

# MAR 19950016: PEMBINA

Received date: Sep 07, 1995

Public release date: Sep 08, 1996

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**DOCUMENT NAME: Operation Pembina Laboratory Report**  
**CLIENT NAME: Operation Pembina**

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**PAGE NO: 1**  
**DATE: September, 1993**

**OPERATION PEMBINA  
GEOCHEMICAL LABORATORY REPORT**

**Submitted by  
Western Diamex Limited  
prepared by  
Ron Stewart  
&  
Douglas Sraega**

**September, 1993**

## Introduction

This portion of the final report concerning the Pembina Diamond Exploration Program is intended to summarize the complex process necessary to reduce bulk field samples by as much as 99% of the original to a small heavy mineral component suitable for Micro-probe analysis.

Results obtained from these analysis form the basis for our recommendations for further work.

## Sample Processing

Samples were washed in a 4% solution of sodium metahexaphosphate for 18 hours. The clay size fraction was removed, the sample was rinsed and heated to 120°C until dry. Each sample was separated in heavy liquid (ethylene tetrabromoethane) to remove quartz, feldspar, and other light minerals. The separates were then washed in acetone and the heavy liquid recycled. The mineral separates were then magnetically separated using a Frantz Isodynamic Magnetic Separator. The final separates were the visually picked against known indicator minerals using a 10x40 power stereoscopic microscope. Picked mineral grains were then mounted in 154 petroepoxy and diamond polished. Each grain was probed utilizing the Energy Dispersive System (EDS) at the University of Alberta electron microprobe lab. Minerals were identified by characteristic x-ray spectra and the relative amounts of trace and accessory minerals quantified.

## The Energy Dispersive System and Its Limitations

The EDS system is a cost effective method for the reconnaissance of a large number of mineral grains. The system does not give a definitive analysis of all minerals and for this reason all anomalous minerals listed in the Compilation of EDS Results are recommended for probing by the wavelength dispersive system (WDS).

The energy dispersive system is based on the characteristic x-ray energy released when an accelerated electron removes an inner shell electron of the target atom and an outer shell electron drops to a lower energy level. The emitted electrons pass through a beryllium window and at a silicon based energy detector. The individual x-ray energies then accumulated by computer to produce a spectrum of energies.

The system has many limitations. Elements with proton numbers lower than Na can not be analyzed and some emitted x-ray energies overlap or mask other x-ray emissions.

Titanium and Ba can not be discriminated since their emitted x-ray energies overlap. Incident x-rays on the silicon based detector cause secondary x-rays known as escape peaks on the x-ray spectrum and pulse pile up occurs when two x-rays reach the detector at the same time to produce an erroneous energy. Calcium and Al emissions hitting the detector at the same time combine to produce an erroneous Cr peak which can be partially corrected by lowering the current of the incident electrons and increasing the detection counting time.

The lower limits of detection for pyroxenes for a 20.00 nA electron current and a 100 second counting time are: 0.0161 wt% for Na<sub>2</sub>O, 0.0177 wt% for MgO, 0.0189 for Al<sub>2</sub>O<sub>3</sub>, 0.0229 wt% for SiO<sub>2</sub>, 0.0135 wt% for K<sub>2</sub>O, 0.0139 wt% for CaO, 0.0176 wt% for TiO<sub>2</sub>, 0.0415 wt% for Cr<sub>2</sub>O<sub>3</sub>, 0.0479 wt% for MnO, 0.0422 wt% for FeO and 0.022 wt% for NiO.

Anomalous Cr was found in 75 pyroxenes. The possibility that the Cr peak was erroneous due pulse pile in the presence of Al and Ca was determined by lowering the current and increasing the counting time. It was found that Cr<sub>2</sub>O<sub>3</sub> less than 1 wt% may erroneous and Cr<sub>2</sub>O<sub>3</sub> greater than 1 wt% was real. In this report weight percents of less than 1 wt% Cr<sub>2</sub>O<sub>3</sub> are reported as trace chromium and analysis greater than 1 wt % are prefixed by the element.

Clinopyroxenes of the from XYZ206 contain may cation coupled substitutions in the X and Y structural sites and Al can substitute for Si in the tetrahedral silicon in the Z site. The EDS method can not distinguish site substitutions and for this reason all non-endmember pyroxenes are reported as augites even though they may be omphacites.

The classification scheme for garnets by Stephen and Dawson (1975) for garnet is based on WDS analysis and all anomalous garnets using this system are reported as 'possible'.

It is recommended WDS analysis be done on these garnets to definitively define which garnets are truly anomalous.

### Discussion of Indicator Minerals

The focus of the laboratory concentration was to find pathfinder minerals which indicate presence of diamond bearing rock. The provenance of sediments in the Western Canadian Sedimentary Basin demands that the minerals are readily broken down or altered in the environment. Pyroxenes and garnets are most easily recognized but phlogopite, olivine and orthopyroxene were looked for but not found. Zircon and spinels group minerals were not used because they are found in great abundance and do not break down in the environment. The ilmenites that were probed had Mn rich cores and although this corresponds to some lamproite ilmenites it is commonly found in carbonatites.

Indicator minerals are grouped into ones that indicate the presence of potentially diamond bearing rock and those that indicate the presence of diamond. Possible garnets of the eclogitic paragenesis (G3, G5, G6 and G8; Stephen and Dawson, 1975) were found which indicate the presence of potentially diamond bearing rock. The G3 paragenesis is further divided into type I and II eclogites. The type I eclogitic garnets, which indicate the presence of diamonds, have Na<sub>2</sub>O greater than 0.07 wt% accompanied by elevated TiO<sub>2</sub> (Gurney et al., 1993).

The pyroxenes found were predominantly described as augites but could be in fact omphacites due to uncertainties in the EDS method. At high pressure Cr is incorporated into the clinopyroxene lattice by a coupled substitution with Na or by a Tshermaks like substitution with Al substituting for Si. High chromium clinopyroxenes indicate the presence of deep seated rocks at the surface of possible xenocrystic origin. Low chromium pyroxenes are found in mafic complexes, type II kimberlites, lamproites and lamprophyres as phenocryst phases.

Jadeite is found in high pressure metamorphic rocks and in eclogites and was found in a few samples.

