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Report #1008

# DIGHEM$^{III}$ SURVEY
# FOR
# WILZEL RESOURCES LTD.
# MATACHEWAN AREA, ONTARIO

N.T.S. 41 P/15, 42 A/2

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MINING LANDS SECTION

DIGHEM SURVEYS & PROCESSING INC.
MISSISSAUGA, ONTARIO
October 30, 1987

A-DLM-4

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# SUMMARY

A total of 534 km of survey was flown with the DIGHEM$^{III}$ system from September 8 to September 13, 1987, over a survey block in the Matachewan area of Ontario, for Wilzel Resources Ltd.

The survey mapped two discrete bedrock conductors. Possible bedrock conductors and sources of conductivity associated with magnetite were also identified. The magnetic parameters, including the second vertical derivative, provide useful information about structures within the bedrock. Further investigation using appropriate surface exploration techniques is warranted based on the survey results. Areas of interest may be assigned priorities for follow-up work on the basis of supporting geological and/or geochemical information.

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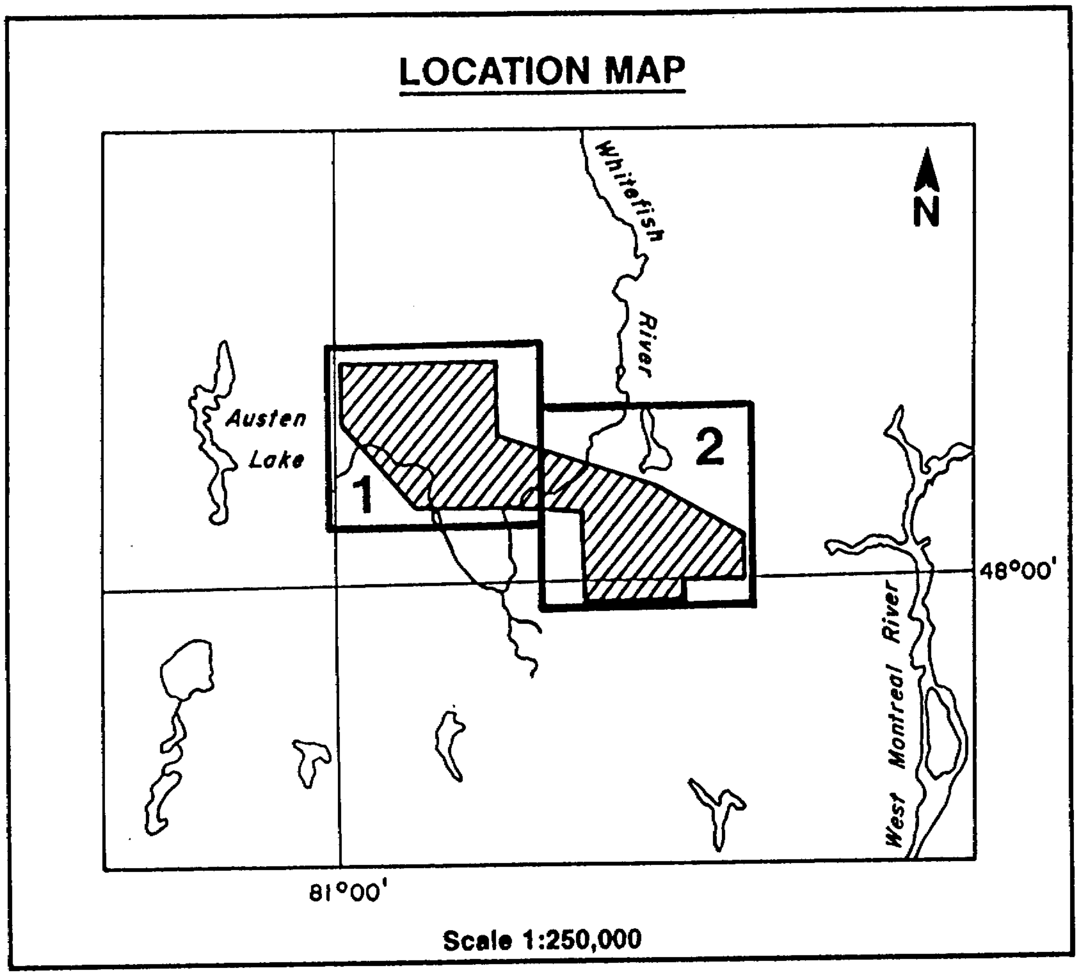
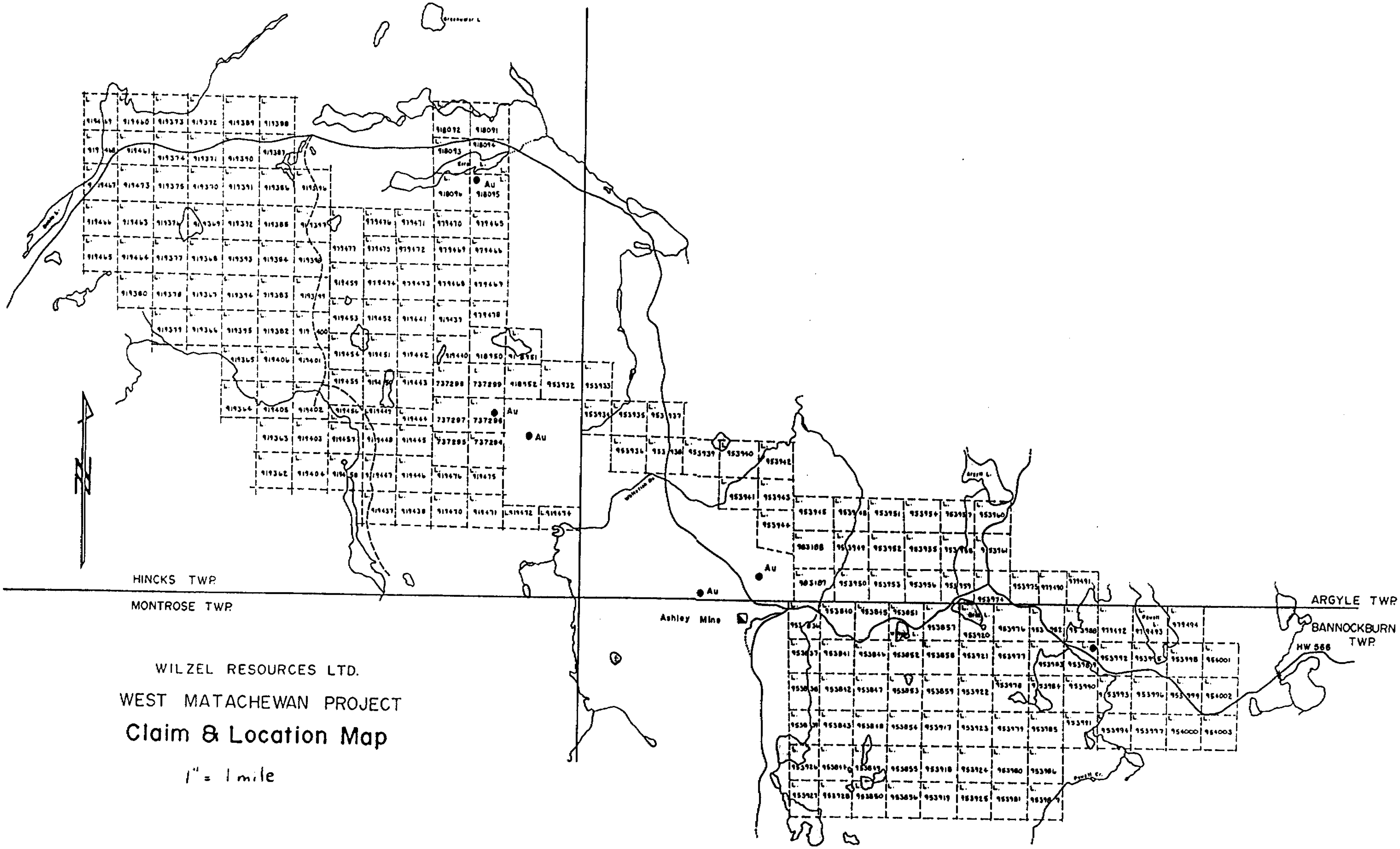


FIGURE 1

THE SURVEY AREA



WILZEL RESOURCES LTD.

WEST MATACHEWAN PROJECT

## Claim & Location Map

1" = 1 mile

NOV 1987

## INTRODUCTION

A DIGHEM$^{III}$ electromagnetic/magnetic survey totalling approximately 534 line-km was flown with a 100 m line-spacing for Wilzel Resources Ltd., from September 8 to September 13, 1987. Traverse lines were flown in an azimuthal direction of 37°/217°. The survey block is located on NTS map sheets 41P/15 and 42A/2 (see location map, Figure 1).

An Aerospatiale AS350B turbine helicopter (Registration C-GCKP) was provided by Frontier Helicopters Limited. The helicopter flew at an average airspeed of 110 km/hr with an EM bird height of approximately 30 m. Ancillary equipment consisted of a Scintrex Cesium magnetometer with its bird at an average height of 45 m, a Sperry radio altimeter, a Geocam sequence camera, an RMS GR33-1 digital graphics recorder, a Sonotek SDS 1200 digital data acquisition system, and an RMS TCR12 4-track 6400-bpi magnetic cassette recorder. The analog equipment recorded six channels of EM data with four EM channels at approximately 900 Hz, and two at 7200 Hz. Also recorded were two channels of magnetics (coarse and fine count), and a channel of radio altitude. The digital equipment recorded the EM data with a sensitivity of 0.2 ppm at 900 Hz, 0.40 ppm at 7200 Hz, and the magnetic field to 0.01 nT.

A Geometrics 826 proton precession magnetometer was operated at the survey base to record diurnal variations of the earth's magnetic field. The clock of the base station was synchronized with that of the airborne system to permit subsequent removal of diurnal drift.

A Herz Industries Totem-2A VLF receiver was also used to record the total field and quadrature components of the secondary VLF signals from Cutler, Maine (NAA-24.0 kHz) and Seattle, Washington (NLK-24.8 kHz). VLF maps showing the filtered total field information obtained from either transmitter are available as optional products.

In addition to the above equipment, a Del Norte navigation system was employed to track the aircraft's progress across the ground. This information was recorded in a range-range mode to an accuracy of 3 metres with a once-per-second update.

Appendix A provides details on the data channels, their respective sensitivities, and the navigation/flight path recovery procedure. Noise levels of less than 2 ppm are generally maintained for wind speeds up to 35 km/h. Higher winds may cause the system to be grounded because excessive bird swinging produces difficulties in flying the helicopter. The swinging results from the 5 $m^2$ of area which is presented by the bird to broadside gusts.

In areas where EM responses are evident primarily on the quadrature components, zones of poor conductivity are indicated. Where these responses are coincident with strong magnetic anomalies, it is possible that the inphase component amplitudes have been suppressed by the effects of magnetite. Most of these poorly-conductive magnetic features give rise to resistivity anomalies which are only slightly below background. If it is expected that poorly-conductive economic mineralization may be associated with magnetite-rich units, most of these weakly anomalous features will be of interest. In areas where magnetite causes the inphase components to become negative, the apparent conductance and depth of EM anomalies may be unreliable.

Anomalies which occur near the ends of the survey lines (i.e., outside the survey area) should be viewed with caution. Some of the weaker anomalies could be due to aerodynamic noise, i.e., bird bending, which is created by abnormal stresses to which the bird is subjected during the climb and turn of the aircraft between lines. Such aerodynamic noise is usually manifested by an anomaly on the coaxial inphase channel only, although severe stresses can affect the coplanar inphase channels as well.

