0.10	0.51	153	1.1	0.05
WR99-1-63.0	Till	63.0	40	3.8	32.2	11.2	690	1.40	83.8	6.5	11.0	<5	0.15	0.52	147	1.2	0.05
WR99-1-65.4	Till	65.4	50	3.0	30.6	11.2	730	1.45	87.8	6.4	11.0	<5	0.05	0.57	154	1.2	0.05
WR99-1-66.4	Till	66.4	40	3.0	32.4	12.0	750	1.42	88.2	6.3	11.0	<5	0.15	0.56	157	1.2	0.05
WR99-1-68.0	Till	68.0	40	3.0	29.8	10.6	740	1.40	81.4	6.1	11.0	<5	0.80	0.60	150	1.4	0.05
WR99-1-69.5	Till	69.5	50	2.0	29.2	9.8	680	1.43	85.0	6.0	12.0	<5	<0.05	0.61	141	1.1	0.05

Appendix 3 - Table A3-5: Geochemical analysis of samples from corehole WR99-1

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
WR99-1-26.0	Till	26.0	0.7	0.74	11.0	<100	0.34	1.3	3.6	114	2	23.7	82	380
WR99-1-28.9	Till	28.9	0.8	0.74	11.0	<100	0.34	1.3	3.8	114	3	23.4	82	<200
WR99-1-30.6	Till	30.6	1.0	0.64	11.0	<100	0.29	1.3	3.5	96	2	21.9	70	290
WR99-1-31.6	Till	31.6	0.7	0.70	11.0	<100	0.27	1.3	3.7	117	3	21.5	80	<200
WR99-1-34.8	Till	34.8	0.7	0.66	11.0	<100	0.29	1.0	3.7	130	3	20.6	90	280
WR99-1-35.0	Till	35.0	0.8	0.68	11.0	<100	0.27	1.1	3.9	123	3	21.2	86	350
WR99-1-35.9	Till	35.9	1.0	0.66	11.0	<100	0.28	1.0	3.6	128	3	21.3	92	450
WR99-1-36.6	Till	36.6	0.9	0.66	11.0	<100	0.29	1.0	3.5	128	3	20.9	90	260
WR99-1-37.7	Till	37.7	0.8	0.72	10.0	<100	0.30	1.0	3.8	129	2	22.1	88	290
WR99-1-38.6	Till	38.6	0.9	0.68	11.0	<100	0.30	1.1	3.4	130	2	21.8	94	<200
WR99-1-39.9	Till	39.9	0.9	0.70	11.0	<100	0.30	1.0	3.7	129	3	21.9	90	310
WR99-1-40.9	Till	40.9	1.0	0.64	11.0	<100	0.30	1.2	3.5	132	3	20.5	92	490
WR99-1-43.0	Silt & Clay	43.0	0.9	0.58	8.8	<100	0.28	0.8	2.7	107	2	18.4	76	260
WR99-1-46.5	Silt & Clay	46.5	0.8	0.72	11.0	<100	0.33	1.2	3.3	141	2	21.8	94	<200
* WR99-1-46.5	Silt & Clay	46.5	0.9	0.64	10.0	<100	0.32	1.0	3.3	137	3	20.4	94	420
WR99-1-47.5	Till	47.5	1.0	0.80	11.0	<100	0.31	1.2	4.7	149	3	22.1	104	<200
WR99-1-48.6	Till	48.6	0.7	0.74	11.0	<100	0.30	1.0	4.3	152	3	21.2	100	360
WR99-1-49.8	Till	49.8	1.0	0.74	11.0	<100	0.30	1.1	4.0	147	3	21.4	98	360
WR99-1-51.0	Till	51.0	0.9	0.80	11.0	<100	0.30	1.2	4.3	145	3	23.3	98	360
WR99-1-52.3	Till	52.3	0.9	0.76	11.0	<100	0.29	1.1	4.1	138	2	23.0	94	460
WR99-1-53.2	Till	53.2	1.0	0.70	11.0	<100	0.28	1.1	4.3	131	3	22.0	94	260
WR99-1-54.3	Till	54.3	0.9	0.72	11.0	<100	0.28	1.1	4.2	130	3	22.2	94	<200
WR99-1-58.2	Till	58.2	0.9	0.72	11.0	<100	0.29	1.1	3.9	132	2	22.3	92	530
WR99-1-59.0	Till	59.0	0.9	0.68	11.0	<100	0.28	1.0	4.2	118	2	21.6	86	430
WR99-1-60.0	Till	60.0	0.7	0.68	11.0	<100	0.29	1.0	4.1	119	2	21.8	88	<200
WR99-1-61.0	Till	61.0	0.7	0.62	11.0	<100	0.26	0.9	3.8	102	3	20.5	82	530
WR99-1-62.0	Till	62.0	0.7	0.66	11.0	<100	0.27	0.9	3.7	104	3	21.8	80	420
WR99-1-63.0	Till	63.0	1.0	0.68	10.0	<100	0.28	1.2	3.8	107	3	21.7	84	410
WR99-1-65.4	Till	65.4	0.7	0.62	11.0	<100	0.27	1.1	3.5	111	3	21.7	80	300
WR99-1-66.4	Till	66.4	1.0	0.64	11.0	<100	0.28	1.0	3.5	113	3	22.1	86	360
WR99-1-68.0	Till	68.0	0.8	0.62	10.0	<100	0.26	1.0	3.4	108	2	20.7	82	370
WR99-1-69.5	Till	69.5	0.9	0.54	10.0	<100	0.26	1.0	3.1	107	2	19.1	72	440

Appendix 3 - Table A3-5: Geochemical analysis of samples from corehole WR99-1

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
WR99-1-71.2	Till	71.2	13.0	<2	5.94	0.8	10.0	520	530	1.6	0.25	1.4	0.28	0.98	71	4.7	75
* WR99-1-71.2	Till	71.2	11.7	<2	5.96	0.8	10.0	540	510	1.6	0.23	1.6	0.30	0.99	74	4.9	68
WR99-1-72.5	Till	72.5	11.8	<2	5.84	0.7	10.0	550	510	1.5	0.23	1.3	0.28	0.95	77	4.8	76
WR99-1-73.6	Till	73.6	10.6	<2	5.85	0.8	10.0	590	550	1.7	0.26	1.6	0.28	0.81	74	5.1	78
WR99-1-74.5	Till	74.5	11.0	5.0	6.03	0.8	11.0	590	540	1.6	0.26	2.2	0.34	0.95	74	5.2	74
WR99-1-80.6	Till & Clay	80.6	10.8	<2	6.09	0.7	8.1	610	600	1.5	0.25	1.3	0.34	1.11	75	4.4	69
WR99-1-86.0	Clay	86.0	8.7	<2	5.11	0.6	12.0	520	90	1.3	0.20	7.5	0.26	4.25	53	4.1	61
WR99-1-89.5	Sand	89.5	10.5	4.0	4.76	0.4	3.5	450	400	1.4	0.19	1.1	0.12	0.85	63	2.9	58
WR99-1-93.0	Till	93.0	11.6	<2	6.06	0.7	7.8	480	460	1.4	0.23	1.5	0.22	1.01	80	4.8	85
WR99-1-94.0	Till	94.0	11.1	7.0	6.58	0.8	9.4	500	560	1.8	0.27	1.6	0.26	0.93	71	5.4	76
WR99-1-95.0	Till	95.0	14.0	<2	6.43	0.8	10.0	500	460	1.8	0.26	1.4	0.24	0.98	74	5.1	68
WR99-1-96.0	Silt	96.0	12.1	<2	6.94	0.8	11.0	590	650	1.7	0.30	1.7	0.26	0.85	82	5.7	82
WR99-1-98.0	Silt	98.0	15.4	<2	5.19	0.8	10.0	650	560	1.3	0.22	1.0	0.32	0.94	64	3.7	63
WR99-1-101.8	Clay	101.8	8.4	3.0	6.94	0.9	13.0	670	740	2.1	0.29	2.0	0.42	0.81	72	6.1	85
WR99-1-110.0	Clay	110.0	11.0	<2	7.72	0.8	10.0	510	500	1.9	0.34	1.3	0.36	0.82	78	6.6	92
WR99-1-118.0	Silt	118.0	12.4	<2	6.03	1.0	5.7	710	630	1.6	0.24	1.6	0.40	1.17	70	4.9	82
WR99-1-122.0	Silt	122.0	12.9	<2	4.92	0.8	8.6	600	520	1.2	0.18	1.2	0.30	1.19	64	3.0	65
WR99-1-139.0	Sand	139.0	14.3	<2	4.28	0.6	5.3	580	530	1.0	0.14	0.7	0.16	1.13	72	2.3	64
WR99-1-146.0	Clay	146.0	11.8	<2	6.25	0.8	7.1	710	670	1.4	0.23	0.8	0.24	1.06	69	4.0	79
WR99-1-238.7	Shale	238.7	10.0	5.0	6.43	0.5	12.0	490	470	1.7	0.30	0.8	0.12	0.54	75	6.8	68
WR99-1-242.5	Shale	242.5	12.5	4.0	6.64	0.5	25.0	510	310	2.1	0.33	1.1	0.16	0.55	90	6.6	78
WR99-1-245.8	Shale	245.8	12.3	<2	7.43	0.5	15.0	610	580	2.0	0.42	1.5	0.14	0.50	76	10.0	82
WR99-1-249.5	Shale	249.5	10.9	5.0	7.94	0.5	12.0	710	660	2.0	0.33	1.5	0.16	0.54	72	10.0	83

Appendix 3 - Table A3-5: Geochemical analysis of samples from corehole WR99-1

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
WR99-1-71.2	Till	71.2	57	13.4	22	1	15.1	1.6	10	<50	3.1	43	15.0	45	0.3	0.77	405
* WR99-1-71.2	Till	71.2	58	12.8	22	2	14.7	1.5	10	<50	3.0	40	13.5	42	0.4	0.75	390
WR99-1-72.5	Till	72.5	56	12.0	22	1	14.1	1.5	10	<50	2.9	42	13.5	39	0.3	0.74	375
WR99-1-73.6	Till	73.6	56	12.4	22	1	14.8	1.6	9	<50	2.9	42	14.5	40	0.3	0.69	340
WR99-1-74.5	Till	74.5	57	13.4	22	2	14.8	1.5	11	<50	3.0	45	15.0	40	0.4	0.74	380
WR99-1-80.6	Till & Clay	80.6	59	12.6	23	2	15.4	1.5	8	<50	3.3	42	14.5	43	0.3	0.93	520
WR99-1-86.0	Clay	86.0	50	11.0	20	1	12.4	1.1	6	<50	4.3	30	12.5	35	0.2	0.67	1510
WR99-1-89.5	Sand	89.5	44	8.8	16	1	12.1	1.3	10	<50	2.1	35	13.5	39	0.3	0.65	290
WR99-1-93.0	Till	93.0	59	12.4	22	1	15.5	1.5	9	<50	2.9	43	14.5	45	0.3	0.80	395
WR99-1-94.0	Till	94.0	65	13.4	24	2	16.4	1.6	8	<50	3.1	42	15.5	48	0.3	0.84	405
WR99-1-95.0	Till	95.0	63	13.8	23	<1	16.6	1.6	8	<50	3.1	42	15.5	46	0.3	0.83	400
WR99-1-96.0	Silt	96.0	69	14.0	24	<1	17.7	1.7	7	<50	3.3	42	15.0	51	0.3	0.85	380
WR99-1-98.0	Silt	98.0	49	11.6	20	1	13.2	1.5	10	<50	2.7	35	13.5	35	0.3	0.73	360
WR99-1-101.8	Clay	101.8	75	15.2	27	<1	17.8	1.8	6	<50	3.9	38	15.5	52	0.2	0.88	420
WR99-1-110.0	Clay	110.0	74	15.6	27	3	19.5	1.7	6	<50	4.3	42	17.0	51	0.3	0.93	1215
WR99-1-118.0	Silt	118.0	57	10.4	26	2	14.5	1.4	8	<50	2.9	41	14.0	38	0.3	0.83	380
WR99-1-122.0	Silt	122.0	45	9.4	17	1	11.4	1.4	12	<50	2.5	39	11.5	29	0.3	0.72	475
WR99-1-139.0	Sand	139.0	35	8.2	13	1	9.6	1.2	17	<50	2.0	41	11.5	21	0.4	0.55	560
WR99-1-146.0	Clay	146.0	56	12.0	22	1	15.2	1.5	8	<50	2.9	41	14.0	35	0.3	0.74	475
WR99-1-238.7	Shale	238.7	60	12.2	19	2	16.3	1.7	9	<50	2.7	46	16.5	39	0.4	0.77	445
WR99-1-242.5	Shale	242.5	60	14.2	23	2	17.1	1.7	13	<50	3.4	50	19.0	50	0.5	0.78	280
WR99-1-245.8	Shale	245.8	73	16.0	28	2	19.5	1.8	5	<50	4.0	46	20.5	50	0.4	0.87	350
WR99-1-249.5	Shale	249.5	72	14.4	25	1	18.7	1.6	5	<50	3.9	46	17.0	47	0.3	0.93	230

Appendix 3 - Table A3-5: Geochemical analysis of samples from corehole WR99-1

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
WR99-1-71.2	Till	71.2	40	2.0	31.6	11.2	630	1.46	88.4	6.1	12.0	<5	0.05	0.57	143	1.1	0.05
* WR99-1-71.2	Till	71.2	40	2.0	29.8	10.6	650	1.46	86.2	6.1	12.0	<5	0.05	0.57	139	0.9	0.05
WR99-1-72.5	Till	72.5	40	2.0	27.6	10.4	660	1.49	83.8	6.1	12.0	<5	<0.05	0.57	137	1.2	0.05
WR99-1-73.6	Till	73.6	40	2.4	29.6	11.2	660	1.42	87.8	6.3	12.0	<5	0.05	0.54	145	1.1	0.05
WR99-1-74.5	Till	74.5	40	2.2	29.6	11.4	700	1.47	86.2	6.5	12.0	<5	<0.05	0.57	147	1.0	<0.05
WR99-1-80.6	Till & Clay	80.6	40	1.6	31.2	11.0	700	1.56	90.4	6.1	12.0	<5	<0.05	0.69	150	1.2	<0.05
WR99-1-86.0	Clay	86.0	40	1.6	27.4	7.8	770	1.32	73.6	4.6	10.0	<5	<0.05	0.57	202	1.0	0.05
WR99-1-89.5	Sand	89.5	40	1.0	21.6	8.6	520	1.29	69.4	4.9	9.2	<5	0.20	0.62	140	0.9	<0.05
WR99-1-93.0	Till	93.0	30	1.6	29.4	10.6	620	1.47	88.2	6.1	12.0	<5	0.05	0.63	140	1.1	0.05
WR99-1-94.0	Till	94.0	40	1.6	31.2	11.6	700	1.61	97.2	6.1	13.0	<5	0.05	0.60	146	0.9	0.05
WR99-1-95.0	Till	95.0	30	1.8	31.6	11.8	710	1.69	96.8	6.0	12.0	<5	<0.05	0.58	144	1.3	0.05
WR99-1-96.0	Silt	96.0	40	2.0	34.2	11.6	730	1.63	102.0	5.9	13.0	<5	0.05	0.55	146	1.1	0.05
WR99-1-98.0	Silt	98.0	50	1.6	28.2	10.0	710	1.46	80.4	5.3	11.0	<5	0.05	0.78	146	1.1	0.05
WR99-1-101.8	Clay	101.8	80	1.8	37.2	11.4	740	1.69	106.0	5.6	14.0	<5	0.05	0.59	137	1.4	0.05
WR99-1-110.0	Clay	110.0	50	1.8	34.2	11.6	660	1.64	109.0	6.2	14.0	<5	0.05	0.45	142	1.2	0.05
WR99-1-118.0	Silt	118.0	40	3.2	28.0	9.6	560	1.48	84.0	6.0	12.0	<5	<0.05	0.70	147	1.0	0.05
WR99-1-122.0	Silt	122.0	40	3.4	22.6	8.8	580	1.33	67.8	5.9	10.0	<5	<0.05	0.84	146	1.1	<0.05
WR99-1-139.0	Sand	139.0	10	0.8	17.0	8.0	480	1.27	57.0	6.2	8.3	<5	0.10	0.86	146	1.0	<0.05
WR99-1-146.0	Clay	146.0	30	1.6	28.6	10.6	490	1.45	83.0	6.0	12.0	<5	0.05	0.75	151	0.9	0.05
WR99-1-238.7	Shale	238.7	30	3.2	26.6	14.4	670	1.42	96.0	6.8	12.0	<5	0.10	0.42	154	1.2	0.05
WR99-1-242.5	Shale	242.5	50	2.0	27.4	14.8	770	0.80	52.0	7.6	13.0	<5	0.15	0.46	185	1.4	0.15
WR99-1-245.8	Shale	245.8	50	2.0	32.8	14.0	470	1.60	119.0	6.4	15.0	<5	0.15	0.53	249	1.1	0.05
WR99-1-249.5	Shale	249.5	30	1.6	30.8	12.4	530	1.55	104.5	6.3	16.0	<5	0.05	0.64	306	1.1	0.05

Appendix 3 - Table A3-5: Geochemical analysis of samples from corehole WR99-1

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
WR99-1-71.2	Till	71.2	0.8	0.56	11.0	<100	0.28	1.4	3.4	110	3	20.3	78	250
* WR99-1-71.2	Till	71.2	0.9	0.50	10.0	<100	0.27	1.1	3.3	109	3	19.3	80	240
WR99-1-72.5	Till	72.5	0.8	0.48	10.0	100	0.28	1.1	3.2	106	2	19.1	74	280
WR99-1-73.6	Till	73.6	0.8	0.56	11.0	<100	0.28	1.5	3.2	111	3	20.1	72	250
WR99-1-74.5	Till	74.5	0.8	0.56	11.0	<100	0.29	1.1	3.6	108	3	20.9	82	370
WR99-1-80.6	Till & Clay	80.6	0.9	0.54	11.0	<100	0.29	1.1	2.6	108	2	19.2	74	340
WR99-1-86.0	Clay	86.0	0.6	0.44	7.8	<100	0.21	0.8	2.6	91	<2	15.0	76	<200
WR99-1-89.5	Sand	89.5	0.6	0.36	9.2	<100	0.22	0.8	2.1	73	<2	15.6	56	270
WR99-1-93.0	Till	93.0	0.9	0.50	11.0	<100	0.27	0.9	2.9	110	2	19.2	74	<200
WR99-1-94.0	Till	94.0	0.7	0.56	11.0	<100	0.30	1.2	3.9	124	2	19.8	86	400
WR99-1-95.0	Till	95.0	0.8	0.56	11.0	<100	0.30	1.2	3.2	119	2	20.2	80	320
WR99-1-96.0	Silt	96.0	0.8	0.58	11.0	<100	0.30	1.1	3.0	132	2	20.3	84	<200
WR99-1-98.0	Silt	98.0	0.6	0.56	8.9	<100	0.25	0.9	3.0	102	2	19.2	74	350
WR99-1-101.8	Clay	101.8	1.0	0.64	11.0	<100	0.29	1.1	3.1	148	2	19.4	102	<200
WR99-1-110.0	Clay	110.0	0.8	0.64	12.0	<100	0.31	1.1	3.5	152	<2	21.8	96	260
WR99-1-118.0	Silt	118.0	0.8	0.64	10.0	<100	0.26	0.9	3.1	121	2	19.4	78	240
WR99-1-122.0	Silt	122.0	0.7	0.50	10.0	<100	0.25	0.8	3.6	86	2	18.2	58	220
WR99-1-139.0	Sand	139.0	0.9	0.36	11.0	<100	0.25	0.7	3.1	63	3	17.3	38	560
WR99-1-146.0	Clay	146.0	0.6	0.56	11.0	<100	0.29	1.1	3.0	109	2	19.2	70	450
WR99-1-238.7	Shale	238.7	0.8	0.52	12.0	<100	0.28	1.5	3.2	117	3	25.1	88	410
WR99-1-242.5	Shale	242.5	0.9	0.52	12.0	<100	0.31	1.4	3.8	115	3	30.3	116	420
WR99-1-245.8	Shale	245.8	0.8	0.54	13.0	<100	0.28	1.5	3.3	137	2	23.7	120	<200
WR99-1-249.5	Shale	249.5	1.0	0.50	13.0	<100	0.28	1.2	3.3	139	2	20.5	106	<200

Notes:
< denotes less than
NAA denotes neutron activation analysis
CVAA denotes analysis by cold vapour atomic absorption
IMS denotes plasma-mass spectrometry analysis
All results are reported on a dry basis.
Ba* and Cr* denotes acid soluble portion
* WR99-1-46.5 denotes sample duplicate of WR99-1-46.5

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-1-2.9	Till	2.90	5.0	<2	5.59	0.9	9.5	820.0	434.0	1.20	0.50	2.8	0.22	3.46	120.0	4.9	79.0
W00-1-4.25	Till	4.25	5.0	<4	5.34	0.6	5.4	500.0	442.0	1.05	0.45	2.2	0.24	3.65	66.0	2.7	51.0
W00-1-6.0	Till	6.00	7.7	<2	5.22	0.5	5.9	460.0	443.5	1.00	0.46	1.8	0.30	3.78	53.0	2.9	55.0
W00-1-7.0	Till	7.00	7.8	<2	5.21	0.6	5.1	520.0	438.5	1.20	0.47	1.6	0.48	3.45	66.0	2.8	60.0
W00-1-9.3	Till	9.30	7.9	<2	5.23	0.5	4.5	500.0	428.5	1.10	0.43	1.7	0.30	3.52	57.0	2.6	46.0
* W00-1-9.3	Till	9.30	6.8	<2	5.48	0.5	4.9	460.0	421.5	1.05	0.43	1.7	0.24	3.50	65.0	2.7	53.0
W00-1-10.35	Till	10.35	8.7	<2	5.32	0.5	5.9	500.0	432.5	1.10	0.46	1.9	0.36	3.19	69.0	2.8	64.0
W00-1-12.0	Till	12.00	8.3	<2	5.59	0.5	4.8	500.0	445.0	1.10	0.45	1.8	0.32	3.58	70.0	2.7	60.0
W00-1-13.4	Till	13.40	9.7	<2	4.91	0.5	4.7	510.0	418.0	1.05	0.43	2.0	0.32	3.65	65.0	2.9	56.0
W00-1-14.65	Till	14.65	5.7	<2	5.49	0.5	5.4	540.0	431.5	1.00	0.53	1.8	0.40	3.34	67.0	3.2	63.0
W00-1-22.95	Till	22.95	8.3	5.0	5.54	0.6	13.0	600.0	440.5	1.30	0.45	1.3	0.24	1.27	84.0	3.2	68.0
W00-1-24.45	Till	24.45	8.4	<2	6.02	0.5	7.4	550.0	453.0	1.35	0.47	1.3	0.20	1.35	84.0	3.8	65.0
W00-1-25.5	Till	25.50	8.9	<2	6.01	0.6	8.4	600.0	464.5	1.25	0.47	1.5	0.26	1.38	77.0	4.0	63.0
W00-1-27.3	Till	27.30	10.5	<2	5.90	0.6	7.6	610.0	462.5	1.30	0.47	1.5	0.30	1.34	86.0	3.9	70.0
W00-1-28.5	Till	28.50	5.8	<2	5.89	0.5	6.9	570.0	446.0	1.25	0.46	1.4	0.26	1.34	81.0	3.8	77.0
W00-1-29.5	Till	29.50	10.8	<2	5.53	0.6	7.4	530.0	426.0	1.30	0.44	1.3	0.22	1.39	76.0	3.7	71.0
W00-1-32.2	Till	32.20	5.2	<2	6.08	0.5	8.0	610.0	428.5	1.30	0.44	2.2	0.22	1.58	86.0	4.2	77.0
W00-1-34.0	Till	34.00	5.7	<2	5.62	0.5	7.4	530.0	432.0	1.30	0.45	1.2	0.22	1.64	87.0	3.3	73.0
W00-1-34.9	Till	34.90	5.2	<2	6.40	0.5	5.9	580.0	475.0	1.50	0.48	1.5	0.30	1.45	94.0	3.7	68.0
W00-1-45.4	Till	45.40	6.3	<2	5.48	0.5	8.8	550.0	418.0	1.25	0.48	1.4	0.20	1.41	79.0	4.2	62.0
W00-1-46.4	Till	46.40	5.1	<2	5.73	0.5	6.7	580.0	435.0	1.25	0.45	1.5	0.20	1.33	73.0	3.1	65.0
W00-1-82.05	Till	82.05	7.2	<2	6.05	0.7	7.3	520.0	488.5	1.30	0.49	1.6	0.20	1.23	90.0	4.0	74.0
W00-1-83.1	Till	83.10	6.4	7.0	6.00	0.6	6.8	560.0	475.0	1.15	0.46	1.4	0.18	1.17	78.0	4.0	79.0
W00-1-84.1	Till	84.10	8.3	<2	5.83	0.6	7.9	590.0	481.0	1.20	0.47	1.5	0.24	1.30	79.0	3.7	63.0
* W00-1-84.1	Till	84.10	5.9	<2	5.93	0.6	7.8	560.0	480.5	1.45	0.50	1.3	0.24	1.28	72.0	3.8	61.0
W00-1-85.2	Till	85.20	7.3	3.0	6.01	0.6	7.9	600.0	465.0	1.30	0.51	1.2	0.22	1.20	73.0	4.5	83.0
W00-1-86.2	Till	86.20	6.4	5.0	5.96	0.6	8.2	640.0	484.0	1.35	0.47	1.5	0.22	1.20	76.0	3.7	67.0
W00-1-87.2	Till	87.20	6.8	5.0	5.83	0.6	7.2	590.0	470.5	1.15	0.44	1.2	0.26	1.24	73.0	4.1	77.0
W00-1-89.4	Till	89.40	7.3	<2	6.14	0.6	7.9	580.0	485.0	1.35	0.50	1.3	0.24	1.20	75.0	4.1	69.0
W00-1-90.4	Till	90.40	7.4	<2	5.83	0.6	7.0	600.0	479.0	1.20	0.45	1.2	0.38	1.27	76.0	3.7	77.0
W00-1-91.4	Till	91.40	6.1	20.0	5.81	0.6	7.6	590.0	481.0	1.35	0.45	1.3	0.28	1.29	74.0	3.3	54.0
W00-1-92.35	Till	92.35	5.4	<2	5.79	0.6	7.7	580.0	471.0	1.30	0.45	1.5	0.22	1.25	74.0	4.3	76.0

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-1-2.9	Till	2.90	56.0	Co	26.8	<1	11.85	1.20	13.0	<50	4.2	48.0	15.0	30.6	0.3	1.73	500
W00-1-4.25	Till	4.25	51.0	19.0	25.8	2.0	11.95	1.45	9.0	<50	2.4	30.0	14.5	31.2	0.3	1.73	365
W00-1-6.0	Till	6.00	48.0	14.0	25.0	2.0	11.65	1.20	8.0	<50	2.2	30.0	15.5	30.4	0.3	1.83	415
W00-1-7.0	Till	7.00	52.0	10.0	25.6	<1	12.50	1.20	8.0	<50	2.5	31.0	14.0	33.6	0.3	1.64	355
W00-1-9.3	Till	9.30	50.0	10.0	24.0	2.0	11.85	1.05	8.0	<50	2.4	31.0	15.0	32.0	0.2	1.70	420
* W00-1-9.3	Till	9.30	50.0	13.0	24.6	1.0	11.90	1.15	8.0	<50	2.5	31.0	14.0	32.4	0.3	1.76	440
W00-1-10.35	Till	10.35	49.0	9.0	24.4	<1	11.90	1.15	8.0	<50	2.6	32.0	15.5	33.6	0.3	1.50	405
W00-1-12.0	Till	12.00	53.0	12.0	24.8	2.0	12.20	1.15	9.0	<50	2.4	32.0	14.0	35.2	0.3	1.81	450
W00-1-13.4	Till	13.40	48.0	12.0	25.2	1.0	11.15	1.05	9.0	<50	2.2	32.0	20.0	30.0	0.3	1.69	405
W00-1-14.65	Till	14.65	53.0	8.0	24.4	2.0	12.05	1.10	7.0	<50	2.5	33.0	13.5	32.4	0.3	1.68	440
W00-1-22.95	Till	22.95	51.0	12.0	27.8	<1	12.70	1.40	11.0	<50	3.5	37.0	18.0	32.2	0.4	0.92	280
W00-1-24.45	Till	24.45	60.0	13.0	27.4	3.0	14.00	1.35	10.0	<50	2.9	39.0	15.0	37.8	0.3	0.96	485
W00-1-25.5	Till	25.50	58.0	14.0	28.0	2.0	14.05	1.35	10.0	<50	3.1	40.0	16.0	38.2	0.3	1.02	495
W00-1-27.3	Till	27.30	58.0	17.0	27.8	2.0	13.40	1.30	9.0	<50	2.8	38.0	19.0	36.8	0.3	1.02	485
W00-1-28.5	Till	28.50	55.0	13.0	26.2	2.0	13.25	1.35	10.0	<50	3.0	38.0	16.5	35.8	0.4	0.97	440
W00-1-29.5	Till	29.50	52.0	15.0	24.8	1.0	12.30	1.30	11.0	<50	2.7	39.0	15.0	33.4	0.4	0.92	415
W00-1-32.2	Till	32.20	62.0	13.0	28.2	<1	13.95	1.15	7.0	<50	3.0	42.0	15.5	41.6	0.3	1.12	410
W00-1-34.0	Till	34.00	55.0	13.0	27.0	1.0	13.45	1.15	8.0	<50	2.8	39.0	14.5	40.2	0.3	1.09	375
W00-1-34.9	Till	34.90	64.0	14.0	30.4	<1	15.60	1.40	8.0	<50	3.0	40.0	15.5	44.2	0.3	1.09	395
W00-1-45.4	Till	45.40	51.0	14.0	24.6	2.0	12.55	1.35	10.0	<50	2.7	38.0	15.5	35.0	0.3	0.85	370
W00-1-46.4	Till	46.40	51.0	12.0	26.4	2.0	12.65	1.30	11.0	<50	2.9	39.0	20.5	33.6	0.4	0.84	470
W00-1-82.05	Till	82.05	58.0	13.0	27.2	1.0	14.00	1.40	11.0	<50	3.0	39.0	18.0	38.8	0.4	0.90	385
W00-1-83.1	Till	83.10	55.0	15.0	26.2	<1	13.30	1.35	11.0	<50	3.2	34.0	16.0	37.0	0.3	0.90	380
W00-1-84.1	Till	84.10	53.0	12.0	25.2	<1	12.85	1.30	11.0	<50	2.7	34.0	15.0	36.2	0.3	0.93	395
* W00-1-84.1	Till	84.10	54.0	12.0	25.8	2.0	13.30	1.40	9.0	<50	2.8	36.0	14.5	36.4	0.3	0.92	395
W00-1-85.2	Till	85.20	56.0	11.0	26.4	<1	13.30	1.25	11.0	<50	2.9	36.0	19.5	36.4	0.3	0.92	385
W00-1-86.2	Till	86.20	55.0	11.0	25.8	2.0	13.80	1.40	10.0	<50	2.9	37.0	15.5	37.2	0.3	0.90	380
W00-1-87.2	Till	87.20	53.0	13.0	26.2	1.0	13.10	1.35	10.0	<50	2.8	36.0	19.5	35.4	0.3	0.92	395
W00-1-89.4	Till	89.40	56.0	12.0	26.8	1.0	13.95	1.35	9.0	<50	2.7	36.0	17.0	38.8	0.3	0.88	365
W00-1-90.4	Till	90.40	51.0	12.0	25.0	2.0	12.75	1.35	10.0	<50	2.7	36.0	14.5	34.4	0.4	0.88	375
W00-1-91.4	Till	91.40	52.0	11.0	24.6	<1	13.20	1.35	10.0	<50	2.6	37.0	15.0	34.6	0.3	0.85	360
W00-1-92.35	Till	92.35	53.0	11.0	25.0	1.0	13.05	1.30	10.0	<50	2.7	36.0	14.5	35.0	0.3	0.88	375

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-1-2.9	Till	2.90	30.0	1.10	28.6	8.7	600	1.61	65.6	7.9	14.0	<5	0.25	1.10	136.5	1.1	<0.05
W00-1-4.25	Till	4.25	40.0	1.05	23.0	9.3	580	1.61	65.7	4.8	8.8	<5	0.30	0.67	140.0	0.8	0.05
W00-1-6.0	Till	6.00	30.0	1.05	23.0	8.8	570	1.59	64.4	4.7	8.7	<5	0.30	0.73	143.5	0.9	<0.05
W00-1-7.0	Till	7.00	30.0	1.10	25.0	9.1	560	1.61	67.8	5.1	9.0	<5	0.30	0.68	138.0	0.8	<0.05
W00-1-9.3	Till	9.30	20.0	0.95	22.8	8.7	540	1.55	64.0	4.9	8.7	<5	0.30	0.71	140.0	0.9	<0.05
* W00-1-9.3	Till	9.30	20.0	0.95	22.4	9.0	570	1.54	62.6	5.1	10.0	<5	0.30	0.75	141.0	0.7	0.05
W00-1-10.35	Till	10.35	30.0	1.00	23.0	9.1	540	1.56	64.9	5.1	9.2	<5	0.30	0.70	133.5	0.9	<0.05
W00-1-12.0	Till	12.00	30.0	0.90	25.2	9.0	570	1.61	67.5	5.1	10.0	<5	0.30	0.71	146.0	0.8	<0.05
W00-1-13.4	Till	13.40	20.0	0.85	21.4	8.2	540	1.56	60.4	4.9	9.2	<5	0.25	0.76	135.5	0.8	<0.05
W00-1-14.65	Till	14.65	20.0	1.00	24.2	9.2	580	1.60	64.8	5.1	9.4	<5	0.25	0.72	134.0	0.8	<0.05
W00-1-22.95	Till	22.95	20.0	1.50	23.8	10.0	710	1.45	65.3	5.8	11.0	<5	0.35	0.61	111.0	1.1	<0.05
W00-1-24.45	Till	24.45	20.0	1.15	25.4	10.8	590	1.54	70.6	6.0	11.0	<5	0.35	0.56	114.5	1.4	<0.05
W00-1-25.5	Till	25.50	30.0	1.10	25.2	11.1	590	1.58	71.8	6.0	12.0	<5	0.40	0.62	124.0	1.3	0.05
W00-1-27.3	Till	27.30	30.0	1.10	24.4	10.9	610	1.53	69.3	6.0	11.0	<5	0.35	0.61	124.0	0.8	<0.05
W00-1-28.5	Till	28.50	30.0	1.00	23.4	10.8	610	1.55	68.3	6.0	11.0	<5	0.35	0.62	124.0	1.1	<0.05
W00-1-29.5	Till	29.50	30.0	1.00	22.6	9.6	590	1.41	62.8	6.0	11.0	<5	0.30	0.64	121.5	1.0	<0.05
W00-1-32.2	Till	32.20	20.0	1.60	26.8	10.3	550	1.51	67.7	6.1	12.0	<5	0.35	0.67	143.0	0.7	0.05
W00-1-34.0	Till	34.00	20.0	1.15	25.4	10.7	550	1.55	68.0	5.8	10.0	<5	0.35	0.66	147.5	0.7	<0.05
W00-1-34.9	Till	34.90	20.0	1.00	28.8	12.0	580	1.75	78.9	6.2	11.0	<5	0.35	0.61	145.0	1.1	<0.05
W00-1-45.4	Till	45.40	30.0	1.10	22.4	10.6	570	1.45	66.5	6.0	10.0	<5	0.35	0.55	118.0	1.0	0.05
W00-1-46.4	Till	46.40	20.0	1.10	22.2	10.7	600	1.48	65.9	6.2	12.0	<5	0.35	0.54	115.5	1.0	<0.05
W00-1-82.05	Till	82.05	30.0	1.10	24.0	10.8	650	1.63	74.8	5.9	12.0	<5	0.35	0.68	131.5	1.1	<0.05
W00-1-83.1	Till	83.10	40.0	1.05	23.8	10.4	600	1.59	71.4	5.5	12.0	<5	0.35	0.61	125.0	1.1	0.05
W00-1-84.1	Till	84.10	30.0	1.05	23.0	10.1	610	1.58	69.7	5.6	10.0	<5	0.45	0.58	131.5	1.3	<0.05
* W00-1-84.1	Till	84.10	30.0	1.15	23.0	10.5	610	1.59	69.6	5.7	10.0	<5	0.35	0.63	132.0	1.0	<0.05
W00-1-85.2	Till	85.20	30.0	1.10	23.0	10.3	630	1.55	67.0	5.8	11.0	<5	0.35	0.62	128.5	1.0	<0.05
W00-1-86.2	Till	86.20	30.0	1.10	23.2	10.1	620	1.51	70.6	6.0	11.0	<5	0.30	0.67	132.0	0.9	<0.05
W00-1-87.2	Till	87.20	20.0	1.15	22.4	9.8	620	1.55	69.1	6.0	10.0	<5	0.35	0.68	135.0	1.1	0.05
W00-1-89.4	Till	89.40	30.0	1.20	23.6	10.6	610	1.62	73.0	5.8	11.0	<5	0.35	0.63	133.5	1.1	<0.05
W00-1-90.4	Till	90.40	30.0	1.15	21.8	10.2	600	1.62	67.9	6.1	11.0	<5	0.30	0.70	132.5	1.1	0.05
W00-1-91.4	Till	91.40	40.0	1.15	22.2	10.4	620	1.61	68.3	5.9	10.0	<5	0.35	0.71	133.5	1.3	<0.05
W00-1-92.35	Till	92.35	30.0	1.10	22.0	10.4	620	1.58	68.0	5.9	11.0	<5	0.30	0.67	134.0	1.1	<0.05