The presence of high K<sub>2</sub>O in clinopyroxene, up to 1.5 wt%, is only possible at high pressure with the amount of K<sub>2</sub>O also dependent on the amount of K<sub>2</sub>O in the rock. Eclogitic pyroxenes with K<sub>2</sub>O in excess of 0.08 wt% indicate the presence of diamond bearing rock (Gurney et al., 1993).

### **Conclusion and Recommendations**

While there is a certain degree of uncertainty inherent in the EDS results, eclogitic garnets with anomalous Na values and pyroxenes bearing anomalous K values have been found within the confines of the study area. The presence of such minerals within the study area indicate the presence of a possible diamond bearing rock source.

The presence of anomalous diamond indicator minerals, eg. chrome diopside, and possible eclogitic garnets indicate that further work in the Pembina area is warranted, to better delineate possible sources.

### **References**

Dawson J.B. and Stephen W.E., 1975, Statistical Classification of Garnets from Kimberlites and Associated Xenoliths, Journal of Geology., vol 83, p 589-607.

Gurney J.J. and Moore R.O., 1993, Geochemical Correlations Between Kimberlitic Indicator Minerals and Diamonds, in: Diamonds: Exploration Sampling and Evaluation, p147-171.

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**Compilation of EDS Results**

Sample	Results
Wilfley Con. run of L@LD2	5 diopsides tr. Cr
Wilfley Mid. run of L@LD2	1 possible G4 garnet
#1	2 diopsides tr. Cr 1 augite tr. Cr
#2	5 possible G3 garnets 4 chromium augites 3 augites tr. Cr
#3	1 possible G3 garnet tr. Ti, Na 1 possible G3 garnet 3 augites tr. Cr 2 augites tr. K
#4	3 possible G8 garnets 2 augites tr Cr
#5	1 possible G3 garnet
#6	3 Chrome diopsides low Al 1 possible G5 or G6 garnet
#7	1 augite tr. Cr 2 possible G5 or G6 garnets
#8	nothing of significance
#9	3 augites tr. Cr 1 possible G8 garnet 2 possible G5 or G6 garnets 1 aluminous vanadium calcium silicate tr. Ti, Fe
#10	1 Chrome diopside 6 diopsides tr. Cr 1 possible G8 garnet

Sample	Results
#11	1 possible G5 or G6 garnet 1 chrome augite 1 diopside tr Cr
#12	1 possible G5 or G6 garnet 1 chrome augite 1 diopside tr. Cr
#15	nothing of significance
#16	1 Chromium augite 1 augite tr. Cr 1 diopside tr. Cr 2 possible G5 or G6 garnets
#17	nothing of significance
#18	1 jadeite 1 augite tr. Cr 1 diopside tr. Cr
#24	1 diopside tr. Cr, Ni, Mn 1 diopside tr. Cr
#26	nothing of significance
#29	2 possible G8 garnets
#31	1 clinopyroxene tr. K, Cr 3 augites tr. Cr 1 chrome diopside
#32	1 Chromium augite 1 augite tr. Cr
#35	1 low Al Clinopyroxene tr. Cr 1 possible G3 garnet 1 possible G5 or G6 garnet



Sample	Results
#36	9 possible G8 garnets
#37	2 augites tr. Cr 2 possible G5 or G6 garnets
#38	8 diopsides tr. Cr 3 augites tr. Cr 1 diopside low Al tr. Cr
#39	nothing of significance
#40	1 chrome diopside 1 augite tr Cr, K, Mn 1 augite tr K, Ti 1 potassic augite 1 augite tr. Cr 1 diopside tr. Cr
Athabasca-Whitecourt (no number)	nothing of significance
McLeod at #1 (no number)	1 augite tr. Cr
#45	1 chrome diopside 1 chrome diopside low Al 1 chromium augite 5 augites tr. Cr 1 diopside tr Cr 1 possible G4 garnet
#46	1 chrome augite 2 diopsides tr. Cr 1 possible G8 garnet

Sample	Results
#47	2 diopsides tr. Cr 2 augites tr. Cr 1 jadeite 1 chrome diopside 1 possible G3 garnet 1 augite low Al tr. Cr

FP- nothing of significance

AA 1 possible G3 garnet

\*tr. - trace amount which is less than 1 wt %. Minimum detection limits utilizing EDS for pyroxenes are 0.0161 wt% for Na<sub>2</sub>O, 0.0177 wt% for MgO, 0.0189 wt% for Al<sub>2</sub>O<sub>3</sub>, 0.0229 wt% for SiO<sub>2</sub>, 0.0135 wt% for K<sub>2</sub>O, 0.0139 wt% for CaO, 0.0176 wt% for TiO<sub>2</sub>, 0.0415 wt% for Cr<sub>2</sub>O<sub>3</sub>, 0.0479 wt% for MnO, 0.0422 wt% for FeO and 0.0522 wt% for NiO. If an element appears as quantifier prefixing the mineral name it occurs in excess of 1 wt %. The closer the adjective is to the mineral name the higher the concentration.

CERTIFICATE

I, Paul A. Wagner, of the City of Edmonton in the Province of Alberta, do hereby certify that:

I am the Facility Operations Manager and sole commercial analyst in the Electron Microprobe Laboratory in the Department of Geology at the University of Alberta.

I further certify that:

I am a graduate of the Department of Geology at the University of Alberta and hold an MSc, Geochemistry (1982) and a BSc, Specialization (1979) in Geology.

I am a registered Professional Geologist and member in good standing with the Association of Professional Engineers, Geologists and Geophysicists of Alberta.

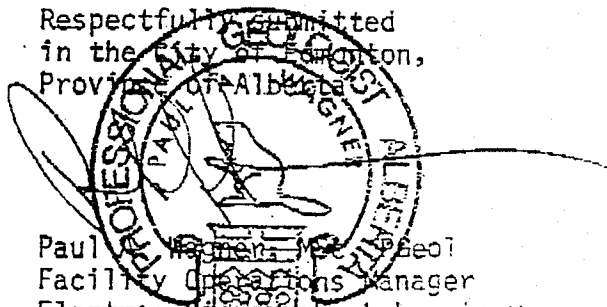
I am a Fellow of the Geological Association of Canada and a member of six (6) additional national and international geological and mineralogical associations.

The data contained herein are the results of quantitative electron microprobe analysis of specimens submitted to this laboratory under contract to the University of Alberta.