# SECTION I: SURVEY RESULTS

## General Discussion

The survey covered a single survey block, the results of which are shown on two separate map sheets for each parameter. Table I-1 summarizes the EM responses in the area, with respect to conductance grade and interpretation.

Anomalous electromagnetic responses were selected and analysed by computer to provide preliminary electromagnetic anomaly maps. The resulting maps were used in conjunction with the computer processed digital data profiles during the interpretation stage, to produce the final EM anomaly maps.

The anomalies shown on the electromagnetic anomaly maps are based on a near-vertical, half plane model. This model best reflects "discrete" bedrock conductors. Wide bedrock conductors or flat-lying conductive units, whether from surficial or bedrock sources, may give rise to very broad anomalous responses on the EM profiles. These may not appear on the electromagnetic anomaly maps if they have a

## TABLE I-1

## EM ANOMALY STATISTICS OF THE MATACHEWAN AREA, ONTARIO

| CONDUCTOR GRADE | CONDUCTANCE RANGE SEIMENS (MHOS) | NUMBER OF RESPONSES |
|---|---|---|
| 6 | > 100 | 0 |
| 5 | 50 - 100 | 0 |
| 4 | 20 - 50 | 0 |
| 3 | 10 - 20 | 0 |
| 2 | 5 - 10 | 3 |
| 1 | < 5 | 38 |
| X | INDETERMINATE | 45 |
| TOTAL | | 86 |

| CONDUCTOR MODEL | MOST LIKELY SOURCE | NUMBER OF RESPONSES |
|---|---|---|
| D | DISCRETE BEDROCK CONDUCTOR | 4 |
| B | DISCRETE BEDROCK CONDUCTOR | 13 |
| S | CONDUCTIVE COVER | 69 |
| TOTAL | | 86 |

(SEE EM MAP LEGEND FOR EXPLANATIONS)

regional character rather than a locally anomalous character. These broad conductors, which more closely approximate a half space model, may be more evident on the resistivity parameter. Resistivity maps, therefore, may be more valuable than the electromagnetic anomaly maps, in areas where broad or flat-lying conductors are considered to be of importance. Contoured resistivity maps are not included as products for this survey but can be made available on request.

As previously mentioned in the introduction to this report, the effects of magnetite can reduce the positive amplitude of the inphase responses and can yield negative inphase responses in poorly conductive areas. It should be reiterated that the effects of magnetite can yield higher (overstated) apparent resistivities, lower (understated) EM conductance values, and erroneously shallow depth estimates. Furthermore, the apparent dips of conductors may also be incorrect if they are flanking, or contained within, magnetite-rich units.

Negative inphase responses are clearly evident on many survey lines, depicting zones of magnetite-rich material. These magnetite-rich rock units can be displayed on EM magnetite maps which are not included as a survey product, but can be provided on request.

## Magnetics

The magnetic data were interpolated onto a regular grid at a 2.5 mm interval using a cubic spline technique. The resulting grid provided the basis for presenting the magnetic contours.

Although there was no correction applied to the magnetic data for local variations in the IGRF field across the survey grid, the background levels have been related to the mean IGRF value for the survey area.

The total field magnetic data have been presented as contours on the photomosaic base maps using a contour interval of 10 nT where gradients permit. Colour plots of the total magnetic field are also included as survey products. These maps show the magnetic properties of the rock units underlying the survey area.

The total field magnetic information has also been subjected to a processing technique which produces maps of the second vertical derivative. This procedure suppresses regional gradients, provides better definition and resolution of magnetic units, and also develops weak magnetic features which may not be clearly evident on the total field map.

Strikes inferred from the magnetic data are generally northwest/southeast. Several magnetic dike-like features with approximate NNW/SSE strikes can be identified within the survey area.

One such feature extends from fiducial 3527 on line 10841 to fiducial 3054 on line 10951. Others include: fiducial 1105 on line 10742 to fiducial 2776 on line 10800, and fiducial 2041 on line 10391 to fiducial 1009 on line 10471.

A relatively broad, non magnetic, intrusive-like feature is apparent on the second vertical derivative contour map. It consists of a zone about 300 m wide in the east-west direction, centered on fiducial 3498 on line 11222. It extends north, to the vicinity of fiducial 1435 on line 11110, where it has a width of about 600 m in the east-west direction.

## VLF

VLF data was acquired using transmissions from the Cutler, Maine, and Seattle, Washington stations. Filtered total field VLF contour maps are not included as deliverable final products for this survey but are available as optional products. Preliminary VLF contour maps were prepared for this survey and used during the interpretation process. Strong VLF trends with approximate northwest/southeast orientations are apparent on the contour maps from both stations.

## CONDUCTORS IN THE SURVEY AREA

The electromagnetic anomaly maps show the anomaly locations with the interpreted conductor type, dip, conductance and depth being indicated by symbols. Direct magnetic correlation is also shown if it exists. The strike direction and length of the conductors are indicated when anomalies can be correlated from line to line. When studying the map sheets for follow-up planning, consult the anomaly listings appended to this report to ensure that none of the conductors are overlooked.

The effects of conductive overburden are evident over portions of the survey area. Although a comparison of the coaxial/coplanar anomaly shapes is useful in detecting bedrock conductors which are partially masked by conductive overburden, sharp undulations in the bedrock/overburden interface can yield anomalies which may be interpreted as possible bedrock conductors. Such anomalies usually fall into the "S?" or "B?" classification.

A proper assessment of all bedrock anomalies in the survey area, including those that are weak or questionable, should be carried out. This should include a compilation of all available geophysical, geological and geochemical data.

Conductor 10080A-10090A

This apparently weak, thin conductor has no magnetic association. A moderately strong east/west trending VLF anomaly correlates with this conductor.

Conductor 10373A-10471xA

This conductor is likely due to a thin bedrock source. The conductor appears to be moderately strong and well defined from 10373A-10431A, but weakens or is masked by surficial material south of line 10431. A northeast dip can be inferred from the profiles for anomalies 10373A and 10381A. These anomalies have direct correlation with a broad, weak magnetic high. A strong VLF trend is coincident with this conductor, and extends southeast to include 10570xA.

Conductor 10570xA

This is possibly a weak, thin, bedrock conductor. It occurs on strike with 10373A-10471xA, but the response here may be due in part to noise.

Conductor 11100xA-11130xA

This is possibly a weak, thin, bedrock conductor with no direct magnetic association. A VLF trend occurs coincident with its location.

Groups A and B

These zones of conductivity contain several weak anomalies which are possibly due to material associated with magnetite. VLF trends coincide with both zones.

# SECTION II: BACKGROUND INFORMATION

Section II provides background information on products which are available from your survey data. Those products not obtained as part of the survey contract may be generated later from raw data which is available on your archive digital tape.

## ELECTROMAGNETICS

DIGHEM electromagnetic responses fall into two general classes, discrete and broad. The discrete class consists of sharp, well-defined anomalies from discrete conductors such as sulfide lenses and steeply dipping sheets of graphite and sulfides. The broad class consists of wide anomalies from conductors having a large horizontal surface such as flatly dipping graphite or sulfide sheets, saline water-saturated sedimentary formations, conductive overburden and rock, and geothermal zones. A vertical conductive slab with a width of 200 m would straddle these two classes.

The vertical sheet (half plane) is the most common model used for the analysis of discrete conductors. All anomalies plotted on the electromagnetic map are analyzed according to this model. The following section entitled Discrete Conductor Analysis describes this model in detail, including the effect of using it on anomalies caused by broad conductors such as conductive overburden.

The conductive earth (half space) model is suitable for broad conductors. Resistivity contour maps result from the use of this model. A later section entitled Resistivity Mapping describes the method further, including the effect of using it on anomalies caused by discrete conductors such as sulfide bodies.

## Geometric interpretation

The geophysical interpreter attempts to determine the geometric shape and dip of the conductor. Figure II-1 shows typical DIGHEM anomaly shapes which are used to guide the geometric interpretation.

## Discrete conductor analysis

The EM anomalies appearing on the electromagnetic map are analyzed by computer to give the conductance (i.e., conductivity-thickness product) in mhos of a vertical sheet model. This is done regardless of the interpreted geometric shape of the conductor. This is not an unreasonable procedure, because the computed conductance increases as the

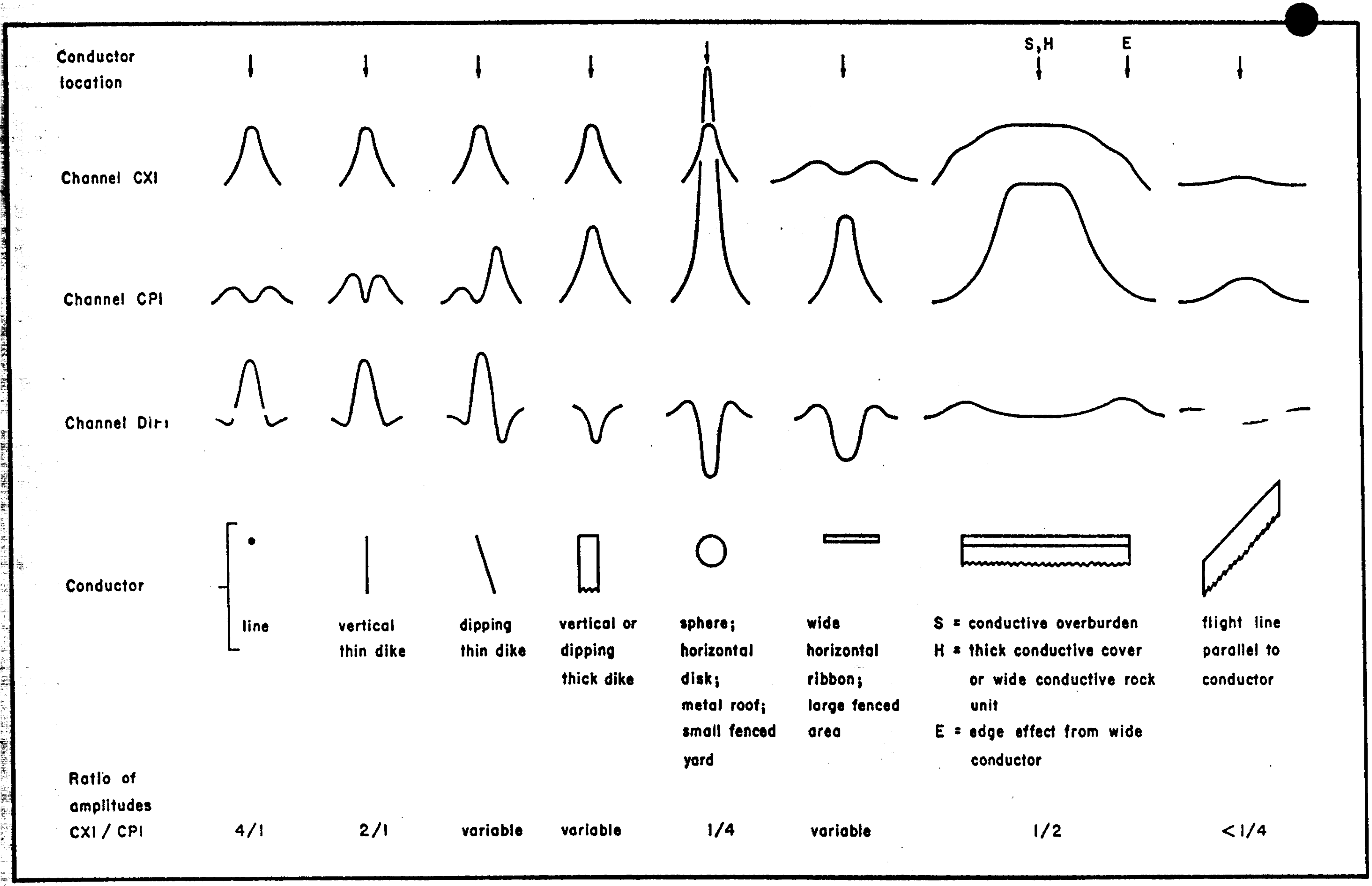


Fig. II-1 Typical DIGHEM anomaly shape

electrical quality of the conductor increases, regardless of its true shape. DIGHEM anomalies are divided into six grades of conductance, as shown in Table II-1. The conductance in mhos is the reciprocal of resistance in ohms.