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-1-2.9	Till	2.90	1.10	0.48	15.0	<100	0.26	0.8	3.4	92.0	3.0	17.9	<100	620
W00-1-4.25	Till	4.25	0.80	0.44	8.4	<100	0.25	0.8	2.1	89.0	2.0	18.2	<100	<200
W00-1-6.0	Till	6.00	0.70	0.46	8.4	<100	0.24	0.7	2.3	85.0	<2	18.0	<100	550
W00-1-7.0	Till	7.00	0.70	0.48	8.8	<100	0.23	0.8	2.5	88.0	<2	18.8	<100	440
W00-1-9.3	Till	9.30	<0.5	0.44	8.2	<100	0.24	0.7	2.8	83.0	<2	17.6	<100	<200
* W00-1-9.3	Till	9.30	0.60	0.44	8.5	<100	0.25	0.7	2.7	87.0	2.0	17.2	<100	<200
W00-1-10.35	Till	10.35	0.60	0.44	8.8	<100	0.25	0.8	2.5	82.0	<2	17.9	<100	<200
W00-1-12.0	Till	12.00	0.70	0.46	8.7	<100	0.25	0.6	2.9	90.0	<2	18.7	<100	590
W00-1-13.4	Till	13.40	0.60	0.42	8.4	<100	0.22	0.8	2.9	79.0	2.0	17.1	<100	570
W00-1-14.65	Till	14.65	0.70	0.44	8.5	<100	0.26	0.7	2.4	92.0	<2	17.4	<100	<200
W00-1-22.95	Till	22.95	0.70	0.44	10.0	<100	0.27	0.8	2.4	91.0	3.0	19.9	<100	580
W00-1-24.45	Till	24.45	0.70	0.48	10.0	<100	0.29	0.9	3.2	97.0	2.0	19.8	<100	<200
W00-1-25.5	Till	25.50	0.90	0.48	10.0	<100	0.30	1.1	3.5	96.0	3.0	20.3	<100	590
W00-1-27.3	Till	27.30	0.90	0.46	11.0	<100	0.29	1.1	3.1	99.0	3.0	19.8	<100	<200
W00-1-28.5	Till	28.50	0.80	0.46	10.0	<100	0.29	0.9	2.7	94.0	3.0	19.5	<100	<200
W00-1-29.5	Till	29.50	0.90	0.44	10.0	<100	0.27	0.8	2.9	84.0	3.0	18.8	110	300
W00-1-32.2	Till	32.20	0.70	0.44	11.0	<100	0.29	1.4	2.7	92.0	<2	18.2	130	<200
W00-1-34.0	Till	34.00	<0.5	0.44	10.0	<100	0.28	0.9	2.9	85.0	<2	18.9	<100	<200
W00-1-34.9	Till	34.90	0.80	0.50	11.0	<100	0.31	1.0	2.8	101.0	<2	20.0	<100	<200
W00-1-45.4	Till	45.40	0.60	0.44	11.0	<100	0.27	0.9	3.1	86.0	2.0	19.5	<100	<200
W00-1-46.4	Till	46.40	0.70	0.44	10.0	<100	0.29	0.9	3.3	87.0	3.0	20.5	140	800
W00-1-82.05	Till	82.05	1.00	0.50	10.0	<100	0.28	1.0	3.1	102.0	3.0	20.3	<100	<200
W00-1-83.1	Till	83.10	0.70	0.48	10.0	<100	0.29	0.9	3.1	98.0	2.0	19.3	<100	650
W00-1-84.1	Till	84.10	0.60	0.48	10.0	<100	0.28	0.9	2.9	94.0	<2	19.4	<100	<200
* W00-1-84.1	Till	84.10	0.70	0.48	9.3	<100	0.29	0.9	2.9	96.0	2.0	19.5	<100	<200
W00-1-85.2	Till	85.20	0.80	0.48	10.0	<100	0.28	2.7	3.1	103.0	2.0	19.3	<100	430
W00-1-86.2	Till	86.20	0.60	0.46	10.0	<100	0.28	0.9	3.1	98.0	2.0	19.6	110	<200
W00-1-87.2	Till	87.20	0.70	0.46	10.0	<100	0.27	0.9	3.1	94.0	3.0	19.6	<100	<200
W00-1-89.4	Till	89.40	0.80	0.50	10.0	<100	0.29	0.9	2.9	100.0	2.0	19.5	110	280
W00-1-90.4	Till	90.40	0.70	0.46	10.0	<100	0.29	0.9	3.1	90.0	2.0	19.3	100	480
W00-1-91.4	Till	91.40	0.80	0.46	10.0	<100	0.28	0.9	2.9	91.0	<2	20.0	<100	340
W00-1-92.35	Till	92.35	0.90	0.46	10.0	<100	0.29	1.0	3.3	93.0	<2	19.3	<100	<200

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-1-93.4	Till	93.40	10.6	<2	5.87	0.6	7.2	590.0	487.5	1.40	0.47	1.1	0.28	1.28	80.0	3.8	72.0
W00-1-95.1	Till	95.10	6.9	<2	5.47	0.6	6.4	600.0	513.8	1.15	0.45	1.0	0.30	1.46	72.0	2.8	55.0
W00-1-96.0	Till	96.00	4.5	<2	5.79	0.6	11.0	650.0	390.5	0.95	0.37	1.8	0.28	1.31	78.0	3.0	60.0
W00-1-96.9	Till	96.90	6.4	<2	5.90	0.6	7.3	560.0	472.5	1.30	0.46	1.9	0.46	1.21	75.0	4.0	69.0
W00-1-98.05	Till	98.05	4.5	<2	5.97	0.6	7.5	600.0	452.0	1.35	0.45	1.4	0.44	1.27	74.0	3.9	62.0
W00-1-99.0	Till	99.00	7.0	<2	6.12	0.6	8.5	570.0	480.0	1.35	0.48	1.2	0.24	1.29	77.0	4.1	73.0
W00-1-100.0	Till	100.00	5.1	<2	6.08	0.6	8.2	560.0	455.0	1.15	0.46	1.4	0.20	1.28	70.0	3.7	64.0
W00-1-101.0	Till	101.00	3.8	<5	5.95	0.7	9.2	570.0	490.5	1.25	0.48	1.4	0.24	1.29	74.0	3.4	71.0
W00-1-102.0	Till	102.00	4.4	<2	5.96	0.6	7.7	600.0	481.5	1.20	0.47	1.4	0.24	1.21	66.0	3.4	69.0
W00-1-104.6	Till	104.60	6.2	<2	6.07	0.7	8.1	590.0	457.0	1.30	0.45	1.5	0.22	1.28	81.0	4.1	62.0
W00-1-105.7	Till	105.70	8.3	<2	5.95	0.6	8.1	610.0	480.5	1.30	0.45	1.3	0.20	1.21	79.0	3.9	73.0
* W00-1-105.7	Till	105.70	8.9	7.0	5.77	0.6	8.0	640.0	509.8	1.35	0.52	1.1	0.22	1.22	78.0	4.4	74.0
W00-1-106.7	Till	106.70	10.1	<2	6.05	0.6	7.7	590.0	477.0	1.30	0.50	1.2	0.28	1.25	84.0	3.7	68.0
W00-1-107.7	Till	107.70	8.5	4.0	5.96	0.7	7.8	570.0	487.0	1.35	0.58	1.2	0.24	1.20	80.0	3.6	86.0
W00-1-108.7	Till	108.70	8.0	<2	5.99	0.6	8.7	530.0	481.5	1.25	0.48	1.4	2.50	1.16	82.0	3.7	70.0
W00-1-110.9	Till	110.90	10.1	<2	6.15	0.6	7.7	580.0	481.0	1.35	0.47	1.2	0.22	1.30	79.0	4.0	67.0
W00-1-115.4	Till	115.40	6.6	<2	6.04	1.0	11.0	580.0	482.5	1.35	0.54	2.6	0.60	0.73	83.0	4.5	73.0
W00-1-117.3	Till	117.30	7.4	<2	6.22	1.3	13.0	600.0	513.8	1.65	0.57	2.9	0.80	0.74	89.0	4.5	64.0
W00-1-120.05	Till	120.05	7.8	<2	6.03	1.4	13.0	550.0	473.5	1.50	0.58	3.0	0.84	0.72	91.0	4.9	66.0
W00-1-120.95	Till	120.95	6.7	<2	5.86	1.1	13.0	620.0	533.8	1.30	0.55	2.8	0.64	0.77	85.0	4.3	46.0
W00-1-121.9	Till	121.90	8.0	<2	6.13	1.3	13.0	1100.0	808.4	1.35	0.54	2.7	0.70	0.86	88.0	4.7	64.0
W00-1-123.7	Till	123.70	7.9	<2	5.84	0.6	8.3	590.0	491.0	1.35	0.45	1.9	0.28	1.64	100.0	3.1	64.0
W00-1-124.6	Till	124.60	8.5	5.0	6.06	0.6	8.1	580.0	444.0	1.15	0.39	1.5	0.40	1.68	92.0	3.0	68.0
W00-1-125.55	Till	125.55	7.4	<2	6.23	0.6	6.9	630.0	625.6	1.60	0.57	1.2	0.40	1.61	92.0	3.7	64.0
W00-1-127.0	Sand	127.00	7.6	<2	6.03	0.7	8.0	680.0	464.5	1.00	0.42	1.5	0.34	1.41	98.0	3.4	74.0
W00-1-153.0	Till	153.00	8.2	<2	5.83	1.0	16.0	380.0	338.5	1.45	0.58	3.0	0.62	0.75	95.0	4.7	61.0
W00-1-154.0	Till	154.00	8.3	<2	6.06	1.0	17.0	560.0	433.0	1.50	0.56	2.7	0.54	0.70	94.0	5.0	62.0
W00-1-155.0	Till	155.00	7.3	<2	5.69	1.0	15.0	410.0	349.0	1.55	0.62	2.4	0.60	0.70	92.0	4.9	61.0
W00-1-156.0	Till	156.00	8.5	<2	5.81	1.0	15.0	460.0	309.5	1.35	0.53	2.7	0.54	0.67	93.0	4.7	59.0
W00-1-157.35	Till	157.35	8.9	<2	5.70	1.0	16.0	1200.0	313.5	1.60	0.67	2.8	0.62	0.65	92.0	4.9	66.0
* W00-1-157.35	Till	157.35	6.5	<2	5.78	1.0	16.0	1200.0	197.5	1.55	0.61	2.6	0.60	0.66	91.0	5.1	73.0
W00-1-158.4	Till	158.40	6.6	7.0	5.76	1.0	16.0	770.0	239.0	1.55	0.58	2.7	0.56	0.62	87.0	5.0	76.0

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-1-93.4	Till	93.40	55.0	11.0	25.6	<1	13.30	1.40	11.0	<50	2.7	37.0	15.5	36.4	0.4	0.90	380
W00-1-95.1	Till	95.10	48.0	12.0	24.6	1.0	12.05	1.30	9.0	<50	2.6	34.0	15.0	30.0	0.4	0.96	465
W00-1-96.0	Till	96.00	51.0	10.0	20.8	1.0	10.05	1.05	8.0	<50	2.9	36.0	14.0	26.8	0.4	0.94	435
W00-1-96.9	Till	96.90	52.0	15.0	26.2	2.0	13.45	1.35	10.0	<50	2.8	36.0	18.5	36.6	0.4	0.85	355
W00-1-98.05	Till	98.05	54.0	11.0	25.6	1.0	13.20	1.30	10.0	<50	2.8	36.0	18.5	37.6	0.4	0.87	365
W00-1-99.0	Till	99.00	57.0	12.0	26.2	1.0	14.25	1.45	10.0	<50	2.9	36.0	16.0	40.2	0.3	0.94	385
W00-1-100.0	Till	100.00	54.0	13.0	25.2	<1	13.00	1.35	10.0	<50	2.7	34.0	16.0	36.6	0.3	0.89	365
W00-1-101.0	Till	101.00	54.0	11.0	26.0	2.0	13.60	1.50	10.0	<50	2.6	39.0	15.5	37.8	0.3	0.93	390
W00-1-102.0	Till	102.00	53.0	10.0	25.2	2.0	13.50	1.30	10.0	<50	2.8	38.0	15.5	36.2	0.3	0.89	370
W00-1-104.6	Till	104.60	54.0	13.0	25.8	1.0	13.55	1.40	11.0	<50	3.1	37.0	18.5	37.2	0.4	0.90	380
W00-1-105.7	Till	105.70	54.0	13.0	24.8	<1	13.30	1.35	10.0	<50	2.7	36.0	15.0	35.8	0.3	0.91	375
* W00-1-105.7	Till	105.70	55.0	12.0	27.2	<1	13.45	1.50	10.0	<50	3.0	38.0	15.5	37.0	0.3	0.87	360
W00-1-106.7	Till	106.70	53.0	10.0	25.6	2.0	13.40	1.45	12.0	<50	3.0	39.0	15.0	36.4	0.4	0.89	375
W00-1-107.7	Till	107.70	53.0	12.0	25.4	<1	13.35	1.45	11.0	<50	3.1	38.0	15.0	37.0	0.3	0.90	370
W00-1-108.7	Till	108.70	54.0	11.0	28.0	2.0	13.85	1.40	12.0	<50	2.9	34.0	27.0	37.0	0.3	0.87	365
W00-1-110.9	Till	110.90	53.0	12.0	25.4	2.0	14.00	1.45	11.0	<50	2.7	34.0	15.5	39.0	0.3	0.93	385
W00-1-115.4	Till	115.40	54.0	11.0	28.8	2.0	13.80	1.60	12.0	<50	2.8	40.0	19.0	34.4	0.3	0.63	715
W00-1-117.3	Till	117.30	57.0	12.0	31.2	2.0	14.00	1.45	13.0	<50	2.9	42.0	20.0	35.6	0.4	0.65	430
W00-1-120.05	Till	120.05	57.0	12.0	29.8	1.0	13.85	1.50	12.0	<50	3.0	42.0	20.0	33.6	0.4	0.64	460
W00-1-120.95	Till	120.95	54.0	13.0	28.4	1.0	13.35	1.45	12.0	<50	2.8	40.0	20.5	33.0	0.4	0.63	545
W00-1-121.9	Till	121.90	55.0	12.0	29.2	<1	13.30	1.40	12.0	<50	3.0	43.0	18.5	33.2	0.5	0.65	505
W00-1-123.7	Till	123.70	48.0	13.0	24.2	1.0	12.70	1.25	13.0	<50	2.9	47.0	16.0	28.8	0.4	0.89	675
W00-1-124.6	Till	124.60	51.0	13.0	20.8	<1	10.70	1.15	12.0	<50	2.8	47.0	16.5	24.6	0.5	0.95	720
W00-1-125.55	Till	125.55	54.0	15.0	32.0	2.0	17.15	1.60	13.0	<50	3.0	48.0	20.0	40.6	0.4	0.97	625
W00-1-127.0	Sand	127.00	53.0	13.0	25.0	1.0	11.70	1.15	13.0	<50	3.2	46.0	14.5	28.0	0.4	0.90	620
W00-1-153.0	Till	153.00	52.0	13.0	30.2	2.0	13.50	1.60	11.0	<50	3.1	44.0	19.5	28.8	0.4	0.61	310
W00-1-154.0	Till	154.00	53.0	13.0	30.4	1.0	13.65	1.55	11.0	<50	3.1	44.0	19.0	30.4	0.4	0.59	350
W00-1-155.0	Till	155.00	52.0	13.0	30.0	1.0	13.10	1.55	10.0	<50	3.0	45.0	23.0	28.6	0.4	0.60	285
W00-1-156.0	Till	156.00	52.0	13.0	25.6	1.0	11.55	1.45	11.0	<50	3.0	44.0	19.5	24.8	0.4	0.61	290
W00-1-157.35	Till	157.35	51.0	13.0	35.2	1.0	14.30	1.65	10.0	<50	2.9	44.0	26.0	31.8	0.5	0.59	285
* W00-1-157.35	Till	157.35	52.0	15.0	34.2	1.0	13.25	1.55	11.0	<50	3.1	42.0	29.5	28.6	0.4	0.58	280
W00-1-158.4	Till	158.40	51.0	12.0	28.0	2.0	12.75	1.60	12.0	<50	3.1	45.0	18.5	28.6	0.4	0.58	300

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-1-93.4	Till	93.40	30.0	1.15	22.8	10.9	640	1.63	71.7	6.0	11.0	<5	0.40	0.72	137.0	0.9	<0.05
W00-1-95.1	Till	95.10	20.0	1.00	20.0	10.2	640	1.67	65.8	5.8	10.0	<5	0.35	0.83	147.5	1.0	0.05
W00-1-96.0	Till	96.00	30.0	0.85	18.0	8.0	620	1.61	54.3	5.9	10.0	<5	0.25	0.75	142.5	0.8	<0.05
W00-1-96.9	Till	96.90	30.0	1.10	23.2	10.3	620	1.59	71.2	5.9	11.0	<5	0.35	0.69	131.0	1.1	<0.05
W00-1-98.05	Till	98.05	30.0	1.15	22.8	10.5	600	1.60	69.2	5.9	11.0	<5	0.30	0.63	129.0	1.3	<0.05
W00-1-99.0	Till	99.00	40.0	1.20	24.2	11.0	630	1.63	73.3	6.0	11.0	<5	0.35	0.63	137.0	1.2	<0.05
W00-1-100.0	Till	100.00	30.0	1.15	23.2	10.0	610	1.59	70.3	5.6	11.0	<5	0.35	0.63	130.5	1.1	<0.05
W00-1-101.0	Till	101.00	30.0	1.35	26.4	10.6	600	1.60	71.7	5.9	11.0	<5	0.35	0.67	136.5	1.1	<0.05
W00-1-102.0	Till	102.00	30.0	1.10	22.8	10.5	620	1.58	69.8	5.9	11.0	<5	0.35	0.66	136.0	0.9	<0.05
W00-1-104.6	Till	104.60	30.0	1.10	23.0	10.3	590	1.59	68.7	6.2	11.0	<5	0.35	0.66	131.0	0.7	0.05
W00-1-105.7	Till	105.70	30.0	1.10	22.6	10.0	630	1.54	68.2	6.0	11.0	<5	0.30	0.72	136.5	1.2	<0.05
* W00-1-105.7	Till	105.70	30.0	1.15	23.0	10.8	620	1.67	73.9	6.1	11.0	<5	0.45	0.70	137.5	0.8	0.05
W00-1-106.7	Till	106.70	30.0	1.10	23.2	10.2	610	1.56	69.9	6.0	12.0	<5	0.35	0.68	135.0	1.0	<0.05
W00-1-107.7	Till	107.70	30.0	1.10	23.2	10.4	620	1.62	72.7	5.8	11.0	<5	0.35	0.69	141.5	0.9	<0.05
W00-1-108.7	Till	108.70	30.0	1.15	23.0	10.4	600	1.56	71.9	5.5	11.0	<5	0.35	0.60	136.5	1.0	0.05
W00-1-110.9	Till	110.90	30.0	1.20	23.8	10.6	600	1.59	71.7	5.8	10.0	<5	0.35	0.53	137.0	1.2	<0.05
W00-1-115.4	Till	115.40	30.0	3.85	27.0	12.1	760	1.41	70.9	6.6	10.0	<5	0.45	0.39	136.5	1.1	0.05
W00-1-117.3	Till	117.30	40.0	5.15	30.0	12.7	860	1.47	73.4	7.0	11.0	<5	0.40	0.39	146.0	1.3	0.05
W00-1-120.05	Till	120.05	30.0	5.05	29.6	12.2	900	1.42	69.9	7.2	11.0	<5	0.45	0.39	144.0	1.2	0.05
W00-1-120.95	Till	120.95	30.0	4.40	27.6	11.6	700	1.40	69.0	6.9	11.0	<5	0.40	0.40	142.5	1.4	0.05
W00-1-121.9	Till	121.90	40.0	4.75	27.6	11.5	730	1.46	68.4	7.0	11.0	<5	0.40	0.42	151.5	1.1	<0.05
W00-1-123.7	Till	123.70	30.0	1.20	21.6	11.1	670	1.79	73.5	7.4	10.0	<5	0.40	0.71	146.0	1.0	0.05
W00-1-124.6	Till	124.60	30.0	1.05	18.6	9.6	700	1.83	61.8	7.2	10.0	<5	0.35	0.75	156.0	1.2	<0.05
W00-1-125.55	Till	125.55	20.0	1.60	28.0	14.6	680	1.74	91.2	7.2	11.0	<5	0.45	0.69	163.0	1.0	0.05
W00-1-127.0	Sand	127.00	30.0	1.35	22.2	10.3	680	1.82	65.3	7.1	11.0	<5	0.35	0.68	129.0	1.2	0.05
W00-1-153.0	Till	153.00	40.0	3.75	25.6	13.0	900	1.44	73.0	7.4	11.0	<5	0.45	0.45	161.0	1.4	0.05
W00-1-154.0	Till	154.00	40.0	3.25	25.4	12.7	810	1.46	71.7	7.2	11.0	<5	0.45	0.42	156.5	1.3	0.05
W00-1-155.0	Till	155.00	40.0	3.55	25.0	12.4	860	1.38	70.6	7.3	11.0	<5	0.40	0.42	158.5	1.5	0.05
W00-1-156.0	Till	156.00	40.0	2.95	20.8	10.8	800	1.40	61.8	7.3	11.0	<5	0.40	0.42	144.5	1.3	0.05
W00-1-157.35	Till	157.35	40.0	3.65	26.2	13.6	840	1.39	77.2	7.2	10.0	<5	0.50	0.39	175.0	1.3	0.05
* W00-1-157.35	Till	157.35	40.0	3.30	24.0	12.8	840	1.40	69.3	7.3	11.0	<5	0.40	0.40	167.5	1.1	0.05
W00-1-158.4	Till	158.40	40.0	3.00	23.4	12.6	790	1.40	69.8	7.4	11.0	<5	0.40	0.47	158.5	1.2	0.05

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-1-93.4	Till	93.40	0.90	0.50	10.0	<100	0.29	1.7	3.4	96.0	3.0	20.5	<100	470
W00-1-95.1	Till	95.10	0.90	0.46	9.5	<100	0.28	0.8	2.9	80.0	3.0	19.8	<100	420
W00-1-96.0	Till	96.00	0.80	0.38	10.0	<100	0.28	0.9	2.7	89.0	2.0	15.5	<100	<200
W00-1-96.9	Till	96.90	0.80	0.46	10.0	<100	0.28	0.8	2.8	93.0	2.0	19.4	<100	330
W00-1-98.05	Till	98.05	0.70	0.46	10.0	<100	0.28	1.2	3.2	95.0	2.0	18.9	<100	<200
W00-1-99.0	Till	99.00	0.60	0.48	10.0	<100	0.29	0.9	2.8	99.0	2.0	20.0	<100	420
W00-1-100.0	Till	100.00	0.60	0.46	10.0	<100	0.29	0.9	2.9	99.0	2.0	19.4	<100	580
W00-1-101.0	Till	101.00	0.60	0.50	10.0	<100	0.29	1.0	3.1	93.0	3.0	20.4	<100	460
W00-1-102.0	Till	102.00	<0.5	0.48	10.0	<100	0.28	0.9	3.2	95.0	3.0	19.8	<100	420
W00-1-104.6	Till	104.60	0.80	0.48	10.0	<100	0.28	0.8	3.2	96.0	<2	19.3	<100	<200
W00-1-105.7	Till	105.70	0.80	0.46	10.0	<100	0.28	0.9	3.1	96.0	2.0	19.2	<100	470
* W00-1-105.7	Till	105.70	0.70	0.50	11.0	<100	0.30	1.0	3.2	93.0	3.0	20.5	<100	340
W00-1-106.7	Till	106.70	0.80	0.48	11.0	<100	0.28	1.8	3.2	95.0	2.0	19.4	100	360
W00-1-107.7	Till	107.70	0.80	0.50	10.0	<100	0.28	0.9	2.9	95.0	3.0	19.6	<100	420
W00-1-108.7	Till	108.70	0.70	0.48	10.0	<100	0.28	1.2	2.6	95.0	<2	19.9	<100	400
W00-1-110.9	Till	110.90	1.00	0.50	10.0	<100	0.29	0.9	2.9	97.0	<2	20.1	<100	<200
W00-1-115.4	Till	115.40	0.90	0.72	11.0	<100	0.30	1.1	4.2	117.0	2.0	24.6	<100	<200
W00-1-117.3	Till	117.30	1.00	0.84	12.0	<100	0.31	1.3	4.5	134.0	2.0	26.2	<100	490
W00-1-120.05	Till	120.05	1.00	0.86	11.0	<100	0.31	1.6	5.1	135.0	3.0	25.5	<100	520
W00-1-120.95	Till	120.95	1.10	0.76	11.0	<100	0.29	2.0	4.4	126.0	3.0	24.2	<100	<200
W00-1-121.9	Till	121.90	0.90	0.82	11.0	<100	0.31	1.6	4.6	133.0	3.0	24.5	<100	<200
W00-1-123.7	Till	123.70	0.90	0.52	13.0	<100	0.31	1.0	3.6	82.0	3.0	23.3	<100	530
W00-1-124.6	Till	124.60	0.60	0.46	13.0	<100	0.31	2.5	3.9	84.0	3.0	20.1	<100	770
W00-1-125.55	Till	125.55	0.90	0.66	13.0	<100	0.33	3.0	3.7	92.0	3.0	27.8	<100	<200
W00-1-127.0	Sand	127.00	0.90	0.48	12.0	<100	0.32	1.0	3.5	88.0	3.0	20.7	<100	670
W00-1-153.0	Till	153.00	0.80	0.78	12.0	<100	0.30	1.3	4.7	112.0	3.0	28.1	<100	360
W00-1-154.0	Till	154.00	1.20	0.72	13.0	<100	0.31	1.9	4.5	112.0	3.0	26.0	<100	380
W00-1-155.0	Till	155.00	1.10	0.78	12.0	<100	0.29	1.4	4.5	109.0	3.0	27.1	150	<200
W00-1-156.0	Till	156.00	0.90	0.70	12.0	<100	0.29	1.2	4.9	109.0	3.0	22.9	120	390
W00-1-157.35	Till	157.35	1.10	0.88	12.0	<100	0.29	1.6	4.6	107.0	3.0	29.0	<100	410
* W00-1-157.35	Till	157.35	1.00	0.78	12.0	<100	0.29	1.5	4.7	103.0	3.0	26.5	<100	570
W00-1-158.4	Till	158.40	1.10	0.72	12.0	<100	0.30	2.6	4.8	102.0	3.0	25.4	<100	720

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-1-159.3	Till	159.30	7.6	<2	6.08	1.0	15.0	620.0	543.5	1.45	0.60	3.0	0.58	0.70	89.0	5.0	62.0
W00-1-160.2	Till	160.20	6.6	<2	5.85	0.8	15.0	650.0	555.8	1.50	0.59	1.9	0.58	0.63	97.0	4.6	68.0
W00-1-162.2	Till	162.20	7.3	<2	5.92	0.7	15.0	470.0	393.0	1.60	0.59	2.5	0.52	0.68	86.0	5.3	83.0
W00-1-164.35	Till	164.35	8.0	<2	6.05	0.6	14.0	600.0	477.5	1.65	0.59	2.1	0.64	0.69	92.0	4.8	68.0
W00-1-165.4	Till	165.40	7.6	<2	6.20	0.8	12.0	570.0	475.5	1.50	0.58	2.1	0.84	0.74	90.0	4.3	73.0
W0O-1-166.4	Till	166.40	7.4	<2	6.10	1.0	13.0	750.0	653.5	1.55	0.60	2.6	0.60	0.80	98.0	4.3	35.0
W00-1-167.6	Till	167.60	7.7	<2	6.60	1.8	17.0	710.0	402.0	1.75	0.64	4.3	1.08	1.24	91.0	5.1	65.0
W00-1-168.9	Till	168.90	6.2	5.0	6.85	2.6	19.0	660.0	389.0	1.65	0.63	4.6	1.62	1.31	91.0	5.2	84.0
W00-1-169.9	Till	169.90	7.6	<2	6.92	2.7	19.0	670.0	439.0	1.65	0.63	4.7	2.06	1.25	85.0	5.8	76.0
W00-1-171.0	Till	171.00	6.3	<2	6.69	3.0	19.0	680.0	559.6	1.85	0.62	4.8	1.90	1.22	88.0	4.9	88.0
W00-1-172.0	Till	172.00	5.9	8.0	6.75	2.6	19.0	680.0	494.5	1.70	0.64	4.4	1.88	1.22	92.0	5.7	91.0
W00-1-173.0	Till	173.00	6.3	<2	7.09	2.7	20.0	730.0	544.5	1.40	0.59	4.5	1.82	1.27	99.0	4.9	93.0

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-1-159.3	Till	159.30	60.0	13.0	29.0	2.0	13.30	1.65	11.0	<50	3.0	43.0	21.0	30.0	0.4	0.67	350
W00-1-160.2	Till	160.20	50.0	12.0	31.0	3.0	13.20	1.55	11.0	<50	3.2	43.0	28.0	31.0	0.4	0.57	385
W00-1-162.2	Till	162.20	53.0	12.0	29.2	1.0	13.55	1.60	11.0	<50	3.0	43.0	23.5	31.0	0.3	0.62	370
W00-1-164.35	Till	164.35	54.0	14.0	29.0	1.0	13.80	1.60	10.0	<50	3.1	45.0	20.0	31.0	0.4	0.61	340
W00-1-165.4	Till	165.40	55.0	13.0	28.2	1.0	13.95	1.50	12.0	<50	2.8	43.0	19.0	34.0	0.3	0.60	390
W0O-1-166.4	Till	166.40	57.0	12.0	30.0	2.0	14.05	1.45	13.0	<50	3.1	43.0	19.5	34.6	0.5	0.63	435
W00-1-167.6	Till	167.60	70.0	13.0	37.4	1.0	15.45	1.50	9.0	<50	3.0	38.0	23.5	37.0	0.4	0.75	405
W00-1-168.9	Till	168.90	71.0	15.0	46.4	<1	15.85	1.50	8.0	<50	3.3	42.0	20.5	37.6	0.4	0.74	400
W00-1-169.9	Till	169.90	72.0	16.0	46.4	2.0	15.65	1.55	9.0	<50	3.2	42.0	21.5	38.6	0.3	0.73	415
W00-1-171.0	Till	171.00	69.0	13.0	42.4	2.0	15.30	1.55	9.0	<50	3.3	46.0	21.0	36.4	0.4	0.70	400
W00-1-172.0	Till	172.00	72.0	16.0	44.2	2.0	15.80	1.55	9.0	<50	3.4	45.0	20.5	38.6	0.4	0.70	420
W00-1-173.0	Till	173.00	75.0	19.0	41.6	2.0	14.00	1.30	9.0	<50	3.3	47.0	18.5	32.8	0.4	0.76	415

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-1-159.3	Till	159.30	40.0	3.50	32.4	12.7	910	1.46	73.0	7.1	11.0	<5	0.40	0.39	180.5	1.3	0.05
W00-1-160.2	Till	160.20	40.0	2.45	24.6	12.4	810	1.42	69.6	7.1	11.0	<5	0.40	0.42	157.0	1.1	0.10
W00-1-162.2	Till	162.20	40.0	2.50	24.2	12.7	850	1.44	72.1	7.3	11.0	<5	0.40	0.42	152.0	1.2	<0.05
W00-1-164.35	Till	164.35	30.0	2.35	23.8	12.5	900	1.43	72.6	7.1	12.0	<5	0.40	0.39	151.0	1.2	0.05
W00-1-165.4	Till	165.40	30.0	2.75	25.6	12.4	750	1.41	72.5	6.7	11.0	<5	0.40	0.42	148.5	1.3	0.05
W0O-1-166.4	Till	166.40	30.0	3.60	27.8	12.7	710	1.41	72.2	6.7	12.0	<5	0.40	0.43	162.0	1.2	0.05
W00-1-167.6	Till	167.60	50.0	7.15	38.0	12.8	980	1.54	81.1	6.9	11.0	<5	0.50	0.37	196.0	1.1	0.05
W00-1-168.9	Till	168.90	50.0	10.35	42.2	12.5	990	1.52	80.3	7.5	13.0	<5	0.50	0.42	181.0	1.2	0.10
W00-1-169.9	Till	169.90	50.0	9.75	42.4	12.8	890	1.55	80.7	7.3	12.0	<5	0.50	0.42	179.0	1.3	0.05
W00-1-171.0	Till	171.00	60.0	9.15	40.8	12.5	850	1.50	76.7	7.5	12.0	6.0	0.50	0.45	171.0	0.9	0.10
W00-1-172.0	Till	172.00	50.0	9.25	42.0	12.8	940	1.52	80.3	7.5	13.0	<5	0.50	0.44	170.5	1.5	0.05
W00-1-173.0	Till	173.00	50.0	7.90	37.2	11.3	910	1.59	71.0	7.5	13.0	<5	0.45	0.49	170.0	1.3	0.10

Appendix 3 - Table A3-6: Geochemical Analysis of Samples from Corehole WEPA00-1

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-1-159.3	Till	159.30	1.00	0.76	12.0	<100	0.30	1.2	4.4	119.0	3.0	27.0	<100	400
W00-1-160.2	Till	160.20	0.90	0.68	12.0	<100	0.30	2.1	4.4	95.0	3.0	26.3	110	<200
W00-1-162.2	Till	162.20	0.80	0.66	12.0	<100	0.30	1.4	4.4	99.0	3.0	26.7	130	490
W00-1-164.35	Till	164.35	1.10	0.64	12.0	<100	0.30	1.4	4.5	98.0	3.0	26.7	<100	450
W00-1-165.4	Till	165.40	0.90	0.64	11.0	<100	0.31	1.3	4.2	107.0	2.0	24.5	<100	560
W0O-1-166.4	Till	166.40	1.20	0.78	12.0	<100	0.31	1.3	4.6	123.0	2.0	24.5	<100	590
W00-1-167.6	Till	167.60	0.90	1.12	11.0	<100	0.30	1.3	5.2	207.0	<2	28.2	130	530
W00-1-168.9	Till	168.90	0.90	1.40	12.0	<100	0.30	1.3	6.4	243.0	3.0	29.3	140	340
W00-1-169.9	Till	169.90	0.80	1.38	12.0	<100	0.31	2.9	6.4	239.0	3.0	28.9	<100	360
W00-1-171.0	Till	171.00	1.00	1.38	13.0	<100	0.30	1.4	6.3	239.0	3.0	27.8	120	510
W00-1-172.0	Till	172.00	1.00	1.36	13.0	<100	0.30	1.3	6.1	233.0	3.0	28.9	150	340
W00-1-173.0	Till	173.00	0.90	1.26	13.0	<100	0.32	1.3	6.1	245.0	2.0	24.8	140	380