I have no direct or indirect interest in the property or properties represented by the mineral specimens, nor the company or companies holding any rights or titles to said property or properties, and do not expect to receive any.

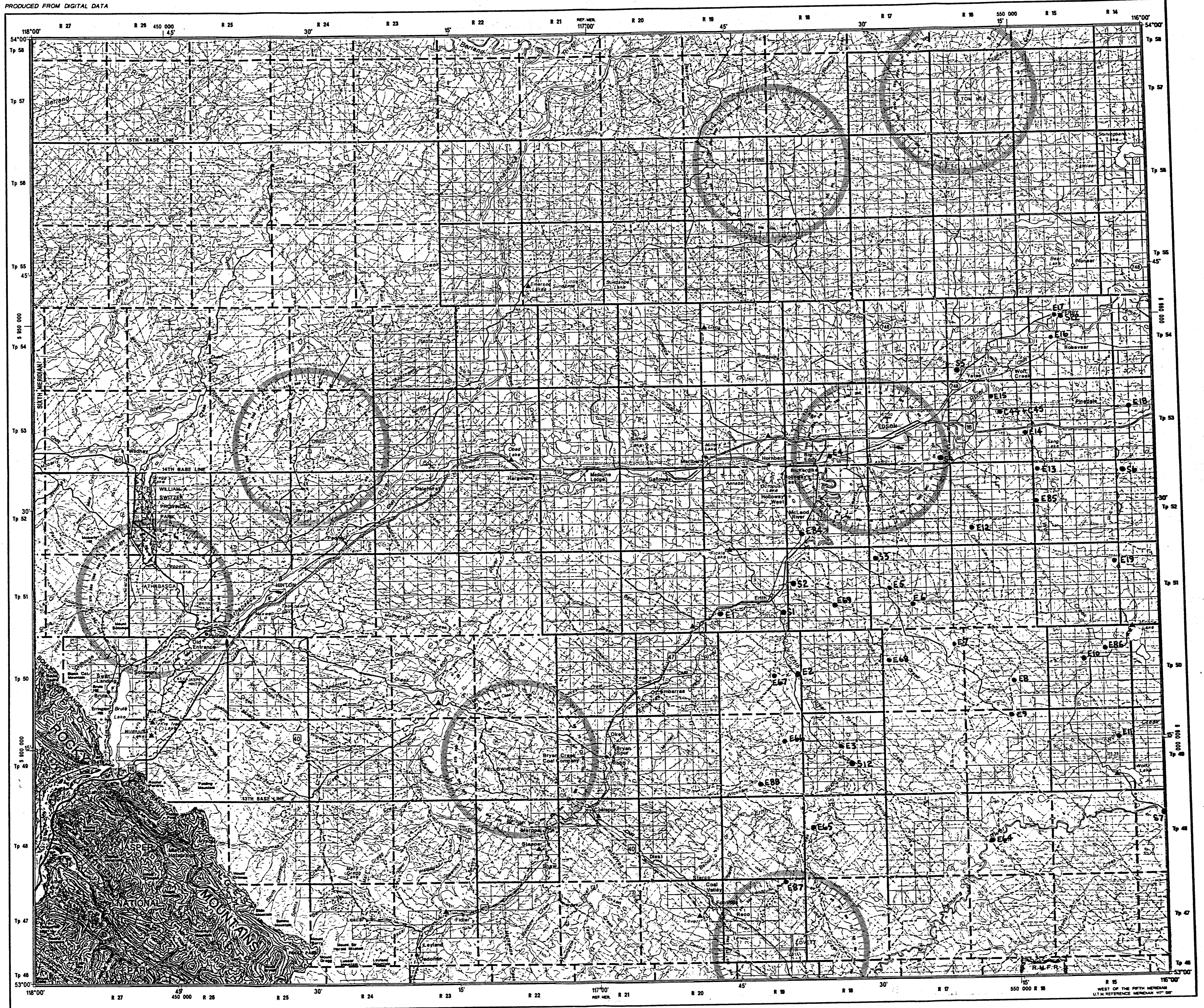
The results of the analyses contained herein may be utilized by the holder(s) of the property or properties for inclusion in a Prospectus or Statement of Material Facts within the limits of liability of the University of Alberta as specified by this contract.

Respectfully Submitted  
in the City of Edmonton,  
Province of Alberta



Paul A. Wagner, M.Sc. Geol.  
Facility Operations Manager  
Electron Microprobe Laboratory  
Department of Geology  
University of Alberta

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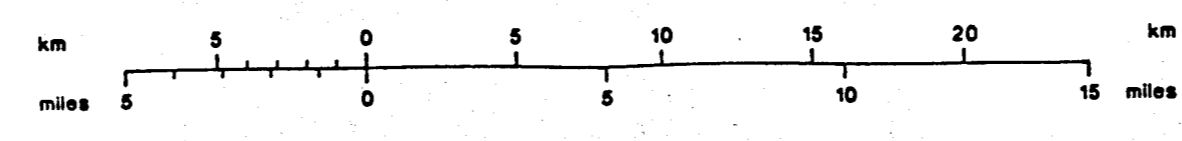
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|---------------------------|----------------|--|
| CITY                      | GRANDE PRAIRIE |  |
| TOWN                      | BEAVERLODGE    |  |
| VILLAGE                   |                |  |
| HAMLET                    |                |  |
| LOCALITY                  |                |  |
| POST OFFICE               |                |  |
| STATION                   |                |  |
| RAILWAY                   |                |  |
| TOWNSHIP LINE, SURVEYED   |                |  |
| TOWNSHIP LINE, UNSURVEYED |                |  |
| SECTION LINE              |                |  |
| PIPELINE                  |                |  |

- |                       |  |
|-----------------------|--|
| PRIMARY HIGHWAY       |  |
| DIVIDED               |  |
| PAVED                 |  |
| GRAVEL                |  |
| SECONDARY HIGHWAY     |  |
| PAVED                 |  |
| GRAVEL                |  |
| IMPROVED ROAD         |  |
| UNIMPROVED ROAD       |  |
| TRUCK TRAIL           |  |
| TRAIL OR SEISMIC LINE |  |
| TRANSMISSION LINE     |  |