Table II-1. EM Anomaly Grades

| Anomaly Grade | Mho Range |
|---|---|
| 6 | > 99 |
| 5 | 50 - 99 |
| 4 | 20 - 49 |
| 3 | 10 - 19 |
| 2 | 5 - 9 |
| 1 | < 5 |

The conductance value is a geological parameter because it is a characteristic of the conductor alone. It generally is independent of frequency, flying height or depth of burial, apart from the averaging over a greater portion of the conductor as height increases.[1] Small anomalies from deeply buried strong conductors are not confused with small anomalies from shallow weak conductors because the former will have larger conductance values.

Conductive overburden generally produces broad EM responses which may not be shown as anomalies on the EM maps. However, patchy conductive overburden in otherwise

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[1] This statement is an approximation. DIGHEM, with its short coil separation, tends to yield larger and more accurate conductance values than airborne systems having a larger coil separation.

resistive areas can yield discrete anomalies with a conductance grade (cf. Table II-1) of 1, or even of 2 for conducting clays which have resistivities as low as 50 ohm-m. In areas where ground resistivities can be below 10 ohm-m, anomalies caused by weathering variations and similar causes can have any conductance grade. The anomaly shapes from the multiple coils often allow such conductors to be recognized, and these are indicated by the letters S, H, G and sometimes E on the map (see EM legend).

For bedrock conductors, the higher anomaly grades indicate increasingly higher conductances. Examples: DIGHEM's New Insco copper discovery (Noranda, Canada) yielded a grade 4 anomaly, as did the neighbouring copper-zinc Magusi River ore body; Mattabi (copper-zinc, Sturgeon Lake, Canada) and Whistle (nickel, Sudbury, Canada) gave grade 5; and DIGHEM's Montcalm nickel-copper discovery (Timmins, Canada) yielded a grade 6 anomaly. Graphite and sulfides can span all grades but, in any particular survey area, field work may show that the different grades indicate different types of conductors.

Strong conductors (i.e., grades 5 and 6) are characteristic of massive sulfides or graphite. Moderate conductors (grades 3 and 4) typically reflect graphite or sulfides of a less massive character, while weak bedrock conductors (grades 1 and 2) can signify poorly connected graphite or heavily disseminated sulfides. Grade 1 conductors may not respond to ground EM equipment using frequencies less than 2000 Hz.

The presence of sphalerite or gangue can result in ore deposits having weak to moderate conductances. As an example, the three million ton lead-zinc deposit of Restigouche Mining Corporation near Bathurst, Canada, yielded a well defined grade 1 conductor. The 10 percent by volume of sphalerite occurs as a coating around the fine grained massive pyrite, thereby inhibiting electrical conduction.

Faults, fractures and shear zones may produce anomalies which typically have low conductances (e.g., grades 1 and 2). Conductive rock formations can yield anomalies of any conductance grade. The conductive materials in such rock formations can be salt water, weathered products such as clays, original depositional clays, and carbonaceous material.

On the electromagnetic map, a letter identifier and an interpretive symbol are plotted beside the EM grade symbol. The horizontal rows of dots, under the interpretive symbol, indicate the anomaly amplitude on the flight record. The vertical column of dots, under the anomaly letter, gives the estimated depth. In areas where anomalies are crowded, the letter identifiers, interpretive symbols and dots may be obliterated. The EM grade symbols, however, will always be discernible, and the obliterated information can be obtained from the anomaly listing appended to this report.

The purpose of indicating the anomaly amplitude by dots is to provide an estimate of the reliability of the conductance calculation. Thus, a conductance value obtained from a large ppm anomaly (3 or 4 dots) will tend to be accurate whereas one obtained from a small ppm anomaly (no dots) could be quite inaccurate. The absence of amplitude dots indicates that the anomaly from the coaxial coil-pair is 5 ppm or less on both the inphase and quadrature channels. Such small anomalies could reflect a weak conductor at the surface or a stronger conductor at depth. The conductance grade and depth estimate illustrates which of these possibilities fits the recorded data best.

Flight line deviations occasionally yield cases where two anomalies, having similar conductance values but dramatically different depth estimates, occur close together on the same conductor. Such examples illustrate the reliability of the conductance measurement while showing that the depth estimate can be unreliable. There are a number of factors which can produce an error in the depth estimate, including the averaging of topographic variations by the altimeter, overlying conductive overburden, and the location and attitude of the conductor relative to the flight line. Conductor location and attitude can provide an erroneous depth estimate because the stronger part of the conductor may be deeper or to one side of the flight line, or because it has a shallow dip. A heavy tree cover can also produce errors in depth estimates. This is because the depth estimate is computed as the distance of bird from conductor, minus the altimeter reading. The altimeter can lock onto the top of a dense forest canopy. This situation yields an erroneously large depth estimate but does not affect the conductance estimate.

Dip symbols are used to indicate the direction of dip of conductors. These symbols are used only when the anomaly shapes are unambiguous, which usually requires a fairly resistive environment.

A further interpretation is presented on the EM map by means of the line-to-line correlation of anomalies, which is based on a comparison of anomaly shapes on adjacent lines. This provides conductor axes which may define the geological structure over portions of the survey area. The absence of conductor axes in an area implies that anomalies could not be correlated from line to line with reasonable confidence.

DIGHEM electromagnetic maps are designed to provide a correct impression of conductor quality by means of the conductance grade symbols. The symbols can stand alone with geology when planning a follow-up program. The actual conductance values are printed in the attached anomaly list for those who wish quantitative data. The anomaly ppm and depth are indicated by inconspicuous dots which should not distract from the conductor patterns, while being helpful to those who wish this information. The map provides an interpretation of conductors in terms of length, strike and dip, geometric shape, conductance, depth, and thickness (see below). The accuracy is comparable to an interpretation from a high quality ground EM survey having the same line spacing.

The attached EM anomaly list provides a tabulation of anomalies in ppm, conductance, and depth for the vertical sheet model. The EM anomaly list also shows the conductance and depth for a thin horizontal sheet (whole plane) model, but only the vertical sheet parameters appear on the EM map. The horizontal sheet model is suitable for a flatly dipping thin bedrock conductor such as a sulfide sheet having a thickness less than 10 m. The list also shows the resistivity and depth for a conductive earth (half space) model, which is suitable for thicker slabs such as thick conductive overburden. In the EM anomaly list, a depth value of zero for the conductive earth model, in an area of thick cover, warns that the anomaly may be caused by conductive overburden.

Since discrete bodies normally are the targets of EM surveys, local base (or zero) levels are used to compute local anomaly amplitudes. This contrasts with the use of true zero levels which are used to compute true EM amplitudes. Local anomaly amplitudes are shown in the EM anomaly list and these are used to compute the vertical sheet parameters of conductance and depth. Not shown in the EM anomaly list are the true amplitudes which are used to compute the horizontal sheet and conductive earth parameters.

## X-type electromagnetic responses

DIGHEM maps contain x-type EM responses in addition to EM anomalies. An x-type response is below the noise threshold of 3 ppm, and reflects one of the following: a weak conductor near the surface, a strong conductor at depth (e.g., 100 to 120 m below surface) or to one side of the flight line, or aerodynamic noise. Those responses that have the appearance of valid bedrock anomalies on the flight profiles are indicated by appropriate interpretive symbols (see EM map legend). The others probably do not warrant further investigation unless their locations are of considerable geological interest.

## The thickness parameter

DIGHEM can provide an indication of the thickness of a steeply dipping conductor. The amplitude of the coplanar anomaly (e.g., CPI channel on the digital profile) increases relative to the coaxial anomaly (e.g., CXI) as the apparent thickness increases, i.e., the thickness in the horizontal plane. (The thickness is equal to the conductor width if the conductor dips at 90 degrees and strikes at right angles to the flight line.) This report refers to a conductor as thin when the thickness is likely to be less than 3 m, and thick when in excess of 10 m. Thick conductors are indicated on the EM map by crescents. For base metal exploration in steeply dipping geology, thick conductors can be high priority targets because many massive sulfide ore bodies are thick, whereas non-economic bedrock conductors are often thin. The system cannot sense the thickness when the strike of the conductor is subparallel to the flight line, when the conductor has a shallow dip, when the anomaly amplitudes are small, or when the resistivity of the environment is below 100 ohm-m.

## Resistivity mapping

Areas of widespread conductivity are commonly encountered during surveys. In such areas, anomalies can be generated by decreases of only 5 m in survey altitude as well as by increases in conductivity. The typical flight record in conductive areas is characterized by inphase and quadrature channels which are continuously active. Local EM peaks reflect either increases in conductivity of the earth or decreases in survey altitude. For such conductive areas, apparent resistivity profiles and contour maps are necessary for the correct interpretation of the airborne data. The advantage of the resistivity parameter is that anomalies caused by altitude changes are virtually eliminated, so the resistivity data reflect only those anomalies caused by conductivity changes. The resistivity analysis also helps the interpreter to differentiate between conductive trends in the bedrock and those patterns typical of conductive overburden. For example, discrete conductors will generally appear as narrow lows on the contour map and broad conductors (e.g., overburden) will appear as wide lows.

The resistivity profile (see table in Appendix A) and the resistivity contour map present the apparent resistivity using the so-called pseudo-layer (or buried) half space model defined by Fraser (1978)[2]. This model consists of a resistive layer overlying a conductive half space. The depth channel (see Appendix A) gives the apparent depth below surface of the conductive material. The apparent depth is simply the apparent thickness of the overlying resistive layer. The apparent depth (or thickness) parameter will be positive when the upper layer is more resistive than the underlying material, in which case the apparent depth may be quite close to the true depth.

The apparent depth will be negative when the upper layer is more conductive than the underlying material, and will be zero when a homogeneous half space exists. The apparent depth parameter must be interpreted cautiously because it will contain any errors which may exist in the measured altitude of the EM bird (e.g., as caused by a dense tree cover). The inputs to the resistivity algorithm are the inphase and quadrature components of the coplanar coil-pair. The outputs are the apparent resistivity of the

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[2] Resistivity mapping with an airborne multicoil electromagnetic system: Geophysics, v. 43, p. 144-172.

conductive half space (the source) and the sensor-source distance. The flying height is not an input variable, and the output resistivity and sensor-source distance are independent of the flying height. The apparent depth, discussed above, is simply the sensor-source distance minus the measured altitude or flying height. Consequently, errors in the measured altitude will affect the apparent depth parameter but not the apparent resistivity parameter.

The apparent depth parameter is a useful indicator of simple layering in areas lacking a heavy tree cover. The DIGHEM system has been flown for purposes of permafrost mapping, where positive apparent depths were used as a measure of permafrost thickness. However, little quantitative use has been made of negative apparent depths because the absolute value of the negative depth is not a measure of the thickness of the conductive upper layer and, therefore, is not meaningful physically. Qualitatively, a negative apparent depth estimate usually shows that the EM anomaly is caused by conductive overburden. Consequently, the apparent depth channel can be of significant help in distinguishing between overburden and bedrock conductors.