Notes: < denotes less than
NAA denotes neutron activation analysis
CVAA denotes analysis by cold vapour atomic absorption
IMS denotes plasma-mass spectrometry analysis
All results are reported on a dry basis.
Ba* and Cr* denotes acid soluble portion
* W00-1-9.3 denotes sample duplicate of W00-1-9.3

Appendix 3 - Table A3-7: Geochemical Analysis of Samples from Corehole WEPA00-2

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-2-5.7	Till	5.70	9.0	<2	5.61	0.5	5.0	490.0	427.0	1.25	0.47	1.5	0.52	2.96	72.0	3.1	66.0
W00-2-8.6	Till	8.60	9.4	<2	6.05	0.5	4.2	530.0	460.0	1.30	0.50	1.5	0.32	3.07	72.0	3.2	75.0
W00-2-9.5	Till	9.50	8.1	<2	5.92	0.6	5.7	550.0	463.5	1.20	0.49	1.7	0.30	3.16	72.0	3.4	75.0
W00-2-13.2	Till	13.20	8.1	<2	6.08	0.6	6.1	520.0	448.0	1.15	0.49	1.7	0.36	3.29	72.0	3.3	69.0
W00-2-14.2	Till	14.20	9.0	<2	6.08	0.6	6.4	520.0	456.0	1.25	0.47	2.0	0.32	3.20	73.0	3.2	72.0
* W00-2-14.2	Till	14.20	7.2	<2	5.87	0.6	6.6	550.0	434.5	1.15	0.46	1.9	0.38	3.22	69.0	3.9	55.0
W00-2-15.2	Till	15.20	8.7	5.0	6.02	0.6	6.0	500.0	537.7	1.35	0.54	1.6	0.64	3.10	74.0	3.4	68.0
W00-2-15.6	Till	15.60	8.5	<2	5.99	0.6	5.9	540.0	490.5	1.15	0.52	1.6	0.86	3.27	70.0	3.6	68.0
W00-2-16.75	Till	16.75	7.7	5.0	5.81	0.6	7.3	500.0	418.0	1.25	0.47	1.7	0.34	3.08	70.0	3.5	63.0
W00-2-18.3	Till	18.30	9.7	<2	5.77	0.5	5.7	540.0	416.0	1.00	0.44	1.8	1.32	3.47	70.0	3.1	63.0
W00-2-19.6	Till	19.60	6.6	<2	5.60	0.6	7.7	520.0	437.5	1.25	0.51	2.1	0.32	3.05	73.0	3.9	74.0
W00-2-20.6	Till	20.60	8.0	<2	5.60	0.5	6.0	490.0	416.5	1.10	0.47	1.8	0.54	3.53	69.0	3.5	75.0
W00-2-21.6	Till	21.60	7.3	<2	5.61	0.5	5.9	490.0	417.5	1.15	0.44	1.4	0.28	3.40	65.0	2.8	59.0
W00-2-22.8	Till	22.80	5.5	<2	5.81	0.5	5.0	520.0	458.0	1.15	0.47	1.8	0.32	3.58	63.0	3.1	61.0
W00-2-25.9	Till	25.90	6.7	4.0	5.92	0.5	6.4	500.0	445.0	1.15	0.46	1.9	0.40	3.62	76.0	3.4	73.0
W00-2-26.9	Till	26.90	6.8	<2	6.07	0.6	5.5	540.0	464.0	1.35	0.46	1.7	1.04	3.62	74.0	2.9	61.0
W00-2-27.9	Till	27.90	8.3	<2	6.22	0.8	11.0	690.0	444.0	1.25	0.46	2.3	0.78	3.50	81.0	4.6	77.0
W00-2-29.0	Till	29.00	7.6	<2	6.11	0.5	6.2	540.0	443.5	1.30	0.45	1.9	0.58	3.65	70.0	3.2	65.0
W00-2-30.1	Till	30.10	6.3	<2	6.00	0.5	6.1	570.0	438.5	1.25	0.44	2.3	0.42	3.73	64.0	3.5	55.0
W00-2-31.4	Till	31.40	7.1	<2	6.00	0.6	5.9	510.0	463.5	1.20	0.49	2.2	0.56	3.77	71.0	3.0	64.0
W00-2-32.3	Till	32.30	9.0	<2	5.98	0.6	5.9	550.0	428.0	1.35	0.47	1.6	1.54	3.17	69.0	3.5	67.0
W00-2-46.7	Silt & Clay	46.70	10.4	<2	4.99	0.5	6.6	520.0	405.5	1.00	0.45	1.8	0.28	1.87	69.0	3.4	66.0
W00-2-87.9	Till	87.90	10.2	<2	5.74	0.6	9.0	560.0	447.0	1.25	0.47	1.4	0.50	2.74	75.0	2.6	60.0
W00-2-89.1	Till	89.10	9.2	<2	5.78	0.6	7.7	570.0	419.5	1.05	0.46	1.3	0.32	2.80	75.0	3.9	64.0
* W00-2-89.1	Till	89.10	7.8	<2	5.85	0.6	7.6	520.0	448.5	1.35	0.49	1.5	0.42	2.79	76.0	3.5	59.0
W00-2-90.10	Till	90.10	7.4	<2	5.60	0.6	7.5	580.0	426.0	1.15	0.50	1.8	0.28	2.79	73.0	3.6	69.0
W00-2-91.1	Till	91.10	10.1	<2	5.60	0.6	7.8	570.0	459.0	1.30	0.48	2.0	0.38	2.72	75.0	3.8	64.0
W00-2-92.15	Till	92.15	11.6	<2	5.79	0.6	7.5	570.0	430.5	1.30	0.46	1.8	1.02	2.92	71.0	3.8	86.0
W00-2-93.2	Till	93.20	8.5	<2	5.66	0.6	7.4	500.0	437.5	1.15	0.45	2.0	0.44	2.75	73.0	3.0	75.0
W00-2-93.9	Till	93.90	10.4	<2	5.56	0.6	7.6	540.0	443.0	1.20	0.45	1.6	0.36	2.72	77.0	3.5	62.0
W00-2-95.2	Till	95.20	6.7	<2	6.80	0.6	7.1	530.0	528.1	1.55	0.49	1.8	0.52	2.14	68.0	3.7	64.0
W00-2-96.3	Till	96.30	10.8	<2	6.29	0.8	8.6	700.0	496.0	1.50	0.50	1.4	0.34	1.96	98.0	4.7	95.0

Appendix 3 - Table A3-7: Geochemical Analysis of Samples from Corehole WEPA00-2

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-2-5.7	Till	5.70	55.0	17.0	35.8	<1	12.00	1.20	8.0	<50	2.5	35.0	21.0	33.6	0.3	1.56	395
W00-2-8.6	Till	8.60	58.0	12.0	38.2	<1	13.05	1.30	8.0	<50	2.7	35.0	16.5	35.6	0.3	1.71	485
W00-2-9.5	Till	9.50	57.0	10.0	42.2	<1	13.50	1.15	8.0	<50	2.7	35.0	16.5	35.2	0.3	1.70	480
W00-2-13.2	Till	13.20	57.0	12.0	39.8	1.0	12.95	1.20	7.0	<50	2.6	35.0	15.0	35.2	0.3	1.78	485
W00-2-14.2	Till	14.20	57.0	13.0	25.8	<1	13.00	1.25	8.0	<50	2.7	35.0	15.5	35.4	0.3	1.75	485
* W00-2-14.2	Till	14.20	53.0	11.0	30.2	2.0	12.65	1.25	7.0	<50	2.6	31.0	14.0	34.4	0.2	1.70	480
W00-2-15.2	Till	15.20	56.0	12.0	32.4	<1	14.35	1.35	8.0	<50	2.6	36.0	21.0	38.4	0.3	1.65	470
W00-2-15.6	Till	15.60	55.0	12.0	37.8	<1	13.70	1.25	8.0	<50	2.6	36.0	23.0	36.8	0.3	1.69	490
W00-2-16.75	Till	16.75	54.0	12.0	26.6	2.0	12.05	1.20	9.0	<50	2.6	34.0	18.0	36.0	0.3	1.45	395
W00-2-18.3	Till	18.30	57.0	12.0	24.4	<1	11.55	1.10	9.0	<50	2.7	33.0	13.5	33.2	0.3	1.82	450
W00-2-19.6	Till	19.60	51.0	12.0	25.4	2.0	12.30	1.25	8.0	<50	2.5	33.0	15.0	35.4	0.3	1.40	380
W00-2-20.6	Till	20.60	55.0	12.0	23.8	<1	11.85	1.15	9.0	<50	2.6	33.0	14.5	33.4	0.3	1.77	445
W00-2-21.6	Till	21.60	50.0	9.0	26.0	<1	11.70	1.20	8.0	<50	2.5	32.0	17.5	33.0	0.2	1.75	440
W00-2-22.8	Till	22.80	50.0	10.0	33.8	1.0	12.85	1.20	7.0	<50	2.4	33.0	22.5	34.4	0.2	1.90	465
W00-2-25.9	Till	25.90	53.0	9.0	28.8	<1	12.85	1.25	7.0	<50	2.6	32.0	15.0	36.4	0.3	1.81	455
W00-2-26.9	Till	26.90	59.0	12.0	32.2	<1	13.35	1.25	8.0	<50	2.7	33.0	27.5	35.6	0.3	1.91	485
W00-2-27.9	Till	27.90	58.0	11.0	28.6	1.0	12.50	1.20	9.0	<50	3.4	35.0	14.5	34.0	0.3	1.97	490
W00-2-29.0	Till	29.00	53.0	19.0	29.4	<1	12.75	1.15	8.0	<50	2.4	30.0	14.0	34.6	<0.2	1.94	490
W00-2-30.1	Till	30.10	57.0	8.0	32.6	<1	13.05	1.20	8.0	<50	2.5	31.0	21.5	34.2	0.2	1.95	490
W00-2-31.4	Till	31.40	58.0	10.0	29.2	<1	13.60	1.25	7.0	<50	2.7	33.0	15.5	36.6	<0.2	1.97	490
W00-2-32.3	Till	32.30	55.0	10.0	36.2	2.0	12.60	1.25	8.0	<50	2.6	33.0	16.5	35.8	0.3	1.72	470
W00-2-46.7	Silt & Clay	46.70	40.0	11.0	28.4	2.0	10.05	1.30	8.0	<50	2.6	33.0	15.5	25.4	0.3	1.03	490
W00-2-87.9	Till	87.90	52.0	11.0	25.2	1.0	12.40	1.30	11.0	<50	2.6	35.0	15.0	37.4	0.4	1.47	435
W00-2-89.1	Till	89.10	55.0	9.0	26.0	<1	12.10	1.25	8.0	<50	2.8	35.0	15.5	35.8	0.3	1.48	445
* W00-2-89.1	Till	89.10	53.0	13.0	36.2	1.0	13.00	1.25	9.0	<50	2.8	35.0	16.0	39.2	0.3	1.53	465
W00-2-90.10	Till	90.10	51.0	10.0	26.6	1.0	12.25	1.25	10.0	<50	2.8	36.0	14.0	36.2	0.3	1.43	420
W00-2-91.1	Till	91.10	52.0	12.0	31.6	1.0	13.05	1.20	9.0	<50	2.7	35.0	15.5	38.4	0.3	1.41	425
W00-2-92.15	Till	92.15	57.0	12.0	24.4	2.0	12.30	1.25	8.0	<50	2.8	36.0	15.0	37.6	0.3	1.54	455
W00-2-93.2	Till	93.20	55.0	12.0	24.8	<1	12.30	1.30	9.0	<50	2.6	33.0	14.5	37.0	0.3	1.46	440
W00-2-93.9	Till	93.90	52.0	13.0	31.8	<1	11.85	1.30	9.0	<50	2.9	36.0	34.0	34.8	0.3	1.44	450
W00-2-95.2	Till	95.20	62.0	11.0	32.8	2.0	15.15	1.55	10.0	<50	2.6	35.0	17.5	35.6	0.3	1.02	590
W00-2-96.3	Till	96.30	63.0	11.0	28.8	3.0	14.00	1.50	11.0	<50	3.5	45.0	17.0	32.8	0.4	1.02	515

Appendix 3 - Table A3-7: Geochemical Analysis of Samples from Corehole WEPA00-2

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-2-5.7	Till	5.70	60.0	1.00	23.8	10.4	550	1.57	63.8	5.4	10.0	<5	0.30	0.70	134.5	1.1	<0.05
W00-2-8.6	Till	8.60	40.0	1.00	24.2	10.4	580	1.68	68.5	5.5	10.0	<5	0.30	0.70	148.0	1.0	<0.05
W00-2-9.5	Till	9.50	40.0	1.15	25.8	10.7	590	1.66	69.3	5.5	10.0	<5	0.30	0.76	146.0	0.9	<0.05
W00-2-13.2	Till	13.20	40.0	1.15	24.6	10.8	580	1.71	68.6	5.5	10.0	<5	0.30	0.76	160.5	1.0	<0.05
W00-2-14.2	Till	14.20	30.0	1.25	25.6	10.5	620	1.68	68.4	5.4	10.0	<5	0.40	0.77	156.0	0.9	<0.05
* W00-2-14.2	Till	14.20	30.0	1.15	24.0	9.9	580	1.69	67.2	5.5	9.5	<5	0.30	0.70	152.0	1.0	<0.05
W00-2-15.2	Till	15.20	30.0	1.95	28.2	11.5	590	1.66	74.8	5.5	10.0	<5	0.40	0.77	164.0	0.8	0.05
W00-2-15.6	Till	15.60	40.0	1.35	25.8	10.7	580	1.72	71.9	5.6	10.0	<5	0.45	0.77	162.0	1.1	0.05
W00-2-16.75	Till	16.75	40.0	1.25	21.6	10.1	590	1.53	63.7	5.4	10.0	<5	0.30	0.61	141.5	1.1	<0.05
W00-2-18.3	Till	18.30	30.0	1.00	22.4	9.3	660	1.57	61.1	5.3	10.0	<5	0.35	0.71	155.5	0.6	0.05
W00-2-19.6	Till	19.60	50.0	1.60	23.2	10.5	580	1.53	64.7	5.3	10.0	<5	0.30	0.60	139.5	0.9	0.05
W00-2-20.6	Till	20.60	30.0	1.05	22.4	9.6	580	1.59	62.0	5.2	9.3	<5	0.30	0.70	150.5	0.6	<0.05
W00-2-21.6	Till	21.60	30.0	1.05	22.2	9.3	570	1.57	61.5	5.1	9.1	<5	0.30	0.69	148.5	1.0	<0.05
W00-2-22.8	Till	22.80	30.0	1.15	25.0	10.2	560	1.66	66.6	5.1	9.3	<5	0.30	0.75	152.5	1.1	<0.05
W00-2-25.9	Till	25.90	30.0	1.25	25.4	10.2	570	1.66	68.0	5.1	9.4	<5	0.35	0.71	151.0	1.1	<0.05
W00-2-26.9	Till	26.90	20.0	1.25	25.6	10.2	620	1.75	70.4	5.1	10.0	<5	0.35	0.75	157.0	0.9	<0.05
W00-2-27.9	Till	27.90	40.0	1.20	26.8	10.0	610	1.67	66.7	5.4	12.0	<5	0.40	0.53	156.0	0.8	<0.05
W00-2-29.0	Till	29.00	40.0	1.15	25.4	10.1	560	1.72	68.9	5.2	8.0	<5	0.30	0.61	156.0	0.9	<0.05
W00-2-30.1	Till	30.10	30.0	1.25	25.6	10.0	630	1.73	67.7	5.2	8.9	<5	0.30	0.67	153.0	0.7	<0.05
W00-2-31.4	Till	31.40	30.0	1.25	26.4	10.8	590	1.72	71.0	5.5	10.0	<5	0.35	0.74	156.0	0.6	<0.05
W00-2-32.3	Till	32.30	30.0	1.15	23.6	10.1	590	1.65	67.3	5.7	9.3	<5	0.30	0.71	148.0	0.9	<0.05
W00-2-46.7	Silt & Clay	46.70	30.0	1.15	19.0	10.5	630	1.41	53.9	5.6	10.0	<5	0.35	0.71	126.0	0.8	<0.05
W00-2-87.9	Till	87.90	30.0	1.15	23.0	10.2	610	1.55	64.3	6.1	8.3	<5	0.35	0.65	145.0	1.4	0.05
W00-2-89.1	Till	89.10	30.0	1.10	22.2	9.8	610	1.57	63.6	5.6	10.0	<5	0.30	0.65	141.5	0.7	<0.05
* W00-2-89.1	Till	89.10	40.0	1.20	24.4	10.8	610	1.58	69.3	5.6	10.0	<5	0.35	0.64	149.5	1.0	<0.05
W00-2-90.10	Till	90.10	30.0	1.15	22.4	9.9	570	1.51	64.0	5.8	11.0	<5	0.35	0.67	143.5	1.1	0.05
W00-2-91.1	Till	91.10	40.0	1.25	23.6	11.2	590	1.57	68.1	5.5	10.0	<5	0.35	0.69	142.5	0.8	0.05
W00-2-92.15	Till	92.15	30.0	1.25	22.8	9.0	650	1.58	65.4	5.7	11.0	<5	0.35	0.71	147.5	1.0	<0.05
W00-2-93.2	Till	93.20	30.0	1.25	23.2	9.3	630	1.55	65.2	5.5	10.0	<5	0.35	0.73	139.5	1.0	<0.05
W00-2-93.9	Till	93.90	30.0	1.20	21.8	9.7	640	1.55	63.4	5.6	11.0	<5	0.40	0.74	144.5	1.2	<0.05
W00-2-95.2	Till	95.20	30.0	1.85	26.8	12.4	730	1.67	76.9	5.7	10.0	<5	0.40	0.69	150.5	1.1	0.05
W00-2-96.3	Till	96.30	40.0	1.70	24.4	11.5	800	1.63	72.9	7.0	13.0	<5	0.40	0.68	147.5	1.2	0.05

Appendix 3 - Table A3-7: Geochemical Analysis of Samples from Corehole WEPA00-2

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-2-5.7	Till	5.70	0.6	0.48	9.1	<100	0.28	0.9	2.6	91.0	2.0	17.9	<100	390
W00-2-8.6	Till	8.60	0.7	0.54	10.0	<100	0.30	1.0	2.7	98.0	<2	18.9	<100	<200
W00-2-9.5	Till	9.50	0.5	0.52	10.0	<100	0.30	0.9	2.7	96.0	<2	18.9	<100	330
W00-2-13.2	Till	13.20	0.7	0.52	10.0	<100	0.30	0.9	2.8	96.0	<2	18.3	<100	<200
W00-2-14.2	Till	14.20	0.6	0.52	10.0	<100	0.29	0.9	2.7	97.0	2.0	18.8	<100	260
* W00-2-14.2	Till	14.20	0.9	0.48	10.0	<100	0.28	0.9	2.8	90.0	2.0	17.9	<100	<200
W00-2-15.2	Till	15.20	0.7	0.62	10.0	<100	0.29	1.0	2.7	103.0	2.0	21.0	<100	390
W00-2-15.6	Till	15.60	0.6	0.54	10.0	<100	0.29	1.2	2.6	94.0	<2	19.1	<100	<200
W00-2-16.75	Till	16.75	0.7	0.48	9.5	<100	0.29	1.0	3.0	93.0	2.0	18.3	<100	520
W00-2-18.3	Till	18.30	<0.5	0.44	9.5	<100	0.27	0.8	2.5	99.0	<2	16.9	<100	290
W00-2-19.6	Till	19.60	0.6	0.50	9.2	<100	0.29	1.0	2.9	92.0	<2	18.8	<100	340
W00-2-20.6	Till	20.60	0.8	0.46	9.1	<100	0.29	0.8	2.6	91.0	<2	17.4	<100	<200
W00-2-21.6	Till	21.60	0.6	0.46	8.9	<100	0.27	0.8	2.6	86.0	<2	17.1	<100	430
W00-2-22.8	Till	22.80	0.7	0.48	9.2	<100	0.29	0.9	2.5	92.0	<2	18.0	<100	540
W00-2-25.9	Till	25.90	0.8	0.52	9.0	<100	0.29	1.1	2.6	93.0	<2	18.2	<100	550
W00-2-26.9	Till	26.90	<0.5	0.52	10.0	<100	0.29	1.2	2.5	101.0	2.0	18.9	160	<200
W00-2-27.9	Till	27.90	0.8	0.50	10.0	<100	0.30	0.9	2.7	96.0	<2	18.2	<100	360
W00-2-29.0	Till	29.00	0.7	0.48	10.0	<100	0.29	1.0	2.8	93.0	<2	17.8	<100	<200
W00-2-30.1	Till	30.10	0.5	0.50	9.2	<100	0.29	1.0	2.8	98.0	<2	17.6	<100	<200
W00-2-31.4	Till	31.40	0.7	0.52	10.0	<100	0.29	1.3	2.8	98.0	<2	18.7	100	<200
W00-2-32.3	Till	32.30	0.8	0.50	10.0	<100	0.29	1.1	2.7	95.0	<2	18.4	<100	290
W00-2-46.7	Silt & Clay	46.70	0.5	0.46	9.4	<100	0.31	0.9	2.7	68.0	2.0	20.5	<100	<200
W00-2-87.9	Till	87.90	0.9	0.50	10.0	<100	0.29	0.8	3.4	93.0	3.0	18.8	<100	360
W00-2-89.1	Till	89.10	0.5	0.48	10.0	<100	0.29	0.9	2.8	94.0	<2	18.3	<100	340
* W00-2-89.1	Till	89.10	0.6	0.52	10.0	<100	0.30	0.9	2.6	95.0	2.0	19.8	<100	<200
W00-2-90.10	Till	90.10	0.9	0.46	10.0	<100	0.29	0.8	2.8	89.0	2.0	18.3	120	340
W00-2-91.1	Till	91.10	0.8	0.48	10.0	<100	0.29	0.9	2.8	89.0	2.0	19.4	<100	640
W00-2-92.15	Till	92.15	0.7	0.48	10.0	<100	0.27	0.7	2.7	98.0	2.0	18.7	130	480
W00-2-93.2	Till	93.20	0.6	0.46	10.0	<100	0.27	0.9	2.6	93.0	2.0	18.8	<100	<200
W00-2-93.9	Till	93.90	0.8	0.46	10.0	<100	0.29	0.9	2.9	89.0	<2	19.5	120	420
W00-2-95.2	Till	95.20	0.7	0.58	10.0	<100	0.35	1.1	2.7	116.0	2.0	22.8	130	400
W00-2-96.3	Till	96.30	1.0	0.54	12.0	<100	0.31	1.0	3.9	106.0	3.0	23.1	<100	340

Appendix 3 - Table A3-7: Geochemical Analysis of Samples from Corehole WEPA00-2

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-2-97.3	Till	97.30	6.8	<2	7.09	0.6	7.8	620.0	533.0	1.60	0.49	1.5	0.42	2.11	89.0	4.5	74.0
W00-2-98.3	Till	98.30	8.9	10.0	7.16	0.9	16.0	650.0	543.3	1.65	0.50	2.1	0.42	2.15	97.0	4.9	81.0
W00-2-99.3	Till	99.30	5.5	<2	6.94	0.9	8.4	630.0	546.0	1.60	0.50	1.9	0.44	2.21	90.0	4.4	71.0
W00-2-100.3	Till	100.30	10.9	<2	6.90	0.9	13.0	790.0	566.5	1.65	0.49	1.8	1.70	2.22	76.0	5.3	87.0
W00-2-101.3	Till	101.30	7.5	<2	6.89	0.8	8.0	690.0	580.2	1.60	0.51	1.4	0.42	2.19	95.0	4.6	75.0
W00-2-102.3	Till	102.30	7.8	<2	6.79	0.8	7.4	700.0	537.0	1.45	0.47	1.6	0.36	2.22	100.0	4.0	95.0
W00-2-103.3	Till	103.30	8.0	8.0	6.78	0.8	7.7	660.0	525.7	1.60	0.47	1.2	0.42	2.17	100.0	3.9	81.0
W00-2-104.45	Till	104.45	6.7	<2	6.85	0.8	8.5	670.0	536.2	1.60	0.49	1.9	0.56	2.11	83.0	4.2	72.0
W00-2-105.5	Till	105.50	5.2	<2	6.76	0.8	7.3	630.0	561.1	1.65	0.46	2.0	0.52	2.18	78.0	4.2	67.0
W00-2-107.7	Till	107.70	7.2	<2	7.06	1.0	17.0	710.0	588.8	1.70	0.48	1.7	0.46	1.91	84.0	4.1	83.0
W00-2-108.7	Till	108.70	6.5	<2	6.36	0.9	7.3	720.0	563.1	1.40	0.46	1.0	0.96	2.23	82.0	5.0	75.0
W00-2-109.6	Till	109.60	7.4	<2	6.50	0.9	11.0	710.0	601.5	1.50	0.49	1.6	0.72	2.28	76.0	4.3	58.0
W00-2-111.45	Silt & Clay	111.45	6.4	7.0	6.05	0.9	6.5	700.0	556.0	1.30	0.44	2.3	0.72	3.70	74.0	3.5	60.0

Appendix 3 - Table A3-7: Geochemical Analysis of Samples from Corehole WEPA00-2

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-2-97.3	Till	97.30	68.0	15.0	31.8	2.0	15.65	1.45	10.0	<50	3.1	40.0	17.0	37.2	0.4	1.07	635
W00-2-98.3	Till	98.30	65.0	14.0	32.2	1.0	16.00	1.60	11.0	<50	3.3	46.0	18.5	37.8	0.4	1.06	665
W00-2-99.3	Till	99.30	68.0	14.0	31.4	1.0	15.30	1.50	11.0	<50	3.3	46.0	18.5	36.0	0.3	1.10	645
W00-2-100.3	Till	100.30	67.0	14.0	30.2	2.0	15.40	1.50	9.0	<50	3.4	35.0	18.5	35.8	0.3	1.07	610
W00-2-101.3	Till	101.30	70.0	17.0	29.8	1.0	15.70	1.50	12.0	<50	3.4	45.0	18.0	37.2	0.3	1.09	635
W00-2-102.3	Till	102.30	66.0	15.0	28.6	2.0	14.95	1.50	12.0	<50	3.2	46.0	17.0	35.0	0.4	1.13	655
W00-2-103.3	Till	103.30	64.0	14.0	27.6	<1	14.80	1.60	12.0	<50	3.5	45.0	23.5	34.6	0.4	1.05	605
W00-2-104.45	Till	104.45	68.0	11.0	30.2	1.0	15.20	1.45	10.0	<50	2.7	36.0	21.5	35.4	0.2	1.06	620
W00-2-105.5	Till	105.50	63.0	13.0	29.8	3.0	15.35	1.60	9.0	<50	2.8	36.0	18.0	35.4	0.3	1.05	600
W00-2-107.7	Till	107.70	65.0	10.0	31.4	3.0	15.55	1.65	10.0	<50	3.1	43.0	17.5	38.6	0.4	0.95	500
W00-2-108.7	Till	108.70	59.0	14.0	26.2	1.0	14.00	1.40	9.0	<50	3.3	41.0	16.0	31.8	0.3	1.05	610
W00-2-109.6	Till	109.60	63.0	13.0	30.4	1.0	15.05	1.50	10.0	<50	2.7	39.0	17.5	34.6	0.3	1.07	600
W00-2-111.45	Silt & Clay	111.45	55.0	14.0	25.8	2.0	12.95	1.30	11.0	<50	2.9	40.0	15.0	29.8	0.4	1.64	595

Appendix 3 - Table A3-7: Geochemical Analysis of Samples from Corehole WEPA00-2

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-2-97.3	Till	97.30	30.0	1.95	32.4	11.4	750	1.71	78.8	6.7	11.0	<5	0.35	0.63	154.5	1.2	<0.05
W00-2-98.3	Till	98.30	40.0	2.10	28.4	12.7	730	1.74	80.8	7.0	14.0	<5	0.40	0.68	154.5	1.1	0.05
W00-2-99.3	Till	99.30	40.0	2.00	28.2	11.5	800	1.70	77.9	6.9	13.0	<5	0.35	0.62	160.5	1.4	<0.05
W00-2-100.3	Till	100.30	30.0	1.80	28.4	12.0	720	1.72	77.3	5.8	12.0	<5	0.35	0.55	158.5	1.0	0.05
W00-2-101.3	Till	101.30	30.0	2.00	29.6	11.7	790	1.69	80.3	6.7	12.0	<5	0.35	0.68	158.0	0.7	0.05
W00-2-102.3	Till	102.30	30.0	1.90	27.2	11.5	730	1.69	75.5	6.7	13.0	<5	0.35	0.69	158.0	1.0	0.05
W00-2-103.3	Till	103.30	40.0	2.00	28.0	11.4	730	1.66	74.0	6.5	12.0	<5	0.35	0.68	152.0	1.3	0.05
W00-2-104.45	Till	104.45	30.0	2.05	26.4	11.9	740	1.70	76.6	6.5	10.0	<5	0.35	0.54	153.5	1.2	0.05
W00-2-105.5	Till	105.50	30.0	2.50	30.8	11.5	930	1.67	76.2	6.5	10.0	<5	0.35	0.56	160.0	1.3	0.05
W00-2-107.7	Till	107.70	40.0	2.25	27.8	11.7	910	1.68	79.6	7.3	11.0	<5	0.40	0.62	149.0	1.0	0.05
W00-2-108.7	Till	108.70	30.0	1.55	26.6	11.1	720	1.63	70.0	7.1	11.0	<5	0.30	0.50	158.5	1.2	0.05
W00-2-109.6	Till	109.60	30.0	1.60	27.6	11.6	740	1.66	74.8	6.8	11.0	<5	0.35	0.67	164.0	0.9	<0.05
W00-2-111.45	Silt & Clay	111.45	20.0	1.40	23.8	9.6	680	1.71	66.6	6.6	11.0	<5	0.35	0.65	186.0	0.7	0.05

Appendix 3 - Table A3-7: Geochemical Analysis of Samples from Corehole WEPA00-2

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-2-97.3	Till	97.30	0.8	0.60	11.0	<100	0.32	1.1	3.5	124.0	3.0	22.5	<100	<200
W00-2-98.3	Till	98.30	0.8	0.60	12.0	<100	0.34	1.1	4.0	120.0	3.0	24.0	<100	<200
W00-2-99.3	Till	99.30	0.9	0.58	12.0	<100	0.32	2.7	4.5	126.0	3.0	23.2	<100	<200
W00-2-100.3	Till	100.30	0.8	0.58	10.0	<100	0.33	3.1	2.9	122.0	3.0	22.6	120	<200
W00-2-101.3	Till	101.30	1.1	0.58	11.0	<100	0.32	1.1	4.1	121.0	2.0	23.3	120	<200
W00-2-102.3	Till	102.30	1.0	0.56	12.0	<100	0.33	1.5	3.6	126.0	3.0	21.7	<100	550
W00-2-103.3	Till	103.30	0.8	0.56	12.0	<100	0.33	1.5	3.5	120.0	2.0	21.3	140	<200
W00-2-104.45	Till	104.45	0.9	0.58	12.0	<100	0.33	1.1	3.7	125.0	<2	21.7	<100	<200
W00-2-105.5	Till	105.50	0.9	0.60	11.0	<100	0.32	1.0	3.6	118.0	<2	27.9	<100	590
W00-2-107.7	Till	107.70	1.1	0.60	12.0	<100	0.32	1.2	5.1	131.0	3.0	23.6	<100	440
W00-2-108.7	Till	108.70	1.0	0.54	12.0	<100	0.31	0.9	3.7	113.0	<2	21.1	<100	520
W00-2-109.6	Till	109.60	0.6	0.56	11.0	<100	0.33	1.5	4.3	119.0	2.0	22.6	100	380
W00-2-111.45	Silt & Clay	111.45	1.0	0.52	12.0	<100	0.30	0.8	3.8	103.0	2.0	20.5	<100	<200

Notes: < denotes less than
NAA denotes neutron activation analysis
CVAA denotes analysis by cold vapour atomic absorption
IMS denotes plasma-mass spectrometry analysis
All results are reported on a dry basis.
Ba* and Cr* denotes acid soluble portion
* W00-2-14.2 denotes sample duplicate of W00-2-14.2

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-3-1.3	Till	1.30	6.9	<2	5.60	0.9	5.2	660.0	413.5	1.20	0.43	1.7	0.40	3.21	74.0	3.0	63.0
W00-3-4.0	Till	4.00	8.1	13.0	4.03	0.5	4.0	540.0	329.0	0.95	0.40	1.7	0.20	3.17	70.0	2.8	65.0
W00-3-5.0	Till	5.00	7.5	<2	4.88	0.4	4.5	400.0	393.0	1.10	0.41	2.1	0.60	3.28	56.0	2.2	63.0
W00-3-6.5	Till	6.50	10.7	<2	5.64	0.5	6.4	500.0	422.0	1.15	0.43	1.3	0.68	3.58	64.0	2.6	55.0
W00-3-7.6	Till	7.60	8.1	3.0	5.65	0.6	4.8	550.0	407.5	1.20	0.43	1.6	0.24	3.42	75.0	3.0	68.0
W00-3-8.75	Till	8.75	7.4	4.0	5.81	0.5	6.5	510.0	409.5	1.15	0.42	1.6	0.60	3.55	67.0	3.1	68.0
W00-3-17.5	Till	17.50	8.6	<2	5.68	0.5	6.4	530.0	420.5	1.25	0.42	2.2	0.52	4.20	69.0	3.1	76.0
W00-3-18.5	Till	18.50	11.0	4.0	5.58	0.6	6.4	520.0	437.5	1.10	0.46	1.7	0.52	3.22	64.0	3.2	71.0
W00-3-19.5	Till	19.50	7.0	<2	6.11	0.5	5.7	520.0	444.0	1.10	0.46	1.3	0.32	3.01	65.0	3.4	75.0
W00-3-20.5	Till	20.50	8.3	<2	5.95	0.6	6.8	540.0	410.5	1.30	0.42	2.4	0.34	3.16	70.0	3.7	77.0
W00-3-22.25	Till	22.25	6.9	<2	5.96	0.6	6.2	500.0	438.5	1.30	0.43	2.3	0.32	2.85	56.0	3.5	72.0
W00-3-23.5	Till	23.50	8.3	<2	5.99	0.6	5.7	540.0	446.5	1.35	0.42	2.2	0.34	2.88	75.0	3.4	60.0
W00-3-26.7	Till	26.70	9.2	<2	5.59	0.9	13.0	770.0	407.0	1.20	0.41	2.2	0.58	3.02	76.0	5.0	83.0
W00-3-27.3	Till	27.30	9.2	<2	5.10	0.6	7.0	510.0	408.5	1.15	0.41	2.3	0.96	2.75	70.0	3.5	73.0
W00-3-28.5	Till	28.50	7.0	<2	5.55	0.9	11.0	700.0	413.5	1.35	0.42	1.6	0.54	3.33	85.0	3.9	79.0
W00-3-29.5	Till	29.50	6.4	<2	5.28	0.5	5.8	500.0	430.5	1.15	0.43	1.4	0.40	3.26	62.0	3.0	75.0
* W00-3-29.5	Till	29.50	6.2	<2	5.46	0.6	6.7	540.0	418.5	1.25	0.42	1.9	0.28	3.29	72.0	3.3	55.0
W00-3-30.5	Till	30.50	5.2	<2	5.71	0.5	5.8	520.0	486.5	1.20	0.42	1.5	0.40	3.22	57.0	2.9	43.0
W00-3-32.2	Till	32.20	6.4	<2	6.58	0.5	6.8	510.0	531.8	1.55	0.51	1.9	0.36	3.81	73.0	2.9	70.0
W00-3-33.35	Till	33.35	9.0	<2	5.65	0.6	6.1	580.0	412.0	1.10	0.42	1.7	0.34	3.67	73.0	3.3	65.0
W00-3-34.3	Till	34.30	6.5	<2	5.19	0.5	5.6	550.0	428.0	1.15	0.42	1.8	0.38	3.99	62.0	2.6	57.0
W00-3-35.55	Till	35.55	7.2	4.0	5.55	0.5	5.3	530.0	427.0	1.35	0.43	2.2	0.40	3.95	57.0	2.5	68.0
W00-3-36.65	Till	36.65	8.3	<2	5.55	0.5	5.7	500.0	424.5	1.25	0.43	1.8	0.50	3.37	68.0	3.1	63.0
W00-3-38.0	Till	38.00	7.3	<2	5.78	0.5	5.8	560.0	441.0	1.25	0.43	1.8	5.42	3.38	63.0	3.3	62.0
W00-3-39.8	Till	39.80	8.3	<2	6.41	0.5	6.4	500.0	455.5	1.60	0.45	1.9	0.34	2.69	66.0	3.7	56.0
W00-3-41.2	Till	41.20	9.4	<2	6.17	0.6	7.7	610.0	433.0	1.20	0.45	2.0	0.38	3.09	67.0	4.3	75.0
W00-3-43.2	Till	43.20	11.3	<2	4.71	0.6	6.7	570.0	339.5	1.10	0.34	1.7	0.28	2.51	73.0	3.6	65.0
W00-3-44.2	Till	44.20	6.4	<2	5.59	0.6	6.9	530.0	446.0	1.20	0.44	2.1	0.50	3.20	73.0	3.1	65.0
W00-3-45.2	Till	45.20	8.2	<2	5.83	0.9	13.0	760.0	480.5	1.35	0.43	2.3	0.46	3.44	69.0	4.8	72.0
W00-3-46.25	Till	46.25	7.4	<2	5.76	0.6	5.8	540.0	435.0	1.15	0.42	1.4	1.34	3.45	68.0	4.0	67.0
W00-3-47.3	Till	47.30	7.0	<2	5.89	0.5	6.7	560.0	438.0	1.40	0.44	1.9	0.44	3.44	71.0	3.4	66.0
W00-3-48.3	Till	48.30	6.2	<2	5.94	0.6	6.7	560.0	476.0	1.15	0.42	2.2	0.34	3.40	73.0	3.4	59.0