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| 1990 |  |
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 LANDS AND WILDLIFE  
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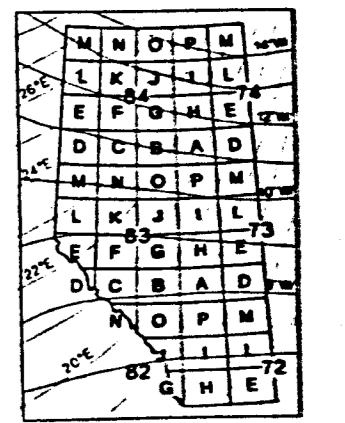


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**Operation Pembina**  
 Geochemical Sample Location Map  
 Western Diamex Limited  
 September, 1993

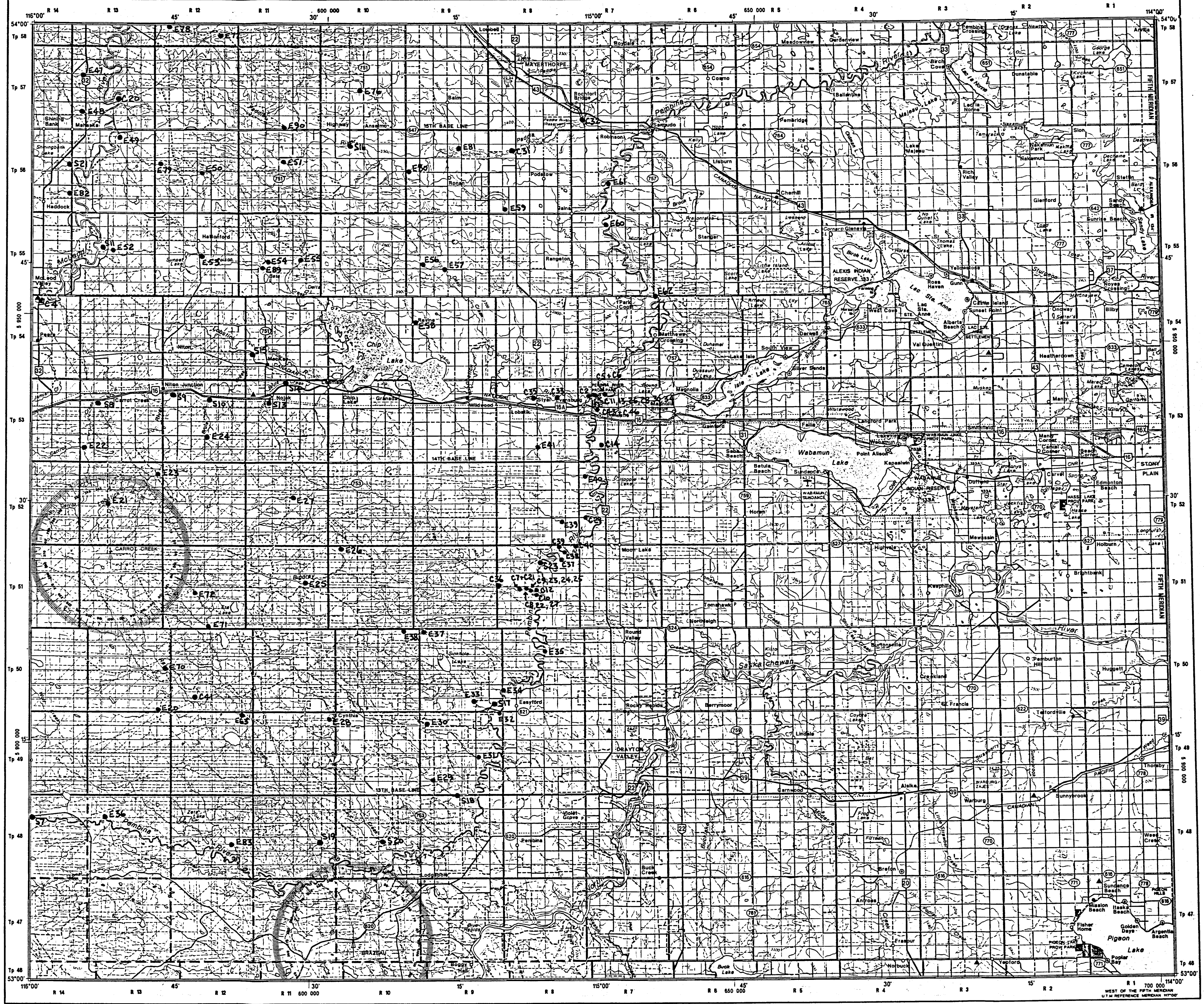
MAGNETIC CHART OF ALBERTA  
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AVERAGE DECLINATION OF THE COMPASS IN DEGREES  
 ANNUAL CHANGE OF DECLINATION IN MINUTES OF ARC

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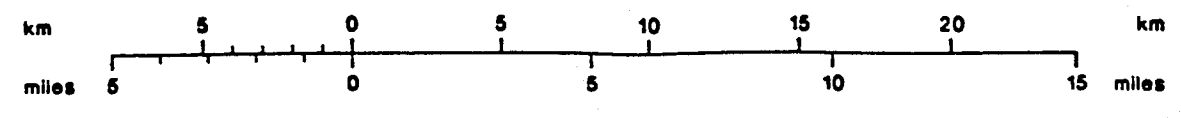


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CITY	GRANDE PRAIRIE		PRIMARY HIGHWAY	
TOWN	BEAVER LODGE		DIVIDED	
VILLAGE			PAVED	
HAMLET			GRAVEL	
LOCALITY			SECONDARY HIGHWAY	
POST OFFICE			PAVED	
STATION			GRAVEL	
RAILWAY			IMPROVED ROAD	1991
TOWNSHIP LINE, SURVEYED			UNIMPROVED ROAD	1991
TOWNSHIP LINE, UNSURVEYED			TRUCK TRAIL	1991
SECTION LINE			TRAIL OR SEISMIC LINE	1985
PIPELINE			TRANSMISSION LINE	