The resistivity map often yields more useful information on conductivity distributions than the EM map. In comparing the EM and resistivity maps, keep in mind the following:

(a) The resistivity map portrays the absolute value of the earth's resistivity.
(Resistivity = 1/conductivity.)

(b) The EM map portrays anomalies in the earth's resistivity. An anomaly by definition is a change from the norm and so the EM map displays anomalies, (i) over narrow, conductive bodies and (ii) over the boundary zone between two wide formations of differing conductivity.

The resistivity map might be likened to a total field map and the EM map to a horizontal gradient in the direction of flight[3]. Because gradient maps are usually more sensitive than total field maps, the EM map therefore is to be preferred in resistive areas. However, in conductive areas, the absolute character of the resistivity map usually causes it to be more useful than the EM map.

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[3] The gradient analogy is only valid with regard to the identification of anomalous locations.

## Interpretation in conductive environments

Environments having background resistivities below 30 ohm-m cause all airborne EM systems to yield very large responses from the conductive ground. This usually prohibits the recognition of discrete bedrock conductors. The processing of DIGHEM data, however, produces six channels which contribute significantly to the recognition of bedrock conductors. These are the inphase and quadrature difference channels (DIFI and DIFQ), and the resistivity and depth channels (RES and DP) for each coplanar frequency; see table in Appendix A.

The EM difference channels (DIFI and DIFQ) eliminate up to 99% of the response of conductive ground, leaving responses from bedrock conductors, cultural features (e.g., telephone lines, fences, etc.) and edge effects. An edge effect arises when the conductivity of the ground suddenly changes, and this is a source of geologic noise. While edge effects yield anomalies on the EM difference channels, they do not produce resistivity anomalies. Consequently, the resistivity channel aids in eliminating anomalies due to edge effects. On the other hand, resistivity anomalies will coincide with the most highly conductive sections of conductive ground, and this is another source of geologic noise. The recognition of a bedrock conductor in a conductive environment therefore is based on the anomalous responses of the two difference channels (DIFI and DIFQ) and the two resistivity channels (RES). The most favourable situation is where anomalies coincide on all four channels.

The DP channels, which give the apparent depth to the conductive material, also help to determine whether a conductive response arises from surficial material or from a conductive zone in the bedrock. When these channels ride above the zero level on the digital profiles (i.e., depth is negative), it implies that the EM and resistivity profiles are responding primarily to a conductive upper layer, i.e., conductive overburden. If both DP channels are below the zero level, it indicates that a resistive upper layer exists, and this usually implies the existence of a bedrock conductor. If the low frequency DP channel is below the zero level and the high frequency DP is above, this suggests that a bedrock conductor occurs beneath conductive cover.

The conductance channel CDT identifies discrete conductors which have been selected by computer for appraisal by the geophysicist. Some of these automatically selected anomalies on channel CDT are discarded by the geophysicist. The automatic selection algorithm is intentionally oversensitive to assure that no meaningful responses are missed. The interpreter then classifies the anomalies according to their source and eliminates those that are not substantiated by the data, such as those arising from geologic or aerodynamic noise.

## Reduction of geologic noise

Geologic noise refers to unwanted geophysical responses. For purposes of airborne EM surveying, geologic noise refers to EM responses caused by conductive overburden and magnetic permeability. It was mentioned above that the EM difference channels (i.e., channel DIFI for inphase and DIFQ for quadrature) tend to eliminate the response of conductive overburden. This marked a unique development in airborne EM technology, as DIGHEM is the only EM system which yields channels having an exceptionally high degree of immunity to conductive overburden.

Magnetite produces a form of geological noise on the inphase channels of all EM systems. Rocks containing less than 1% magnetite can yield negative inphase anomalies caused by magnetic permeability. When magnetite is widely distributed throughout a survey area, the inphase EM channels may continuously rise and fall reflecting variations in the magnetite percentage, flying height, and overburden thickness. This can lead to difficulties in recognizing deeply buried bedrock conductors, particularly if conductive overburden also exists. However, the response of broadly distributed magnetite generally vanishes on the inphase difference channel DIFI. This feature can be a significant aid in the recognition of conductors which occur in rocks containing accessory magnetite.

## EM magnetite mapping

The information content of DIGHEM data consists of a combination of conductive eddy current response and magnetic permeability response. The secondary field resulting from conductive eddy current flow is frequency-dependent and consists of both inphase and quadrature components, which are positive in sign. On the other hand, the secondary field resulting from magnetic permeability is independent of frequency and consists of only an inphase component which is negative in sign. When magnetic permeability manifests itself by decreasing the measured amount of positive inphase, its presence may be difficult to recognize. However, when it manifests itself by yielding a negative inphase anomaly (e.g., in the absence of eddy current flow), its presence is assured. In this latter case, the negative component can be used to estimate the percent magnetite content.

A magnetite mapping technique was developed for the coplanar coil-pair of DIGHEM. The technique yields channel FEO (see Appendix A) which displays apparent weight percent magnetite according to a homogeneous half space model.[4] The method can be complementary to magnetometer mapping in certain cases. Compared to magnetometry, it is far less sensitive but is more able to resolve closely spaced magnetite zones, as well as providing an estimate of the amount of magnetite in the rock. The method is sensitive to 1/4% magnetite by weight when the EM sensor is at a height of 30 m above a magnetitic half space. It can individually resolve steeply dipping narrow magnetite-rich bands which are separated by 60 m. Unlike magnetometry, the EM magnetite method is unaffected by remanent magnetism or magnetic latitude.

The EM magnetite mapping technique provides estimates of magnetite content which are usually correct within a

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[4] Refer to Fraser, 1981, Magnetite mapping with a multi-coil airborne electromagnetic system: Geophysics, v. 46, p. 1579-1594.

factor of 2 when the magnetite is fairly uniformly distributed. EM magnetite maps can be generated when magnetic permeability is evident as indicated by anomalies in the magnetite channel FEO.

Like magnetometry, the EM magnetite method maps only bedrock features, provided that the overburden is characterized by a general lack of magnetite. This contrasts with resistivity mapping which portrays the combined effect of bedrock and overburden.

## Recognition of culture

Cultural responses include all EM anomalies caused by man-made metallic objects. Such anomalies may be caused by inductive coupling or current gathering. The concern of the interpreter is to recognize when an EM response is due to culture. Points of consideration used by the interpreter, when coaxial and coplanar coil-pairs are operated at a common frequency, are as follows:

1. Channels CXS and CPS (see Appendix A) measure 50 and 60 Hz radiation. An anomaly on these channels shows that the conductor is radiating cultural power. Such an indication is normally a guarantee that the conduc-

tor is cultural. However, care must be taken to ensure that the conductor is not a geologic body which strikes across a power line, carrying leakage currents.

2. A flight which crosses a "line" (e.g., fence, telephone line, etc.) yields a center-peaked coaxial anomaly and an m-shaped coplanar anomaly.[5] When the flight crosses the cultural line at a high angle of intersection, the amplitude ratio of coaxial/coplanar (e.g., CXI/CPI) is 4. Such an EM anomaly can only be caused by a line. The geologic body which yields anomalies most closely resembling a line is the vertically dipping thin dike. Such a body, however, yields an amplitude ratio of 2 rather than 4. Consequently, an m-shaped coplanar anomaly with a CXI/CPI amplitude ratio of 4 is virtually a guarantee that the source is a cultural line.

3. A flight which crosses a sphere or horizontal disk yields center-peaked coaxial and coplanar anomalies with a CXI/CPI amplitude ratio (i.e., coaxial/coplanar) of 1/4. In the absence of geologic bodies of this geometry, the most likely conductor is a metal roof or

---

[5] See Figure II-1 presented earlier.

small fenced yard.[6] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

4. A flight which crosses a horizontal rectangular body or wide ribbon yields an m-shaped coaxial anomaly and a center-peaked coplanar anomaly. In the absence of geologic bodies of this geometry, the most likely conductor is a large fenced area.[6] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

5. EM anomalies which coincide with culture, as seen on the camera film, are usually caused by culture. However, care is taken with such coincidences because a geologic conductor could occur beneath a fence, for example. In this example, the fence would be expected to yield an m-shaped coplanar anomaly as in case #2 above. If, instead, a center-peaked coplanar anomaly occurred, there would be concern that a thick geologic conductor coincided with the cultural line.

---

[6] It is a characteristic of EM that geometrically identical anomalies are obtained from: (1) a planar conductor, and (2) a wire which forms a loop having dimensions identical to the perimeter of the equivalent planar conductor.

6. The above description of anomaly shapes is valid when the culture is not conductively coupled to the environment. In this case, the anomalies arise from inductive coupling to the EM transmitter. However, when the environment is quite conductive (e.g., less than 100 ohm-m at 900 Hz), the cultural conductor may be conductively coupled to the environment. In this latter case, the anomaly shapes tend to be governed by current gathering. Current gathering can completely distort the anomaly shapes, thereby complicating the identification of cultural anomalies. In such circumstances, the interpreter can only rely on the radiation channels CXS and CPS, and on the camera film.

## TOTAL FIELD MAGNETICS

The existence of a magnetic correlation with an EM anomaly is indicated directly on the EM map. An EM anomaly with magnetic correlation has a greater likelihood of being produced by sulfides than one that is non-magnetic. However, sulfide ore bodies may be non-magnetic (e.g., the Kidd Creek deposit near Timmins, Canada) as well as magnetic (e.g., the Mattabi deposit near Sturgeon Lake, Canada).

The magnetometer data are digitally recorded in the aircraft to an accuracy of one nT (i.e., one gamma). The digital tape is processed by computer to yield a total field magnetic contour map. When warranted, the magnetic data also may be treated mathematically to enhance the magnetic response of the near-surface geology, and an enhanced magnetic contour map is then produced. The response of the enhancement operator in the frequency domain is illustrated in Figure II-2. This figure shows that the passband components of the airborne data are amplified 20 times by the enhancement operator. This means, for example, that a 100 nT anomaly on the enhanced map reflects a 5 nT anomaly for the passband components of the airborne data.

The enhanced map, which bears a resemblance to a downward continuation map, is produced by the digital bandpass filtering of the total field data. The enhancement is equivalent to continuing the field downward to a level (above the source) which is 1/20th of the actual sensor-source distance.