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-3-1.3	Till	1.30	55.0	12.0	25.0	1.0	12.15	1.25	10.0	<50	2.1	35.0	15.0	32.4	0.3	1.63	190
W00-3-4.0	Till	4.00	38.0	11.0	17.6	1.0	8.65	1.10	9.0	<50	2.2	34.0	11.5	25.2	0.3	1.38	190
W00-3-5.0	Till	5.00	47.0	7.0	24.4	<1	10.60	1.20	10.0	<50	1.9	26.0	18.0	28.4	0.3	1.61	365
W00-3-6.5	Till	6.50	56.0	8.0	27.8	<1	12.85	1.25	9.0	<50	2.5	31.0	17.5	34.0	0.3	1.83	260
W00-3-7.6	Till	7.60	54.0	9.0	24.8	<1	11.85	1.15	8.0	<50	2.4	34.0	13.5	31.8	0.3	1.78	560
W00-3-8.75	Till	8.75	59.0	11.0	28.0	<1	12.20	1.15	7.0	<50	3.1	34.0	14.5	31.6	0.3	1.86	300
W00-3-17.5	Till	17.50	58.0	10.0	31.2	1.0	12.60	1.20	8.0	<50	3.1	36.0	15.0	35.0	0.3	2.08	500
W00-3-18.5	Till	18.50	54.0	9.0	29.2	2.0	13.05	1.30	7.0	<50	2.8	34.0	18.5	36.0	0.3	1.64	445
W00-3-19.5	Till	19.50	61.0	12.0	33.4	2.0	14.15	1.40	9.0	<50	2.6	35.0	17.5	40.2	0.3	1.65	485
W00-3-20.5	Till	20.50	57.0	13.0	25.8	1.0	12.30	1.15	8.0	<50	2.9	35.0	15.5	35.2	0.3	1.74	485
W00-3-22.25	Till	22.25	60.0	12.0	26.6	<1	13.45	1.25	8.0	<50	2.6	35.0	15.0	36.6	0.2	1.59	485
W00-3-23.5	Till	23.50	59.0	12.0	29.4	1.0	13.50	1.30	8.0	<50	2.8	36.0	24.5	38.0	0.3	1.62	485
W00-3-26.7	Till	26.70	53.0	11.0	26.4	1.0	12.30	1.30	9.0	<50	3.3	34.0	13.5	33.6	0.3	1.53	450
W00-3-27.3	Till	27.30	47.0	17.0	22.2	<1	11.15	1.25	8.0	<50	2.6	33.0	12.5	31.2	0.3	1.36	395
W00-3-28.5	Till	28.50	54.0	9.0	25.0	<1	12.05	1.15	12.0	<50	2.9	41.0	13.5	34.8	0.4	1.68	445
W00-3-29.5	Till	29.50	51.0	13.0	25.6	2.0	12.40	1.15	9.0	<50	2.8	33.0	14.0	36.6	0.3	1.59	420
* W00-3-29.5	Till	29.50	52.0	13.0	24.0	3.0	12.15	1.25	7.0	<50	2.6	34.0	14.0	36.0	0.2	1.62	435
W00-3-30.5	Till	30.50	56.0	12.0	26.4	2.0	12.90	1.25	8.0	<50	2.4	28.0	15.0	37.0	<0.2	1.66	460
W00-3-32.2	Till	32.20	69.0	7.0	33.4	1.0	15.85	1.55	8.0	<50	2.5	32.0	19.0	45.8	0.2	1.91	520
W00-3-33.35	Till	33.35	55.0	10.0	34.2	2.0	12.25	1.15	8.0	<50	2.6	33.0	16.0	34.0	0.2	1.86	465
W00-3-34.3	Till	34.30	50.0	11.0	27.2	<1	11.60	1.15	7.0	<50	2.5	30.0	25.0	31.8	0.3	1.94	455
W00-3-35.55	Till	35.55	55.0	10.0	26.0	<1	12.35	1.15	7.0	<50	2.3	30.0	17.5	34.8	0.3	1.92	455
W00-3-36.65	Till	36.65	56.0	9.0	24.6	<1	12.25	1.20	7.0	<50	2.5	32.0	13.5	34.8	0.3	1.72	445
W00-3-38.0	Till	38.00	59.0	11.0	27.8	<1	13.05	1.25	7.0	<50	2.4	32.0	17.0	37.4	0.3	1.74	470
W00-3-39.8	Till	39.80	63.0	12.0	30.2	1.0	14.70	1.40	7.0	<50	2.6	33.0	15.5	42.8	0.3	1.60	505
W00-3-41.2	Till	41.20	61.0	12.0	29.8	1.0	13.45	1.20	7.0	<50	3.0	37.0	23.5	38.8	0.3	1.71	490
W00-3-43.2	Till	43.20	48.0	14.0	21.4	<1	10.20	1.00	7.0	<50	2.7	34.0	12.0	30.0	0.3	1.32	375
W00-3-44.2	Till	44.20	54.0	13.0	25.2	1.0	12.70	1.25	8.0	<50	2.7	34.0	15.5	36.6	0.3	1.62	450
W00-3-45.2	Till	45.20	57.0	12.0	26.0	1.0	12.95	1.20	9.0	<50	3.1	34.0	16.0	36.2	0.3	1.77	480
W00-3-46.25	Till	46.25	57.0	16.0	26.8	1.0	12.85	1.25	7.0	<50	2.6	33.0	15.5	36.2	0.3	1.77	475
W00-3-47.3	Till	47.30	59.0	12.0	26.4	1.0	12.70	1.20	7.0	<50	2.6	35.0	14.0	35.6	0.3	1.80	485
W00-3-48.3	Till	48.30	56.0	10.0	25.6	2.0	12.60	1.20	7.0	<50	2.8	34.0	16.5	35.6	0.3	1.81	490

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-3-1.3	Till	1.30	30.0	0.80	19.4	9.0	550	1.59	63.1	5.8	9.3	<5	0.55	0.85	129.0	1.1	<0.05
W00-3-4.0	Till	4.00	30.0	0.75	16.8	7.1	440	1.21	45.7	5.3	10.0	<5	0.40	0.73	111.5	1.0	<0.05
W00-3-5.0	Till	5.00	30.0	0.90	19.2	8.7	540	1.43	55.9	4.4	7.4	<5	0.30	0.56	126.0	0.6	<0.05
W00-3-6.5	Till	6.50	30.0	1.05	26.8	9.6	560	1.70	66.5	5.0	9.0	<5	0.35	0.71	135.0	1.0	0.05
W00-3-7.6	Till	7.60	40.0	1.15	24.2	9.1	570	1.60	61.9	5.3	10.0	<5	0.25	0.76	134.5	1.1	<0.05
W00-3-8.75	Till	8.75	40.0	0.90	19.6	9.5	640	1.69	64.1	5.2	10.0	<5	0.30	0.73	134.5	0.9	<0.05
W00-3-17.5	Till	17.50	30.0	1.30	25.2	9.6	560	1.65	64.8	5.4	11.0	<5	0.30	0.75	148.0	0.8	<0.05
W00-3-18.5	Till	18.50	30.0	1.15	25.0	10.1	570	1.63	66.2	5.2	10.0	<5	0.35	0.75	139.0	1.0	<0.05
W00-3-19.5	Till	19.50	20.0	1.20	27.6	10.5	590	1.73	72.3	5.4	10.0	<5	0.40	0.74	144.5	0.9	<0.05
W00-3-20.5	Till	20.50	30.0	0.90	23.6	8.9	580	1.66	64.2	5.5	11.0	<5	0.25	0.74	142.0	1.0	<0.05
W00-3-22.25	Till	22.25	20.0	1.05	25.2	10.0	610	1.70	69.1	5.3	10.0	<5	0.30	0.73	144.0	0.8	<0.05
W00-3-23.5	Till	23.50	30.0	1.05	27.6	10.4	600	1.71	70.1	5.5	10.0	<5	0.60	0.74	144.5	0.9	0.05
W00-3-26.7	Till	26.70	20.0	1.05	22.8	9.6	580	1.58	61.8	5.7	12.0	<5	0.30	0.57	136.0	1.0	<0.05
W00-3-27.3	Till	27.30	10.0	0.85	21.0	8.9	520	1.45	58.7	5.4	10.0	<5	0.90	0.72	130.5	1.3	<0.05
W00-3-28.5	Till	28.50	30.0	1.00	23.2	9.0	600	1.59	60.9	6.4	11.0	<5	0.35	0.73	140.0	1.0	<0.05
W00-3-29.5	Till	29.50	30.0	1.10	24.2	8.9	540	1.59	64.6	4.9	9.5	<5	0.35	0.69	139.5	0.9	<0.05
* W00-3-29.5	Till	29.50	20.0	1.10	23.6	8.9	540	1.62	62.7	5.5	10.0	<5	0.30	0.76	138.5	1.0	<0.05
W00-3-30.5	Till	30.50	20.0	1.15	25.0	9.3	580	1.68	66.7	4.6	7.9	<5	0.40	0.57	143.5	0.8	<0.05
W00-3-32.2	Till	32.20	30.0	1.35	31.2	11.2	710	2.01	82.3	5.1	9.3	<5	0.35	0.68	172.5	0.9	<0.05
W00-3-33.35	Till	33.35	30.0	1.25	23.8	9.4	580	1.66	62.5	5.3	9.3	<5	0.30	0.71	142.5	0.9	<0.05
W00-3-34.3	Till	34.30	20.0	0.95	22.6	9.1	580	1.62	61.3	5.0	8.8	<5	0.30	0.70	149.0	0.8	<0.05
W00-3-35.55	Till	35.55	30.0	1.05	25.6	9.3	570	1.65	64.8	4.8	8.5	<5	0.40	0.71	146.5	0.7	<0.05
W00-3-36.65	Till	36.65	30.0	1.00	23.6	8.9	570	1.61	64.1	5.0	9.0	<5	0.50	0.72	139.0	0.7	<0.05
W00-3-38.0	Till	38.00	30.0	1.10	26.2	9.8	600	1.69	69.4	5.1	9.5	<5	0.50	0.71	144.0	0.9	<0.05
W00-3-39.8	Till	39.80	30.0	1.15	29.2	11.0	620	1.79	76.0	5.3	10.0	<5	0.60	0.70	143.0	1.0	<0.05
W00-3-41.2	Till	41.20	40.0	1.05	26.0	9.4	610	1.75	69.9	5.9	12.0	<5	0.55	0.70	142.5	1.1	0.05
W00-3-43.2	Till	43.20	30.0	0.85	19.8	7.2	480	1.35	53.2	5.6	10.0	<5	0.50	0.71	108.0	1.1	<0.05
W00-3-44.2	Till	44.20	30.0	1.00	24.6	9.0	570	1.66	66.3	5.5	11.0	<5	0.50	0.69	136.5	1.0	<0.05
W00-3-45.2	Till	45.20	20.0	1.35	25.2	8.9	590	1.72	68.4	5.8	11.0	<5	0.45	0.50	146.5	0.9	<0.05
W00-3-46.25	Till	46.25	20.0	1.10	25.6	9.3	580	1.71	67.5	5.5	10.0	<5	0.50	0.72	148.0	0.7	<0.05
W00-3-47.3	Till	47.30	30.0	1.20	25.6	9.1	610	1.71	67.3	5.6	10.0	<5	0.50	0.75	142.5	1.0	<0.05
W00-3-48.3	Till	48.30	30.0	1.15	24.8	9.1	560	1.71	65.0	5.5	10.0	<5	0.45	0.73	142.5	1.1	0.05

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-3-1.3	Till	1.30	0.9	0.44	10.0	<100	0.27	0.8	4.1	91.0	2.0	17.3	<100	<200
W00-3-4.0	Till	4.00	0.8	0.34	9.5	<100	0.22	0.5	2.5	62.0	<2	14.8	<100	<200
W00-3-5.0	Till	5.00	<0.5	0.40	7.7	<100	0.26	0.9	2.3	78.0	<2	16.6	<100	510
W00-3-6.5	Till	6.50	<0.5	0.48	8.8	<100	0.27	0.7	2.3	92.0	<2	17.3	<100	<200
W00-3-7.6	Till	7.60	0.6	0.44	9.4	<100	0.28	0.7	2.6	96.0	<2	17.0	110	<200
W00-3-8.75	Till	8.75	0.9	0.42	9.1	<100	0.28	0.7	2.7	96.0	<2	17.2	<100	270
W00-3-17.5	Till	17.50	0.6	0.50	10.0	<100	0.28	0.8	2.4	102.0	<2	17.0	<100	270
W00-3-18.5	Till	18.50	0.7	0.48	8.9	<100	0.28	0.8	2.6	88.0	<2	18.3	<100	340
W00-3-19.5	Till	19.50	0.5	0.50	9.1	<100	0.30	0.8	2.5	101.0	<2	18.8	<100	410
W00-3-20.5	Till	20.50	0.6	0.44	10.0	<100	0.28	0.7	2.8	98.0	2.0	17.6	110	<200
W00-3-22.25	Till	22.25	0.6	0.46	9.2	<100	0.29	0.8	2.8	98.0	<2	18.5	<100	330
W00-3-23.5	Till	23.50	0.7	0.50	10.0	<100	0.29	0.8	2.7	99.0	<2	18.0	<100	<200
W00-3-26.7	Till	26.70	0.7	0.44	10.0	<100	0.28	0.8	2.9	88.0	2.0	17.1	110	<200
W00-3-27.3	Till	27.30	<0.5	0.42	9.3	<100	0.26	0.7	2.8	79.0	<2	16.6	<100	<200
W00-3-28.5	Till	28.50	0.8	0.44	11.0	<100	0.27	0.7	4.1	90.0	3.0	17.4	<100	480
W00-3-29.5	Till	29.50	0.7	0.44	9.0	<100	0.25	0.7	2.3	87.0	<2	17.8	110	<200
* W00-3-29.5	Till	29.50	0.6	0.46	10.0	<100	0.27	0.7	2.9	86.0	<2	17.8	<100	<200
W00-3-30.5	Till	30.50	<0.5	0.48	8.5	<100	0.27	0.7	2.5	97.0	<2	17.7	<100	340
W00-3-32.2	Till	32.20	0.8	0.56	10.0	<100	0.33	0.9	2.7	108.0	<2	22.0	<100	<200
W00-3-33.35	Till	33.35	0.6	0.46	9.3	<100	0.27	0.8	2.6	94.0	<2	16.9	<100	330
W00-3-34.3	Till	34.30	0.7	0.44	9.0	<100	0.26	0.8	2.6	83.0	<2	17.2	<100	330
W00-3-35.55	Till	35.55	0.5	0.50	8.4	<100	0.26	0.8	2.4	94.0	<2	17.2	<100	290
W00-3-36.65	Till	36.65	0.6	0.44	9.1	<100	0.26	0.7	2.6	92.0	<2	17.3	<100	<200
W00-3-38.0	Till	38.00	0.6	0.50	9.1	<100	0.28	0.8	2.6	98.0	<2	18.4	<100	<200
W00-3-39.8	Till	39.80	0.7	0.52	9.3	<100	0.31	0.8	2.7	109.0	<2	19.1	<100	290
W00-3-41.2	Till	41.20	0.8	0.50	11.0	<100	0.28	1.0	2.6	104.0	<2	18.2	<100	<200
W00-3-43.2	Till	43.20	0.7	0.38	10.0	<100	0.22	0.6	2.7	80.0	<2	14.0	<100	<200
W00-3-44.2	Till	44.20	0.6	0.48	10.0	<100	0.27	0.7	2.7	92.0	2.0	17.9	<100	<200
W00-3-45.2	Till	45.20	0.7	0.48	10.0	<100	0.27	0.7	2.8	97.0	2.0	18.1	120	390
W00-3-46.25	Till	46.25	0.6	0.50	10.0	<100	0.27	0.7	2.7	95.0	2.0	17.9	<100	360
W00-3-47.3	Till	47.30	0.7	0.48	10.0	<100	0.27	0.7	2.7	98.0	<2	17.8	<100	500
W00-3-48.3	Till	48.30	0.6	0.48	10.0	<100	0.28	0.6	2.9	92.0	<2	18.0	<100	<200

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-3-49.3	Till	49.30	6.0	<2	6.08	0.5	6.4	520.0	451.5	1.40	0.44	1.6	0.36	3.46	74.0	3.8	67.0
W00-3-50.5	Till	50.50	7.2	<2	5.65	0.6	6.4	520.0	431.0	1.30	0.42	1.7	0.32	3.34	66.0	3.2	58.0
W00-3-51.5	Till	51.50	6.3	<2	6.06	0.6	5.9	530.0	430.5	1.25	0.42	2.1	0.36	3.48	65.0	2.9	68.0
* W00-3-51.5	Till	51.50	5.2	<2	6.15	0.6	5.8	540.0	441.0	1.30	0.44	1.9	0.40	3.52	72.0	4.1	64.0
W00-3-52.5	Till	52.50	5.1	<2	5.63	0.6	6.4	520.0	416.5	1.15	0.41	1.7	0.36	3.29	66.0	3.2	55.0
W00-3-53.5	Till	53.50	7.3	<2	6.18	0.6	7.0	530.0	410.0	1.35	0.41	1.8	0.26	3.08	79.0	3.3	75.0
W00-3-54.5	Till	54.50	6.5	<2	5.87	0.6	6.5	510.0	441.0	1.35	0.44	1.6	0.26	3.16	71.0	3.0	71.0
W00-3-55.5	Till	55.50	6.6	<2	6.72	0.5	5.5	480.0	448.5	1.50	0.45	1.8	0.32	2.75	69.0	2.5	68.0
W00-3-56.6	Till	56.60	10.5	<2	7.14	0.6	7.4	530.0	456.0	1.85	0.47	2.0	0.40	2.53	81.0	3.7	70.0
W00-3-57.6	Till	57.60	6.2	<2	6.87	0.7	9.4	660.0	452.5	1.55	0.44	2.2	0.32	2.63	81.0	4.4	72.0
W00-3-58.6	Till	58.60	6.0	<2	7.00	0.6	7.4	590.0	468.5	1.60	0.48	1.8	0.32	2.68	73.0	4.6	80.0
W00-3-59.6	Till	59.60	7.3	<2	6.48	0.9	13.0	800.0	479.0	1.50	0.47	2.3	0.34	2.78	72.0	5.0	78.0
W00-3-60.6	Till	60.60	6.3	<2	6.95	0.6	7.6	650.0	450.5	1.65	0.46	2.1	0.38	2.67	80.0	4.2	76.0
W00-3-62.0	Till	62.00	6.4	<2	5.94	0.6	7.5	540.0	458.0	1.45	0.42	1.7	0.36	2.77	79.0	4.0	73.0
W00-3-63.0	Till	63.00	5.7	<2	6.39	0.6	6.6	560.0	438.0	1.45	0.41	1.9	0.56	2.97	69.0	3.6	61.0
W00-3-64.1	Till	64.10	6.5	<2	6.19	0.5	6.0	560.0	434.5	1.35	0.41	1.7	0.44	2.86	70.0	2.9	62.0
W00-3-65.45	Till	65.45	7.1	6.0	6.73	0.6	6.5	580.0	473.5	1.45	0.46	2.1	0.34	2.59	76.0	4.2	72.0
W00-3-66.5	Till	66.50	7.1	<2	6.37	0.6	7.6	590.0	475.5	1.55	0.43	1.7	0.34	2.88	74.0	3.9	81.0
W00-3-68.0	Till	68.00	6.2	<2	6.67	0.6	6.3	570.0	452.0	1.45	0.44	2.1	0.30	2.82	81.0	4.2	63.0
W00-3-68.9	Till	68.90	6.3	<2	6.83	0.6	6.8	590.0	430.0	1.50	0.44	1.5	0.38	2.53	78.0	3.6	63.0
W00-3-73.3	Till	73.30	7.2	<2	6.32	0.6	7.1	540.0	429.0	1.40	0.43	1.7	3.70	3.00	82.0	4.1	75.0
W00-3-77.05	Till & Clay	77.05	6.5	<2	6.10	0.6	6.6	550.0	446.0	1.30	0.43	1.9	0.34	3.14	77.0	3.3	62.0
* W00-3-77.05	Till & Clay	77.05	7.5	<2	6.09	0.6	6.3	570.0	438.0	1.35	0.43	1.9	0.52	3.12	71.0	3.2	58.0
W00-3-77.85	Till	77.85	7.1	<2	5.82	0.6	5.7	570.0	457.0	1.50	0.43	2.0	0.26	1.01	72.0	3.2	70.0
W00-3-78.35	Till	78.35	8.3	<2	5.92	0.6	11.0	560.0	424.0	1.30	0.41	1.3	0.48	1.01	78.0	4.0	68.0
W00-3-78.85	Till	78.85	6.8	<2	5.92	0.6	26.0	550.0	428.0	1.45	0.46	1.7	0.42	0.95	75.0	4.5	70.0
W00-3-79.85	Till	79.85	9.7	<2	6.00	0.6	12.0	560.0	427.5	1.40	0.42	1.2	0.42	1.28	83.0	3.9	57.0
W00-3-80.85	Till	80.85	7.5	5.0	6.14	0.6	6.7	550.0	428.0	1.45	0.45	1.2	1.04	1.24	84.0	3.4	67.0
W00-3-82.55	Till	82.55	7.3	5.0	6.19	0.6	7.3	520.0	408.5	1.30	0.43	1.4	0.24	1.25	85.0	4.3	80.0
W00-3-83.60	Till	83.60	7.3	<2	6.13	0.9	12.0	710.0	434.5	1.35	0.44	2.1	0.32	1.27	84.0	4.3	85.0
W00-3-84.6	Till	84.60	5.7	<2	6.06	0.5	7.1	550.0	420.5	1.35	0.44	1.7	0.22	1.26	92.0	4.0	70.0
W00-3-92.0	Till	92.00	6.7	<2	6.10	0.6	7.9	610.0	480.5	1.30	0.43	1.5	0.24	1.39	81.0	3.7	63.0

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-3-49.3	Till	49.30	59.0	10.0	25.8	1.0	12.80	1.25	8.0	<50	2.7	34.0	16.5	36.6	0.3	1.85	495
W00-3-50.5	Till	50.50	53.0	11.0	25.8	1.0	12.35	1.20	7.0	<50	2.7	33.0	15.5	35.0	0.3	1.75	470
W00-3-51.5	Till	51.50	57.0	11.0	25.4	1.0	12.90	1.20	8.0	<50	2.5	32.0	14.5	36.0	0.3	1.85	495
* W00-3-51.5	Till	51.50	57.0	12.0	26.6	2.0	13.05	1.30	8.0	<50	2.8	34.0	13.5	37.8	0.3	1.89	515
W00-3-52.5	Till	52.50	63.0	11.0	25.0	<1	12.20	1.20	8.0	<50	2.6	32.0	15.5	36.2	0.3	1.69	465
W00-3-53.5	Till	53.50	58.0	10.0	25.0	2.0	12.75	1.15	8.0	<50	2.7	32.0	13.5	37.0	0.2	1.74	495
W00-3-54.5	Till	54.50	56.0	11.0	26.6	2.0	12.80	1.20	8.0	<50	2.7	34.0	16.5	37.6	0.3	1.68	475
W00-3-55.5	Till	55.50	63.0	11.0	29.6	<1	14.50	1.35	8.0	<50	2.5	32.0	18.5	42.6	0.3	1.65	515
W00-3-56.6	Till	56.60	73.0	10.0	33.2	2.0	15.90	1.30	8.0	<50	3.0	35.0	16.0	48.2	0.3	1.70	590
W00-3-57.6	Till	57.60	66.0	11.0	29.8	3.0	14.80	1.30	7.0	<50	3.3	38.0	16.0	42.8	0.3	1.74	550
W00-3-58.6	Till	58.60	69.0	17.0	41.6	<1	15.85	1.40	8.0	<50	3.2	38.0	46.5	46.8	0.3	1.78	590
W00-3-59.6	Till	59.60	66.0	13.0	29.2	1.0	14.35	1.30	8.0	<50	3.3	34.0	15.0	41.2	0.3	1.74	540
W00-3-60.6	Till	60.60	71.0	16.0	30.8	1.0	15.35	1.40	8.0	<50	3.1	37.0	15.0	44.6	0.3	1.77	590
W00-3-62.0	Till	62.00	57.0	12.0	28.0	1.0	13.60	1.30	6.0	<50	3.1	38.0	15.0	39.2	0.3	1.55	500
W00-3-63.0	Till	63.00	60.0	15.0	27.2	<1	13.05	1.25	8.0	<50	2.8	34.0	17.5	37.4	0.2	1.68	540
W00-3-64.1	Till	64.10	57.0	12.0	25.8	<1	13.00	1.20	6.0	<50	2.6	34.0	15.0	37.6	0.2	1.62	510
W00-3-65.45	Till	65.45	65.0	11.0	31.2	2.0	14.60	1.35	8.0	<50	3.0	35.0	18.5	43.2	0.2	1.62	520
W00-3-66.5	Till	66.50	62.0	11.0	31.8	2.0	13.80	1.35	7.0	<50	2.9	37.0	21.5	40.4	0.3	1.66	505
W00-3-68.0	Till	68.00	62.0	15.0	30.0	<1	14.35	1.30	7.0	<50	2.8	36.0	19.0	42.4	0.2	1.65	500
W00-3-68.9	Till	68.90	65.0	13.0	30.2	2.0	14.85	1.35	7.0	<50	3.1	37.0	15.0	43.2	0.3	1.61	520
W00-3-73.3	Till	73.30	62.0	14.0	27.8	1.0	13.55	1.25	7.0	<50	2.9	38.0	13.5	39.6	0.3	1.77	530
W00-3-77.05	Till & Clay	77.05	56.0	12.0	27.2	<1	13.15	1.25	8.0	<50	2.7	35.0	16.0	37.6	0.3	1.80	575
* W00-3-77.05	Till & Clay	77.05	55.0	13.0	26.4	<1	12.80	1.20	8.0	<50	2.7	34.0	15.0	37.2	0.3	1.79	580
W00-3-77.85	Till	77.85	49.0	12.0	23.6	2.0	12.45	1.50	8.0	<50	2.7	35.0	18.0	32.0	<0.2	0.76	455
W00-3-78.35	Till	78.35	49.0	13.0	24.8	2.0	12.35	1.50	11.0	<50	3.1	40.0	15.0	31.4	0.3	0.77	395
W00-3-78.85	Till	78.85	50.0	11.0	25.0	2.0	12.65	1.45	12.0	<50	3.1	40.0	16.0	33.0	0.3	0.75	350
W00-3-79.85	Till	79.85	49.0	11.0	23.8	2.0	12.30	1.45	12.0	<50	3.0	40.0	15.5	34.6	0.3	0.90	530
W00-3-80.85	Till	80.85	56.0	13.0	27.2	<1	12.85	1.45	12.0	<50	2.6	39.0	24.0	37.8	0.4	0.94	500
W00-3-82.55	Till	82.55	55.0	13.0	24.0	<1	12.75	1.40	10.0	<50	2.7	37.0	16.5	37.8	0.3	0.95	475
W00-3-83.60	Till	83.60	54.0	11.0	26.0	<1	13.55	1.50	9.0	<50	3.6	35.0	15.0	39.8	0.3	0.94	460
W00-3-84.6	Till	84.60	52.0	17.0	25.8	1.0	13.05	1.40	12.0	<50	2.9	39.0	16.0	38.6	0.3	0.96	455
W00-3-92.0	Till	92.00	51.0	11.0	27.8	2.0	13.50	1.45	12.0	<50	2.9	40.0	22.5	38.8	0.4	0.93	430

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-3-49.3	Till	49.30	30.0	1.10	25.2	9.2	580	1.76	66.7	5.5	10.0	<5	0.50	0.75	150.5	1.0	<0.05
W00-3-50.5	Till	50.50	30.0	1.05	23.8	8.7	530	1.69	64.4	5.5	9.4	<5	0.30	0.72	138.0	0.8	<0.05
W00-3-51.5	Till	51.50	30.0	1.10	25.2	9.3	560	1.72	66.5	5.4	9.3	<5	0.30	0.70	150.0	1.1	<0.05
* W00-3-51.5	Till	51.50	20.0	1.20	26.2	9.7	570	1.75	68.1	5.8	11.0	<5	0.30	0.73	148.5	1.3	<0.05
W00-3-52.5	Till	52.50	20.0	1.15	24.6	9.1	560	1.64	64.1	5.4	9.5	<5	0.30	0.74	138.0	1.1	<0.05
W00-3-53.5	Till	53.50	30.0	1.05	23.8	9.0	570	1.69	65.2	5.3	10.0	<5	0.30	0.69	138.0	0.9	<0.05
W00-3-54.5	Till	54.50	40.0	1.00	24.8	9.2	560	1.70	67.2	5.2	10.0	<5	0.30	0.67	142.5	0.8	<0.05
W00-3-55.5	Till	55.50	30.0	1.15	29.0	10.5	600	1.81	75.6	5.0	9.0	<5	0.30	0.67	147.0	0.6	<0.05
W00-3-56.6	Till	56.60	30.0	1.25	32.2	11.5	650	1.91	83.1	5.6	10.0	<5	0.35	0.64	147.0	1.1	0.05
W00-3-57.6	Till	57.60	30.0	1.10	29.2	10.6	630	1.85	76.1	6.3	12.0	<5	0.30	0.71	144.5	1.0	<0.05
W00-3-58.6	Till	58.60	30.0	1.20	31.8	11.2	620	1.90	82.9	6.1	12.0	<5	0.35	0.72	152.5	1.2	<0.05
W00-3-59.6	Till	59.60	30.0	1.05	28.2	10.6	610	1.77	73.2	5.9	11.0	<5	0.30	0.50	147.0	1.0	<0.05
W00-3-60.6	Till	60.60	30.0	1.15	30.4	11.2	650	1.87	78.4	6.0	11.0	<5	0.40	0.73	144.0	1.1	<0.05
W00-3-62.0	Till	62.00	20.0	1.00	26.4	10.3	550	1.72	70.0	6.1	12.0	<5	0.30	0.73	138.5	1.1	0.05
W00-3-63.0	Till	63.00	20.0	1.05	26.4	9.7	580	1.78	67.8	5.8	10.0	<5	0.40	0.70	139.0	1.1	0.05
W00-3-64.1	Till	64.10	30.0	0.95	25.4	9.2	570	1.73	67.3	5.7	10.0	<5	0.30	0.70	132.5	1.1	<0.05
W00-3-65.45	Till	65.45	30.0	1.15	28.8	10.9	580	1.80	76.1	5.8	10.0	<5	0.30	0.75	139.5	1.0	0.05
W00-3-66.5	Till	66.50	30.0	1.05	27.8	10.5	580	1.77	71.9	5.8	11.0	<5	0.40	0.69	140.0	0.9	<0.05
W00-3-68.0	Till	68.00	30.0	1.10	28.4	10.3	560	1.82	74.0	5.8	10.0	<5	0.35	0.73	140.0	1.1	<0.05
W00-3-68.9	Till	68.90	30.0	1.10	29.8	10.6	600	1.84	75.1	5.9	12.0	<5	0.35	0.74	139.5	0.9	0.05
W00-3-73.3	Till	73.30	30.0	1.05	27.0	9.7	620	1.74	70.1	5.9	11.0	<5	0.30	0.70	143.0	1.0	<0.05
W00-3-77.05	Till & Clay	77.05	30.0	1.00	25.6	9.6	580	1.69	67.8	5.6	10.0	<5	0.25	0.78	150.5	0.9	<0.05
* W00-3-77.05	Till & Clay	77.05	30.0	1.05	25.4	9.4	550	1.69	66.7	5.4	10.0	<5	0.30	0.74	145.0	0.9	<0.05
W00-3-77.85	Till	77.85	30.0	2.25	22.6	10.5	630	1.62	66.0	5.7	10.0	<5	0.35	0.79	125.0	0.9	0.05
W00-3-78.35	Till	78.35	30.0	2.65	22.8	10.2	740	1.62	64.0	6.6	10.0	<5	0.35	0.73	119.0	1.2	<0.05
W00-3-78.85	Till	78.85	40.0	4.00	23.6	10.6	740	1.64	65.4	6.5	10.0	<5	0.30	0.70	123.5	1.1	<0.05
W00-3-79.85	Till	79.85	30.0	1.10	21.2	10.6	580	1.65	65.7	6.6	11.0	<5	0.30	0.68	128.5	1.2	<0.05
W00-3-80.85	Till	80.85	30.0	1.00	22.2	10.4	580	1.61	67.0	6.5	10.0	<5	0.35	0.65	129.0	1.6	<0.05
W00-3-82.55	Till	82.55	40.0	0.95	22.4	10.2	580	1.63	66.1	6.2	11.0	<5	0.30	0.62	130.5	0.9	<0.05
W00-3-83.60	Till	83.60	30.0	1.05	23.2	11.4	580	1.64	70.3	5.5	12.0	<5	0.35	0.50	134.0	1.0	0.05
W00-3-84.6	Till	84.60	30.0	1.35	22.8	10.5	560	1.64	67.8	6.2	11.0	<5	0.35	0.69	130.5	1.3	<0.05
W00-3-92.0	Till	92.00	30.0	1.15	23.2	10.3	590	1.66	68.7	6.6	11.0	<5	0.35	0.73	135.0	1.1	<0.05