All features updated to year of production unless otherwise indicated

**Alberta**  
FORESTRY  
LANDS AND WILDLIFE  
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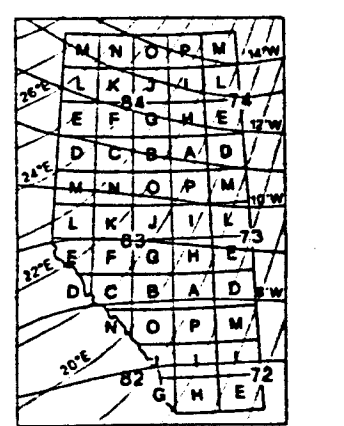


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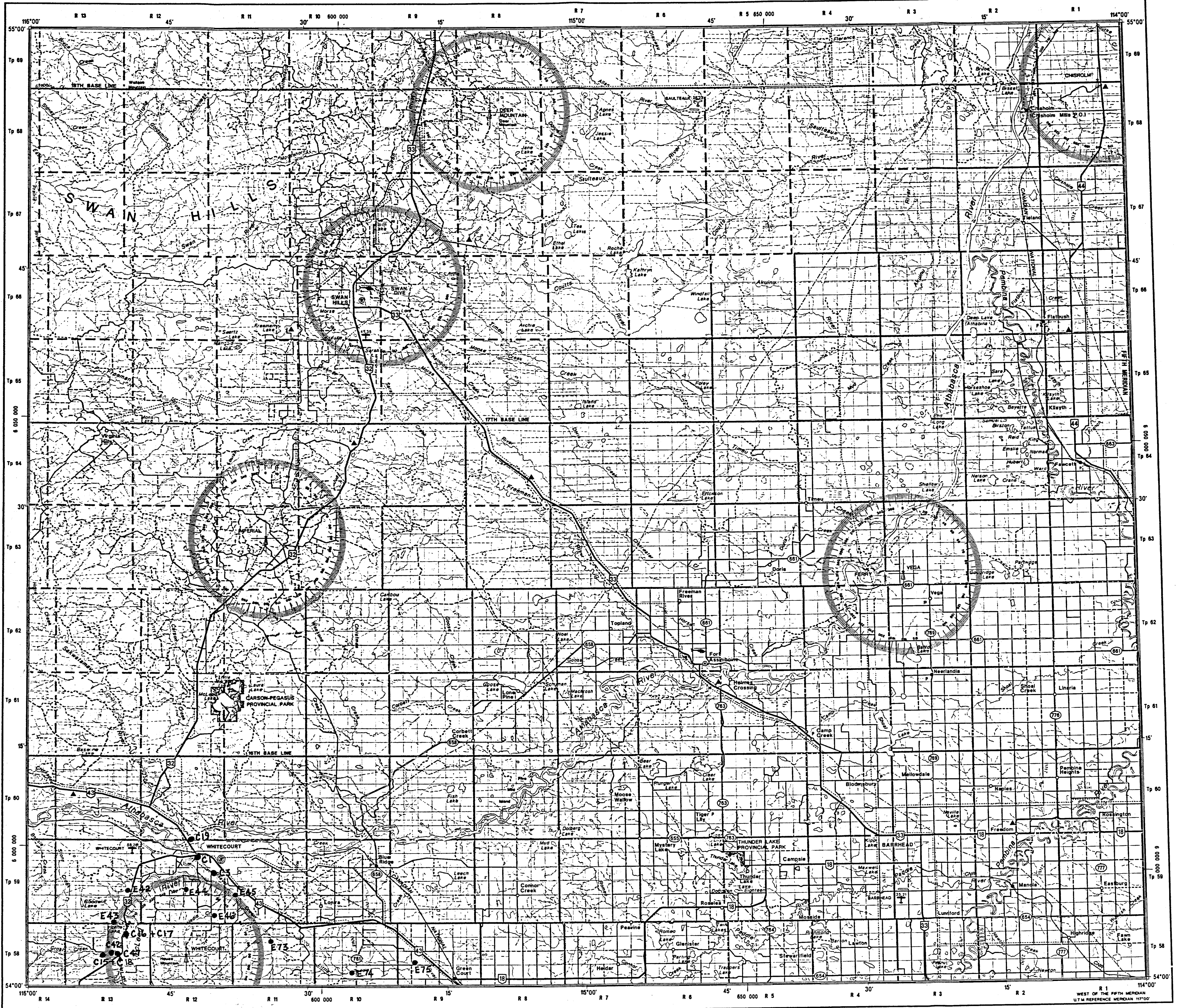
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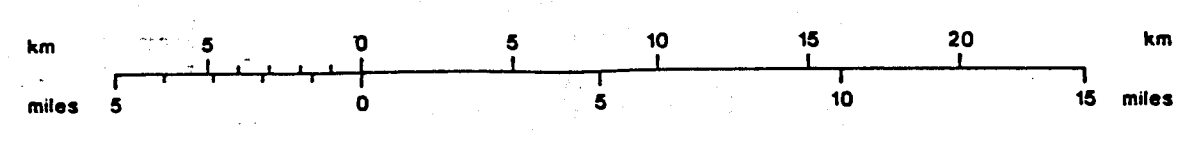
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TOWN	BEAVERLODGE	
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TOWNSHIP LINE, UNSURVEYED		
SECTION LINE		
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PRIMARY HIGHWAY		
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GRAVEL		
IMPROVED ROAD	1990	
UNIMPROVED ROAD	1990	
TRUCK TRAIL	1990	
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TRANSMISSION LINE		

All features updated to year of production unless otherwise indicated

**Alberta**  
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LANDS AND WILDLIFE  
1:250 000

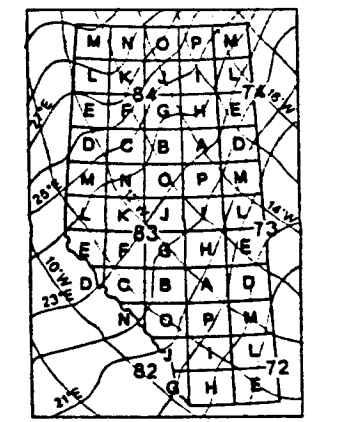


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**DOCUMENT NAME:** Operation Pembina Field Report  
**CLIENT NAME:** Operation Pembina

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**PAGE NO:** 1  
**DATE:** September, 1993

**PROJECT PEMBINA  
FIELD REPORT**

**SUBMITTED BY  
WESTERN DIAMEX LIMITED**

**PREPARED BY  
TOM BRYANT  
AND  
BOB CANTIN**

**SEPTEMBER, 1993**

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**DOCUMENT NAME: Operation Pembina Field Report**  
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## OPERATION PEMBINA FIELD REPORT