Because the enhanced magnetic map bears a resemblance to a ground magnetic map, it simplifies the recognition of trends in the rock strata and the interpretation of

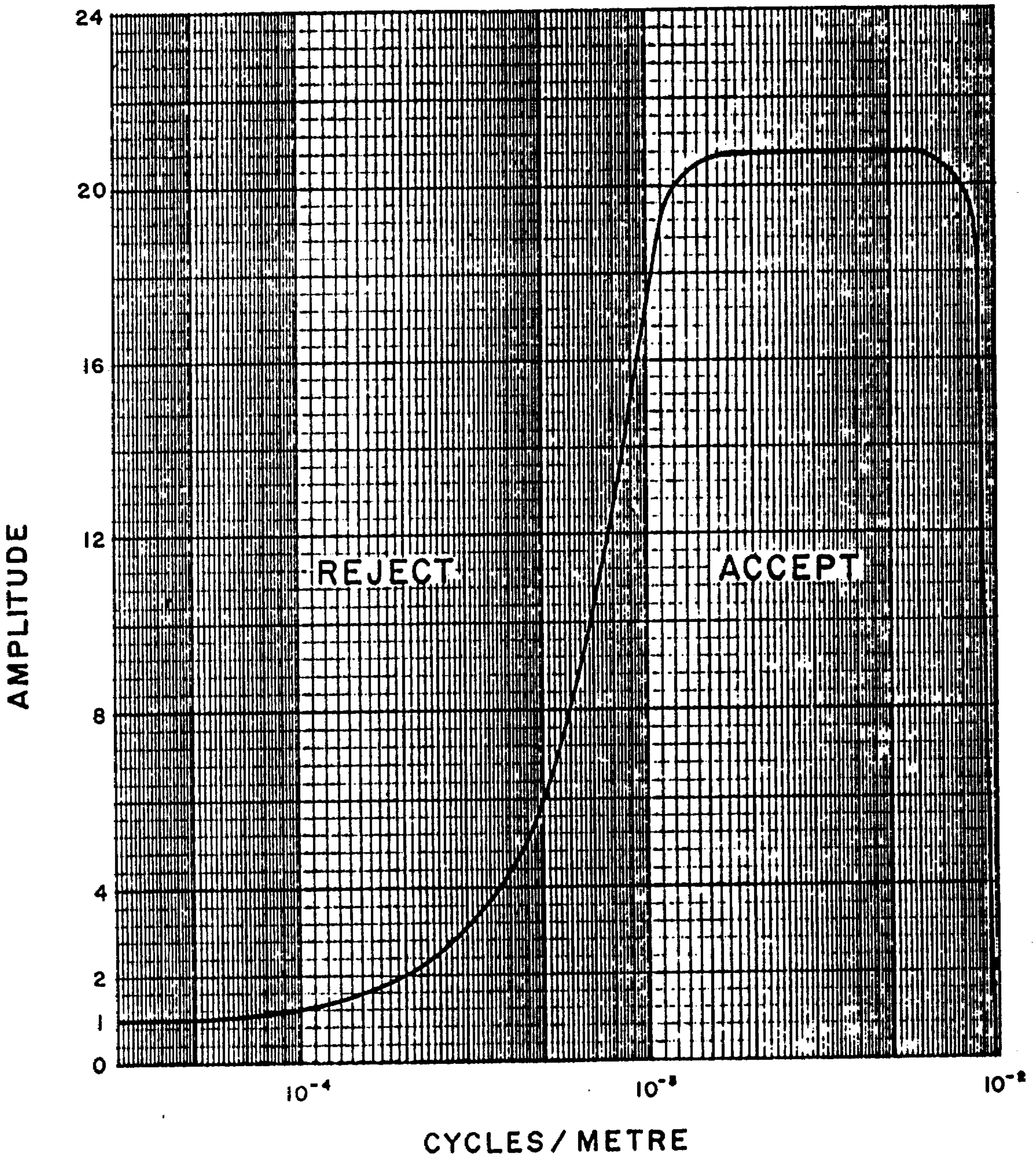

Figure 2 Frequency response of magnetic operator.

geological structure. It defines the near-surface local geology while de-emphasizing deep-seated regional features. It primarily has application when the magnetic rock units are steeply dipping and the earth's field dips in excess of 60 degrees.

## VLF

VLF anomalies are not EM anomalies in the conventional sense. EM anomalies primarily reflect eddy currents flowing in conductors which have been energized inductively by the primary field. In contrast, VLF anomalies primarily reflect current gathering, which is a non-inductive phenomenon. The primary field sets up currents which flow weakly in rock and overburden, and these tend to collect in low resistivity zones. Such zones may be due to massive sulfides, shears, river valleys and even unconformities.

The Herz Industries Ltd Totem VLF measures the total field and vertical quadrature components. Both these components are digitally recorded in the aircraft with a sensitivity of 0.1 percent. The total field yields peaks over VLF current concentrations whereas the quadrature component tends to yield crossovers. Both appear as traces

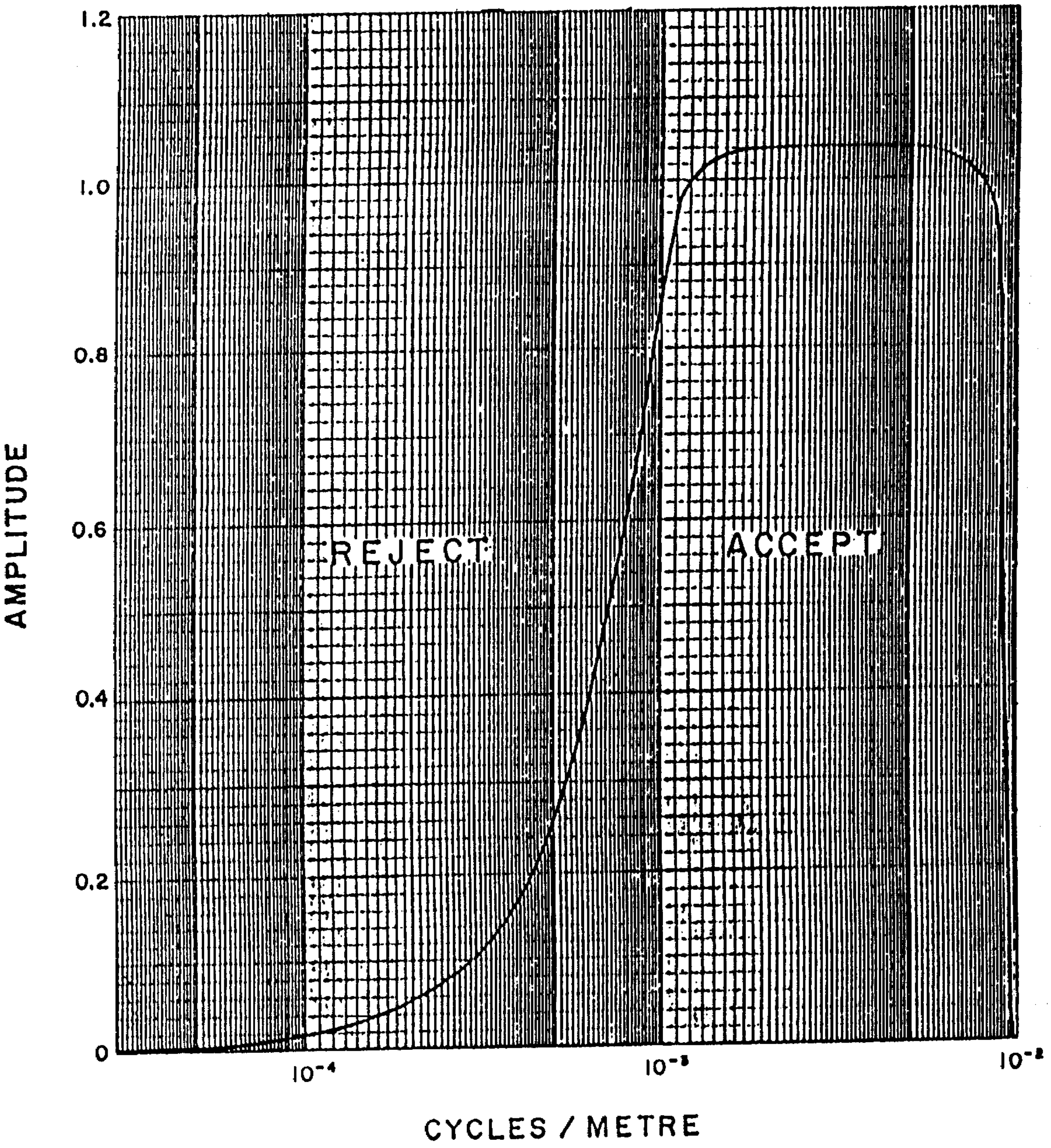

Figure 3 Frequency response of VLF operator.

on the profile records. The total field data also are filtered digitally and displayed on a contour map, to facilitate the recognition of trends in the rock strata and the interpretation of geologic structure.

The response of the VLF total field filter operator in the frequency domain (Figure II-3) is basically similar to that used to produce the enhanced magnetic map (Figure II-2). The two filters are identical along the abscissa but different along the ordinant. The VLF filter removes long wavelengths such as those which reflect regional and wave transmission variations. The filter sharpens short wavelength responses such as those which reflect local geological variations. The filtered total field VLF contour map is produced with a contour interval of one percent.

## MAPS ACCOMPANYING THIS REPORT

4 map sheets at a scale of 1:10,000 accompany this report.

| | |
|---|---|
| ELECTROMAGNETIC ANOMALIES | 2 map sheets |
| TOTAL FIELD MAGNETICS | 2 map sheets |

Respectfully submitted,
DIGHEM SURVEYS & PROCESSING INC.

Douglas McConnell
D.L. McConnell
Geophysicist

A-DLM-4

# APPENDIX A

## THE FLIGHT RECORDS

Both analog and digital flight records were produced. The analog profiles were recorded on chart paper in the aircraft during the survey. The digital profiles were generated later by computer and plotted on electrostatic chart paper at a scale of 1:10,000. The analog and digital profiles are listed in Tables A-1 and A-2 respectively.

In Table A-2, the log resistivity scale of 0.06 decade/mm means that the resistivity changes by an order of magnitude in 16.5 mm. The resistivities at 0, 33 and 67 mm up from the bottom of the digital flight record are respectively 1, 100 and 10,000 ohm-m.

## FLIGHT PATH RECOVERY

Aircraft positioning and post-survey recovery of aircraft position was accomplished through the use of a Del Norte positioning system. This electronic navigation system operates in the UHF band and is therefore range limited by hills and by the curvature of the earth.

## Table A-1. The Analog Profiles

| Channel Number | Parameter | Sensitivity per mm | Designation on digital profile |
|---|---|---|---|
| CXI | coaxial inphase ( 900 Hz) | 2.5 ppm | CXI ( 900 Hz) |
| CXQ | coaxial quad ( 900 Hz) | 2.5 ppm | CXQ ( 900 Hz) |
| CP1I | coplanar inphase ( 900 Hz) | 2.5 ppm | CPI ( 900 Hz) |
| CP1Q | coplanar quad ( 900 Hz) | 2.5 ppm | CPQ ( 900 Hz) |
| CP2I | coplanar inphase (7200 Hz) | 5.0 ppm | CPI (7200 Hz) |
| CP2Q | coplanar quad (7200 Hz) | 5.0 ppm | CPQ (7200 Hz) |
| ALT | altimeter | 3 m | ALT |
| VL1T | VLF-total: Cutler | 2% | |
| VL1Q | VLF-quad: Cutler | 2% | |
| VL2T | VLF-total: Seattle | 2% | |
| VL2Q | VLF-quad: Seattle | 2% | |
| CMGC | Mag (coarse) | 10 nT | MAG |
| CMGF | Mag (fine) | 2 nT | |

## Table A-2. The Digital Profiles

| Channel Name (Freq) | Observed parameters | Scale units/mm |
|---|---|---|
| MAG | magnetics | 10 nT |
| ALT | bird height | 6 m |
| CXI ( 900 Hz) | horizontal coaxial coil-pair inphase | 2 ppm |
| CXQ ( 900 Hz) | horizontal coaxial coil-pair quadrature | 2 ppm |
| CPI ( 900 Hz) | horizontal coplanar coil-pair inphase | 2 ppm |
| CPQ ( 900 Hz) | horizontal coplanar coil-pair quadrature | 2 ppm |
| CPI (7200 Hz) | horizontal coplanar coil-pair inphase | 4 ppm |
| CPQ (7200 Hz) | horizontal coplanar coil-pair quadrature | 4 ppm |
| | Computed Parameters | |
| DIFI ( 900 Hz) | difference function inphase from CXI and CPI | 2 ppm |
| DIFQ ( 900 Hz) | difference function quadrature from CXQ and CPQ | 2 ppm |
| CDT | conductance | 1 grade |
| RES ( 900 Hz) | log resistivity | .06 decade |
| RES (7200 Hz) | log resistivity | .06 decade |
| DP ( 900 Hz) | apparent depth | 6 m |
| DP (7200kHz) | apparent depth | 6 m |

The Del Norte system uses two ground based transponder stations which transmit distance information back to the helicopter. The onboard Central Processing Unit then takes the two distances and determines the helicopter position relative to the two ground stations. This is accomplished once every second. The ground stations are set up well away from the survey area and are positioned such that the signals cross the survey blocks at an angle between 30° and 150°. After site selection, a baseline is flown at right angles to a line drawn through the transmitter sites to establish an arbitrary coordinate system for the survey area. The distance from each ground transmitter site (range-range) is continuously recorded digitally.