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-3-49.3	Till	49.30	0.6	0.48	10.0	<100	0.28	0.7	2.8	96.0	<2	17.9	<100	<200
W00-3-50.5	Till	50.50	0.8	0.46	10.0	<100	0.27	0.8	2.7	87.0	<2	17.2	<100	340
W00-3-51.5	Till	51.50	0.6	0.48	10.0	<100	0.28	0.7	2.6	94.0	<2	17.9	<100	<200
* W00-3-51.5	Till	51.50	0.7	0.48	10.0	<100	0.30	0.8	2.7	96.0	<2	18.1	<100	<200
W00-3-52.5	Till	52.50	<0.5	0.46	9.5	<100	0.28	0.7	2.9	93.0	<2	17.4	<100	370
W00-3-53.5	Till	53.50	0.8	0.46	9.4	<100	0.29	0.8	2.7	96.0	<2	17.6	100	<200
W00-3-54.5	Till	54.50	0.8	0.48	10.0	<100	0.28	0.8	2.6	93.0	<2	18.2	<100	<200
W00-3-55.5	Till	55.50	0.8	0.52	8.9	<100	0.32	0.8	2.6	107.0	<2	19.5	120	350
W00-3-56.6	Till	56.60	0.6	0.56	11.0	<100	0.33	0.9	2.7	123.0	<2	20.0	<100	<200
W00-3-57.6	Till	57.60	0.6	0.52	11.0	<100	0.33	0.8	2.9	117.0	<2	18.9	<100	<200
W00-3-58.6	Till	58.60	0.7	0.56	11.0	<100	0.33	1.0	2.8	121.0	2.0	20.1	<100	<200
W00-3-59.6	Till	59.60	0.8	0.54	10.0	<100	0.31	0.8	3.2	111.0	2.0	19.1	<100	340
W00-3-60.6	Till	60.60	0.5	0.52	11.0	140	0.33	0.9	2.9	122.0	<2	19.1	140	<200
W00-3-62.0	Till	62.00	0.8	0.50	11.0	<100	0.30	0.8	2.9	94.0	2.0	18.1	<100	<200
W00-3-63.0	Till	63.00	0.7	0.48	10.0	<100	0.31	0.9	2.8	98.0	<2	18.1	<100	<200
W00-3-64.1	Till	64.10	0.7	0.46	10.0	<100	0.30	0.7	2.6	97.0	<2	17.9	<100	400
W00-3-65.45	Till	65.45	0.7	0.52	10.0	<100	0.32	0.8	2.8	107.0	<2	19.0	<100	<200
W00-3-66.5	Till	66.50	0.9	0.52	10.0	<100	0.31	0.9	2.8	101.0	<2	18.8	<100	<200
W00-3-68.0	Till	68.00	0.8	0.52	10.0	<100	0.30	0.8	2.9	103.0	<2	18.8	<100	370
W00-3-68.9	Till	68.90	0.6	0.52	11.0	<100	0.33	0.8	2.9	109.0	<2	18.3	<100	<200
W00-3-73.3	Till	73.30	0.8	0.50	11.0	<100	0.29	0.8	3.0	104.0	<2	18.3	<100	<200
W00-3-77.05	Till & Clay	77.05	<0.5	0.52	9.4	<100	0.29	0.8	2.7	95.0	<2	18.1	<100	<200
* W00-3-77.05	Till & Clay	77.05	0.7	0.54	9.4	<100	0.29	0.7	3.2	91.0	<2	17.9	160	<200
W00-3-77.85	Till	77.85	0.6	0.46	10.0	<100	0.31	0.9	3.4	81.0	<2	19.9	<100	<200
W00-3-78.35	Till	78.35	0.9	0.46	12.0	<100	0.31	0.8	2.9	84.0	3.0	19.4	110	480
W00-3-78.85	Till	78.85	0.9	0.50	12.0	<100	0.31	0.8	2.8	82.0	3.0	20.2	<100	380
W00-3-79.85	Till	79.85	0.9	0.46	11.0	<100	0.32	0.9	2.8	83.0	2.0	19.2	<100	480
W00-3-80.85	Till	80.85	0.9	0.44	11.0	<100	0.30	1.3	3.3	91.0	2.0	18.7	<100	<200
W00-3-82.55	Till	82.55	0.9	0.44	11.0	<100	0.31	0.8	3.2	89.0	<2	18.7	<100	<200
W00-3-83.60	Till	83.60	0.8	0.48	10.0	<100	0.32	0.9	2.8	89.0	2.0	19.5	<100	440
W00-3-84.6	Till	84.60	0.8	0.44	11.0	<100	0.32	0.8	3.5	86.0	2.0	18.9	<100	580
W00-3-92.0	Till	92.00	0.9	0.46	12.0	<100	0.31	1.0	3.5	90.0	3.0	19.1	<100	500

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-3-93.0	Till	93.00	8.1	<2	6.22	0.7	8.0	590.0	451.5	1.50	0.43	1.5	0.54	1.21	80.0	4.0	72.0
W00-3-93.9	Till	93.90	7.1	<2	6.35	0.7	8.2	580.0	466.5	1.50	0.44	1.6	0.32	1.21	78.0	4.1	73.0
W00-2-108.7	Till	108.70	6.9	<2	6.27	0.4	6.9	470.0	562.0	1.30	0.46	1.6	0.52	2.29	65.0	2.7	52.0
W00-3-109.75	Till	109.75	7.4	<2	6.34	0.6	8.6	580.0	406.0	1.30	0.41	1.6	1.48	1.18	76.0	4.5	61.0
W00-3-110.7	Till	110.70	7.2	<2	6.86	0.6	10.0	530.0	411.0	1.40	0.46	1.0	0.66	1.25	80.0	4.6	85.0
W00-3-111.75	Till	111.75	7.7	<2	5.64	0.6	11.0	500.0	421.0	1.30	0.53	1.5	0.16	1.28	82.0	4.2	73.0
W00-3-112.8	Till	112.80	6.6	<2	6.22	0.7	9.1	540.0	477.0	1.45	0.51	1.7	0.28	1.15	85.0	4.9	75.0
W00-3-113.85	Till	113.85	6.0	<2	6.26	0.6	8.8	570.0	474.0	1.45	0.52	1.4	0.38	1.03	81.0	4.9	80.0
W00-3-114.9	Till	114.90	7.5	<2	5.93	0.8	10.0	680.0	496.5	1.30	0.51	2.1	0.34	1.15	88.0	5.0	66.0
W00-3-115.95	Till	115.95	6.0	8.0	6.08	0.8	10.0	660.0	487.5	1.30	0.50	1.4	0.28	1.23	91.0	4.8	70.0
* W00-3-115.95	Till	115.95	6.9	<2	6.20	0.8	9.0	600.0	509.8	1.40	0.51	2.1	1.88	1.24	89.0	4.4	90.0
W00-3-117.05	Till	117.05	7.5	<2	5.87	0.7	10.0	620.0	499.5	1.30	0.50	1.4	0.32	1.16	84.0	5.0	68.0
W00-3-118.05	Till	118.05	6.4	<2	6.15	0.7	10.0	630.0	505.9	1.30	0.52	1.7	0.52	1.19	85.0	4.5	62.0
W00-3-119.05	Till	119.05	7.4	<2	5.83	0.7	10.0	640.0	487.0	1.25	0.50	1.8	0.28	1.10	83.0	4.6	70.0
W00-3-120.10	Till	120.10	7.9	<2	6.40	0.7	8.8	650.0	499.5	1.40	0.49	1.7	0.22	1.06	76.0	4.9	78.0
W00-3-121.0	Till	121.00	7.8	9.0	5.70	0.6	5.9	550.0	427.0	1.35	0.45	1.0	0.20	1.06	99.0	3.9	77.0
W00-3-125.5	Till	125.50	8.8	7.0	4.68	0.7	10.0	540.0	387.5	1.10	0.43	1.5	0.68	0.60	81.0	3.3	72.0
W00-3-127.7	Till	127.70	8.2	<2	4.26	0.6	8.8	520.0	379.0	1.05	0.41	1.2	0.24	0.56	77.0	3.4	66.0
W00-3-129.05	Till	129.05	8.4	<2	5.51	0.6	10.0	530.0	418.0	1.30	0.49	1.4	0.30	0.57	86.0	4.0	69.0
W00-3-131.95	Till	131.95	7.1	<2	5.19	0.6	9.4	530.0	407.0	1.25	0.47	1.8	0.24	0.57	99.0	4.1	70.0
W00-3-133.0	Till	133.00	8.3	<2	5.48	0.7	10.0	550.0	435.5	1.30	0.49	1.8	0.26	0.60	99.0	4.0	73.0
W00-3-134.25	Till	134.25	7.0	<2	5.77	0.6	8.8	450.0	404.0	1.35	0.50	1.5	0.26	0.62	98.0	3.8	59.0
W00-3-135.3	Till	135.30	6.6	<2	6.33	4.0	23.0	670.0	101.5	1.55	0.58	6.0	2.22	1.50	91.0	5.7	94.0
W00-3-136.25	Till	136.25	7.3	<2	5.70	0.8	10.0	560.0	439.5	1.35	0.48	1.6	0.36	0.91	96.0	3.6	66.0
W00-3-138.2	Till	138.20	7.7	<2	5.19	0.8	12.0	550.0	437.5	1.30	0.51	1.4	0.34	0.91	94.0	3.9	60.0
W00-3-139.2	Till	139.20	7.2	<2	5.08	0.8	11.0	520.0	209.0	1.15	0.49	2.3	0.34	0.97	94.0	3.9	79.0
W00-3-140.2	Till	140.20	7.1	6.0	5.47	0.8	12.0	590.0	236.5	1.45	0.50	2.2	0.32	0.92	99.0	4.4	68.0
W00-3-141.65	Till	141.65	5.9	<2	5.74	0.7	11.0	600.0	218.0	1.35	0.49	1.8	0.36	0.91	97.0	4.0	67.0
W00-3-143.1	Till	143.10	9.6	<2	5.87	0.8	8.3	640.0	493.0	1.30	0.47	1.5	0.58	1.61	100.0	4.2	78.0
* W00-3-143.1	Till	143.10	5.9	<4	5.77	0.9	8.3	760.0	504.8	1.30	0.46	1.8	0.54	1.58	90.0	3.5	61.0
W00-3-144.2	Till	144.20	6.1	<2	5.44	0.6	6.3	630.0	473.5	1.40	0.44	1.1	0.30	1.66	88.0	3.6	61.0
W00-3-145.15	Till	145.15	6.8	<2	5.47	2.7	23.0	680.0	184.0	1.65	0.61	4.7	1.88	1.20	82.0	4.2	74.0

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-3-93.0	Till	93.00	55.0	13.0	25.2	1.0	13.75	1.55	10.0	<50	2.8	39.0	14.5	40.4	0.3	0.92	405
W00-3-93.9	Till	93.90	55.0	11.0	26.4	1.0	13.80	1.55	10.0	<50	2.9	38.0	15.5	41.0	0.3	0.92	400
W00-2-108.7	Till	108.70	57.0	12.0	28.4	<1	13.65	1.50	9.0	<50	2.4	30.0	17.0	32.8	<0.2	1.05	605
W00-3-109.75	Till	109.75	57.0	12.0	25.4	2.0	13.55	1.50	10.0	<50	3.1	38.0	19.5	45.0	0.3	0.96	345
W00-3-110.7	Till	110.70	60.0	14.0	26.6	<1	14.85	1.50	9.0	<50	3.1	37.0	15.0	48.6	0.3	1.04	365
W00-3-111.75	Till	111.75	49.0	14.0	27.0	2.0	13.25	1.20	11.0	<50	2.8	37.0	14.5	40.8	0.3	0.96	305
W00-3-112.8	Till	112.80	57.0	12.0	29.8	2.0	14.95	1.40	10.0	<50	3.1	39.0	14.0	44.2	0.3	0.98	365
W00-3-113.85	Till	113.85	55.0	12.0	30.2	1.0	14.90	1.50	10.0	<50	3.2	39.0	15.0	41.8	0.3	0.85	345
W00-3-114.9	Till	114.90	55.0	14.0	29.8	1.0	14.25	1.40	10.0	<50	3.1	41.0	15.0	38.6	0.4	0.83	400
W00-3-115.95	Till	115.95	55.0	13.0	30.2	1.0	14.00	1.45	10.0	<50	3.2	42.0	15.5	38.4	0.3	0.87	430
* W00-3-115.95	Till	115.95	54.0	13.0	30.2	2.0	14.30	1.40	11.0	<50	3.1	37.0	15.0	38.6	0.3	0.87	425
W00-3-117.05	Till	117.05	53.0	13.0	28.8	1.0	13.70	1.40	10.0	<50	3.1	39.0	14.5	37.8	0.4	0.82	405
W00-3-118.05	Till	118.05	54.0	12.0	30.0	1.0	14.30	1.50	9.0	<50	3.2	39.0	15.0	38.4	0.3	0.87	420
W00-3-119.05	Till	119.05	52.0	13.0	28.6	2.0	13.45	1.40	10.0	<50	3.1	40.0	15.5	35.0	0.4	0.80	380
W00-3-120.10	Till	120.10	57.0	14.0	29.8	1.0	14.35	1.40	9.0	<50	3.2	40.0	12.0	41.0	0.3	0.87	365
W00-3-121.0	Till	121.00	47.0	13.0	26.0	1.0	13.65	1.30	13.0	<50	3.0	47.0	12.5	35.2	0.4	0.74	575
W00-3-125.5	Till	125.50	39.0	16.0	25.0	2.0	10.25	1.25	14.0	<50	2.7	40.0	12.0	32.4	0.5	0.52	425
W00-3-127.7	Till	127.70	35.0	14.0	23.6	1.0	9.70	1.30	17.0	<50	2.7	39.0	12.5	30.0	0.5	0.46	425
W00-3-129.05	Till	129.05	47.0	12.0	27.2	2.0	12.70	1.45	14.0	<50	3.0	44.0	14.5	30.8	0.4	0.62	555
W00-3-131.95	Till	131.95	43.0	14.0	27.0	2.0	11.75	1.40	16.0	<50	2.7	44.0	14.5	31.4	0.4	0.59	540
W00-3-133.0	Till	133.00	46.0	16.0	27.4	2.0	12.75	1.40	14.0	<50	2.8	46.0	14.5	32.6	0.4	0.61	495
W00-3-134.25	Till	134.25	49.0	13.0	29.8	3.0	13.20	1.45	15.0	<50	2.7	43.0	16.0	33.6	0.4	0.64	490
W00-3-135.3	Till	135.30	65.0	14.0	46.6	1.0	14.30	1.35	10.0	<50	3.3	42.0	16.0	37.8	0.3	0.72	405
W00-3-136.25	Till	136.25	45.0	17.0	29.2	1.0	12.80	1.35	13.0	<50	3.1	48.0	15.0	31.6	0.5	0.72	535
W00-3-138.2	Till	138.20	44.0	14.0	30.8	2.0	11.95	1.40	13.0	<50	2.7	44.0	17.5	29.0	0.4	0.67	445
W00-3-139.2	Till	139.20	42.0	12.0	28.4	1.0	11.25	1.35	15.0	<50	2.9	45.0	15.5	26.4	0.5	0.63	480
W00-3-140.2	Till	140.20	46.0	10.0	30.0	1.0	12.40	1.35	13.0	<50	2.9	46.0	16.0	30.2	0.5	0.68	440
W00-3-141.65	Till	141.65	47.0	15.0	29.2	2.0	12.60	1.40	13.0	<50	2.8	46.0	16.0	30.6	0.4	0.73	475
W00-3-143.1	Till	143.10	49.0	16.0	29.4	2.0	13.65	1.25	13.0	<50	3.0	48.0	14.5	32.2	0.4	0.87	550
* W00-3-143.1	Till	143.10	49.0	11.0	28.6	2.0	13.45	1.25	13.0	<50	3.0	45.0	14.0	31.6	0.4	0.86	540
W00-3-144.2	Till	144.20	46.0	13.0	26.8	2.0	13.15	1.20	13.0	<50	2.8	48.0	13.5	31.2	0.4	0.83	525
W00-3-145.15	Till	145.15	54.0	17.0	43.0	2.0	13.20	1.50	11.0	<50	3.4	47.0	16.5	31.0	0.4	0.62	500

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-3-93.0	Till	93.00	30.0	1.05	22.8	10.4	630	1.71	71.9	6.3	12.0	<5	0.30	0.73	130.5	0.8	<0.05
W00-3-93.9	Till	93.90	30.0	1.05	23.2	10.2	620	1.71	72.4	6.2	12.0	<5	0.35	0.72	136.5	1.2	<0.05
W00-2-108.7	Till	108.70	30.0	1.70	27.0	11.2	710	1.58	69.1	4.8	9.0	<5	0.35	0.65	157.0	0.8	0.05
W00-3-109.75	Till	109.75	40.0	1.20	24.0	9.8	550	1.69	69.9	6.1	12.0	<5	0.30	0.60	125.5	1.2	0.05
W00-3-110.7	Till	110.70	30.0	1.15	25.2	10.4	610	1.77	75.7	6.2	13.0	<5	0.30	0.64	128.0	1.3	<0.05
W00-3-111.75	Till	111.75	30.0	2.05	24.0	9.9	550	1.48	73.1	6.1	11.0	<5	0.25	0.60	127.0	1.2	0.05
W00-3-112.8	Till	112.80	40.0	1.25	26.2	10.8	600	1.61	83.3	6.2	12.0	<5	0.30	0.60	144.5	1.2	<0.05
W00-3-113.85	Till	113.85	50.0	1.25	24.8	11.1	610	1.56	81.8	6.4	12.0	<5	0.25	0.60	147.0	1.3	0.05
W00-3-114.9	Till	114.90	40.0	2.05	25.6	11.0	670	1.44	76.2	6.5	12.0	<5	0.25	0.62	143.5	1.3	0.05
W00-3-115.95	Till	115.95	30.0	1.85	25.8	10.5	660	1.43	75.5	6.7	12.0	<5	0.25	0.63	147.0	1.0	<0.05
* W00-3-115.95	Till	115.95	30.0	1.80	25.4	11.4	640	1.62	80.8	6.5	11.0	<5	0.30	0.59	150.5	1.1	<0.05
W00-3-117.05	Till	117.05	40.0	1.80	24.8	10.5	620	1.53	77.9	6.4	12.0	<5	0.25	0.60	143.5	1.0	0.05
W00-3-118.05	Till	118.05	30.0	1.85	25.8	11.1	660	1.56	80.0	6.6	12.0	<5	0.25	0.58	150.5	1.1	<0.05
W00-3-119.05	Till	119.05	30.0	1.50	23.8	10.6	630	1.46	73.6	6.6	12.0	<5	0.25	0.64	146.0	1.5	<0.05
W00-3-120.10	Till	120.10	40.0	1.20	25.8	10.7	620	1.64	82.5	6.4	13.0	<5	0.25	0.62	144.5	1.3	<0.05
W00-3-121.0	Till	121.00	30.0	1.00	22.8	11.0	520	1.49	75.1	7.5	11.0	<5	0.25	0.70	130.0	1.3	<0.05
W00-3-125.5	Till	125.50	30.0	1.40	19.8	9.1	500	1.26	56.5	6.8	11.0	<5	0.20	0.62	103.5	1.3	<0.05
W00-3-127.7	Till	127.70	30.0	1.40	18.2	9.1	470	1.19	54.2	6.8	10.0	<5	0.20	0.64	99.8	1.4	<0.05
W00-3-129.05	Till	129.05	30.0	1.35	22.8	11.7	590	1.42	69.0	7.5	11.0	<5	0.30	0.50	117.5	1.6	<0.05
W00-3-131.95	Till	131.95	20.0	1.30	21.6	11.2	550	1.34	66.8	7.4	11.0	<5	0.30	0.54	114.0	1.1	<0.05
W00-3-133.0	Till	133.00	30.0	1.55	22.0	11.0	600	1.34	70.3	7.2	11.0	<5	0.25	0.48	122.0	1.5	<0.05
W00-3-134.25	Till	134.25	30.0	1.75	22.6	12.5	600	1.45	74.4	6.8	10.0	<5	0.30	0.52	129.0	1.2	<0.05
W00-3-135.3	Till	135.30	80.0	15.85	46.8	11.6	900	1.49	79.9	7.4	12.0	5.0	0.45	0.49	183.5	1.4	0.05
W00-3-136.25	Till	136.25	40.0	1.95	22.0	12.0	640	1.62	76.5	7.7	11.0	<5	0.25	0.59	142.5	1.3	<0.05
W00-3-138.2	Till	138.20	40.0	2.15	24.4	10.9	730	1.40	69.0	7.8	11.0	<5	0.30	0.54	141.5	1.2	<0.05
W00-3-139.2	Till	139.20	40.0	2.20	22.8	11.3	760	1.44	65.9	7.9	10.0	<5	0.30	0.56	142.0	1.5	<0.05
W00-3-140.2	Till	140.20	30.0	2.10	23.6	11.8	710	1.47	71.1	7.8	12.0	<5	0.30	0.56	143.0	1.3	<0.05
W00-3-141.65	Till	141.65	30.0	1.80	24.0	11.7	700	1.46	71.6	7.6	11.0	<5	0.30	0.59	148.0	1.5	<0.05
W00-3-143.1	Till	143.10	30.0	2.15	24.0	12.2	640	1.61	75.3	7.5	12.0	<5	0.30	0.70	164.5	1.3	<0.05
* W00-3-143.1	Till	143.10	30.0	2.20	23.4	11.8	650	1.60	74.0	7.4	12.0	<5	0.25	0.69	160.0	1.3	<0.05
W00-3-144.2	Till	144.20	30.0	1.40	22.6	11.3	580	1.63	74.3	7.4	11.0	<5	0.20	0.70	148.0	1.4	<0.05
W00-3-145.15	Till	145.15	60.0	8.50	38.8	12.3	940	1.41	77.0	7.8	11.0	<5	0.45	0.45	179.0	1.3	<0.05

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-3-93.0	Till	93.00	0.9	0.48	11.0	<100	0.31	0.8	3.2	96.0	2.0	19.3	<100	310
W00-3-93.9	Till	93.90	0.7	0.48	11.0	<100	0.30	0.8	3.1	97.0	2.0	19.1	<100	510
W00-2-108.7	Till	108.70	0.6	0.52	8.4	<100	0.32	0.9	2.4	113.0	<2	21.6	<100	<200
W00-3-109.75	Till	109.75	0.7	0.44	10.0	<100	0.31	0.8	3.0	98.0	2.0	17.6	<100	470
W00-3-110.7	Till	110.70	0.8	0.44	10.0	<100	0.32	0.8	3.2	104.0	2.0	19.0	<100	<200
W00-3-111.75	Till	111.75	0.8	0.46	10.0	<100	0.28	0.9	3.1	90.0	2.0	18.5	<100	<200
W00-3-112.8	Till	112.80	0.9	0.52	11.0	<100	0.30	0.9	3.3	108.0	3.0	20.0	<100	390
W00-3-113.85	Till	113.85	0.8	0.54	11.0	<100	0.31	1.0	2.8	103.0	3.0	20.2	130	330
W00-3-114.9	Till	114.90	1.0	0.58	11.0	<100	0.30	1.0	3.7	108.0	2.0	21.2	<100	360
W00-3-115.95	Till	115.95	0.6	0.56	11.0	<100	0.29	0.9	3.9	105.0	2.0	20.9	110	720
* W00-3-115.95	Till	115.95	0.8	0.58	11.0	<100	0.32	0.9	3.7	105.0	<2	21.3	<100	490
W00-3-117.05	Till	117.05	1.0	0.56	11.0	<100	0.30	0.9	3.6	102.0	2.0	20.5	<100	380
W00-3-118.05	Till	118.05	0.9	0.56	11.0	<100	0.30	1.0	3.8	105.0	3.0	21.8	140	500
W00-3-119.05	Till	119.05	0.8	0.52	11.0	<100	0.29	1.0	3.6	100.0	3.0	21.2	<100	<200
W00-3-120.10	Till	120.10	0.8	0.54	11.0	<100	0.31	1.2	3.3	107.0	2.0	20.0	100	550
W00-3-121.0	Till	121.00	0.8	0.48	13.0	<100	0.31	0.9	4.0	83.0	3.0	22.5	<100	550
W00-3-125.5	Till	125.50	0.9	0.42	10.0	<100	0.29	0.8	3.7	70.0	3.0	18.8	<100	520
W00-3-127.7	Till	127.70	1.0	0.40	11.0	<100	0.28	0.7	3.6	63.0	3.0	18.7	<100	570
W00-3-129.05	Till	129.05	1.0	0.48	12.0	<100	0.33	1.0	4.3	83.0	3.0	22.2	<100	490
W00-3-131.95	Till	131.95	0.9	0.44	12.0	<100	0.32	1.0	4.0	81.0	3.0	21.7	<100	510
W00-3-133.0	Till	133.00	0.9	0.48	12.0	<100	0.31	1.3	4.2	86.0	3.0	22.4	<100	530
W00-3-134.25	Till	134.25	1.1	0.54	11.0	<100	0.35	1.2	4.0	88.0	3.0	23.2	<100	510
W00-3-135.3	Till	135.30	1.1	1.66	11.0	<100	0.30	1.2	8.5	282.0	3.0	26.8	160	<200
W00-3-136.25	Till	136.25	1.1	0.58	12.0	<100	0.34	1.1	3.6	80.0	3.0	23.5	<100	360
W00-3-138.2	Till	138.20	1.1	0.62	12.0	<100	0.29	1.1	4.5	85.0	3.0	24.4	<100	520
W00-3-139.2	Till	139.20	1.1	0.58	13.0	<100	0.31	1.1	4.4	78.0	3.0	24.5	<100	620
W00-3-140.2	Till	140.20	0.8	0.58	12.0	<100	0.32	1.1	4.6	86.0	3.0	24.3	150	500
W00-3-141.65	Till	141.65	0.8	0.58	12.0	<100	0.32	1.1	4.4	85.0	3.0	23.8	<100	480
W00-3-143.1	Till	143.10	1.1	0.64	13.0	<100	0.32	1.0	4.4	96.0	3.0	23.4	<100	480
* W00-3-143.1	Till	143.10	0.8	0.62	13.0	<100	0.31	1.0	4.2	97.0	3.0	22.6	<100	660
W00-3-144.2	Till	144.20	1.0	0.52	12.0	<100	0.31	0.9	3.7	80.0	3.0	21.5	<100	530
W00-3-145.15	Till	145.15	1.0	1.50	12.0	<100	0.28	1.1	6.7	200.0	3.0	29.3	<100	<200

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-3-147.1	Till	147.10	7.7	<2	5.44	2.7	22.0	680.0	157.5	1.60	0.60	4.0	1.90	1.22	88.0	4.8	84.0
W00-3-148.0	Till	148.00	6.3	<2	5.38	2.3	20.0	550.0	126.0	1.55	0.58	3.7	1.52	1.13	91.0	4.7	55.0
W00-3-149.3	Till	149.30	5.8	<2	5.27	1.3	15.0	640.0	439.5	1.35	0.50	2.6	0.98	0.82	86.0	4.8	66.0
W00-3-151.0	Till	151.00	6.8	<2	6.44	2.4	19.0	1100.0	174.5	1.65	0.60	3.9	1.58	1.33	98.0	4.3	66.0
W00-3-152.15	Till	152.15	5.9	<5	5.98	2.4	19.0	750.0	244.5	1.55	0.55	2.8	1.54	1.57	92.0	4.8	84.0

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-3-147.1	Till	147.10	53.0	16.0	40.8	2.0	12.75	1.40	11.0	<50	3.2	44.0	16.5	29.6	0.4	0.62	480
W00-3-148.0	Till	148.00	52.0	15.0	37.6	1.0	12.50	1.35	10.0	<50	3.4	44.0	16.0	29.0	0.5	0.60	530
W00-3-149.3	Till	149.30	47.0	14.0	30.4	2.0	12.00	1.35	11.0	<50	3.1	47.0	14.5	28.4	0.4	0.58	365
W00-3-151.0	Till	151.00	59.0	13.0	41.8	<1	15.00	1.50	11.0	<50	3.3	44.0	17.0	35.8	0.4	0.69	450
W00-3-152.15	Till	152.15	57.0	15.0	40.2	2.0	14.05	1.40	9.0	<50	3.5	46.0	17.5	33.4	0.4	0.72	505

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-3-147.1	Till	147.10	50.0	8.25	36.4	11.4	930	1.34	70.0	7.6	11.0	<5	0.40	0.45	173.0	1.4	0.05
W00-3-148.0	Till	148.00	50.0	7.05	32.2	11.1	920	1.31	68.9	7.8	11.0	6.0	0.40	0.49	166.5	1.1	<0.05
W00-3-149.3	Till	149.30	40.0	3.75	25.4	10.7	710	1.31	68.6	7.5	12.0	<5	0.30	0.55	158.5	1.3	<0.05
W00-3-151.0	Till	151.00	50.0	8.10	38.4	12.5	900	1.62	85.1	7.5	12.0	5.0	0.45	0.55	189.5	1.6	<0.05
W00-3-152.15	Till	152.15	50.0	8.75	38.2	11.7	910	1.53	78.1	7.4	12.0	<5	0.40	0.60	179.5	1.0	<0.05

Appendix 3 - Table A3-8: Geochemical Analysis of Samples from Corehole WEPA00-3

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-3-147.1	Till	147.10	0.9	1.38	12.0	<100	0.27	1.2	6.1	199.0	3.0	27.2	100	650
W00-3-148.0	Till	148.00	0.8	1.18	12.0	<100	0.28	1.2	6.0	168.0	3.0	26.9	110	400
W00-3-149.3	Till	149.30	1.0	0.76	12.0	<100	0.28	1.0	4.7	111.0	2.0	23.1	<100	<200
W00-3-151.0	Till	151.00	0.9	1.32	13.0	<100	0.32	1.1	5.6	184.0	3.0	27.9	100	<200
W00-3-152.15	Till	152.15	1.0	1.30	11.0	<100	0.29	1.2	6.5	179.0	3.0	25.8	<100	<200

Notes: < denotes less than
NAA denotes neutron activation analysis
CVAA denotes analysis by cold vapour atomic absorption
IMS denotes plasma-mass spectrometry analysis
All results are reported on a dry basis.
Ba* and Cr* denotes acid soluble portion
* W00-3-29.5 denotes sample duplicate of W00-3-29.5

Appendix 3 - Table A3-9: Geochemical analysis of samples from corehole WEPA00-4

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-4-10.1	Till	10.10	6.0	<2	4.86	0.6	10.0	520.0	333.5	1.00	0.45	2.0	0.14	0.59	94.0	3.3	48.0
W00-4-11.5	Till	11.50	7.3	<2	5.87	0.6	7.3	540.0	422.0	1.35	0.47	<0.5	0.14	0.85	89.0	4.0	61.0
W00-4-12.2	Till	12.20	8.8	<2	5.40	0.7	8.6	520.0	414.5	1.40	0.46	1.6	0.16	0.77	92.0	3.5	53.0
W00-4-13.1	Till	13.10	7.8	<2	6.05	0.7	11.0	590.0	448.5	1.35	0.49	1.2	0.20	0.78	87.0	4.0	52.0
W00-4-16.1	Till	16.10	11.2	<2	6.49	0.6	10.0	590.0	446.5	1.50	0.50	1.2	0.22	1.17	93.0	5.7	77.0
W00-4-17.1	Till	17.10	8.7	<2	5.87	0.6	7.5	590.0	455.0	1.30	0.45	2.0	0.28	2.36	86.0	3.5	81.0
W00-4-23.1	Till	23.10	7.6	<2	6.11	0.8	8.7	560.0	463.5	1.45	0.49	1.7	0.28	1.43	88.0	3.9	78.0
W00-4-34.0	Till	34.00	10.4	<2	5.74	0.7	8.6	610.0	473.0	1.30	0.46	1.1	0.32	1.61	79.0	4.1	74.0
W00-4-34.9	Till	34.90	7.0	<2	6.59	0.8	11.0	590.0	481.5	1.50	0.50	1.6	0.22	1.04	76.0	5.4	88.0
W00-4-40.0	Sand & Clay	40.00	9.0	8.0	6.29	0.9	7.9	670.0	509.3	1.40	0.50	1.5	0.42	1.88	81.0	4.8	71.0
W00-4-41.0	Till	41.00	7.5	<2	6.47	0.9	8.6	640.0	510.4	1.55	0.50	1.9	0.36	1.85	85.0	4.7	78.0
* W00-4-41.0	Till	41.00	6.4	<2	6.34	0.9	8.9	620.0	504.4	1.55	0.49	1.6	0.32	1.82	87.0	4.6	76.0
W00-4-41.7	Till	41.70	7.0	<2	5.92	0.7	8.4	590.0	468.5	1.35	0.47	1.5	1.04	1.48	83.0	4.2	72.0
W00-4-43.2	Till	43.20	6.7	<2	5.75	0.7	8.7	620.0	446.5	1.30	0.44	1.2	0.22	1.42	88.0	3.8	64.0
W00-4-44.05	Till	44.05	9.1	<2	6.58	0.8	9.4	660.0	523.3	1.50	0.47	1.4	0.32	1.75	79.0	4.0	67.0
W00-4-52.8	Till	52.80	6.0	<2	6.09	0.8	13.0	760.0	543.4	1.45	0.53	2.5	0.26	0.75	85.0	5.0	74.0
W00-4-54.05	Till	54.05	7.5	<2	5.43	0.7	9.3	630.0	509.0	1.30	0.48	1.8	0.28	0.75	75.0	3.8	63.0
W00-4-57.9	Till	57.90	5.8	<2	5.85	0.6	9.3	540.0	410.5	1.40	0.47	1.4	0.16	0.84	88.0	4.7	60.0
W00-4-58.45	Till	58.45	6.6	<2	6.15	0.7	12.0	580.0	452.0	1.60	0.50	1.8	0.20	0.76	83.0	5.0	77.0
W00-4-59.4	Till	59.40	6.1	<2	6.05	0.8	12.0	630.0	480.5	1.50	0.53	2.4	0.28	0.74	79.0	5.4	63.0
W00-4-60.4	Till	60.40	8.9	<2	6.02	0.7	13.0	650.0	482.5	1.35	0.52	2.7	0.24	0.73	79.0	4.9	70.0
W00-4-61.9	Till	61.90	9.3	<2	6.01	0.7	12.0	580.0	473.0	1.60	0.51	2.4	0.64	0.76	79.0	5.0	65.0
W00-4-63.1	Till	63.10	7.6	<2	6.27	0.8	12.0	610.0	510.3	1.65	0.53	2.0	0.26	0.73	82.0	5.1	73.0
W00-4-64.1	Till	64.10	6.0	<2	6.19	0.8	12.0	580.0	460.0	1.55	0.52	2.4	0.26	0.73	86.0	5.5	77.0
W00-4-70.3	Clay	70.30	7.7	<2	6.20	0.9	14.0	610.0	499.5	1.55	0.53	3.1	0.64	0.74	82.0	5.2	83.0
W00-4-74.5	Till	74.50	6.1	<2	5.22	0.6	7.9	470.0	399.0	1.25	0.45	1.1	0.14	0.58	83.0	3.8	57.0
W00-4-75.5	Till	75.50	8.5	<2	4.93	0.6	9.0	550.0	436.0	1.25	0.45	1.4	0.14	0.56	94.0	4.0	66.0
W00-4-76.7	Till	76.70	9.1	<2	4.92	0.6	9.2	510.0	393.5	1.20	0.46	1.6	0.16	0.56	91.0	3.7	54.0
W00-4-77.7	Till	77.70	7.1	4.0	4.50	0.5	8.0	440.0	436.5	1.10	0.43	0.9	0.14	0.52	70.0	2.6	36.0
W00-4-78.7	Till	78.70	7.4	<2	4.73	0.5	8.6	410.0	389.0	1.15	0.43	1.2	0.14	0.55	100.0	3.2	70.0
* W00-4-78.7	Till	78.70	8.0	<2	4.78	0.6	9.3	440.0	380.5	1.25	0.43	1.6	0.12	0.55	92.0	3.7	76.0
W00-4-80.0	Till	80.00	6.7	<2	5.26	0.6	10.0	450.0	400.5	1.35	0.48	1.1	0.14	0.59	81.0	3.9	58.0