Work for the project has finished with all samples having been processed by the lab. Since the main thrust of this project was reconnaissance the sampling focus was on natural concentration areas that would have the greatest likelihood of yielding a heavy mineral concentrate. Much of the area was not conducive to these concentration zones as the materials in the drainages were muskeg derived and too fine. The materials were primarily clays and silts of undetermined origin. A glacial outwash silt covers much of the area which restricts sampling without drilling technology to those areas already cut by drainages. Our primary focus was to use existing drainage and natural concentration zones as our sample sites to determine if any potential for diamond pipes existed in the test area. Samples that yielded indicators would be followed up on in a second more detailed examination that would put together the field examination with glacial direction information, and more detailed geophysics. It was felt that this type of reconnaissance was needed to help us focus more detailed and more expensive exploration efforts. This relatively inexpensive first look is a valuable step in the exploration process.

In total, 160 sites were examined. Of those sites 70 were viable sites as determined by our operation philosophy for this reconnaissance examination.

### SAMPLE GATHERING AND PREPARATION

While preliminary sample site decisions were made using topographic maps and air photos, actual ground truthing did not give us viable concentration zones for examination in all cases. These sites were noted as examined but no sample taken. A further group of samples were taken but did not yield a heavy mineral concentrate that could be picked. The rest of the samples yielded a heavy mineral concentrate that could be examined and picked for indicator minerals.

The following is a general outline of the steps taken in our sample program;

1. POTENTIAL SAMPLE SITE CHOSEN
2. ON GROUND EXAMINATION
3. SAMPLE TAKING DECISION
4. SAMPLE SCREENED TO 3/8 INCH

5. MINUS 3/8 INCH TO GRAVITY CONCENTRATION
6. GRAVITY CONS TO LAB
7. SAMPLE SCREENED FOR LAB PROCESSING
8. MAGNETIC SEPARATION TO SEVERAL MAGNETIC SUSCEPTIBILITY FRACTIONS.
9. ALL FRACTIONS TO HEAVY MEDIA
10. SINKS TO MICRO-EXAM AND PICKING
11. PICKING OF POTENTIAL INDICATOR MINERALS
12. PICKED GRAINS TO MICROPROBE

Typical sample sizes ranged from 20 to 200 kg. in the field. Many sample sites were so remote or so poor in concentration materials that samples in the 20 kg. size were all that could be taken. Samples in the 100 to 200 kg. were the norm.

### PROJECT AREA

The Project Pembina reconnaissance work was carried out over a 9,000 square kilometer area. This equates to 900,000 hectares. Since we were primarily interested in natural concentration areas most of our samples were taken along existing drainage systems. Much of the project area particularly in the central portion was muskeg which is not suitable for our type of investigation. This area would need to be drilled for till sampling in the winter when the frozen ground would give some support. Even with the limitations caused by the muskeg we were able to gather good samples from much of the project area. No attempt was made to run samples on a grid basis as the terrain was too difficult and the aim was to investigate natural concentration zones that had sampled significant areas as a result of drainage. We attempted to investigate both current drainage and pre glacial channels when intersected by current drainages.

### SUGGESTED FURTHER WORK

As this preliminary work has progressed several avenues for further exploration have suggested themselves. There is a real need for detailed aerial magnetometer work to be done. A co-operative effort would be ideal in this type of exploration. The presence of indicator minerals gives a good level of confidence that there are source systems within the project area. As a matter of fact there may be several sources if the wide indicator mineral dispersion train is any indication.

Because the indicator minerals have been found in several widely spaced areas that are not linked by ice movement or drainage patterns, it would seem that we are dealing with a cluster of sources. In order to evaluate this it would be helpful to try to fingerprint the indicators geochemically and use cluster analysis to determine if geochemical trends exist that would suggest separate sources. It would be advisable to go back to those areas that yielded indicator minerals and run larger samples to get large numbers of indicators that would present statistically significant data for geochemical analysis.

If an attempt to sample till is made there will have to be some reliance on drilling to till as much of the area is covered with a layer of fine grained soil that seems to be left as a result of glacial meltwater. Unless the investigator is prepared to try picking in the microscopic fractions this material is too fine. A well run auger drill would be suitable for this work as the depths would be less than 10 meters.

If the use of aerial magnetometer is approved then drilling could probably proceed on highly specific targets without relying on till sampling. If bedrock is shallow, auger drilling would be suitable for quick examinations. Valid samples could be obtained to 25 meters with some mixing of the sample to be expected. As long as the operator is conscientious there should be little problem with sample pollution. The auger is suggested because of its high mobility, low cost to operate, speed of mobilization, and low environmental impact.

Very strong efforts should be made to run large samples from those areas that have already given us promising indicator minerals to see if diamonds might be recovered. Samples in the 1,000 to 5,000 kg. sizes would be advised.

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### GEOCHEMICAL SAMPLE LOCATION MAP

Sample locations are indicated on three 1:250,000 scale topographic maps which accompany this report. The mapsheets are 83F Edson, 83G Wabamun Lake and 83J Whitecourt.

The sample numbers correspond to the sample list below. Sample prefix codes are as follows:

- E Sites examined - no sample taken
- S Samples taken but no pickable concentrate
- C Samples yielding pickable concentrate

Additional maps can be obtained at cost upon request.