The range-range data is transposed during data processing into an arbitrary x-y coordinate system based on the location of the two transmitter sites. The x-y grid is transferred to the base map by correlating a number of prominent topographical features to the navigational data points. The use of numerous visual tie-in points serves two purposes: to correct for distortions in the photomosaic (if any) and to accurately relate the navigation data to the map sheet.

# APPENDIX B

## LIST OF PERSONNEL

The following personnel were involved in the acquisition, processing, interpretation and presentation of data, relating to a DIGHEM$^{III}$ airborne geophysical survey carried out for Wilzel Resources Ltd., over a property in the Matachewan area, Ontario.

| | |
|---|---|
| Bill Cooke | Survey Operations Supervisor |
| Syed Shah | Senior Geophysical Operator |
| C. Pharand | Pilot (Frontier Helicopters Ltd.) |
| Gord Smith | Computer Processor |
| Paul A. Smith | Interpretation Supervisor |
| D.L. McConnell | Geophysicist |
| Gary Hohs | Draftsman |
| Angela Secker | Word Processing Operator |

The survey consisted of 534 km of coverage, flown from September 8 to September 13, 1987. Geophysical data were compiled utilizing a VAX 11-780 computer.

All personnel are employees of Dighem Surveys & Processing Inc., except for the pilot who is an employee of Frontier Helicopters Ltd.

DIGHEM SURVEYS & PROCESSING INC.

Douglas McConnell

D.L. McConnell
Geophysicist

Ref: Report #1008

B-DLM-4/as

# APPENDIX C

## STATEMENT OF QUALIFICATIONS

I, Douglas L. McConnell of the City of Etobicoke, Province of Ontario, do hereby certify that:

1. I am a geophysicist, residing at 124 Stapleton Dr., Etobicoke, Ontario M9R 3A8.
2. I have graduated from Queens Univeristy, Kingston, Ontario.
3. I have been actively engaged in geophysical exploration since 1986.
4. I am presently employed by Dighem Surveys & Processing Inc.
5. I was personally responsible for the interpretation of the geophysical data described in this report.
6. The statements made in this report represent my best opinion and judgment.

Dated at Toronto this 30th day of October, 1987.

Douglas McConnell
D.L. McConnell
Geophysicist

B-DLM-4/as

Land Management

Ministry of Northern Development and Mines
Ontario

# Report of Work

(Geophysical, Geological, Geochemical and Expenditures)

40, 2.1

W8708.00407

Mining Act

42A02SW0119 2.10593 ARGYLE

900

– Do not use shaded areas below.

| | |
|---|---|
| **Type of Survey(s)** Airborne Magnetics & EM | **Township or Area** ARGYLE TOWNSHIP |
| **Claim Holder(s)** WILZEL RESOURCES LIMITED | **Prospector's Licence No.** T4699 |

**Address** 300 ELM ST. WEST, SUDBURY, ONTARIO, P3C1V4

| **Survey Company** | **Date of Survey (from & to)** | **Total Miles of line Cut** |
|---|---|---|
| DIGHEM | 08 Day, 09 Mo., 87 Yr. – 19 Day, 10 Mo., 87 Yr. | — |

**Name and Address of Author (of Geo-Technical report)** Doug McConnell, Dighem Surveys, 228 Matheson Blvd E, Mississauga, Ont L4Z1X1

## Credits Requested per Each Claim in Columns at right

| **Special Provisions** | **Geophysical** | **Days per Claim** |
|---|---|---|
| For first survey: Enter 40 days. (This includes line cutting) | - Electromagnetic | |
| | - Magnetometer | |
| For each additional survey: using the same grid: Enter 20 days (for each) | - Radiometric | |
| | - Other | |
| | Geological | |
| | Geochemical | |

| **Man Days** | **Geophysical** | **Days per Claim** |
|---|---|---|
| Complete reverse side and enter total(s) here | - Electromagnetic | |
| | - Magnetometer | |
| | - Radiometric | |
| | - Other | |
| | Geological | |
| | Geochemical | |

LARDER LAKE MINING DIVISION
RECEIVED
OCT 10 1987

| **Airborne Credits** | | **Days per Claim** |
|---|---|---|
| Note: Special provisions credits do not apply to Airborne Surveys. | Electromagnetic | 40 |
| | Magnetometer | 40 |
| | Radiometric | |

## Expenditures (excludes power stripping)

**Type of Work Performed**

**Performed on Claim(s)**

**Calculation of Expenditure Days Credits**

| **Total Expenditures** | | | | **Total Days Credits** |
|---|---|---|---|---|
| $ | ÷ | 15 | = | |

**Instructions**
Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

| **Date** | **Recorded Holder or Agent (Signature)** |
|---|---|
| OCT 19/87 | |

## Mining Claims Traversed (List in numerical sequence)

| Mining Claim Prefix | Mining Claim Number | Expend. Days Cr. | Mining Claim Prefix | Mining Claim Number | Expend. Days Cr. |
|---|---|---|---|---|---|
| L. | 953933 | | L. | 953959 | |
| | 953934 | | | 953960 | |
| | 953935 | | | 953961 | |
| | 953936 | | | 953974 | |
| | 953937 | | | 953975 | |
| | 953938 | | | 979490 | |
| | 953939 | | | 979491 | |
| | 953940 | | | 953949 | |
| | 953941 | | | | |
| | 953942 | | | | |
| | 953943 | | | | |
| | 953944 | | | | |
| | 953945 | | | | |
| | 953948 | | | | |
| | 953950 | | | | |
| | 953951 | | | | |
| | 953952 | | | | |
| | 953953 | | | | |
| | 953954 | | | | |
| | 953955 | | | | |
| | 953956 | | | | |
| | 953957 | | | | |
| | 953958 | | | | |

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[illegible] 1987
MININ[illegible]DS SECTION

Total number of mining claims covered by this report of work. 31

**For Office Use Only**

| **Total Days Cr. Recorded** | **Date Recorded** | **Mining Recorder** |
|---|---|---|
| 2480 | Oct. 19/87 | |
| | **Date Approved as Recorded** | **Branch Director** |
| | 27 Jan 88 | |

## Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

**Name and Postal Address of Person Certifying**
R.A. Bennett RR4, SITE37, BOX1 SUDBURY ONTARIO P3E4M9

| **Date Certified** | **Certified by (Signature)** |
|---|---|
| OCT 19/87 | |

Northern Development and Mines
Ontario

Land Management

408/87

(Geophysical, Geological, Geochemical and Expenditures) 210593

Mining Act

Note:
- If number of mining claims traversed exceeds space on this form, attach a list.
- Only days credits calculated in the "Expenditures" section may be entered in the "Expend. Days Cr." columns.
- Do not use shaded areas below.

Dec 8

| | |
|---|---|
| Type of Survey: Airborne Magnetics & EM | Township or Area: Bannockburn Township |
| Claim Holder(s): WILZEL RESOURCES LIMITED | Prospector's Licence No.: T4699 |
| Address: 300 ELM ST. WEST, SUDBURY, ONTARIO, P3C1U4 | |
| Survey Company: ~~DIGH~~ DIGHEM | Date of Survey (from & to): 08 Day 09 Mo. 87 Yr. / 19 Day 10 Mo. 87 Yr. |
| | Total Miles of line Cut: — |

Name and Address of Author (of Geo-Technical report): Doug McConnell, Dighem Surveys, 228 Matheson Blvd E, Mississauga, Ont. L4Z 1X1

**Credits Requested per Each Claim in Columns at right**

| Special Provisions | Geophysical | Days per Claim |
|---|---|---|
| For first survey: Enter 40 days. (This includes line cutting) | - Electromagnetic | |
| | - Magnetometer | |
| For each additional survey: using the same grid: Enter 20 days (for each) | - Radiometric | |
| | - Other | |
| | Geological | |
| | Geochemical | |

| Man Days | Geophysical | Days per Claim |
|---|---|---|
| Complete reverse side and enter total(s) here | - Electromagnetic | |
| | - Magnetometer | |
| | - Radiometric | |
| | - Other | |
| | Geological | |
| | Geochemical | |

| Airborne Credits | | Days per Claim |
|---|---|---|
| Note: Special provisions credits do not apply to Airborne Surveys. | Electromagnetic | 40 |
| | Magnetometer | 40 |
| | Radiometric | |

LARDER LAKE MINING DIV.
RECEIVED
OCT 19 1987
7,8,9,10,11,12,1,2,3,4,5,6

**Expenditures (excludes power stripping)**

Type of Work Performed:

Performed on Claim(s):

RECEIVED
OCT 20 1987
MINING LANDS SECTION

Calculation of Expenditure Days Credits

Total Expenditures $ ÷ 15 = Total Days Credits

Instructions
Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

| Date | Recorded Holder or Agent (Signature) |
|---|---|
| Oct 19/87 | |

**Mining Claims Traversed (List in numerical sequence)**

| Prefix | Number | Expend. Days Cr. | Prefix | Number | Expend. Days Cr. |
|---|---|---|---|---|---|
| L. | 953836 | | L | 953859 | |
| | 953837 | | | 953917 | |
| | 953838 | | | 953918 | |
| | 953839 | | | 953919 | |
| | 953840 | | | 953920 | |
| | 953841 | | | 953921 | |
| | 953842 | | | 953922 | |
| | 953843 | | | 953923 | |
| | 953844 | | | 953924 | |
| | 953845 | | | 953925 | |
| | 953846 | | | 953926 | |
| | 953847 | | | 953927 | |
| | 953848 | | | 953928 | |
| | 953849 | | | 953976 | |
| | 953850 | | | 953977 | |
| | 953851 | | | 953978 | |
| | 953852 | | | 953979 | |
| | 953853 | | | 953980 | |
| | 953854 | | | 953981 | |
| | 953855 | | | 953982 | |
| | 953856 | | | 953983 | |
| | 953857 | | | 953984 | |
| | 953858 | | | 953985 | |

CONTINUED →

Total number of mining claims covered by this report of work: 67

**For Office Use Only**

| Total Days Cr. Recorded | Date Recorded | Mining Recorder |
|---|---|---|
| 5360 | Oct. 19/87 | for J. Bettin |
| | Date Approved as Recorded: 21 Jan 88 | Branch Director |

**Certification Verifying Report of Work**

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying:
ROBERT A. BENNETT RR4, SITE 37, BOX 1
SUDBURY, ONT P3E 4M9

Date Certified: Oct 19/87

Certified by (Signature):

1362 (85/12)

# BANNOCKBURN TOWNSHIP - WILZEL RESOURCES LTD

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L. 979492
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979494

Total =
67 claims

LARDER LAKE
MINING DIV.
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Land Management

Ontario

Ministry of Northern Development and Mines

# Report of Work

(Geophysical, Geological, Geochemical and Expenditures)

409/87
2.10593

Mining Act

Instructions: – Please type or print.
– If number of mining claims traver... exceeds space on this form, attach a li...
Note: – Only days credits calculated in the "Expenditures" section may be entered in the "Expend. Days Cr." columns.
– Do not use shaded areas below.