Appendix 3 - Table A3-9: Geochemical analysis of samples from corehole WEPA00-4

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-4-10.1	Till	10.10	39.0	14.0	24.2	1.0	10.85	1.40	14.0	<50	2.7	40.0	14.5	29.4	0.4	0.58	470
W00-4-11.5	Till	11.50	48.0	13.0	26.6	1.0	13.55	1.40	12.0	<50	2.8	44.0	14.5	40.6	0.5	0.79	510
W00-4-12.2	Till	12.20	45.0	13.0	25.2	2.0	12.70	1.45	13.0	<50	2.9	41.0	14.0	39.6	0.5	0.66	435
W00-4-13.1	Till	13.10	51.0	13.0	29.2	2.0	13.90	1.40	12.0	<50	3.3	44.0	16.0	45.0	0.4	0.73	400
W00-4-16.1	Till	16.10	61.0	16.0	31.0	1.0	15.10	1.50	9.0	<50	3.5	45.0	15.0	41.4	0.4	0.94	370
W00-4-17.1	Till	17.10	53.0	13.0	27.6	<1	12.95	1.25	10.0	<50	3.1	35.0	12.5	37.0	0.3	1.33	445
W00-4-23.1	Till	23.10	54.0	14.0	37.4	1.0	14.05	1.35	13.0	<50	3.0	38.0	30.5	38.4	0.3	0.94	515
W00-4-34.0	Till	34.00	52.0	14.0	28.8	<1	13.10	1.45	11.0	<50	3.1	39.0	19.0	36.8	0.3	0.95	410
W00-4-34.9	Till	34.90	61.0	10.0	34.2	2.0	15.60	1.50	7.0	<50	3.5	37.0	20.0	43.4	0.4	0.88	340
W00-4-40.0	Sand & Clay	40.00	57.0	13.0	33.6	2.0	15.10	1.45	10.0	<50	3.2	41.0	17.0	40.0	0.3	1.02	440
W00-4-41.0	Till	41.00	58.0	13.0	31.6	1.0	15.10	1.45	10.0	<50	3.1	42.0	14.0	41.0	0.3	1.04	490
* W00-4-41.0	Till	41.00	56.0	14.0	31.8	2.0	14.80	1.40	10.0	<50	3.2	40.0	14.5	40.6	0.3	1.01	480
W00-4-41.7	Till	41.70	51.0	13.0	28.2	1.0	13.80	1.40	11.0	<50	2.8	39.0	14.5	40.2	0.4	0.90	505
W00-4-43.2	Till	43.20	50.0	14.0	27.8	<1	13.40	1.35	12.0	<50	2.7	39.0	13.0	39.2	0.4	0.89	505
W00-4-44.05	Till	44.05	58.0	15.0	32.6	1.0	15.95	1.45	9.0	<50	3.0	41.0	15.0	45.2	0.3	1.03	525
W00-4-52.8	Till	52.80	59.0	15.0	32.0	2.0	14.60	1.55	9.0	<50	3.1	38.0	16.5	44.8	0.3	0.76	385
W00-4-54.05	Till	54.05	47.0	14.0	28.4	2.0	12.70	1.45	11.0	<50	2.8	38.0	16.0	40.2	0.4	0.72	380
W00-4-57.9	Till	57.90	51.0	14.0	28.6	2.0	13.55	1.40	10.0	<50	3.0	42.0	14.0	45.2	0.3	0.85	405
W00-4-58.45	Till	58.45	56.0	18.0	30.2	2.0	14.10	1.50	10.0	<50	3.2	40.0	14.0	46.4	0.3	0.75	380
W00-4-59.4	Till	59.40	55.0	15.0	31.2	<1	14.50	1.60	10.0	<50	3.3	38.0	14.0	45.2	0.3	0.76	355
W00-4-60.4	Till	60.40	54.0	13.0	30.6	2.0	14.10	1.60	10.0	<50	3.2	39.0	16.0	43.8	0.4	0.75	350
W00-4-61.9	Till	61.90	55.0	15.0	31.0	2.0	13.90	1.55	10.0	<50	3.1	40.0	16.0	45.0	0.4	0.78	355
W00-4-63.1	Till	63.10	57.0	14.0	33.0	2.0	15.10	1.65	10.0	<50	3.3	40.0	15.5	47.2	0.4	0.75	340
W00-4-64.1	Till	64.10	57.0	13.0	32.4	1.0	14.45	1.55	10.0	<50	3.1	38.0	15.0	46.2	0.3	0.77	350
W00-4-70.3	Clay	70.30	59.0	16.0	32.8	2.0	14.60	1.65	9.0	<50	3.4	39.0	16.0	45.6	0.4	0.74	350
W00-4-74.5	Till	74.50	44.0	16.0	25.0	<1	12.25	1.45	13.0	<50	2.7	38.0	13.5	37.6	0.4	0.59	500
W00-4-75.5	Till	75.50	42.0	11.0	24.6	<1	11.45	1.45	15.0	<50	2.6	38.0	13.0	34.4	0.4	0.56	425
W00-4-76.7	Till	76.70	42.0	13.0	24.2	1.0	11.45	1.50	15.0	<50	2.6	41.0	15.5	33.2	0.4	0.57	430
W00-4-77.7	Till	77.70	36.0	14.0	23.2	<1	9.80	1.50	15.0	<50	2.3	35.0	13.0	29.0	0.4	0.49	410
W00-4-78.7	Till	78.70	40.0	12.0	23.4	1.0	10.80	1.50	19.0	<50	3.2	45.0	13.5	32.6	0.6	0.54	435
* W00-4-78.7	Till	78.70	40.0	15.0	24.0	<1	10.90	1.45	17.0	<50	2.8	43.0	13.0	32.8	0.5	0.55	445
W00-4-80.0	Till	80.00	46.0	16.0	27.2	<1	12.30	1.50	13.0	<50	2.6	40.0	16.0	36.8	0.4	0.61	465

Appendix 3 - Table A3-9: Geochemical analysis of samples from corehole WEPA00-4

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-4-10.1	Till	10.10	30.0	0.95	19.4	10.5	570	1.39	64.1	6.8	10.0	<5	0.20	0.59	121.0	1.1	<0.05
W00-4-11.5	Till	11.50	20.0	1.15	23.2	11.3	530	1.57	75.1	6.9	12.0	<5	0.25	0.59	127.0	1.6	<0.05
W00-4-12.2	Till	12.20	30.0	1.05	22.2	10.9	530	1.49	71.4	6.7	11.0	<5	0.25	0.65	123.5	1.4	<0.05
W00-4-13.1	Till	13.10	40.0	1.60	23.8	11.0	580	1.65	80.4	6.8	13.0	<5	0.30	0.55	132.0	1.3	<0.05
W00-4-16.1	Till	16.10	30.0	1.35	26.2	11.6	640	1.62	84.9	6.6	14.0	<5	0.30	0.59	159.0	1.3	<0.05
W00-4-17.1	Till	17.10	30.0	1.10	24.2	9.6	570	1.58	72.5	5.6	11.0	<5	0.25	0.74	163.0	1.2	<0.05
W00-4-23.1	Till	23.10	30.0	1.60	25.8	10.8	580	1.59	77.2	6.6	11.0	<5	0.25	0.59	138.0	1.0	<0.05
W00-4-34.0	Till	34.00	30.0	1.35	24.0	9.6	590	1.53	74.7	6.3	12.0	<5	0.25	0.70	142.0	1.0	<0.05
W00-4-34.9	Till	34.90	30.0	1.30	26.6	10.6	600	1.68	85.4	6.1	13.0	<5	0.25	0.62	133.5	1.1	<0.05
W00-4-40.0	Sand & Clay	40.00	30.0	2.05	27.6	11.6	700	1.71	83.6	6.8	12.0	<5	0.25	0.68	149.0	1.4	<0.05
W00-4-41.0	Till	41.00	30.0	2.15	26.8	11.2	630	1.72	84.5	6.7	12.0	<5	0.25	0.65	153.0	1.3	<0.05
* W00-4-41.0	Till	41.00	20.0	2.10	26.6	10.8	590	1.67	83.0	6.5	12.0	<5	0.25	0.65	150.0	1.1	<0.05
W00-4-41.7	Till	41.70	30.0	1.40	24.0	10.7	570	1.58	76.4	6.7	11.0	<5	0.25	0.71	143.0	1.3	<0.05
W00-4-43.2	Till	43.20	10.0	1.30	23.6	10.1	550	1.53	74.0	6.7	11.0	<5	0.25	0.67	139.5	1.1	<0.05
W00-4-44.05	Till	44.05	10.0	1.60	27.6	11.9	600	1.73	86.9	6.6	13.0	<5	0.25	0.67	151.5	1.1	<0.05
W00-4-52.8	Till	52.80	50.0	2.75	27.0	11.1	660	1.55	81.8	6.7	13.0	<5	0.30	0.53	141.5	1.3	<0.05
W00-4-54.05	Till	54.05	40.0	1.65	25.0	10.5	570	1.48	71.3	6.6	11.0	<5	0.30	0.58	127.0	1.0	<0.05
W00-4-57.9	Till	57.90	30.0	1.20	22.6	10.3	590	1.61	75.9	6.9	12.0	<5	0.20	0.58	127.5	1.5	<0.05
W00-4-58.45	Till	58.45	40.0	2.10	26.8	10.5	620	1.51	77.9	6.7	12.0	<5	0.25	0.55	136.5	1.2	<0.05
W00-4-59.4	Till	59.40	40.0	2.45	26.6	10.9	630	1.51	81.1	6.6	12.0	<5	0.30	0.52	148.5	1.4	<0.05
W00-4-60.4	Till	60.40	40.0	2.45	25.6	10.8	640	1.52	79.4	6.7	12.0	<5	0.30	0.53	149.0	1.4	<0.05
W00-4-61.9	Till	61.90	40.0	2.20	25.6	10.9	660	1.57	79.7	6.7	12.0	<5	0.25	0.56	150.5	1.0	<0.05
W00-4-63.1	Till	63.10	40.0	2.70	27.2	12.3	660	1.63	86.2	6.8	12.0	<5	0.30	0.53	154.5	1.2	<0.05
W00-4-64.1	Till	64.10	40.0	2.45	26.4	11.6	640	1.63	83.1	6.8	12.0	<5	0.30	0.53	147.5	1.0	<0.05
W00-4-70.3	Clay	70.30	40.0	3.05	27.8	11.8	680	1.60	83.5	6.8	12.0	<5	0.30	0.55	157.5	1.3	<0.05
W00-4-74.5	Till	74.50	10.0	0.90	21.0	11.1	490	1.42	66.5	6.6	10.0	<5	0.25	0.58	116.5	1.1	<0.05
W00-4-75.5	Till	75.50	30.0	0.85	20.0	11.1	510	1.40	65.5	6.8	10.0	<5	0.25	0.62	122.5	1.2	<0.05
W00-4-76.7	Till	76.70	30.0	0.85	19.8	10.3	540	1.37	64.2	6.8	10.0	<5	0.20	0.63	123.5	1.4	<0.05
W00-4-77.7	Till	77.70	20.0	0.70	18.2	10.7	510	1.41	59.5	5.7	8.4	<5	0.25	0.57	123.0	1.2	<0.05
W00-4-78.7	Till	78.70	30.0	0.85	19.4	10.6	530	1.39	62.6	6.3	12.0	<5	0.20	0.80	121.5	1.4	<0.05
* W00-4-78.7	Till	78.70	30.0	0.85	19.6	10.2	520	1.34	62.1	6.7	11.0	<5	0.25	0.69	121.5	1.4	<0.05
W00-4-80.0	Till	80.00	20.0	0.90	22.0	12.5	560	1.49	70.3	7.0	11.0	<5	0.25	0.61	129.5	1.8	<0.05

Appendix 3 - Table A3-9: Geochemical analysis of samples from corehole WEPA00-4

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-4-10.1	Till	10.10	1.10	0.42	11.0	<100	0.31	0.9	3.3	70.0	3.0	20.3	<100	560
W00-4-11.5	Till	11.50	0.90	0.48	12.0	<100	0.33	0.9	3.5	85.0	3.0	21.2	<100	410
W00-4-12.2	Till	12.20	0.90	0.46	11.0	<100	0.32	0.9	3.3	79.0	3.0	20.5	<100	380
W00-4-13.1	Till	13.10	0.90	0.54	11.0	<100	0.31	0.9	3.6	93.0	3.0	21.0	<100	560
W00-4-16.1	Till	16.10	0.90	0.54	12.0	<100	0.31	1.3	3.6	113.0	2.0	20.7	<100	370
W00-4-17.1	Till	17.10	0.70	0.50	10.0	<100	0.28	0.9	2.8	98.0	<2	18.3	<100	590
W00-4-23.1	Till	23.10	0.60	0.54	11.0	<100	0.31	2.4	3.6	103.0	2.0	20.7	<100	410
W00-4-34.0	Till	34.00	0.80	0.50	11.0	<100	0.28	1.0	3.5	99.0	2.0	19.5	110	<200
W00-4-34.9	Till	34.90	0.90	0.54	11.0	<100	0.30	1.3	3.4	117.0	<2	18.9	<100	<200
W00-4-40.0	Sand & Clay	40.00	0.80	0.62	12.0	<100	0.32	1.2	3.5	119.0	2.0	21.4	<100	380
W00-4-41.0	Till	41.00	0.90	0.62	12.0	<100	0.32	0.9	3.9	117.0	2.0	21.0	<100	380
* W00-4-41.0	Till	41.00	0.70	0.62	12.0	<100	0.31	0.9	3.8	117.0	3.0	20.5	<100	<200
W00-4-41.7	Till	41.70	0.80	0.52	11.0	<100	0.31	1.1	3.5	94.0	2.0	20.3	<100	<200
W00-4-43.2	Till	43.20	0.80	0.50	11.0	<100	0.30	0.9	3.6	91.0	3.0	19.6	<100	450
W00-4-44.05	Till	44.05	0.80	0.60	11.0	<100	0.34	1.0	3.4	112.0	2.0	21.4	<100	320
W00-4-52.8	Till	52.80	1.10	0.64	11.0	140	0.31	1.1	4.2	111.0	2.0	21.3	<100	<200
W00-4-54.05	Till	54.05	0.70	0.52	11.0	<100	0.30	0.8	3.4	86.0	2.0	20.0	<100	<200
W00-4-57.9	Till	57.90	1.00	0.48	11.0	<100	0.33	0.9	3.0	89.0	2.0	19.3	<100	450
W00-4-58.45	Till	58.45	0.80	0.56	11.0	<100	0.31	0.9	3.8	102.0	2.0	20.3	130	<200
W00-4-59.4	Till	59.40	0.70	0.58	11.0	<100	0.30	0.9	3.3	105.0	3.0	20.9	<100	470
W00-4-60.4	Till	60.40	0.80	0.58	11.0	120	0.31	1.0	3.7	104.0	3.0	20.9	<100	290
W00-4-61.9	Till	61.90	1.00	0.58	11.0	<100	0.32	0.9	3.5	103.0	3.0	20.9	<100	<200
W00-4-63.1	Till	63.10	0.80	0.62	11.0	<100	0.34	1.6	3.8	109.0	3.0	22.1	150	320
W00-4-64.1	Till	64.10	0.90	0.60	11.0	<100	0.34	1.1	3.7	107.0	2.0	21.4	150	<200
W00-4-70.3	Clay	70.30	1.10	0.68	11.0	<100	0.33	2.8	4.0	114.0	3.0	21.7	<100	610
W00-4-74.5	Till	74.50	0.70	0.40	11.0	<100	0.32	1.0	3.5	76.0	3.0	20.1	<100	700
W00-4-75.5	Till	75.50	0.90	0.40	10.0	140	0.32	1.0	3.3	73.0	3.0	20.5	<100	620
W00-4-76.7	Till	76.70	0.90	0.38	11.0	<100	0.30	0.9	3.3	75.0	3.0	20.3	<100	450
W00-4-77.7	Till	77.70	1.00	0.38	8.8	<100	0.32	0.9	3.1	64.0	3.0	20.0	<100	<200
W00-4-78.7	Till	78.70	1.10	0.40	10.0	<100	0.31	1.0	3.3	71.0	4.0	20.2	<100	560
* W00-4-78.7	Till	78.70	1.10	0.38	10.0	<100	0.30	1.0	3.4	71.0	4.0	20.1	<100	390
W00-4-80.0	Till	80.00	1.00	0.42	11.0	<100	0.36	1.0	3.6	79.0	3.0	22.1	<100	770

Appendix 3 - Table A3-9: Geochemical analysis of samples from corehole WEPA00-4

			NAA	NAA	IMS	NAA	NAA	NAA	IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA
Sample #	**Material**	**Depth**	**Wt**	**Au**	**Al**	**Sb**	**As**	**Ba**	**Ba***	**Be**	**Bi**	**Br**	**Cd**	**Ca**	**Ce**	**Cs**	**Cr**
			grams	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-4-81.1	Till	81.10	8.2	<2	5.31	0.6	8.7	470.0	403.0	1.35	0.47	1.3	0.54	0.59	80.0	4.0	66.0
W00-4-82.1	Till	82.10	7.6	<2	6.34	0.8	11.0	520.0	417.5	1.75	0.54	1.1	0.18	0.71	87.0	5.3	70.0
W00-4-83.0	Till	83.00	6.9	<2	4.84	0.5	8.8	500.0	390.0	1.25	0.45	1.4	0.14	0.56	84.0	3.5	60.0
W00-4-84.1	Till	84.10	9.7	5.0	4.86	0.6	9.1	510.0	403.0	1.20	0.45	1.4	0.14	0.58	84.0	3.7	65.0
W00-4-85.95	Till	85.95	8.3	<2	5.01	0.5	9.2	590.0	466.0	1.30	0.45	1.0	0.16	0.56	86.0	3.5	58.0
W00-4-87.7	Till	87.70	7.4	<2	4.90	0.6	10.0	470.0	396.0	1.15	0.43	1.5	0.36	0.57	87.0	3.2	56.0
W00-4-89.5	Till	89.50	10.0	<2	5.10	0.6	9.0	500.0	419.0	1.30	0.45	1.3	0.30	0.58	88.0	3.8	61.0

Appendix 3 - Table A3-9: Geochemical analysis of samples from corehole WEPA00-4

			IMS	IMS	IMS	NAA	IMS	IMS	NAA	NAA	NAA	NAA	IMS	IMS	NAA	IMS	IMS
Sample #	**Material**	**Depth**	**Cr***	**Co**	**Cu**	**Eu**	**Ga**	**Ge**	**Hf**	**Ir**	**Fe**	**La**	**Pb**	**Li**	**Lu**	**Mg**	**Mn**
			ppm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**
W00-4-81.1	Till	81.10	46.0	13.0	25.6	1.0	12.50	1.65	14.0	<50	2.6	39.0	16.0	38.2	0.5	0.61	455
W00-4-82.1	Till	82.10	51.0	12.0	28.4	<1	15.30	1.55	11.0	<50	3.1	41.0	17.0	54.4	0.4	0.77	3540
W00-4-83.0	Till	83.00	41.0	20.0	24.6	2.0	11.00	1.50	14.0	<50	2.5	39.0	13.5	33.2	0.4	0.56	450
W00-4-84.1	Till	84.10	41.0	12.0	25.2	1.0	11.70	1.55	14.0	<50	2.6	41.0	15.0	34.8	0.4	0.56	420
W00-4-85.95	Till	85.95	42.0	12.0	24.0	1.0	11.30	1.70	15.0	<50	2.5	41.0	14.0	34.8	0.4	0.58	460
W00-4-87.7	Till	87.70	42.0	12.0	22.8	<1	10.85	1.50	16.0	<50	2.6	40.0	14.0	32.6	0.6	0.57	425
W00-4-89.5	Till	89.50	43.0	14.0	26.2	2.0	11.85	1.50	14.0	<50	2.6	41.0	14.5	36.0	0.4	0.59	460

Appendix 3 - Table A3-9: Geochemical analysis of samples from corehole WEPA00-4

			CVAA	IMS	IMS	IMS	IMS	IMS	IMS	NAA	NAA	NAA	IMS	NAA	IMS	NAA	IMS
Sample #	**Material**	**Depth**	**Hg**	**Mo**	**Ni**	**Nb**	**P**	**K**	**Rb**	**Sm**	**Sc**	**Se**	**Ag**	**Na**	**Sr**	**Ta**	**Te**
			ppb	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
W00-4-81.1	Till	81.10	30.0	0.85	21.8	11.5	530	1.45	70.9	6.8	10.0	<5	0.25	0.59	128.0	1.6	<0.05
W00-4-82.1	Till	82.10	10.0	3.65	29.2	13.0	620	1.53	82.3	7.2	12.0	<5	0.30	0.56	143.5	1.2	0.05
W00-4-83.0	Till	83.00	10.0	0.85	19.8	11.5	540	1.45	63.5	6.6	9.5	<5	0.25	0.60	124.5	1.1	<0.05
W00-4-84.1	Till	84.10	20.0	0.80	20.8	11.2	530	1.40	66.0	6.8	10.0	<5	0.25	0.60	130.5	1.4	<0.05
W00-4-85.95	Till	85.95	20.0	0.85	20.2	10.8	570	1.41	65.1	6.8	10.0	<5	0.20	0.65	126.0	1.1	<0.05
W00-4-87.7	Till	87.70	30.0	0.75	19.2	10.2	570	1.32	62.3	7.0	10.0	<5	0.25	0.63	125.5	1.4	<0.05
W00-4-89.5	Till	89.50	30.0	0.85	21.2	11.2	600	1.50	69.6	6.9	10.0	<5	0.25	0.65	128.0	1.5	<0.05

Appendix 3 - Table A3-9: Geochemical analysis of samples from corehole WEPA00-4

			NAA	IMS	NAA	NAA	IMS	IMS	NAA	IMS	NAA	IMS	IMS	NAA
Sample #	**Material**	**Depth**	**Tb**	**Tl**	**Th**	**Sn**	**Ti**	**W**	**U**	**V**	**Yb**	**Y**	**Zn**	**Zr**
			ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
W00-4-81.1	Till	81.10	0.90	0.42	10.0	<100	0.33	0.9	3.5	77.0	3.0	21.3	<100	490
W00-4-82.1	Till	82.10	1.00	0.58	11.0	<100	0.34	1.2	3.2	99.0	3.0	24.7	<100	320
W00-4-83.0	Till	83.00	0.90	0.38	10.0	<100	0.34	1.0	3.5	71.0	3.0	21.0	<100	480
W00-4-84.1	Till	84.10	0.80	0.42	11.0	<100	0.32	0.9	3.7	74.0	3.0	21.2	<100	550
W00-4-85.95	Till	85.95	1.00	0.40	10.0	<100	0.31	0.8	3.6	71.0	3.0	20.3	<100	650
W00-4-87.7	Till	87.70	0.90	0.38	11.0	<100	0.29	0.8	3.8	71.0	3.0	20.3	<100	540
W00-4-89.5	Till	89.50	1.10	0.42	11.0	<100	0.32	0.9	3.5	73.0	3.0	21.0	<100	510

Notes: < denotes less than
NAA denotes neutron activation analysis
CVAA denotes analysis by cold vapour atomic absorption
IMS denotes plasma-mass spectrometry analysis
All results are reported on a dry basis.
Ba* and Cr* denotes acid soluble portion
* W00-4-41.0 denotes sample duplicate of W00-4-41.0

Appendix 4 - Table A4-1: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63µm)	Silt (<63µm)	Clay (<4µm)	Sand (>50µm)	Silt (<50µm)	Clay (<2µm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-1-22.4	Till	22.4	1.82	39.9	26.0	34.1	42.4	30.4	27.2	1.0	3.2	4.1	0.30
W99-1-25.1	Till	25.1	0.49	40.1	42.4	17.5	49.2	37.7	13.1	0.9	3.0	3.9	0.32
W99-1-32.6	Till	32.6	0.78	26.5	34.7	38.8	28.5	46.7	24.8	0.9	3.1	4.1	0.30
W99-1-33.0	Till	33.0	1.72	42.9	33.9	23.2	46.4	38.5	15.1	0.9	3.1	4.1	0.30
W99-1-39.5	Till	39.5	0.84	24.3	34.8	40.9	26.4	49.5	24.1	1.0	3.2	4.1	0.30
W99-1-40.2	Till	40.2	1.30	38.4	33.1	28.5	41.3	41.7	17.0	1.0	3.2	4.1	0.30
W99-1-41.4	Till	41.4	0.75	24.3	43.2	32.5	27.1	53.7	19.2	1.0	3.2	4.1	0.30
W99-1-42.3	Till	42.3	1.02	25.5	34.3	40.2	27.7	48.6	23.7	1.0	3.2	4.1	0.30
W99-1-43.3	Till	43.3	0.84	23.4	29.1	47.5	25.2	42.6	32.2	0.9	2.6	3.6	0.36
W99-1-44.7	Till	44.7	0.23	8.9	41.9	49.2	11.6	55.3	33.1	0.9	2.0	2.9	0.46
W99-1-47.3	Till	47.3	0.54	10.5	46.8	42.7	11.2	60.2	28.6	0.9	2.1	3.0	0.45
W99-1-48.3	Till	48.3	0.29	12.4	47.2	40.4	14.0	61.0	25.0	0.8	3.2	3.9	0.24
W99-1-49.5	Till	49.5	1.47	43.7	38.9	17.4	46.9	42.5	10.6	0.7	2.1	2.9	0.34
W99-1-50.4	Till	50.4	1.28	41.9	41.4	16.7	45.3	45.2	9.5	0.8	2.1	2.9	0.39
W99-1-51.5	Till	51.5	1.23	44.2	37.6	18.2	47.3	43.0	9.7	0.7	2.3	3.1	0.31
W99-1-52.5	Till	52.5	1.39	42.1	39.4	18.5	45.5	43.8	10.7	1.0	2.5	3.4	0.39
W99-1-53.5	Till	53.5	1.19	43.1	36.9	20.0	46.2	42.4	11.4	1.0	2.7	3.6	0.36
W99-1-54.4	Till	54.4	1.19	41.8	40.7	17.5	45.1	45.6	9.3	0.9	2.5	3.4	0.37
W99-1-55.5	Till	55.5	1.35	42.5	37.8	19.7	45.8	43.9	10.3	0.9	2.5	3.4	0.37
W99-1-56.4	Till	56.4	1.33	43.3	38.1	18.6	46.8	42.5	10.7	0.9	2.5	3.4	0.37
W99-1-57.9	Till	57.9	1.83	46.1	33.3	20.6	48.9	39.3	11.8	1.0	2.5	3.4	0.39
W99-1-61.0	Till	61.0	1.10	32.7	38.3	29.0	35.8	45.7	18.5	1.0	3.9	4.8	0.25
W99-1-61.7	Till	61.7	1.43	38.3	37.1	24.6	41.0	44.7	14.3	1.0	2.4	3.4	0.41
W99-1-62.1	Till	62.1	2.66	44.4	28.9	26.7	48.1	32.6	19.3	0.7	0.9	1.6	0.78
W99-1-63.1	Till	63.1	2.62	45.3	29.0	25.7	48.7	32.1	19.2	0.8	0.7	1.5	1.06
W99-1-63.9	Till	63.9	2.51	44.0	29.4	26.6	48.1	30.8	21.1	0.9	1.1	2.0	0.89
W99-1-67.2	Till	67.2	2.41	42.5	37.9	19.6	45.9	42.9	11.2	0.9	3.1	4.1	0.30
W99-1-68.2	Till	68.2	2.48	40.9	43.3	15.8	44.7	46.6	8.7	1.0	3.8	4.8	0.27
W99-1-69.2	Till	69.2	2.28	41.3	42.9	15.8	44.6	46.7	8.7	1.2	3.8	5.0	0.31
W99-1-70.0	Till	70.0	1.90	35.8	48.9	15.3	40.8	51.0	8.2	1.0	4.1	5.1	0.25
W99-1-71.0	Till	71.0	2.23	39.4	46.4	14.2	43.0	48.8	8.2	1.0	4.4	5.3	0.22

Appendix 4 - Table A4-1: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63µm)	Silt (<63µm)	Clay (<4µm)	Sand (>50µm)	Silt (<50µm)	Clay (<2µm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-1-72.0	Till	72.0	2.41	38.0	43.3	18.7	42.7	45.9	11.4	1.0	4.4	5.3	0.22
W99-1-73.3	Till	73.3	3.03	49.4	37.3	13.3	52.5	40.6	6.9	1.3	6.0	7.3	0.22
W99-1-74.3	Till	74.3	1.41	31.9	41.7	26.4	36.4	47.4	16.2	0.8	2.5	3.2	0.31
W99-1-75.3	Till	75.3	4.53	52.4	36.2	11.4	55.4	37.7	6.9	1.6	7.8	9.4	0.21
W99-1-76.3	Till	76.3	3.82	50.8	35.4	13.8	54.7	36.7	8.6	1.5	7.7	9.2	0.20
W99-1-77.3	Till	77.3	3.54	51.3	33.7	15.0	54.1	37.0	8.9	1.3	6.3	7.6	0.22
W99-1-78.3	Till	78.3	4.01	51.0	37.5	11.5	54.5	37.8	7.7	1.0	7.1	8.1	0.16
W99-1-79.3	Till	79.3	3.68	50.6	36.1	13.3	53.8	38.6	7.6	1.4	8.2	9.6	0.19
W99-1-80.3	Till	80.3	3.66	51.0	33.7	15.3	54.1	36.3	9.6	1.3	5.3	6.6	0.25
W99-1-80.7	Till	80.7	4.25	49.4	34.9	15.7	52.1	39.6	8.3	1.2	6.7	8.0	0.19
W99-1-81.1	Till	81.1	4.08	49.4	35.2	15.4	52.8	38.9	8.3	1.4	6.4	7.8	0.23
W99-1-87.1	Till	87.1	2.06	37.7	38.9	23.4	40.8	44.1	15.1	1.3	3.0	4.3	0.43
W99-1-88.0	Till	88.0	2.23	35.4	42.2	22.4	39.5	47.3	13.2	1.2	2.8	4.0	0.45
W99-1-89.7	Till	89.7	2.19	36.3	40.9	22.8	39.5	48.2	12.3	1.1	3.0	4.1	0.38
W99-1-91.4	Till	91.4	2.12	33.1	44.4	22.5	37.8	48.6	13.6	1.1	2.6	3.8	0.43
W99-1-92.4	Till	92.4	2.28	34.9	42.4	22.7	38.3	48.2	13.5	1.0	2.8	3.8	0.34
W99-1-93.3	Till	93.3	1.95	33.0	42.8	24.2	37.3	49.1	13.6	0.9	2.5	3.4	0.37
W99-1-95.1	Till	95.1	2.33	37.8	40.1	22.1	41.0	47.2	11.8	0.8	3.5	4.3	0.22
W99-1-95.5	Till	95.5	2.33	39.7	38.8	21.5	43.5	46.0	10.5	1.2	2.9	4.1	0.40
W99-1-96.5	Till	96.5	2.73	30.6	53.3	16.1	33.1	57.6	9.3	1.7	4.7	6.4	0.37
W99-1-97.5	Till	97.5	3.02	29.1	56.5	14.4	33.2	57.4	9.4	1.4	4.8	6.1	0.29
W99-1-98.1	Till	98.1	3.28	33.0	48.5	18.5	35.5	53.9	10.6	1.4	4.8	6.1	0.29
W99-1-99.2	Till	99.2	3.47	29.8	39.1	31.1	34.0	47.6	18.4	1.3	5.2	6.5	0.27
W99-1-100.2	Till	100.2	2.85	33.5	48.9	17.6	36.0	53.5	10.5	1.5	5.5	7.0	0.28
W99-1-101.3	Till	101.3	1.15	9.9	72.4	17.7	11.7	78.9	9.4	1.5	4.4	5.9	0.35
W99-1-102.2	Till	102.2	0.39	11.8	73.9	14.3	14.2	77.0	8.8	0.8	1.0	1.8	0.78
W99-1-103.4	Till	103.4	0.88	12.2	70.4	17.4	15.2	75.7	9.1	0.7	1.7	2.4	0.41
W99-1-104.4	Till	104.4	2.90	33.3	36.0	30.7	36.0	45.4	18.6	1.7	5.6	7.4	0.32
W99-1-105.4	Till	105.4	1.84	19.5	51.7	28.8	23.5	56.3	20.2	1.2	3.8	5.0	0.31
W99-1-106.3	Till	106.3	3.17	37.2	31.5	31.3	40.1	39.4	20.5	1.4	5.6	7.0	0.26
W99-1-109.0	Till	109.0	2.19	34.0	46.7	19.3	38.5	51.3	10.2	1.0	2.1	3.1	0.45

Appendix 4 - Table A4-1: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-1-110.0	Till	110.0	2.11	36.5	41.5	22.0	39.9	47.1	13.0	1.0	1.4	2.4	0.67
W99-1-111.0	Till	111.0	2.75	41.8	41.9	16.3	45.5	45.4	9.1	0.8	1.2	2.0	0.62
W99-1-112.0	Till	112.0	1.94	36.9	43.9	19.2	40.3	50.1	9.6	0.8	1.5	2.4	0.55
W99-1-113.0	Till	113.0	1.99	34.6	42.2	23.2	38.6	49.8	11.6	0.8	1.5	2.4	0.55
W99-1-114.0	Till	114.0	2.07	34.2	43.4	22.4	37.5	51.2	11.3	0.8	1.3	2.2	0.63
W99-1-115.0	Till	115.0	2.19	35.9	43.4	20.7	38.4	51.0	10.6	0.8	1.2	2.0	0.66
W99-1-116.0	Till	116.0	1.70	34.4	44.4	21.2	38.2	49.7	12.1	0.9	1.0	1.8	0.91
W99-1-117.0	Till	117.0	1.86	33.4	39.5	27.1	35.7	49.3	15.0	0.9	1.3	2.2	0.67
W99-1-118.0	Till	118.0	1.98	38.2	39.8	22.0	41.4	45.0	13.6	0.7	1.1	1.8	0.66
W99-1-119.0	Till	119.0	2.02	36.3	40.7	23.0	39.3	46.4	14.3	0.8	1.2	2.0	0.61
W99-1-120.0	Till	120.0	1.56	33.7	38.9	27.4	37.0	45.9	17.1	0.7	1.4	2.1	0.47
W99-1-121.0	Till	121.0	2.15	33.4	40.0	26.6	36.4	47.1	16.5	0.7	1.3	2.0	0.52
W99-1-121.9	Till	121.9	2.36	35.3	43.5	21.2	38.5	48.3	13.2	0.8	1.1	1.8	0.72
W99-1-122.4	Till	122.4	0.19	2.1	66.6	31.3	2.8	79.8	17.4	0.8	1.1	1.8	0.72
W99-1-123.1	Till	123.1	2.24	36.2	41.5	22.3	39.7	47.0	13.3	0.8	1.2	2.0	0.61
W99-1-124.1	Till	124.1	2.11	34.7	43.2	22.1	38.1	48.7	13.2	0.9	1.7	2.7	0.54
W99-1-125.1	Till	125.1	1.70	33.6	37.8	28.6	36.6	47.0	16.4	0.7	1.4	2.1	0.50
W99-1-126.1	Till	126.1	2.10	33.0	39.7	27.3	36.2	48.7	15.1	0.9	1.1	2.0	0.77
W99-1-127.1	Till	127.1	1.64	31.0	35.6	33.4	33.7	46.4	19.9	0.9	1.6	2.5	0.61
W99-1-128.1	Till	128.1	1.59	31.5	36.5	32.0	34.4	47.3	18.3	0.7	1.3	2.0	0.57
W99-1-129.1	Till	129.1	1.48	30.5	36.0	33.5	33.3	45.9	20.8	0.7	1.1	1.8	0.61
W99-1-130.6	Till	130.6	2.03	33.0	38.3	28.7	36.1	46.0	17.9	0.7	1.2	2.0	0.58
W99-1-131.6	Till	131.6	1.76	40.5	31.2	28.3	43.6	39.0	17.4	0.8	1.5	2.3	0.55
W99-1-132.5	Till	132.5	2.01	42.2	33.6	24.2	45.3	39.8	14.9	0.7	1.3	2.0	0.52
W99-1-133.5	Till	133.5	1.88	45.0	31.7	23.3	48.1	39.1	12.8	0.9	1.4	2.3	0.63
W99-1-134.5	Till	134.5	1.98	39.6	39.9	20.5	42.8	45.5	11.7	1.0	1.1	2.0	0.90
W99-1-135.5	Till	135.5	1.00	34.6	42.5	22.9	38.4	49.0	12.6	0.8	1.0	1.8	0.84
W99-1-137.0	Till	137.0	1.99	33.3	41.3	25.4	36.4	49.4	14.2	0.8	1.3	2.2	0.62
W99-1-138.0	Till	138.0	2.23	36.1	45.4	18.5	40.0	48.2	11.8	0.9	1.1	2.0	0.83
W99-1-139.0	Till	139.0	2.17	35.5	44.1	20.4	39.4	46.9	13.7	0.9	1.2	2.2	0.77
W99-1-140.0	Till	140.0	2.21	35.3	46.1	18.6	38.8	50.6	10.6	1.0	1.3	2.4	0.77