SAMPLE LIST

**SITES EXAMINED - NO SAMPLE TAKEN**

- E1 : Embarras River - Off Hwy. 47 upstream from Erith - SW 1/4 Twp.51 R. 19.
- E2 : Erith River - At junction of Raven Creek East side Twp. 50 R.19.
- E3 : Erith River - Middle of Twp.49 R.18.
- E4 : Mouth of Sundance Creek at McLeod River - South end Twp.53 R. 18.
- E5 : Swartz Creek - west half Twp.51 R.17.
- E6 : Swartz Creek - south half Twp. 51 R.17.
- E7 : No name creek North East 1/4 Twp.50 R. 17.
- E8 : No name tributary of Wolf Creek - south half Twp.50 R.16.
- E9 : No name creek - north half Twp.49 R.16.
- E10 : No name creek - north half Twp. 50 R.15.
- E11 : Wolf Creek - east half Twp.49 R.15.
- E12 : Moose Creek - south half Twp.52 R.16.
- E13 : Wolf Creek - north west 1/4 Twp. 52 R. 15.
- E14 : Wolf Creek - Upstream of Hwy.16 - west half Twp.53 R.16.
- E15 : Wolf Creek - Downstream from Hwy.16 - north half Twp.53 R.16.
- E16 : No name creek west of Rosevear - west half Twp.54 R. 15.
- E17 : McLeod River at old ferry site - north half Twp.54 R.15.
- E18 : January Creek - west half Twp.53 R.14.
- E19 : No name tributary of Wolf Creek - north east 1/4 Twp. 51 R: 15.
- E20 : No name tributary of Rat Creek - south east 1/4 Twp. 50 R. 13.
- E21 : Lobstick River - west half Twp. 52 R. 13.
- E22 : Carrot Creek - south west 1/4 Twp. 53 R. 13.
- E23 : Lobstick River - north east 1/4 Twp. 52 R.13.
- E24 : Brule Creek - centre Twp. 53 R. 12.
- E25 : Bigoray River - east half Twp. 51 R.11.
- E26 : Bigoray River - north west 1/4 Twp. 51 R 10.
- E27 : No name tributary of Bigoray River - centre Twp. 52 R 11.
- E28 : Paddy Creek south west of Cynthia - north east 1/4 Twp. 49 R. 11.
- E29 : No name tributary of the Pembina river - south west 1/4 Twp.49 R. 9.
- E30 : No name tributary of the Pembina River - north west 1/4 Twp. 49 R. 9.
- E31 : No name tributary of the Pembina River - south east 1/4 Twp. 49 R.9.
- E32 : Pembina River upstream from Hwy. 621 - north east 1/4 Twp. 49 R. 9.
- E33 : No name creek from Sinkhole Lake. - south east 1/4 Twp. 50 R. 9.
- E34 : Pembina River downstream from Hwy. 621 - south west 1/4 Twp. 50 R. 8.
- E35 : Pembina River - north half Twp. 50 R. 8.
- E36 : Pembina River - north west 1/4 Twp. 48 R. 13.

- E37 : No name creek into Sinkhole Lake - north west 1/4 Twp. 50 R. 9.  
E38 : No name creek into Sinkhole Lake - north east 1/4 Twp. 50 R. 10.  
E39 : No name tributary of Pembina River - south east 1/4 Twp. 52 R. 8.  
E40 : No name tributary of Pembina River - north west 1/4 Twp. 52 R. 7.  
E41 : No name tributary of Lobstick River - south half Twp. 53 R. 8.  
E42 : No name tributary of McLeod River - east half Twp. 59 R. 13.  
E43 : Same tributary as above - South border Twp. 59 R. 13.  
E44 : No name tributary of the McLeod River - centre Twp. 59 R. 12.  
E45 : Beaver Creek - south west 1/4 Twp. 59 R. 11.  
E46 : Hedin Creek - south east 1/4 Twp. 59 R. 12.  
E47 : No name tributary of McLeod River - north 1/2 Twp. 57 R. 13.  
E48 : No name tributary of McLeod River - south 1/2 Twp. 57 R. 13.  
E49 : No name tributary of McLeod River - north east 1/4 Twp. 56 R. 13.  
E50 : No name tributary of the McLeod River - centre Twp. 56 R. 12.  
E51 : Paddle River - centre Twp. 56 R. 11.  
E52 : No name tributary of McLeod River - centre Twp. 55 R. 13.  
E53 : Poison Creek - centre Twp. 55 R. 12.  
E54 : Tributary of Poison Creek - south 1/2 Twp. 55 R. 11.  
E55 : Tributary of Poison Creek - south 1/2 Twp. 55 R. 11.  
E56 : No name tributary of Lobstick River - south west Twp. 55 R. 9.  
E57 : Same as E56 - centre Twp. 55 R. 9.  
E58 : No name creek into Chip Lake - north west 1/4 Twp. 54 R. 9.  
E59 : No name creek into Paddle River - south west 1/4 Twp. 56 R. 8.  
E60 : Pembina River - north 1/2 Twp. 55 R. 7.  
E61 : Pembina River - south 1/2 Twp. 56 R. 7.  
E62 : Pembina River - south west Twp. 55 R. 6.  
E63 : Rat Creek - north east 1/4 Twp. 49 R. 12.  
E64 : Pembina River - west 1/2 Twp. 48 R. 16.  
E65 : Lendram Creek - west 1/2 Twp. 48 R. 18.  
E66 : No name tributary of Erith River - north east 1/4 Twp. 49 R. 19.  
E67 : No name tributary of Erith River - centre Twp. 50 R. 19.  
E68 : Rodney Creek - north west 1/4 Twp. 50 R. 17.  
E69 : Rodney Creek - south east 1/4 Twp. 51 R. 18.  
E70 : Rat Creek - east 1/2 Twp. 50 R. 13.  
E71 : North Fork Rat Creek - north border Twp. 50 R. 12.  
E72 : Same as above - centre Twp. 51 R. 12.  
E73 : Beaver Creek - north 1/2 Twp. 58 R. 11.  
E74 : Little Paddle River - centre Twp. 58 R. 10.  
E75 : Little Paddle River - west 1/2 Twp. 58 R. 9.  
E76 : North Fork Paddle River - centre Twp. 57 R. 10.  
E77 : No name creek into McLeod River - south east Twp. 58 R. 12.

- E78 : Same as above - south west Twp. 58 R.12.
- E79 : No name creek into McLeod River - west 1/2 Twp. 56 R. 12.
- E80 : Paddle River - east 1/2 Twp. 56 R. 9.
- E81 : Paddle River - north east 1/4 Twp. 56 R. 9.
- E82 : No name creek into McLeod River - south east 1/4 Twp. 56 R. 14.
- E83 : No name creek from Zeta Lake - south east 1/4 Twp.48 R. 12.
- E84 : McLeod River - south west 1/4 Twp. 52 R. 18.
- E85 : Wolf Creek - west border Twp. 52 R. 15.
- E86 : Wolf Creek - north east 1/4 Twp. 50 R. 15.
- E87 : Lendram Creek - north east 1/4 Twp. 47 R. 19.
- E88 : Wickham Creek - south 1/2 Twp. 49 R. 19.
- E89 : Poison Creek - south west 1/4 Twp. 55 R.11.
- E90 : Paddle River - south border Twp. 57 R. 11.