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|---|---|
| Type of Survey(s): Airborne Magnetics & EM | Township or Area: Hincks Township |
| Claim Holder(s): WILZEL RESOURCES ~~LTD~~ LIMITED | Prospector's Licence No.: T4699 |
| Address: 300 ELM ST. WEST, SUDBURY, ONTARIO P3C 1V4 | |
| Survey Company: DIGHEM | Date of Survey (from & to): 08 Day 09 Mo. 87 Yr. 19 Day 10 Mo. 87 Yr. — Total Miles of line Cut: — |

Name and Address of Author (of Geo-Technical report): Doug McConnell, Dighem Surveys, 228 Matheson Blvd E., Mississauga, ONT L4Z 1X1

Credits Requested per Each Claim in Columns at right

| Special Provisions | Geophysical | Days per Claim |
|---|---|---|
| For first survey: Enter 40 days. (This includes line cutting) | - Electromagnetic | |
| | - Magnetometer | |
| For each additional survey: using the same grid: Enter 20 days (for each) | - Radiometric | |
| | - Other | |
| | Geological | |
| | Geochemical | |

| Man Days | Geophysical | Days per Claim |
|---|---|---|
| Complete reverse side and enter total(s) here | - Electromagnetic | |
| | - Magnetometer | |
| | - Radiometric | |
| | - Other | |
| | Geological | |
| | Geochemical | |

| Airborne Credits | | Days per Claim |
|---|---|---|
| Note: Special provisions credits do not apply to Airborne Surveys. | Electromagnetic | 40 |
| | Magnetometer | 40 |
| | Radiometric | |

PAY 40 EM AIR.
20 MAG AIR
* MAXIMUM CREDIT OF 80 DAYS. NW
RECORDER & APPROVED.

ONTARIO GEOLOGICAL SURVEY
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MINING DIV.
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OCT 20 1987
MINING LANDS SECTION

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures $ ÷ 15 = Total Days Credits

Instructions
Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

Date: OCT 19/87. Recorded Holder or Agent (Signature): R. Wil...

Mining Claims Traversed (List in numerical sequence)

| Prefix | Number | Expend. Days Cr. |
|---|---|---|
| L. | *737294 | |
| | *737295 | |
| | *737296 | |
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| Prefix | Number | Expend. Days Cr. |
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| L. | 919370 | |
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| | 919392 | |
| | [redacted] RHB | |

CONTINUED...
Total number of mining claims covered by this report of work. 113

For Office Use Only

| Total Days Cr. Recorded | Date Recorded | Mining Recorder |
|---|---|---|
| 8920 | FR. October 19, 1987 | For |
| | Date Approved as Recorded: 21 Jan 88 | Branch Director |

## Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying
Robert A. Bennett RR4, SITE 37, BOX 1, SUDBURY, ONTARIO
P3E 4M7

Date Certified: Oct 19/87 Certified by (Signature): R. Wil...

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979472
979473
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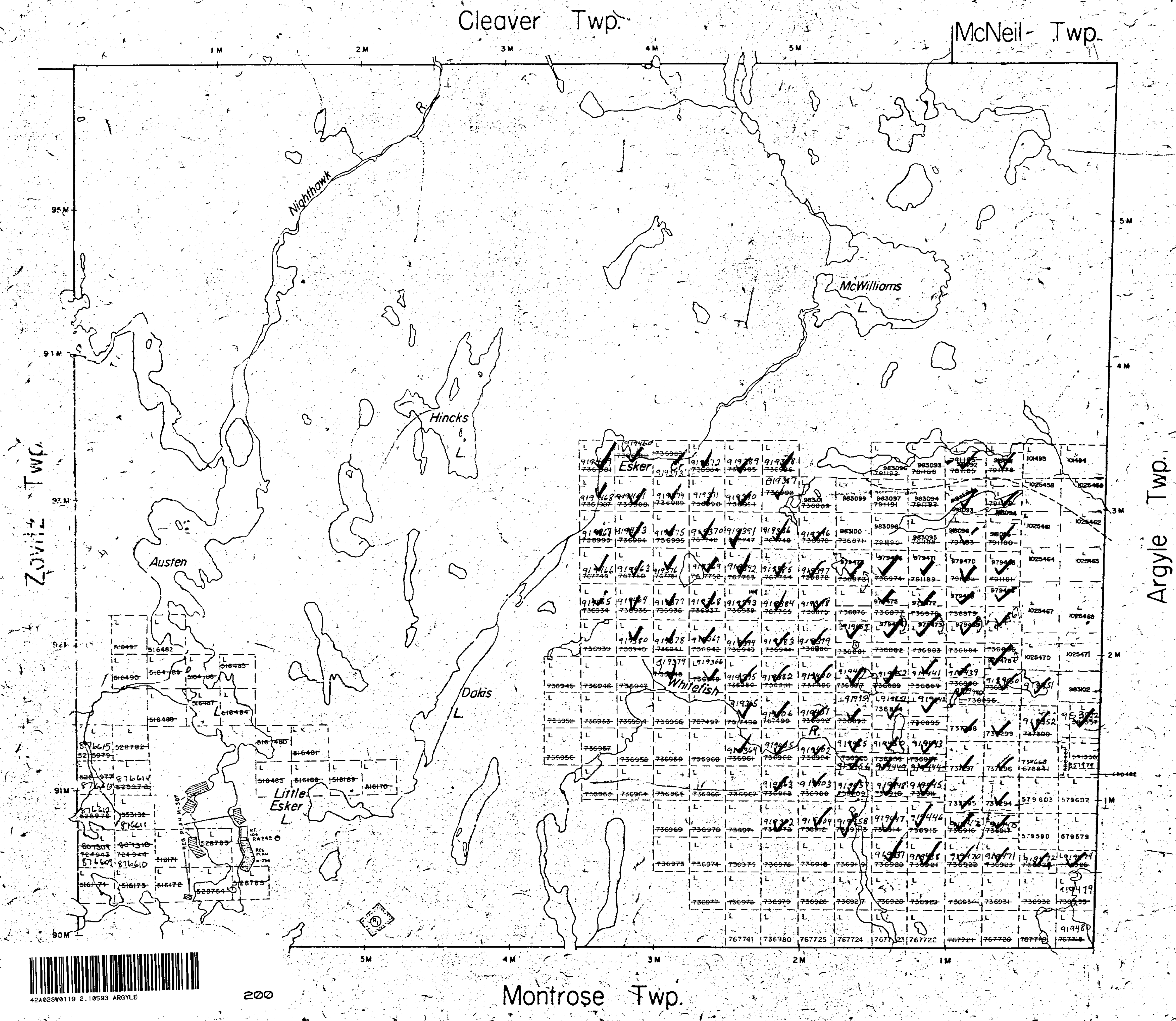
979476
979477
979478

LARDER LAKE
MINING DIV.
RECEIVED
OCT 19 1987
AM 1:35 PM
7 8 9 10 11 12 1 2 3 4 5 6

Total
113 clai

**Declared before me**
**at the** Town **of** Kirkland Lake.
**in the** District **of** Timiskaming



42A02SW0119 2.10593 ARGYLE

200

# THE TOWNSHIP
# OF
# HINCKS

DISTRICT OF
TIMISKAMING

LARDER LAKE
MINING DIVISION

SCALE: 1-INCH = 40 [illegible]S

## LEGEND

PATENTED LAND
CROWN LAND SALE
LEASES
LOCATED LAND
LICENSE OF OCCUPATION
MINING RIGHTS ONLY
SURFACE RIGHTS ONLY
ROADS
IMPROVED ROADS
KING'S HIGHWAYS
RAILWAYS
POWER LINES
MARSH OR MUSKEG
MINES

## NOTE

400' surface rights reservation along the shores of all lakes and rivers.

**Areas withdrawn from staking under Section 43 of the Mining Act (R.S.O. 1970).**

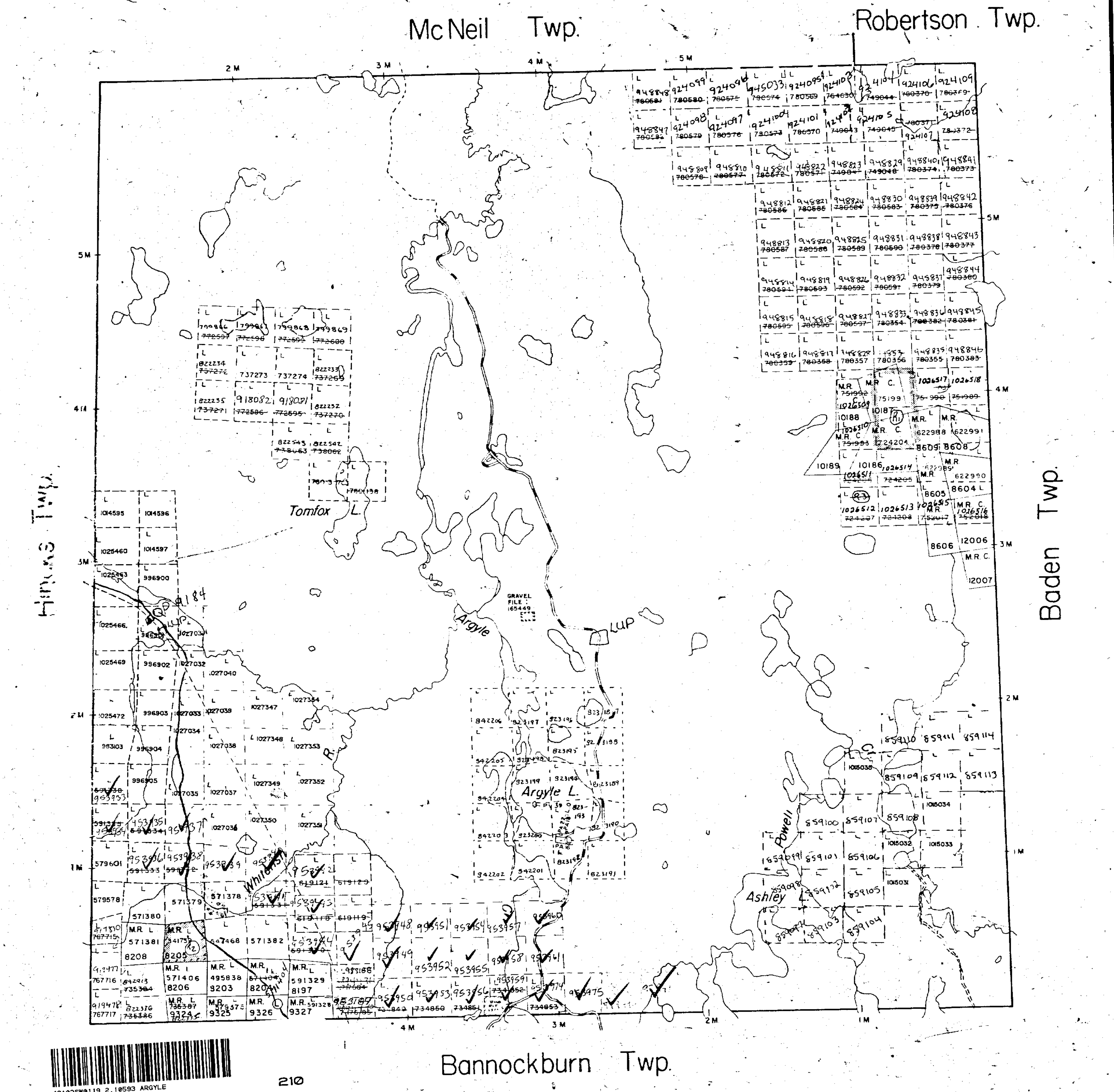
| Order № | File | Date | Disposition |
|---|---|---|---|
| Ⓡ1 W 27/76 | 188522 | May 31, 1978 | S.R.O. |

DATE OF ISSUE
OCT 23 1987
LARDER LAKE
MINING RECORDER'S OFFICE

PLAN NO - M.223

#11

ONTARIO
MINISTRY OF NATURAL RESOURCES
SURVEYS AND MAPPING BRANCH



THE TOWNSHIP
OF

# ARGYLE

DISTRICT OF
TIMISKAMING

LARDER LAKE
MINING DIVISION

SCALE: 1-INCH=40 CHAINS

## LEGEND

- PATENTED LAND
- CROWN LAND SALE
- LEASES
- LOCATED LAND
- LICENSE OF OCCUPATION
- MINING RIGHTS ONLY
- SURFACE RIGHTS ONLY
- ROADS
- IMPROVED ROADS
- KING'S HIGHWAYS
- RAILWAYS
- POWER LINES
- MARSH OR MUSKEG
- MINES
- CANCELLED

## NOTES

400' Surface rights reservatio [illegible] rivers.