Appendix 4 - Table A4-1: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-1-141.0	Till	141.0	2.47	37.2	43.6	19.2	41.0	48.1	10.9	0.9	2.1	3.0	0.45
W99-1-142.0	Till	142.0	2.29	35.8	44.6	19.6	39.1	49.0	11.9	0.9	1.7	2.7	0.54
W99-1-143.0	Till	143.0	2.30	35.6	43.6	20.8	38.6	48.9	12.5	0.9	2.2	3.0	0.39
W99-1-144.0	Till	144.0	2.35	35.5	42.9	21.6	38.8	48.5	12.7	0.9	1.9	2.8	0.50
W99-1-145.0	Till	145.0	2.12	36.1	42.1	21.8	39.3	47.2	13.5	0.9	1.9	2.8	0.50
W99-1-146.0	Till	146.0	2.21	35.6	42.7	21.7	38.7	47.9	13.4	0.9	1.6	2.5	0.60
W99-1-147.0	Till	147.0	2.16	32.8	37.6	29.6	35.5	44.6	19.9	1.1	1.7	2.8	0.64
W99-1-148.0	Till	148.0	2.09	33.9	37.7	28.4	36.9	44.2	18.9	1.0	1.1	2.0	0.90
W99-1-149.0	Till	149.0	2.51	32.8	40.4	26.8	35.8	47.3	16.9	1.0	1.2	2.2	0.78
W99-1-150.0	Till	150.0	0.04	46.4	37.2	16.4	52.4	37.6	10.0	0.9	1.5	2.4	0.63
W99-1-151.0	Till	151.0	2.18	31.4	44.8	23.8	34.4	51.8	13.8	1.0	1.8	2.7	0.54
W99-1-153.0	Till	153.0	2.39	30.8	40.9	28.3	33.8	49.4	16.8	1.0	2.1	3.1	0.50
W99-1-152.0	Till	152.0	2.34	31.6	44.9	23.5	34.5	51.3	14.2	0.9	2.4	3.3	0.38
W99-1-153.4	Till	153.4	2.61	33.8	40.7	25.5	36.7	48.9	14.4	1.2	2.2	3.4	0.54
W99-1-153.6	Shale	153.6	0.06	3.1	49.5	47.4	4.0	61.3	34.7	0.8	1.2	2.0	0.64
WP99-1-155	Shale	155.0	0.10	0.7	78.6	20.7	1.1	83.1	15.8				
WP99-1-156	Shale	156.0	0.17	0.9	58.8	40.3	1.1	69.6	29.3				
WP99-1-157	Shale	157.0	0.12	1.4	64.5	34.1	1.7	70.6	27.7				
WP99-1-158	Shale	158.0	0.16	0.7	63.2	36.1	1.0	71.9	27.1				
WP99-1-159	Shale	159.0	0.10	1.2	65.8	33.0	1.6	72.0	26.4				
WP99-1-160	Shale	160.0	0.06	1.4	65.0	33.6	1.6	71.2	27.2				
WP99-1-161	Shale	161.0	0.00	0.6	82.4	17.0	0.9	86.3	12.8				
WP99-1-162	Shale	162.0	0.25	2.0	79.5	18.5	2.2	84.3	13.5				
WP99-1-163	Shale	163.0	0.00	1.2	73.3	25.5	1.5	80.1	18.4				
WP99-1-164	Shale	164.0	0.02	3.6	85.4	11.0	4.0	88.3	7.7				
WP99-1-165	Shale	165.0	0.00	2.4	84.2	13.4	2.7	88.3	9.0				
WP99-1-166	Shale	166.0	0.06	1.8	75.1	23.1	2.3	80.6	17.1				

Appendix 4 - Table A4-2: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-2

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-2-7.5	7.5	Till	1.34	34.4	40.2	25.4	38.0	44.5	17.5	1.0	3.2	4.1	0.30
W99-2-9.5	9.5	Till	1.12	31.1	40.7	28.2	34.7	45.6	19.7	0.9	2.8	3.8	0.34
W99-2-12.0	12.0	Till	1.29	30.4	40.8	28.8	33.7	47.2	19.1	0.9	2.8	3.7	0.32
W99-2-14.0	14.0	Till	1.75	43.7	30.5	25.8	46.7	35.5	17.8	0.9	3.1	4.1	0.30
W99-2-15.0	15.0	Till	1.16	28.7	44.0	27.3	31.5	49.2	19.3	1.0	2.8	3.8	0.34
W99-2-17.0	17.0	Silt	2.07	43.1	30.7	26.2	46.0	36.3	17.7	1.1	2.7	3.8	0.39
W99-2-21.8	21.8	Till	1.88	46.6	27.9	25.5	49.4	32.7	17.9	1.0	3.2	4.1	0.30
W99-2-22.7	22.7	Till	2.09	46.9	27.2	25.9	50.0	32.2	17.8	0.8	3.6	4.4	0.22
W99-2-23.4	23.4	Till	2.07	45.1	25.2	29.7	47.9	30.4	21.7	0.9	3.5	4.4	0.27
W99-2-29.0	29.0	Till	1.87	38.9	35.1	26.0	42.0	41.2	16.8	1.0	3.5	4.5	0.27
W99-2-30.5	30.5	Till	1.45	20.4	50.4	29.2	22.6	57.3	20.1	1.1	6.8	7.9	0.18
W99-2-32.5	32.5	Till	3.60	49.8	26.2	24.0	53.1	30.4	16.5	1.3	5.6	6.9	0.24
W99-2-33.4	33.4	Till	2.72	43.2	28.3	28.5	46.4	34.7	18.9	1.2	6.2	7.4	0.21
W99-2-35.0	35.0	Till	1.55	43.5	40.5	16.0	51.5	38.0	10.5	0.8	6.8	7.5	0.12
W99-2-35.7	35.7	Till	3.39	54.7	25.0	20.3	58.0	27.6	14.4	1.3	6.3	7.5	0.21
W99-2-37.5	37.5	Till	2.48	47.1	28.0	24.9	50.5	33.4	16.1	1.2	5.6	6.8	0.23
W99-2-38.7	38.7	Till	1.99	8.0	41.6	50.4	10.9	50.6	38.5	1.0	3.5	4.5	0.29
W99-2-40.0	40.0	Silt & Clay	0.33	33.8	36.8	29.4	38.7	39.8	21.5	1.4	2.8	4.2	0.51
W99-2-41.0	41.0	Silt & Clay	1.10	37.8	26.5	35.7	40.8	33.7	25.5	0.5	1.7	2.2	0.27
W99-2-42.0	42.0	Till	0.84	41.3	29.9	28.8	44.6	37.9	17.5	1.2	3.4	4.6	0.35
W99-2-43.0	43.0	Till	0.97	48.1	26.0	25.9	51.3	32.1	16.6	1.1	2.7	3.8	0.41
W99-2-44.0	44.0	Till	1.10	43.9	30.3	25.8	47.2	36.2	16.6	1.0	2.9	4.0	0.35
W99-2-45.0	45.0	Till	1.02	48.8	27.4	23.8	52.1	31.8	16.1	1.0	3.0	4.0	0.32
W99-2-46.0	46.0	Till	1.53	52.9	23.9	23.2	56.1	29.5	14.4	0.9	2.4	3.4	0.39
W99-2-47.0	47.0	Till	3.26	49.0	25.7	25.3	52.0	32.0	16.0	1.1	2.6	3.7	0.41
W99-2-48.0	48.0	Till	0.72	47.0	28.2	24.8	50.3	34.0	15.7	0.9	2.6	3.5	0.36
W99-2-49.0	49.0	Till	1.33	44.2	26.1	29.7	47.0	34.1	18.9	0.7	3.7	4.4	0.18
W99-2-50.0	50.0	Till	1.15	41.0	31.4	27.6	44.2	37.2	18.6	0.6	1.5	2.1	0.43
W99-2-51.0	51.0	Till	0.96	43.9	28.5	27.6	46.9	34.9	18.2	0.9	2.1	3.0	0.45
W99-2-52.0	52.0	Till	0.88	43.4	30.0	26.6	46.5	36.5	17.0	0.9	2.3	3.2	0.42
W99-2-54.0	54.0	Till	0.89	27.2	35.9	36.9	29.6	46.4	24.0	0.8	2.2	3.1	0.38

Appendix 4 - Table A4-2: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-2

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-2-55.0	55.0	Till	0.98	37.5	34.1	28.4	40.6	41.4	18.0	0.7	2.0	2.7	0.37
W99-2-56.0	56.0	Till	1.00	32.7	30.1	37.2	35.2	41.7	23.1	0.8	2.1	2.8	0.36
W99-2-57.0	57.0	Till	1.11	30.3	28.8	40.9	32.8	40.1	27.1	0.8	1.2	2.0	0.61
W99-2-58.0	58.0	Silt & Clay	0.30	11.0	38.9	50.1	12.2	57.8	30.0	0.6	2.6	3.2	0.24
W99-2-59.0	59.0	Silt & Clay	0.04	3.4	70.9	25.7	4.7	80.0	15.3	0.9	2.8	3.7	0.34
W99-2-60.0	60.0	Silt & Clay	0.16	3.8	72.6	23.6	9.6	75.2	15.2	0.7	3.4	4.1	0.21
W99-2-61.0	61.0	Silt & Clay	0.06	4.8	66.8	28.4	11.6	68.8	19.6	0.9	3.3	4.3	0.29
W99-2-62.0	62.0	Silt & Clay	0.18	5.7	63.7	30.6	8.8	70.7	20.5	1.0	2.6	3.6	0.36
W99-2-63.0	63.0	Till	1.47	40.4	35.8	23.8	44.1	40.5	15.4	1.0	2.8	3.8	0.34
W99-2-64.0	64.0	Till	1.48	40.4	34.7	24.9	43.7	40.8	15.5	0.9	3.2	4.1	0.27
W99-2-65.0	65.0	Till	1.56	44.8	29.3	25.9	48.5	34.6	16.9	0.9	2.7	3.6	0.33
W99-2-66.0	66.0	Till	1.43	44.4	34.7	20.9	47.9	38.8	13.3	0.6	2.4	3.0	0.27
W99-2-67.0	67.0	Till	1.41	44.1	33.0	22.9	47.8	38.4	13.8	0.8	2.9	3.7	0.29
W99-2-68.0	68.0	Till	1.64	45.1	31.8	23.1	48.6	37.0	14.4	0.6	2.4	3.0	0.27
W99-2-69.0	69.0	Till	1.50	45.2	29.8	25.0	47.9	34.9	17.2	1.0	2.4	3.4	0.43
W99-2-70.1	70.1	Till	1.23	44.8	32.5	22.7	48.5	37.3	14.2	1.0	2.8	3.8	0.34
W99-2-71.0	71.0	Till	1.35	44.6	30.3	25.1	48.3	35.6	16.1	1.1	2.7	3.8	0.39
W99-2-74.0	74.0	Till	1.77	46.3	34.1	19.6	49.9	38.7	11.4	0.7	2.5	3.2	0.27
W99-2-75.0	75.0	Till	1.66	46.2	30.4	23.4	49.8	35.1	15.1	0.8	2.6	3.4	0.33
W99-2-76.0	76.0	Till	1.80	50.6	29.1	20.3	54.2	32.9	12.9	1.0	2.1	3.1	0.45
W99-2-77.0	77.0	Till	1.43	45.6	31.6	22.8	49.1	35.9	15.0	1.0	2.8	3.8	0.34
W99-2-78.0	78.0	Till	1.66	46.3	32.2	21.5	49.8	36.4	13.8	1.0	2.8	3.8	0.34
W99-2-79.0	79.0	Till	1.33	46.7	31.8	21.5	50.3	35.9	13.8	0.9	3.2	4.1	0.29
W99-2-80.0	80.0	Till	1.39	46.2	36.2	17.6	49.7	39.4	10.9	0.9	2.9	3.8	0.30
W99-2-81.0	81.0	Till	1.21	45.6	35.9	18.5	49.1	38.9	12.0	1.0	2.5	3.4	0.39
W99-2-82.0	82.0	Till	1.25	45.5	33.5	21.0	49.1	37.9	13.0	1.0	2.5	3.4	0.39
W99-2-83.0	83.0	Till	1.23	46.0	34.5	19.5	49.6	39.0	11.4	1.0	2.6	3.6	0.36
W99-2-84.0	84.0	Till	1.31	45.4	34.9	19.7	48.7	39.6	11.7	0.8	2.6	3.4	0.29
W99-2-85.0	85.0	Till	1.35	46.0	34.3	19.7	49.3	39.0	11.7	0.9	2.5	3.4	0.37
W99-2-86.0	86.0	Till	1.47	43.6	34.1	22.3	46.6	39.1	14.3	0.9	2.2	3.1	0.40
W99-2-87.0	87.0	Till	1.50	39.2	36.0	24.8	42.1	42.8	15.1	1.0	2.8	3.8	0.36

Appendix 4 - Table A4-2: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-2

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-2-88.0	88.0	Till	1.27	39.2	34.8	26.0	42.0	42.0	16.0	1.1	2.3	3.4	0.48
W99-2-92.7	92.7	Till	1.75	43.9	35.1	21.0	47.1	40.1	12.8	0.9	2.2	3.1	0.40
W99-2-93.1	93.1	Till	1.64	43.9	34.7	21.4	47.1	39.4	13.5	0.9	2.4	3.2	0.37
W99-2-94.0	94.0	Till	1.96	41.6	35.3	23.1	44.5	42.1	13.4	1.0	2.1	3.1	0.45
W99-2-95.0	95.0	Till	1.55	39.0	33.3	27.7	42.0	41.0	17.0	1.0	2.2	3.2	0.44
W99-2-96.0	96.0	Till	1.82	43.0	35.1	21.9	46.3	40.5	13.2	0.8	2.1	2.9	0.36
W99-2-97.0	97.0	Till	1.43	39.3	37.4	23.3	42.2	43.4	14.4	1.3	2.1	3.4	0.63
W99-2-98.0	98.0	Till	1.43	39.3	33.2	27.5	42.1	41.1	16.8	1.3	2.8	4.1	0.47
W99-2-99.0	99.0	Till	1.57	39.9	32.2	27.9	42.8	40.3	16.9	1.1	2.7	3.8	0.41
W99-2-100.0	100.0	Till	1.52	44.2	32.6	23.2	46.9	38.8	14.3	0.9	2.6	3.6	0.36
W99-2-101.0	101.0	Till	1.33	41.6	33.4	25.0	44.4	41.5	14.1	1.0	2.2	3.2	0.44
W99-2-102.0	102.0	Till	1.37	37.8	36.6	25.6	40.4	45.0	14.6	0.9	2.6	3.6	0.36
W99-2-103.0	103.0	Till	1.54	37.9	35.3	26.8	40.5	44.5	15.0	0.9	2.6	3.6	0.34
W99-2-104.0	104.0	Till	1.62	37.2	32.3	30.5	39.8	41.1	19.1	1.2	1.8	3.0	0.69
W99-2-105.0	105.0	Till	1.29	38.4	33.7	27.9	41.1	42.5	16.4	1.0	2.0	3.0	0.49
W99-2-106.0	106.0	Till	1.46	36.0	41.4	22.6	38.4	49.0	12.6	1.0	2.0	3.0	0.50
W99-2-107.1	107.1	Till	1.18	35.4	38.1	26.5	37.9	46.2	15.9	1.0	1.7	2.7	0.61
W99-2-108.0	108.0	Till	1.28	37.2	40.1	22.7	39.8	47.5	12.7	0.9	1.6	2.5	0.60
W99-2-109.0	109.0	Till	1.52	38.6	41.2	20.2	41.1	47.0	11.9	0.9	1.7	2.7	0.54
W99-2-110.1	110.1	Till	3.39	1.7	76.8	21.5	27.9	58.9	13.2	0.9	1.8	2.7	0.51
W99-2-111.0	111.0	Till	1.48	35.5	43.4	21.1	37.4	49.2	13.4	0.8	1.7	2.5	0.46
W99-2-112.0	112.0	Till	1.28	33.0	37.3	29.7	36.0	44.8	19.2	1.0	2.0	3.0	0.50
W99-2-113.5	113.5	Till	1.06	31.5	37.2	31.3	34.4	45.1	20.5	1.1	2.5	3.6	0.44
W99-2-114.3	114.3	Till	1.20	33.6	38.8	27.6	36.8	45.8	17.4	1.1	2.5	3.6	0.44
W99-2-115.0	115.0	Till	1.44	36.6	37.9	25.5	39.7	45.0	15.3	0.9	2.8	3.7	0.34
W99-2-116.0	116.0	Till	1.40	35.0	36.7	28.3	38.1	42.7	19.2	1.1	2.6	3.7	0.41
W99-2-117.0	117.0	Till	1.23	40.1	30.6	29.3	43.1	38.5	18.4	1.1	3.0	4.1	0.37
W99-2-118.0	118.0	Till	1.62	39.3	31.7	29.0	42.3	39.6	18.1	0.9	2.4	3.4	0.39
W99-2-119.0	119.0	Till	1.42	38.3	31.2	30.5	41.3	38.6	20.1	1.2	2.9	4.1	0.40
W99-2-120.0	120.0	Till	1.33	40.0	29.6	30.4	43.1	35.6	21.3	1.2	2.9	4.1	0.40
W99-2-121.0	121.0	Till	1.25	37.8	32.3	29.9	40.7	39.8	19.5	1.1	3.0	4.1	0.38

Appendix 4 - Table A4-2: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-2

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-2-122.0	122.0	Till	1.33	39.6	32.0	28.4	42.5	39.6	17.9	0.7	2.3	3.0	0.31
W99-2-123.0	123.0	Till	1.37	34.4	34.4	31.2	37.5	41.6	20.9	1.0	3.1	4.1	0.31
W99-2-124.0	124.0	Till	0.76	31.0	31.7	37.3	33.1	41.7	25.2	1.3	4.0	5.3	0.32
W99-2-125.0	125.0	Till	0.70	29.2	30.7	40.1	32.7	37.5	29.8	1.2	3.9	5.1	0.32
W99-2-127.0	127.0	Till	0.70	30.5	33.5	36.0	33.9	41.4	24.7	1.2	3.9	5.1	0.32
W99-2-128.0	128.0	Till	0.88	29.9	35.6	34.5	33.6	43.6	22.8	1.0	3.8	4.7	0.26
W99-2-129.0	129.0	Till	0.68	28.2	32.5	39.3	31.8	40.5	27.7	1.0	3.5	4.5	0.29
W99-2-130.0	130.0	Till	0.54	23.9	32.7	43.4	27.1	43.7	29.2	1.5	3.2	4.7	0.47
W99-2-131.0	131.0	Till	0.45	23.4	24.7	51.9	26.3	38.0	35.7	1.2	3.8	5.0	0.32
W99-2-132.0	132.0	Till	0.70	30.2	31.2	38.6	33.4	39.4	27.2	1.2	4.0	5.2	0.30
W99-2-133.0	133.0	Till	0.54	25.2	34.4	40.4	28.9	42.6	28.5	1.2	3.6	4.9	0.34
W99-2-134.2	134.2	Till	0.76	36.6	27.6	35.8	39.9	35.8	24.3	1.1	3.4	4.5	0.33
W99-2-135.0	135.0	Till	0.49	31.8	29.4	38.8	35.3	37.4	27.3	1.4	3.8	5.2	0.36
W99-2-136.0	136.0	Till	0.12	51.9	20.5	27.6	55.5	25.3	19.2	1.4	6.8	8.2	0.21
W99-2-137.0	137.0	Till	0.00	6.6	54.0	39.4	9.3	69.8	20.9	1.5	8.2	9.8	0.20
W99-2-138.0	138.0	Silt & Clay	0.04	50.2	17.7	32.1	53.8	24.4	21.8	1.3	6.3	7.6	0.21
W99-2-139.0	139.0	Silt & Clay	0.00	4.7	69.4	25.9	10.3	71.6	18.1	1.1	4.9	6.0	0.23
W99-2-140.0	140.0	Silt	0.02	3.2	67.9	28.9	6.9	74.3	18.8	1.2	5.0	6.2	0.25
W99-2-141.0	141.0	Silt	0.04	35.0	35.6	29.4	41.0	37.4	21.6	1.0	4.8	5.9	0.22
W99-2-142.0	142.0	Silt	0.02	53.1	20.8	26.1	56.6	24.8	18.6	1.1	4.8	5.9	0.22
W99-2-143.0	143.0	Silt	0.02	48.8	25.1	26.1	54.6	26.8	18.6	1.3	4.6	5.9	0.27
W99-2-144.0	144.0	Silt	0.00	11.7	59.9	28.4	21.0	59.3	19.7	1.3	4.8	6.1	0.26
W99-2-145.0	145.0	Silt	0.12	48.6	14.6	36.8	49.7	24.5	25.8	1.5	5.8	7.3	0.27
W99-2-146.0	146.0	Silt	0.00	44.7	27.0	28.3	52.1	27.7	20.2	1.3	5.0	6.2	0.26
W99-2-148.1	148.1	Silt & Clay	0.00	1.9	66.2	31.9	5.9	71.6	22.5	1.2	4.6	5.8	0.26
W99-2-149.0	149.0	Till & Clay	0.00	4.3	57.7	38.0	7.6	66.8	25.6	1.0	4.1	5.1	0.24
W99-2-149.9	149.9	Till & Clay	0.00	1.0	58.2	40.8	2.7	69.2	28.1	1.2	4.7	5.9	0.25
W99-2-151.0	151.0	Till & Clay	0.59	24.7	32.9	42.4	27.9	42.6	29.5	1.3	4.4	5.7	0.28
W99-2-152.0	152.0	Till & Clay	0.08	3.3	51.3	45.4	5.4	62.6	32.0	2.0	6.3	8.4	0.33
W99-2-153.0	153.0	Till & Clay	0.86	19.7	39.9	40.4	22.6	49.8	27.6	1.2	4.5	5.7	0.27
W99-2-154.0	154.0	Till & Clay	0.53	24.1	38.0	37.9	28.6	44.3	27.1	1.3	4.4	5.7	0.28

Appendix 4 - Table A4-2: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA99-2

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W99-2-155.0	155.0	Till & Clay	0.04	11.3	45.7	43.0	14.3	58.7	27.0	2.0	5.5	7.5	0.37
W99-2-156.0	156.0	Till	0.90	34.1	33.5	32.4	37.8	40.0	22.2	1.0	2.8	3.8	0.34
W99-2-157.0	157.0	Till	1.03	35.4	34.6	30.0	38.9	41.8	19.3	0.8	3.0	3.7	0.26
W99-2-158.0	158.0	Till	0.76	31.3	32.4	36.3	34.9	39.9	25.2	1.0	3.5	4.5	0.27
W99-2-159.0	159.0	Mudstone	0.00	0.0	6.7	93.3	0.1	17.8	82.1	1.1	2.6	3.8	0.43
W99-2-160.0	160.0	Mudstone	0.00	0.2	19.6	80.2	0.6	35.9	63.5	1.6	3.7	5.4	0.44

Appendix 4 - Table A4-3: Matrix Grain-Size and Carbonate Analyses, Corehole WR99-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63µm)	Silt (<63µm)	Clay (<4µm)	Sand (>50µm)	Silt (<50µm)	Clay (<2µm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
WR99-1-23.4	Till	23.40	1.08	31.3	50.1	18.6	35.3	54.2	10.5	0.7	2.4	3.1	0.31
WR99-1-26.0	Till	26.00	2.42	44.7	37.8	17.5	48.1	42.8	9.1	0.7	2.4	3.1	0.27
WR99-1-28.9	Till	28.90	2.73	40.9	38.3	20.8	44.4	43.0	12.6	0.7	2.2	2.9	0.34
WR99-1-30.6	Till	30.60	1.96	48.1	36.2	15.7	50.9	40.5	8.6	0.6	2.5	3.1	0.22
WR99-1-31.6	Till	31.60	2.64	42.1	41.2	16.7	45.6	44.6	9.8	0.7	1.7	2.4	0.44
WR99-1-33.0	Till	33.00	2.46	41.6	39.2	19.2	45.2	43.0	11.8	0.6	2.5	3.1	0.22
WR99-1-34.8	Till	34.80	1.86	30.4	45.5	24.1	33.4	51.4	15.2	0.7	1.5	2.2	0.47
WR99-1-35.9	Till	35.90	1.66	33.0	42.1	24.9	36.3	48.8	14.9	0.7	2.2	2.9	0.34
WR99-1-36.6	Till	36.60	2.07	32.8	42.4	24.8	35.9	48.7	15.4	0.6	1.6	2.2	0.36
WR99-1-37.7	Till	37.70	1.88	39.1	36.2	24.7	42.6	42.6	14.8	0.7	1.9	2.7	0.38
WR99-1-38.6	Till	38.60	2.17	33.9	46.8	19.3	37.1	50.4	12.5	0.7	1.9	2.5	0.35
WR99-1-39.9	Till	39.90	1.77	34.6	43.3	22.1	37.9	47.7	14.4	0.4	1.5	1.9	0.26
WR99-1-40.9	Till	40.90	1.96	29.4	45.6	25.0	32.3	50.7	17.0	0.6	1.8	2.5	0.36
WR99-1-41.8	Silt & Clay	41.80	0.00	0.4	71.8	27.8	0.9	82.5	16.6	0.6	5.0	5.5	0.12
WR99-1-43.0	Silt & Clay	43.00	0.02	0.7	71.9	27.4	1.1	83.3	15.6	0.3	5.5	5.8	0.07
WR99-1-43.9	Silt & Clay	43.90	0.00	0.9	71.8	27.3	1.3	83.9	14.8	0.9	4.2	5.1	0.22
WR99-1-45.0	Silt & Clay	45.00	0.29	6.6	60.5	32.9	7.9	72.4	19.7	0.9	4.4	5.4	0.21
WR99-1-46.0	Silt & Clay	46.00	0.00	0.4	56.0	43.6	1.6	73.5	24.9	0.7	3.3	3.9	0.20
WR99-1-46.5	Silt & Clay	46.50	0.33	9.0	56.2	34.8	10.8	68.9	20.3	0.7	2.2	2.9	0.29
WR99-1-47.5	Till	47.50	2.05	38.5	40.3	21.2	41.9	44.9	13.2	0.7	1.3	2.0	0.49
WR99-1-48.6	Till	48.60	2.24	38.4	44.5	17.1	41.7	47.4	10.9	0.7	1.7	2.3	0.39
WR99-1-49.8	Till	49.80	2.13	39.4	39.6	21.0	42.8	43.6	13.6	0.7	1.4	2.2	0.50
WR99-1-51.0	Till	51.00	2.26	39.2	41.5	19.3	42.6	44.2	13.2	0.6	1.8	2.5	0.35
WR99-1-52.3	Till	52.30	2.12	39.5	41.3	19.2	43.0	44.6	12.4	0.6	1.7	2.3	0.39
WR99-1-53.2	Till	53.20	2.41	40.7	34.2	25.1	44.2	40.1	15.7	0.9	2.0	2.9	0.47
WR99-1-54.3	Till	54.30	2.31	39.9	41.1	19.0	43.4	45.0	11.6	0.6	1.4	2.0	0.45
WR99-1-58.2	Till	58.20	2.10	39.7	41.2	19.1	43.2	45.2	11.6	0.9	1.5	2.4	0.60
WR99-1-59.0	Till	59.00	1.95	44.0	36.7	19.3	47.7	40.5	11.8	0.7	1.6	2.4	0.44
WR99-1-60.0	Till	60.00	2.47	45.6	35.3	19.1	49.4	38.4	12.2	0.7	1.5	2.2	0.49
WR99-1-61.0	Till	61.00	2.29	45.7	32.1	22.2	49.3	36.4	14.3	0.7	1.8	2.5	0.38
WR99-1-62.0	Till	62.00	2.50	45.3	38.4	16.3	48.8	41.4	9.8	0.6	1.7	2.3	0.36

Appendix 4 - Table A4-3: Matrix Grain-Size and Carbonate Analyses, Corehole WR99-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63µm)	Silt (<63µm)	Clay (<4µm)	Sand (>50µm)	Silt (<50µm)	Clay (<2µm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
WR99-1-63.0	Till	63.00	2.14	44.7	37.3	18.0	48.3	40.8	10.9				
WR99-1-65.4	Till	65.40	2.12	46.7	33.5	19.8	49.9	38.0	12.1	0.7	2.0	2.7	0.34
WR99-1-66.4	Till	66.40	1.82	45.2	34.3	20.5	48.7	38.9	12.4	0.6	1.9	2.5	0.32
WR99-1-68.0	Till	68.00	2.15	41.4	39.3	19.3	44.9	42.8	12.3	0.6	2.3	2.9	0.27
WR99-1-69.5	Till	69.50	1.52	40.1	36.5	23.4	43.4	43.3	13.3	0.6	2.3	2.8	0.26
WR99-1-71.2	Till	71.20	1.37	41.4	37.8	20.8	44.6	43.3	12.1	0.7	2.8	3.5	0.24
WR99-1-72.5	Till	72.50	1.62	42.2	34.6	23.2	45.7	40.8	13.5	0.7	2.4	3.0	0.27
WR99-1-73.6	Till	73.60	1.67	51.0	25.9	23.1	51.3	35.5	13.2	0.7	2.0	2.7	0.32
WR99-1-74.5	Till	74.50	2.01	44.8	32.9	22.3	47.8	39.4	12.8	0.9	2.3	3.2	0.40
WR99-1-80.6	Till & Clay	80.60	0.02	5.4	60.4	34.2	7.7	68.8	23.5	0.8	3.5	4.3	0.22
WR99-1-85.0	Sand	85.00	0.43	26.8	66.0	7.2	33.6	63.0	3.4	1.0	3.1	4.1	0.34
WR99-1-86.0	Clay	86.00	0.00	0.3	92.3	7.4	0.5	95.5	3.6	5.5	3.8	9.4	1.46
WR99-1-86.5	Sand	86.50	0.02	5.3	80.9	13.8	8.0	83.6	8.4	0.7	0.6	1.3	1.15
WR99-1-88.2	Silt	88.20	0.00	8.3	77.1	14.6	9.4	81.5	9.1	1.1	3.6	4.7	0.30
WR99-1-89.5	Sand	89.50	1.37	57.5	28.9	13.6	60.1	32.0	7.9	0.8	2.8	3.5	0.28
WR99-1-91.5	Sand	91.50	1.77	57.9	31.9	10.2	60.5	33.9	5.6	0.9	2.0	2.9	0.47
WR99-1-93.0	Till	93.00	1.20	42.0	40.5	17.5	45.1	43.6	11.3	1.0	3.1	4.1	0.31
WR99-1-94.0	Till	94.00	1.07	33.7	48.7	17.6	36.4	52.2	11.4	0.7	2.2	2.9	0.32
WR99-1-95.0	Till	95.00	1.35	40.2	40.4	19.4	43.2	45.3	11.5	0.7	1.4	2.1	0.46
WR99-1-96.0	Silt	96.00	0.92	28.5	51.9	19.6	31.0	56.2	12.8	0.7	1.7	2.4	0.39
WR99-1-97.2	Silt	97.20	0.00	2.7	82.2	15.1	5.6	86.0	8.4	0.7	2.7	3.4	0.27
WR99-1-98.0	Silt	98.00	0.00	1.6	82.2	16.2	5.5	86.0	8.5	1.0	2.8	3.8	0.34
WR99-1-99.0	Clay	99.00	0.06	5.4	52.2	42.4	6.9	64.4	28.7	0.7	2.7	3.4	0.24
WR99-1-100.0	Clay	100.0	0.00	0.7	75.9	23.4	0.8	85.0	14.2	0.7	2.9	3.6	0.24
WR99-1-101.8	Clay	101.8	0.04	0.6	72.6	26.8	0.7	81.1	18.2	0.7	1.2	1.8	0.56
WR99-1-104.2	Clay	104.2	0.00	0.4	38.1	61.5	0.7	62.2	37.1	0.7	0.6	1.3	1.03
WR99-1-106.5	Clay	106.5	0.04	1.5	69.9	28.6	1.8	82.3	15.9	0.7	1.7	2.3	0.42
WR99-1-108.5	Clay	108.50	0.08	1.7	51.8	46.5	2.2	68.6	29.2	0.8	1.6	2.4	0.48
WR99-1-110.0	Clay	110.00	0.04	1.6	52.0	46.4	2.0	68.9	29.1	0.6	2.5	3.1	0.25
WR99-1-112.0	Clay	112.00	0.06	2.2	55.7	42.1	2.6	68.2	29.2	0.6	1.0	1.6	0.60
WR99-1-114.2	Silt & Clay	114.20	0.00	2.3	77.8	19.9	3.0	85.0	12.0	0.8	6.8	7.6	0.12

Appendix 4 - Table A4-3: Matrix Grain-Size and Carbonate Analyses, Corehole WR99-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
WR99-1-115.4	Silt & Clay	115.40	0.02	2.0	78.8	19.2	2.7	86.5	10.8	0.9	3.3	4.3	0.29
WR99-1-116.5	Silt & Clay	116.50	0.04	3.7	72.2	24.1	5.3	80.0	14.7	0.8	2.9	3.7	0.29
WR99-1-118.0	Silt	118.00	0.19	7.7	62.7	29.6	9.3	74.1	16.6	0.9	3.0	3.9	0.32
WR99-1-120.5	Silt	120.50	0.08	2.4	87.6	10.0	5.1	89.9	5.0	1.3	3.7	5.0	0.35
WR99-1-122.0	Silt	122.00	0.04	16.2	69.4	14.4	23.6	68.2	8.2	0.6	3.1	3.7	0.21
WR99-1-137.0	Sand	137.00	0.06	27.5	60.2	12.3	37.9	55.4	6.7	0.5	2.4	3.0	0.23
WR99-1-139.0	Sand	139.00	0.14	17.4	67.2	15.4	26.4	63.9	9.7	0.7	2.6	3.3	0.27
WR99-1-145.0	Clay	145.00	0.12	1.8	76.6	21.6	3.0	85.7	11.3	0.9	2.3	3.2	0.42
WR99-1-146.0	Clay	146.00	0.08	1.4	76.4	22.2	2.3	84.3	13.4	0.6	2.0	2.7	0.30
WR99-1-149.2	Sand	149.20	2.29	28.0	46.5	25.5	28.8	55.6	15.6	1.0	3.4	4.4	0.29
WR99-1-152.0	Sand & Gravel	152.00	1.48	79.5	12.4	8.1	83.1	12.1	4.8	0.9	1.9	2.9	0.50