**SAMPLES TAKEN BUT NO PICKABLE CONCENTRATE**

- S1 : Erith River - south east 1/4 Twp. 51 R. 19
- S2 : Rodney Creek - north west 1/4 Twp. 51 R. 18.
- S3 : Swartz Creek - north west 1/4 Twp. 51 R. 17.
- S4 : Moose Creek - south east 1/4 Twp. 53 R. 17.
- S5 : Edson River - south west 1/4 Twp. 54 R. 16.
- S6 : Carrot Creek - north west 1/4 Twp. 52 R. 14.
- S7 : Pembina River - north west 1/4 Twp. 48 R. 14.
- S8 : Carrot Creek - north west 1/4 Twp. 53 R. 13.
- S9 : Lobstick River - north west 1/4 Twp. 53 R. 12.
- S10 : Brule Creek - north 1/2 Twp. 53. R. 12.
- S11 : No name creek into McLeod River - centre Twp. 55 R. 13.
- S12 : Hanlan Creek - south east 1/4 Twp. 49 R. 18.
- S13 : Little Brule Creek - north west 1/4 Twp. 53 R. 11.
- S14 : Little Brule Creek - north border Twp. 53 R11.
- S15 : Lobstick River - west 1/2 Twp. 54 R. 11
- S16 : Paddle River - north west 1/4 Twp. 56 R. 10.
- S17 : No name creek out of Sinkhole Lake - Twp. 50 R. 9.
- S18 : No name tributary of Pembina River - north border Twp. 48 R. 9.
- S19 : Rat Creek - Twp. south east 1/4 Twp. 48 R. 11.
- S20 : Paddy Creek - centre Twp. 48 R. 10.
- S21 : No name creek out of Shiningbank Lake - east border Twp. 56 R. 14.
- S22 : McLeod River - north 1/2 Twp.54 R.15.
- S23 : Pembina River - north 1/2 Twp. 51 R. 8.



### SAMPLES YIELDING PICKABLE CONCENTRATE

- C1 : McLeod River at Whitecourt - north east 1/4 Twp.59 R. 12.
- C2 : Lobstick River downstream 200 m. from bridge north west 1/4 Twp. 53 R.7.
- C3 : Beaver Creek at Whitecourt - north east 1/4 Twp. 59 R. 12.
- C4 : McLeod River at Hwy. 32 - north border Twp. 54 R. 14.
- C5 : Pembina River just downstream of campground - north east 1/4 Twp. 53 R. 7.
- C6 : same as C5.
- C7 : Bigoray River first curve upstream from Pembina - centre Twp. 51 R. 8.
- C8 : Bigoray River 75 metres from Pembina River - centre Twp. 51 R.8.
- C9 : Mouth of Bigoray River - centre Twp. 51 R. 8.
- C10 : Pembina River 400 metres upstream from Bigoray River - centre Twp. 51 R.8.
- C11 : Lobstick River 1 KM. from bridge - north west Twp. 53 R. 7.
- C12 : Pembina River 100 metres downstream from Bigoray River - centre Twp.51 R.8.
- C13 : Lobstick River 200 metres downstream from bridge - gravel seam above river -north west Twp. 53 R. 7.
- C14 : Gravel pit above Pembina River - south west 1/4 Twp. 53 R.7.
- C15 : Groat Creek old channel - north half Twp. 58 R. 13.
- C16 : Gravel Pit above McLeod River - north east 1/4 Twp. 58 R. 13.
- C17 : same as C16.
- C18 : Groat Creek panned concentrate - north east 1/4 Twp. 58 R. 13.
- C19 : Athabasca River at Whitecourt - north border Twp. 59 R. 12.
- C20 : McLeod River - centre Twp. 57 R. 13.
- C21 : Bigoray River 300 metres upstream from Pembina River - centre Twp. 51 R. 8.
- C22 : Bigoray River 75 metres from Pembina River - centre Twp. 51 R. 8.
- C23 : Bigoray River mouth at Pembina River - panned cons - centre Twp. 51 R.8.
- C24 : Same as C23.
- C25 : Same as C23.
- C26 : Lobstick River 1 KM. downstream from bridge - north west 1/4 Twp. 53 R. 7.
- C27 : Bigoray 250 metres from mouth - centre Twp. 51 R. 8.
- C28 : Gravel seam above Lobstick River concentrate - north west 1/4 Twp. 53 R. 7.
- C29 : Pembina River - south west 1/4 Twp. 52 R. 7.
- C30 : Lobstick River 500 m. downstream from bridge - north west 1/4 Twp. 53 R.7.
- C31 : Paddle River - north 1/2 Twp. 56 R. 8.
- C32 : Paddle River - south west 1/4 Twp. 57 R.7.
- C33 : Lobstick River - north east 1/4 Twp. 53 R. 7.
- C34 - Garnet rich rock from Lobstick River streambed - north west 1/4 Twp. 53 R. 7.
- C35 - Lobstick River at Hwy. 22 - north 1/2 Twp. 53 R. 8.
- C36 : Bigoray River upstream from bridge - west border Twp. 51 R. 8.
- C37 : Pembina River - north east 1/4 Twp. 51 R. 8.
- C38 : Pembina River - 3 km. downstream from C37 - north east 1/4 Twp. 51 R.8.

- C39 : Pembina River - 1.5 km downstream from C38 - north east 1/4 Twp. 51 R.8.
- C40 : Pembina River - 3 km. downstream from C39 - north east 1/4 Twp. 51 R. 8.
- C41 : Gravel pit near Rat Creek - south west 1/4 Twp. 50 R. 12.
- C42 : Groat Creek - screened material - north east 1/4 Twp. 58 R. 13.
- C43 : Pembina River - screened sample - north west 1/4 Twp. 53 R. 7.
- C44 : Wolf Creek - screened sample - north east Twp. 53 R. 16.
- C45 : Wolf Creek - wilfley cons - north east Twp. 53 R. 16.
- C46 : Pembina River - wilfley cons - north west 1/4 Twp. 53 R. 7.
- C47 : Groat Creek - wilfley cons - north east 1/4 Twp. 58 R 13.