Appendix 4 - Table A4-4: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-1-2.9	Till	2.90	1.21	42.3	35.4	22.3	45.2	39.2	15.6	1.8	9.8	11.6	0.18
W00-1-4.25	Till	4.25	1.09	35.6	39.4	25.0	37.2	44.6	18.2	1.9	10.8	12.7	0.19
W00-1-6.0	Till	6.00	0.72	32.0	44.8	23.2	35.3	46.8	17.9	1.9	11.1	13.0	0.17
W00-1-7.0	Till	7.00	0.91	34.6	39.3	26.1	36.8	46.0	17.2	1.9	10.2	12.1	0.18
W00-1-9.3	Till	9.30	0.84	41.5	37.1	21.4	44.4	42.1	13.5	1.9	10.9	12.8	0.18
W00-1-10.35	Till	10.35	1.11	46.3	34.5	19.2	48.4	39.0	12.6	1.8	9.6	11.4	0.19
W00-1-12.0	Till	12.00	0.99	39.0	43.5	17.5	42.4	45.6	12.0	1.9	10.7	12.6	0.19
W00-1-13.4	Till	13.40	1.44	41.1	34.6	24.3	43.6	41.0	15.4	1.9	11.6	13.5	0.17
W00-1-14.65	Till	14.65	1.48	45.7	35.3	19.0	48.2	39.6	12.2	1.9	10.0	11.9	0.19
W00-1-22.95	Till	22.95	1.69	56.8	18.2	25.0	57.9	22.6	19.5	1.0	3.3	4.4	0.30
W00-1-24.45	Till	24.45	1.38	46.8	40.5	12.7	49.3	43.3	7.4	1.2	3.6	4.8	0.32
W00-1-25.5	Till	25.50	1.32	45.0	43.5	11.5	47.8	44.4	7.8	1.4	4.1	5.4	0.33
W00-1-27.3	Till	27.30	1.34	40.0	46.9	13.1	42.5	49.2	8.3	1.2	3.6	4.8	0.32
W00-1-28.5	Till	28.50	1.19	42.9	38.9	18.2	45.6	42.2	12.2	1.2	3.9	5.1	0.29
W00-1-29.5	Till	29.50	1.42	49.5	34.1	16.4	52.5	35.7	11.8	1.0	3.9	4.9	0.27
W00-1-32.2	Till	32.20	0.86	27.0	60.4	12.6	28.5	62.2	9.3	1.0	4.4	5.3	0.22
W00-1-34.0	Till	34.00	0.86	27.6	60.3	12.1	29.1	61.7	9.2	1.1	4.6	5.7	0.23
W00-1-34.9	Till	34.90	0.94	32.6	53.2	14.2	34.4	54.9	10.7	1.0	3.9	4.8	0.25
W00-1-45.4	Till	45.40	1.15	50.2	38.7	11.1	53.0	38.9	8.1	0.8	3.3	4.1	0.26
W00-1-46.4	Till	46.40	0.99	46.8	35.7	17.5	52.7	35.4	11.9	1.0	3.5	4.4	0.28
W00-1-82.05	Till	82.05	1.64	47.4	33.8	18.8	50.5	37.2	12.3	1.0	3.3	4.2	0.29
W00-1-83.1	Till	83.10	1.57	41.0	36.8	22.2	44.1	40.6	15.3	0.9	3.1	4.1	0.30
W00-1-84.1	Till	84.10	1.05	40.1	39.1	20.8	43.2	42.2	14.6	0.8	3.5	4.2	0.22
W00-1-85.2	Till	85.20	1.37	42.0	35.1	22.9	45.0	39.9	15.1	0.9	3.7	4.6	0.26
W00-1-86.2	Till	86.20	1.48	43.0	36.3	20.7	46.1	42.9	11.0	0.7	3.2	3.9	0.21
W00-1-87.2	Till	87.20	1.80	46.0	33.9	20.1	49.6	39.4	11.0	0.9	3.1	4.1	0.30
W00-1-89.4	Till	89.40	1.56	41.7	30.4	27.9	44.7	38.4	16.9	0.7	3.4	4.1	0.20
W00-1-90.4	Till	90.40	1.87	44.9	35.4	19.7	48.6	40.6	10.8	1.1	3.7	4.8	0.29
W00-1-91.4	Till	91.40	1.71	45.2	34.7	20.1	48.5	39.8	11.7	0.8	4.0	4.8	0.19
W00-1-92.35	Till	92.35	1.68	45.4	32.8	21.8	48.7	38.5	12.8	1.1	3.9	5.0	0.27
W00-1-93.4	Till	93.40	1.95	47.5	27.8	24.7	50.9	34.8	14.3	0.8	3.7	4.5	0.21

Appendix 4 - Table A4-4: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-1-95.1	Till	95.10	0.39	10.8	64.5	24.7	11.7	74.0	14.3	0.8	4.9	5.7	0.16
W00-1-96.0	Till	96.00	1.23	28.5	46.4	25.1	31.3	54.6	14.1	1.0	4.4	5.3	0.22
W00-1-96.9	Till	96.90	1.75	46.1	32.8	21.1	49.4	38.6	12.0	1.0	3.4	4.3	0.29
W00-1-98.05	Till	98.05	1.83	45.1	31.2	23.7	48.7	37.3	14.0	0.7	3.9	4.6	0.19
W00-1-99.0	Till	99.00	1.52	46.8	34.9	18.3	49.9	38.1	12.0	1.0	3.5	4.5	0.27
W00-1-100.0	Till	100.00	1.87	45.5	34.0	20.5	49.2	37.8	13.0	1.0	3.8	4.8	0.27
W00-1-101.0	Till	101.00	1.72	43.2	36.4	20.4	46.7	39.8	13.5	0.8	4.0	4.8	0.19
W00-1-102.0	Till	102.00	1.72	45.0	35.2	19.8	48.1	39.7	12.2	1.0	3.5	4.6	0.30
W00-1-104.6	Till	104.60	2.09	45.8	33.6	20.6	49.2	37.7	13.1	0.8	3.9	4.7	0.20
W00-1-105.7	Till	105.70	1.77	47.1	31.0	21.9	50.2	35.3	14.5	0.8	4.1	4.9	0.19
W00-1-106.7	Till	106.70	1.93	45.4	34.2	20.4	49.1	37.5	13.4	1.0	3.7	4.7	0.26
W00-1-107.7	Till	107.70	1.58	43.2	37.4	19.4	46.2	42.2	11.6	0.9	3.6	4.5	0.24
W00-1-108.7	Till	108.70	1.64	44.2	36.4	19.4	47.7	40.2	12.1	1.0	3.5	4.5	0.28
W00-1-110.9	Till	110.90	1.73	42.8	37.8	19.4	46.0	41.9	12.1	1.0	4.4	5.4	0.22
W00-1-115.4	Till	115.40	1.93	49.0	31.3	19.7	51.7	36.1	12.2	0.8	2.2	3.0	0.39
W00-1-117.3	Till	117.30	1.56	55.5	26.9	17.6	58.1	31.6	10.3	0.8	1.2	2.0	0.64
W00-1-120.05	Till	120.05	2.36	50.7	34.5	14.8	53.6	37.2	9.2	1.0	1.2	2.2	0.78
W00-1-120.95	Till	120.95	1.93	51.8	32.0	16.2	54.7	35.4	9.9	0.8	1.1	2.0	0.74
W00-1-121.9	Till	121.90	2.44	50.7	33.1	16.2	53.4	36.7	9.9	1.0	2.1	3.1	0.45
W00-1-123.7	Till	123.70	4.59	58.2	25.3	16.5	60.7	29.5	9.8	1.2	4.5	5.7	0.26
W00-1-124.6	Till	124.60	3.73	53.1	28.0	18.9	55.9	32.6	11.5	1.3	4.6	5.8	0.28
W00-1-125.55	Till	125.55	3.71	57.9	27.2	14.9	60.6	30.7	8.7	1.3	4.5	5.8	0.28
W00-1-127.0	Sand	127.00	4.81	58.6	30.8	10.6	61.1	32.6	6.3	1.0	3.8	4.7	0.26
W00-1-153.0	Till	153.00	1.83	25.9	56.4	17.7	29.9	58.8	11.3	1.0	1.4	2.4	0.70
W00-1-154.0	Till	154.00	2.95	35.8	49.3	14.9	39.2	51.7	9.1	0.9	1.7	2.5	0.51
W00-1-155.0	Till	155.00	1.70	25.8	53.0	21.2	29.8	58.3	11.9	1.0	1.6	2.5	0.62
W00-1-156.0	Till	156.00	2.26	29.6	59.1	11.3	33.7	59.8	6.5	0.9	0.9	1.7	0.99
W00-1-157.35	Till	157.35	2.50	28.8	57.0	14.2	31.8	59.1	9.1	0.9	1.4	2.2	0.63
W00-1-158.4	Till	158.40	2.46	35.7	53.3	11.0	39.1	54.1	6.8	0.8	1.5	2.2	0.53
W00-1-159.3	Till	159.30	2.36	29.9	55.8	14.3	33.2	59.1	7.7	0.7	1.0	1.7	0.66
W00-1-160.2	Till	160.20	3.20	31.8	52.1	16.1	35.3	54.3	10.4	0.7	1.5	2.2	0.47

Appendix 4 - Table A4-4: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-1

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-1-162.2	Till	162.20	3.16	35.3	53.4	11.3	38.8	54.7	6.5	0.7	1.8	2.5	0.39
W00-1-164.35	Till	164.35	3.02	33.3	53.4	13.3	37.2	53.9	8.9	1.0	2.5	3.5	0.39
W00-1-165.4	Till	165.40	2.70	35.7	48.5	15.8	39.1	50.7	10.2	1.1	1.7	2.7	0.65
W00-1-166.4	Till	166.40	2.16	39.1	45.1	15.8	39.9	50.4	9.7	1.0	1.8	2.7	0.54
W00-1-167.6	Till	167.60	1.98	26.2	56.5	17.3	29.5	60.5	10.0	1.2	2.3	3.6	0.52
W00-1-168.9	Till	168.90	1.98	29.6	54.9	15.5	33.0	57.9	9.1	1.2	2.9	4.1	0.42
W00-1-169.9	Till	169.90	2.75	33.8	50.0	16.2	36.9	52.5	10.6	1.4	2.6	3.9	0.53
W00-1-171.0	Till	171.00	2.56	36.2	48.0	15.8	39.7	49.9	10.4	1.2	2.0	3.2	0.60
W00-1-172.0	Till	172.00	3.04	34.8	47.8	17.4	38.1	49.7	12.2	1.4	2.1	3.4	0.66
W00-1-173.0	Till	173.00	3.25	37.0	45.3	17.7	40.3	47.3	12.4	1.7	2.0	3.7	0.84

Appendix 4 - Table A4-5: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-2

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63µm)	Silt (<63µm)	Clay (<4µm)	Sand (>50µm)	Silt (<50µm)	Clay (<2µm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-2-5.7	Till	5.70	1.25	47.4	30.9	21.7	50.2	33.9	15.9	2.0	9.5	11.6	0.21
W00-2-8.6	Till	8.60	1.07	40.5	34.4	25.1	43.7	38.1	18.2	2.0	9.3	11.3	0.21
W00-2-9.5	Till	9.50	1.36	37.2	38.0	24.8	39.9	42.2	17.9	2.0	9.3	11.3	0.22
W00-2-13.2	Till	13.20	1.19	36.6	35.1	28.3	39.7	40.1	20.2	2.5	10.0	12.5	0.26
W00-2-14.2	Till	14.20	1.29	37.0	35.2	27.8	39.6	40.3	20.1	2.2	10.2	12.3	0.21
W00-2-15.2	Till	15.20	1.47	39.4	32.9	27.7	42.6	37.4	20.0	1.9	10.4	12.3	0.18
W00-2-15.6	Till	15.60	1.44	37.4	36.0	26.6	40.1	41.8	18.1	2.0	10.3	12.3	0.19
W00-2-16.75	Till	16.75	1.77	44.0	36.9	19.1	47.5	41.3	11.2	2.2	9.0	11.1	0.24
W00-2-18.3	Till	18.30	1.07	48.7	28.8	22.5	51.6	34.9	13.5	2.8	10.5	13.2	0.27
W00-2-19.6	Till	19.60	1.58	46.6	33.0	20.4	50.0	37.3	12.7	2.8	9.5	12.3	0.30
W00-2-20.6	Till	20.60	1.15	47.9	30.2	21.9	50.8	36.2	13.0	2.5	10.1	12.6	0.25
W00-2-21.6	Till	21.60	1.07	47.6	30.6	21.8	51.1	35.8	13.1	2.1	10.1	12.2	0.21
W00-2-22.8	Till	22.80	0.70	37.8	33.9	28.3	40.5	42.7	16.8	2.2	11.2	13.4	0.20
W00-2-25.9	Till	25.90	1.01	40.9	31.4	27.7	44.1	39.7	16.2	2.1	10.6	12.7	0.21
W00-2-26.9	Till	26.90	1.16	38.6	31.9	29.5	41.6	40.7	17.7	2.3	10.8	13.1	0.22
W00-2-27.9	Till	27.90	1.34	38.3	31.9	29.8	42.1	39.6	18.3	1.9	11.0	12.9	0.17
W00-2-29.0	Till	29.00	1.27	38.8	29.9	31.3	41.5	39.7	18.8	2.3	11.0	13.3	0.21
W00-2-30.1	Till	30.10	1.08	37.6	29.2	33.2	40.8	38.4	20.8	2.3	11.8	14.1	0.21
W00-2-31.4	Till	31.40	1.06	37.4	36.6	26.0	39.9	43.1	17.0	2.3	10.9	13.2	0.22
W00-2-32.3	Till	32.30	1.27	37.8	38.6	23.6	41.1	43.1	15.8	1.5	9.7	11.3	0.16
W00-2-46.7	Silt & Clay	46.70	0.00	7.3	73.6	19.1	8.1	80.7	11.2	1.0	6.2	7.2	0.17
W00-2-87.9	Till	87.90	0.96	31.5	51.1	17.4	35.6	53.6	10.8	1.4	8.8	10.2	0.16
W00-2-89.1	Till	89.10	0.88	32.6	51.1	16.3	37.7	52.1	10.2	1.3	9.3	10.7	0.14
W00-2-90.1	Till	90.10	1.19	32.6	45.8	21.6	36.5	49.7	13.8	1.3	8.7	10.1	0.15
W00-2-91.1	Till	91.10	0.94	32.9	45.6	21.5	37.6	48.1	14.3	1.6	9.0	10.6	0.18
W00-2-92.15	Till	92.15	1.03	32.2	48.4	19.4	36.8	50.4	12.8	1.7	9.4	11.1	0.18
W00-2-93.2	Till	93.20	1.21	32.9	49.3	17.8	37.6	51.4	11.0	1.4	9.8	11.2	0.15
W00-2-93.9	Till	93.90	0.41	29.3	51.9	18.8	35.6	53.4	11.0	1.8	7.6	9.5	0.25
W00-2-95.2	Till	95.20	2.31	41.9	40.7	17.4	45.3	43.9	10.8	2.1	4.9	7.0	0.44
W00-2-96.3	Till	96.30	1.97	36.6	48.1	15.3	40.2	50.6	9.2	1.6	5.0	6.6	0.33
W00-2-97.3	Till	97.30	2.23	39.9	44.9	15.2	43.3	48.2	8.5	1.8	4.9	6.7	0.37

Appendix 4 - Table A4-5: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-2

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63µm)	Silt (<63µm)	Clay (<4µm)	Sand (>50µm)	Silt (<50µm)	Clay (<2µm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-2-98.3	Till	98.30	2.70	39.5	43.7	16.8	42.3	47.0	10.7	2.6	4.8	7.3	0.54
W00-2-99.3	Till	99.30	2.22	42.3	43.5	14.2	45.6	46.2	8.2	2.7	5.1	7.8	0.55
W00-2-100.3	Till	100.30	2.18	43.9	39.9	16.2	46.7	43.9	9.4	3.2	4.8	8.0	0.65
W00-2-101.3	Till	101.30	2.13	42.3	43.6	14.1	45.9	46.2	7.9	1.6	6.4	8.0	0.27
W00-2-102.3	Till	102.30	2.32	43.3	40.6	16.1	46.3	44.2	9.5	1.8	5.3	7.1	0.35
W00-2-103.3	Till	103.30	1.93	41.9	42.0	16.1	45.4	44.7	9.9	1.8	4.9	6.7	0.36
W00-2-104.45	Till	104.45	2.13	40.4	41.3	18.3	43.4	45.9	10.7	1.2	5.5	6.7	0.23
W00-2-105.5	Till	105.50	2.01	41.7	41.1	17.2	45.6	44.9	9.5	1.9	5.2	7.1	0.38
W00-2-107.7	Till	107.70	2.39	34.4	47.3	18.3	37.4	51.1	11.5	1.9	4.5	6.4	0.42
W00-2-108.7	Till	108.70	2.13	36.7	45.2	18.1	41.5	47.9	10.6	2.0	5.5	7.4	0.37
W00-2-109.6	Till	109.60	2.03	37.2	46.7	16.1	41.1	49.1	9.8	2.0	5.5	7.6	0.37
W00-2-111.45	Silt & Clay	111.45	0.04	1.2	57.7	41.1	2.2	73.3	24.5	2.4	10.8	13.2	0.23

Appendix 4 - Table A4-6: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-3

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-3-1.3	Till	1.3	1.02	42.0	33.8	24.2	44.7	37.9	17.4	1.9	9.3	11.2	0.21
W00-3-4.0	Till	4.0	1.01	66.0	19.8	14.2	69.1	22.3	8.6	2.0	9.4	11.4	0.21
W00-3-5.0	Till	5.0	1.26	49.1	30.3	20.6	51.9	32.0	16.1	2.0	9.6	11.6	0.21
W00-3-6.5	Till	6.5	1.39	40.4	37.0	22.6	42.8	40.9	16.3	2.0	11.3	13.3	0.18
W00-3-7.6	Till	7.6	1.29	41.7	36.5	21.8	43.9	41.0	15.1	1.9	9.6	11.6	0.20
W00-3-8.75	Till	8.75	1.29	41.2	38.2	20.6	43.9	41.8	14.3	2.1	11.1	13.2	0.19
W00-3-17.5	Till	17.5	0.92	40.2	36.7	23.1	42.5	41.4	16.1	2.5	9.9	12.4	0.25
W00-3-18.5	Till	18.5	1.43	43.1	32.1	24.8	45.8	38.3	15.9	2.0	11.0	13.0	0.18
W00-3-19.5	Till	19.5	1.27	31.7	35.2	33.1	34.2	41.9	23.9	1.9	9.2	11.1	0.21
W00-3-20.5	Till	20.5	1.25	42.6	31.1	26.3	45.2	38.2	16.6	1.9	9.7	11.6	0.20
WOO-3-22.25	Till	22.25	1.23	37.2	27.5	35.3	40.3	30.5	29.2	1.5	8.4	10.0	0.18
W00-3-23.5	Till	23.5	1.29	36.6	26.3	37.1	39.3	31.0	29.7	1.6	8.9	10.5	0.18
W00-3-26.7	Till	26.7	1.59	46.6	31.4	22.0	50.0	37.2	12.8	1.6	9.4	11.0	0.17
W00-3-27.3	Till	27.3	1.19	42.7	34.3	23.0	46.2	38.6	15.2	1.5	8.5	10.1	0.18
W00-3-28.5	Till	28.5	1.23	45.5	34.1	20.4	48.8	37.8	13.4	2.0	10.1	12.1	0.20
W00-3-29.5	Till	29.5	1.54	44.1	34.1	21.8	47.0	38.8	14.2	2.0	10.4	12.5	0.19
W00-3-30.5	Till	30.5	1.16	40.7	36.7	22.6	43.9	42.6	13.5	2.1	9.1	11.2	0.23
W00-3-32.2	Till	32.2	1.51	41.7	34.9	23.4	44.4	41.3	14.3	1.8	10.2	12.0	0.17
W00-3-33.35	Till	33.35	1.00	38.4	39.5	22.1	41.2	44.9	13.9	2.1	11.4	13.4	0.18
W00-3-34.3	Till	34.3	0.80	33.0	36.5	30.5	36.2	44.8	19.0	2.1	12.1	14.1	0.17
W00-3-35.55	Till	35.55	1.15	40.3	34.4	25.3	43.3	39.9	16.8	2.2	12.3	14.5	0.18
W00-3-36.65	Till	36.65	1.07	41.1	34.5	24.4	43.8	41.4	14.8	2.1	10.9	13.1	0.21
W00-3-38.0	Till	38.0	1.15	39.9	34.3	25.8	43.0	39.2	17.8	2.0	10.7	12.7	0.19
W00-3-39.8	Till	39.8	0.84	30.9	33.2	35.9	33.1	39.9	27.0	1.5	8.7	10.2	0.18
W00-3-41.2	Till	41.20	1.19	39.3	38.3	22.4	42.3	42.9	14.8	1.7	9.1	10.7	0.18
W00-3-43.2	Till	43.2	1.23	39.0	32.9	28.1	42.1	41.2	16.7	1.7	9.2	10.9	0.19
W00-3-44.2	Till	44.2	1.35	41.6	34.8	23.6	44.3	41.2	14.5	1.9	9.9	11.8	0.20
W00-3-45.2	Till	45.2	1.41	41.3	36.3	22.4	44.1	41.1	14.8	2.1	10.8	12.8	0.20
W00-3-46.25	Till	46.25	1.43	41.9	32.7	25.4	44.5	39.2	16.3	2.0	10.3	12.3	0.20
W00-3-47.3	Till	47.30	1.88	41.9	31.2	26.9	44.8	38.6	16.6	1.6	10.6	12.1	0.16
W00-3-48.3	Till	48.3	1.29	42.3	32.9	24.8	44.9	39.1	16.0	1.9	10.4	12.3	0.19

Appendix 4 - Table A4-6: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-3

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63µm)	Silt (<63µm)	Clay (<4µm)	Sand (>50µm)	Silt (<50µm)	Clay (<2µm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-3-49.3	Till	49.3	1.31	41.7	34.6	23.7	44.7	39.9	15.4	2.1	10.6	12.7	0.21
W00-3-50.5	Till	50.5	1.50	42.0	33.7	24.3	44.6	41.3	14.1	2.1	9.4	11.5	0.22
W00-3-51.5	Till	51.5	1.29	41.8	33.6	24.6	44.3	40.5	15.2	2.1	10.3	12.4	0.20
W00-3-52.5	Till	52.5	1.19	41.4	36.6	22.0	44.4	42.0	13.6	1.9	10.2	12.1	0.19
WOO-3-53.5	Till	53.5	1.31	39.4	34.4	26.2	42.0	41.3	16.7	1.5	9.8	11.4	0.16
W00-3-54.5	Till	54.5	1.60	43.1	34.8	22.1	46.4	38.5	15.1	1.7	9.4	11.2	0.19
W00-3-55.5	Till	55.5	1.13	31.5	31.7	36.8	33.7	42.0	24.3	1.8	8.7	10.5	0.21
W00-3-56.6	Till	56.6	0.91	24.4	23.1	52.5	26.5	36.6	36.9	1.4	8.2	9.5	0.18
W00-3-57.6	Till	57.6	0.56	22.4	26.6	51.0	24.7	37.9	37.4	1.2	8.3	9.5	0.15
W00-3-58.6	Till	58.6	0.52	20.2	25.4	54.4	22.0	39.4	38.6	1.5	9.0	10.4	0.16
W00-3-59.6	Till	59.6	1.03	36.1	28.1	35.8	38.6	35.7	25.7	1.5	8.5	10.1	0.18
W00-3-60.6	Till	60.6	0.70	20.3	24.3	55.4	22.4	36.2	41.4	1.4	8.5	9.9	0.17
W00-3-62.0	Till	62.0	1.37	41.7	27.8	30.5	44.4	34.9	20.7	1.5	9.2	10.7	0.17
W00-3-63.0	Till	63.0	1.61	41.5	28.8	29.7	44.5	34.6	20.9	1.4	10.0	11.4	0.14
W00-3-64.1	Till	64.1	0.99	31.0	27.8	41.2	33.4	35.9	30.7	1.5	9.0	10.5	0.17
W00-3-65.45	Till	65.45	0.82	29.2	27.7	43.1	31.7	37.0	31.3	1.1	7.9	9.0	0.16
W00-3-66.5	Till	66.5	0.84	35.8	29.6	34.6	38.6	37.2	24.2	1.5	8.6	10.1	0.18
W00-3-68.0	Till	68.0	0.92	27.3	26.5	46.2	29.6	38.5	31.9	1.5	8.9	10.5	0.17
W00-3-68.9	Till	68.9	0.76	17.2	33.3	49.5	19.2	43.3	37.5	1.4	8.3	9.7	0.18
W00-3-73.3	Till	73.3	1.39	37.2	30.6	32.2	39.8	38.6	21.6	1.8	9.3	11.0	0.19
W00-3-77.05	Till & Clay	77.05	1.61	47.3	32.8	19.9	50.8	38.0	11.2	1.8	10.0	11.7	0.18
W00-3-77.85	Till	77.85	2.31	51.6	24.2	24.2	54.8	28.0	17.2	1.1	2.4	3.4	0.44
W00-3-78.35	Till	78.35	1.99	50.1	26.5	23.4	53.8	31.0	15.2	1.2	2.9	4.2	0.43
W00-3-78.85	Till	78.85	2.32	50.9	25.8	23.3	54.1	29.5	16.4	0.7	1.9	2.6	0.37
W00-3-79.85	Till	79.85	2.19	48.8	35.3	15.9	52.5	38.6	8.9	0.9	4.2	5.1	0.20
W00-3-80.85	Till	80.85	2.01	49.9	34.5	15.6	53.3	39.5	7.2	0.7	3.2	4.0	0.23
W00-3-82.55	Till	82.55	51.44	51.4	33.1	15.5	54.4	37.1	8.5	1.0	3.7	4.7	0.26
W00-3-83.6	Till	83.6	2.01	47.7	35.4	16.9	51.0	38.6	10.4	1.0	4.4	5.4	0.22
W00-3-84.6	Till	84.6	1.74	47.1	32.8	20.1	49.9	40.9	9.2	0.7	3.8	4.5	0.20
W00-3-92.0	Till	92.0	1.29	46.7	35.6	17.7	50.3	41.6	8.1	1.3	4.2	5.5	0.32
W00-3-93.0	Till	93.0	1.88	45.8	36.5	17.7	49.1	42.7	8.2	1.1	3.8	5.0	0.30

Appendix 4 - Table A4-6: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-3

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-3-93.9	Till	93.9	1.34	45.0	37.0	18.0	48.2	42.0	9.8	1.4	3.6	5.0	0.40
W00-3-109.75	Till	109.75	1.74	46.9	38.3	14.8	50.6	43.3	6.1	1.0	4.1	5.1	0.25
W00-3-110.7	Till	110.7	1.51	40.9	43.2	15.9	43.7	50.2	6.1	1.1	3.9	5.0	0.28
W00-3-111.75	Till	111.75	1.72	44.2	42.5	13.3	48.2	46.4	5.4	1.1	4.9	6.0	0.22
W00-3-112.8	Till	112.8	1.27	43.0	38.4	18.6	45.9	44.8	9.3	1.1	0.7	1.9	1.56
W00-3-113.85	Till	113.85	1.52	47.6	34.9	17.5	50.3	40.0	9.7	1.3	2.9	4.3	0.45
W00-3-114.9	Till	114.9	1.81	47.3	31.0	21.7	50.4	39.0	10.6	1.3	2.8	4.1	0.48
W00-3-115.95	Till	115.95	1.43	45.1	33.4	21.5	48.4	41.3	10.3	1.5	3.2	4.7	0.46
W00-3-117.05	Till	117.05	1.29	46.6	32.3	21.1	50.0	40.8	9.2	1.4	3.4	4.8	0.42
W00-3-118.05	Till	118.05	1.74	48.7	31.2	20.1	51.7	38.3	10.0	1.3	3.4	4.8	0.39
W00-3-119.05	Till	119.05	1.79	46.2	32.0	21.8	49.5	38.4	12.1	1.4	3.2	4.6	0.44
W00-3-120.1	Till	120.1	1.65	41.0	42.4	16.6	44.0	47.3	8.7	1.3	3.1	4.5	0.42
W00-3-121.0	Till	121.0	3.07	51.5	36.4	12.1	54.8	39.5	5.7	1.3	3.8	5.1	0.35
W00-3-125.5	Till	125.5	1.52	47.7	37.7	14.6	52.3	39.8	7.9	1.0	1.9	2.9	0.51
W00-3-127.7	Till	127.7	1.47	51.1	37.3	11.6	56.3	37.3	6.4	1.0	2.3	3.3	0.44
W00-3-129.05	Till	129.05	2.33	44.5	38.7	16.8	48.3	43.0	8.7	0.7	1.5	2.2	0.47
W00-3-131.95	Till	131.95	2.30	45.1	40.3	14.6	49.4	43.9	6.7	1.0	1.9	2.9	0.50
W00-3-133.0	Till	133.0	2.09	48.0	37.4	14.6	51.6	41.7	6.7	1.0	1.9	2.9	0.50
W00-3-134.25	Till	134.25	1.91	45.4	37.9	16.7	49.1	42.2	8.7	0.7	1.6	2.4	0.45
W00-3-135.3	Till	135.3	2.12	42.5	44.0	13.5	45.6	47.8	6.6	1.5	2.6	4.0	0.57
W00-3-136.25	Till	136.25	2.51	36.9	47.6	15.5	40.7	50.7	8.6	1.0	2.6	3.6	0.40
W00-3-138.2	Till	138.2	2.95	43.6	45.0	11.4	47.7	47.8	4.5	1.0	2.3	3.3	0.42
W00-3-139.2	Till	139.2	4.67	50.6	35.4	14.0	54.0	39.4	6.6	0.8	2.1	2.9	0.37
W00-3-140.2	Till	140.2	3.01	45.2	40.9	13.9	48.8	44.7	6.5	0.7	2.2	2.9	0.31
W00-3-141.65	Till	141.65	4.30	45.4	41.1	13.5	48.8	44.7	6.5	0.8	2.2	3.1	0.38
W00-3-143.1	Till	143.1	3.23	46.1	40.9	13.0	49.4	44.1	6.5	1.2	4.8	5.9	0.24
W00-3-144.2	Till	144.2	3.74	48.8	38.6	12.6	52.2	39.9	7.9	1.4	5.4	6.8	0.27
W00-3-145.15	Till	145.15	1.98	33.3	51.5	15.2	37.5	54.9	7.6	1.3	1.8	3.0	0.71
W00-3-147.1	Till	147.1	2.21	31.4	53.5	15.1	34.9	57.6	7.5	1.2	2.1	3.2	0.56
W00-3-148.0	Till	148.0	1.98	35.7	47.9	16.4	39.5	51.3	9.2	1.4	1.9	3.2	0.74
W00-3-149.3	Till	149.3	2.86	39.2	45.7	15.1	43.0	49.5	7.5	1.3	2.0	3.4	0.65

Appendix 4 - Table A4-6: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-3

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-3-151.0	Till	151.0	2.53	33.8	47.7	18.5	37.6	49.9	12.5	1.3	2.1	3.4	0.64
W00-3-152.15	Till	152.15	2.38	42.2	40.7	17.1	45.7	44.8	9.5	1.9	2.3	4.2	0.83

Appendix 4 - Table A4-7: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-4

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-4-10.10	Till	10.10	1.78	41.8	41.1	17.1	45.7	44.8	9.5	0.8	2.4	3.1	0.32
W00-4-11.5	Till	11.5	1.80	43.6	28.9	27.5	47.3	35.3	17.4	1.0	3.2	4.2	0.32
W00-4-12.2	Till	12.2	1.97	54.4	26.1	19.5	57.7	29.3	13.0	1.3	3.1	4.4	0.43
W00-4-13.1	Till	13.1	1.64	42.9	27.6	29.5	46.7	33.9	19.4	1.3	2.7	4.1	0.48
W00-4-16.1	Till	16.1	0.76	26.3	28.3	45.4	29.1	40.6	30.3	1.4	3.6	4.9	0.39
W00-4-17.1	Till	17.1	1.13	39.7	29.8	30.5	42.7	38.6	18.7	1.7	6.5	8.2	0.27
W00-4-23.1	Till	23.1	2.47	45.2	37.0	17.8	48.4	41.9	9.7	1.4	3.8	5.2	0.37
W00-4-34.0	Till	34.0	1.92	46.9	36.9	16.2	49.6	42.1	8.3	0.9	4.7	5.6	0.20
W00-4-34.9	Till	34.9	0.74	27.3	47.4	25.3	29.9	54.5	15.6	1.2	2.7	3.9	0.45
W00-4-40.0	Sand & Clay	40.0	2.39	42.3	30.4	27.3	45.4	36.3	18.3	1.7	4.7	6.4	0.37
W00-4-41.0	Till	41.0	2.41	34.9	40.9	24.2	37.8	47.3	14.9	1.7	4.9	6.5	0.34
W00-4-41.7	Till	41.7	1.53	40.1	41.6	18.3	44.1	44.7	11.2	1.3	4.3	5.6	0.31
W00-4-43.20	Till	43.20	1.76	40.0	40.1	19.9	43.7	44.1	12.2	1.4	4.2	5.6	0.34
W00-4-44.05	Till	44.05	1.19	26.9	45.3	27.8	29.3	54.0	16.7	1.6	4.2	5.8	0.38
W00-4-52.80	Till	52.80	1.29	35.5	44.5	20.0	38.9	49.8	11.3	0.7	2.0	2.7	0.34
W00-4-54.05	Till	54.05	0.96	24.8	52.9	22.3	27.6	58.0	14.4	0.8	1.8	2.5	0.43
W00-4-57.9	Till	57.9	0.54	32.9	37.4	29.7	35.7	45.7	18.6	0.9	2.2	3.1	0.40
W00-4-58.45	Till	58.45	0.76	27.9	44.3	27.8	30.9	50.4	18.7	1.0	2.4	3.4	0.39
W00-4-59.4	Till	59.4	1.41	35.7	48.4	15.9	39.1	51.4	9.5	1.0	2.6	3.6	0.36
W00-4-60.4	Till	60.4	1.33	36.8	41.0	22.2	40.2	45.9	13.9	1.0	1.9	2.9	0.49
W00-4-61.9	Till	61.9	1.50	36.7	45.3	18.0	40.3	50.9	8.8	0.8	1.9	2.7	0.40
W00-4-63.1	Till	63.1	1.19	35.4	45.9	18.7	38.7	50.0	11.3	0.9	1.6	2.4	0.56
W00-4-64.1	Till	64.1	1.19	35.3	46.2	18.5	38.7	50.8	10.5	1.0	2.3	3.3	0.41
W00-4-70.3	Clay	70.3	1.41	34.5	44.9	20.6	37.7	50.5	11.8	0.8	1.7	2.5	0.50
W00-4-74.5	Till	74.5	1.49	43.9	35.4	20.7	48.5	38.9	12.6	1.1	1.7	2.7	0.65
W00-4-75.5	Till	75.5	1.68	44.2	35.3	20.5	48.5	39.8	11.7	1.0	1.7	2.7	0.54
W00-4-76.70	Till	76.70	1.39	43.4	38.0	18.6	48.0	41.0	11.0	0.5	1.5	2.0	0.30
W00-4-77.70	Till	77.70	1.62	42.5	39.1	18.4	46.8	42.3	10.9	0.9	1.8	2.7	0.48
W00-4-78.7	Till	78.7	1.38	43.6	41.8	14.6	48.2	42.8	9.0	0.8	2.1	2.8	0.37
W00-4-80.0	Till	80.0	2.03	45.3	36.2	18.5	49.4	39.6	11.0	1.0	2.3	3.2	0.42
W00-4-81.10	Till	81.10	1.97	37.1	28.8	34.1	41.2	32.0	26.8	1.1	2.7	3.8	0.39

Appendix 4 - Table A4-7: Matrix Grain-Size and Carbonate Analyses, Corehole WEPA00-4

Sample #	Material	Depth	Sand (1-2mm)	Sand (>63μm)	Silt (<63μm)	Clay (<4μm)	Sand (>50μm)	Silt (<50μm)	Clay (<2μm)	Weight percent of carbonates (%)			
		m	% wt	% wt	% wt	% wt	% wt	% wt	% wt	Calcite	Dolomite	Total Carbonates	Calcite/Dolomite Ratio
W00-4-82.10	Till	82.10	2.37	37.2	30.2	32.6	40.7	32.8	26.5	1.2	2.5	3.7	0.46
W00-4-83.0	Till	83.0	1.72	43.9	39.5	16.6	48.4	41.9	9.7	0.9	2.3	3.3	0.40
W00-4-84.1	Till	84.1	1.45	44.6	35.1	20.3	49.0	39.6	11.4	0.9	1.8	2.7	0.48
W00-4-85.95	Till	85.95	1.53	44.6	37.3	18.1	49.2	40.3	10.5	0.9	2.2	3.1	0.40
W00-4-87.70	Till	87.70	1.35	42.6	40.3	17.1	47.2	43.3	9.5	0.7	2.0	2.7	0.37
W00-4-89.50	Till	89.50	1.74	43.7	37.8	18.5	48.1	40.9	11.0	0.7	2.1	2.8	0.35