WITHDRAWALS AND REOPENINGS

Ⓡ1 Surface and Mining Rights Withdrawn from Staking, section 36/80 order No. W. 9/86

Ⓡ2 Surface and Mining Rights Withdrawn from Staking, section 36/80 order No. W. 18/86

Ⓡ3 Surface and Mining Rights Withdrawn from Staking, section 36/80 order No. W. 101/86

Ⓡ3 AND PART Ⓡ1 REOPENED FOR STAKING UNDER ORDER 0-90/87 NR

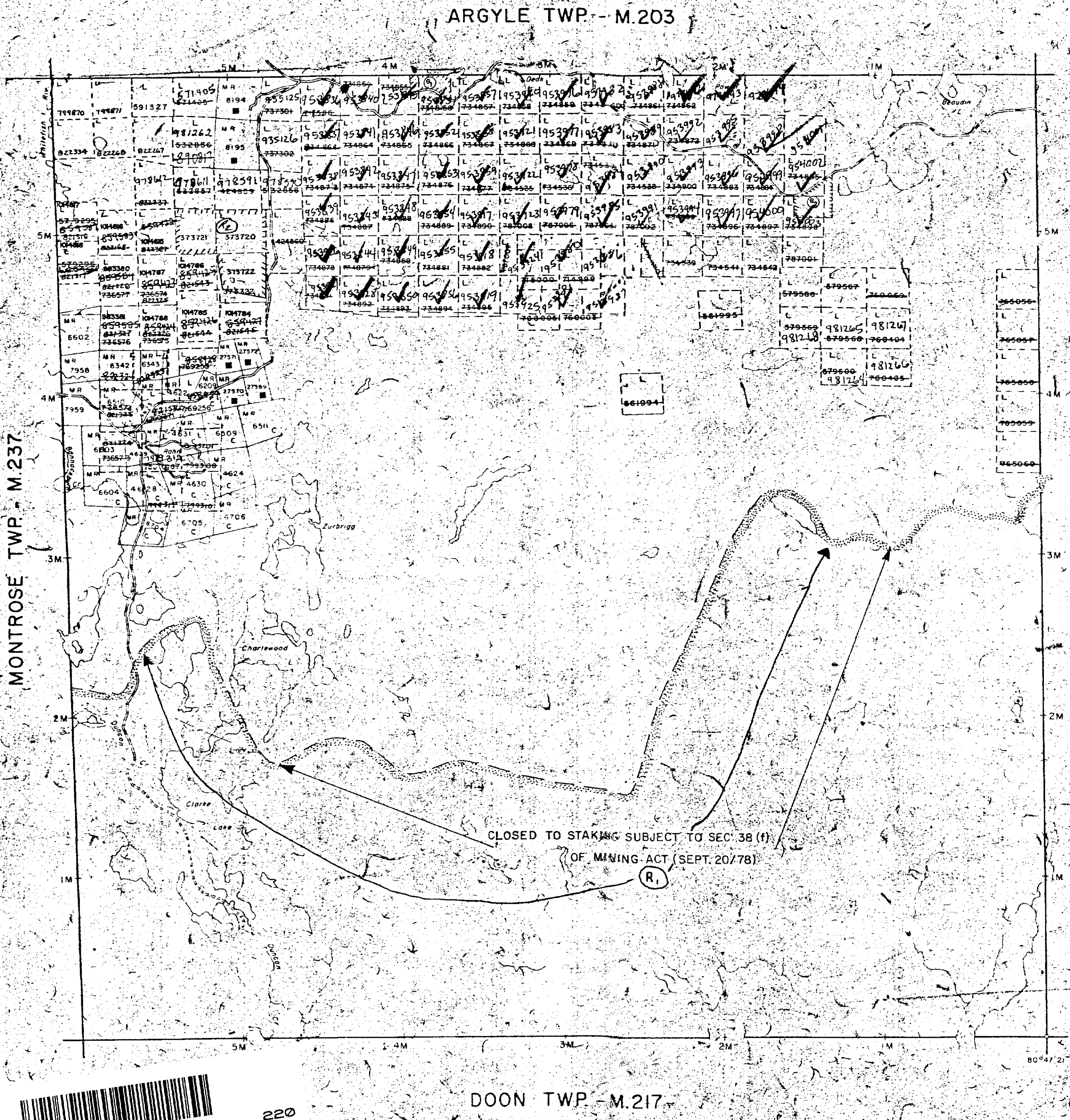
DATE OF ISSUE
NOV 20 1987
LARDER LAKE
MINING RECORDER'S OFFICE

PLAN NO.- M-203 #5

ONTARIO
MINISTRY OF NATURAL RESOURCES
SURVEYS AND MAPPING BRANCH

42A02SW0119 2.10593 ARGYLE

MZ



THE TOWNSHIP
OF

# BANNOCKBURN

DISTRICT OF
TIMISKAMING

LARDER LAKE
MINING DIVISION

SCALE: 1-INCH - 40 CHAINS

## DISPOSITION OF CROWN LANDS

| | |
|---|---|
| PATENT, SURFACE AND MINING RIGHTS | ● |
| " , SURFACE RIGHTS ONLY | ◓ |
| " , MINING RIGHTS ONLY | ◒ |
| LEASE, SURFACE AND MINING RIGHTS | ■ |
| " , SURFACE RIGHTS ONLY | ⬒ |
| " , MINING RIGHTS ONLY | ⬓ |
| LICENCE OF OCCUPATION | ▼ |
| ROADS | |
| IMPROVED ROADS | |
| KING'S HIGHWAYS | |
| RAILWAYS | |
| POWER LINES | |
| MARSH OR MUSKEG | |
| MINES | ⚒ |
| CANCELLED | C |

## NOTES

400' surface rights reservation along the shores of all lakes and rivers.

SAND and GRAVEL

(G1) M.T.C. GRAVEL PIT 3F-25

(G2) M.T.C. GRAVEL PIT 1374

(R1) Surface and Mining Rights Withdrawn from Staking, section 36/80 order No. W 65/83

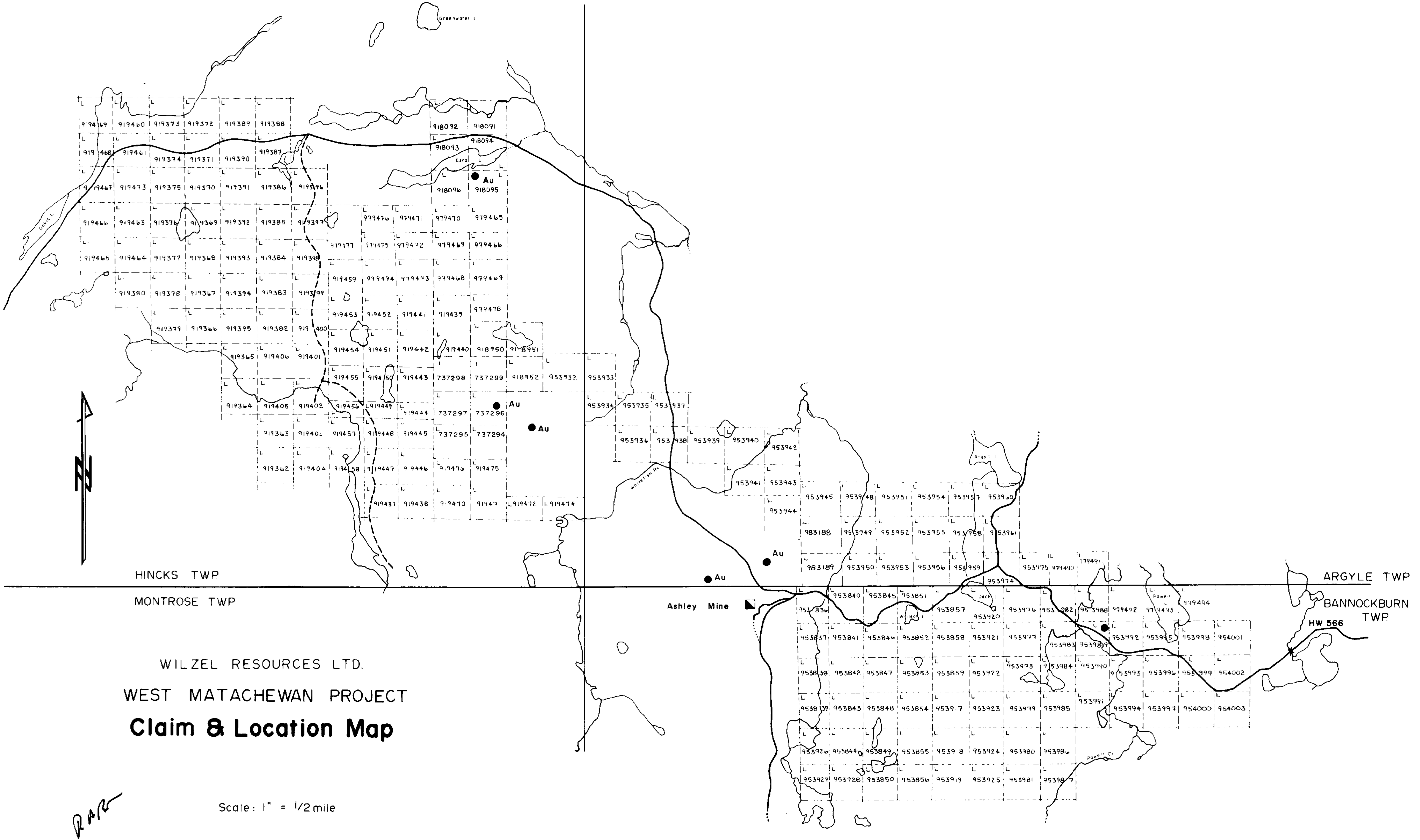
(R2) Surface and Mining Rights Withdrawn from Staking, section 36/80 order No. W 29/85

DATE OF ISSUE
OCT 23 1987
LARDER LAKE
MINING RECORDER'S OFFICE

PLAN NO. M.207#2

ONTARIO
MINISTRY OF NATURAL RESOURCES
SURVEYS AND MAPPING BRANCH

42A02SW0119 2.10593 ARGYLE
220



WILZEL RESOURCES LTD.

## WEST MATACHEWAN PROJECT

# Claim & Location Map

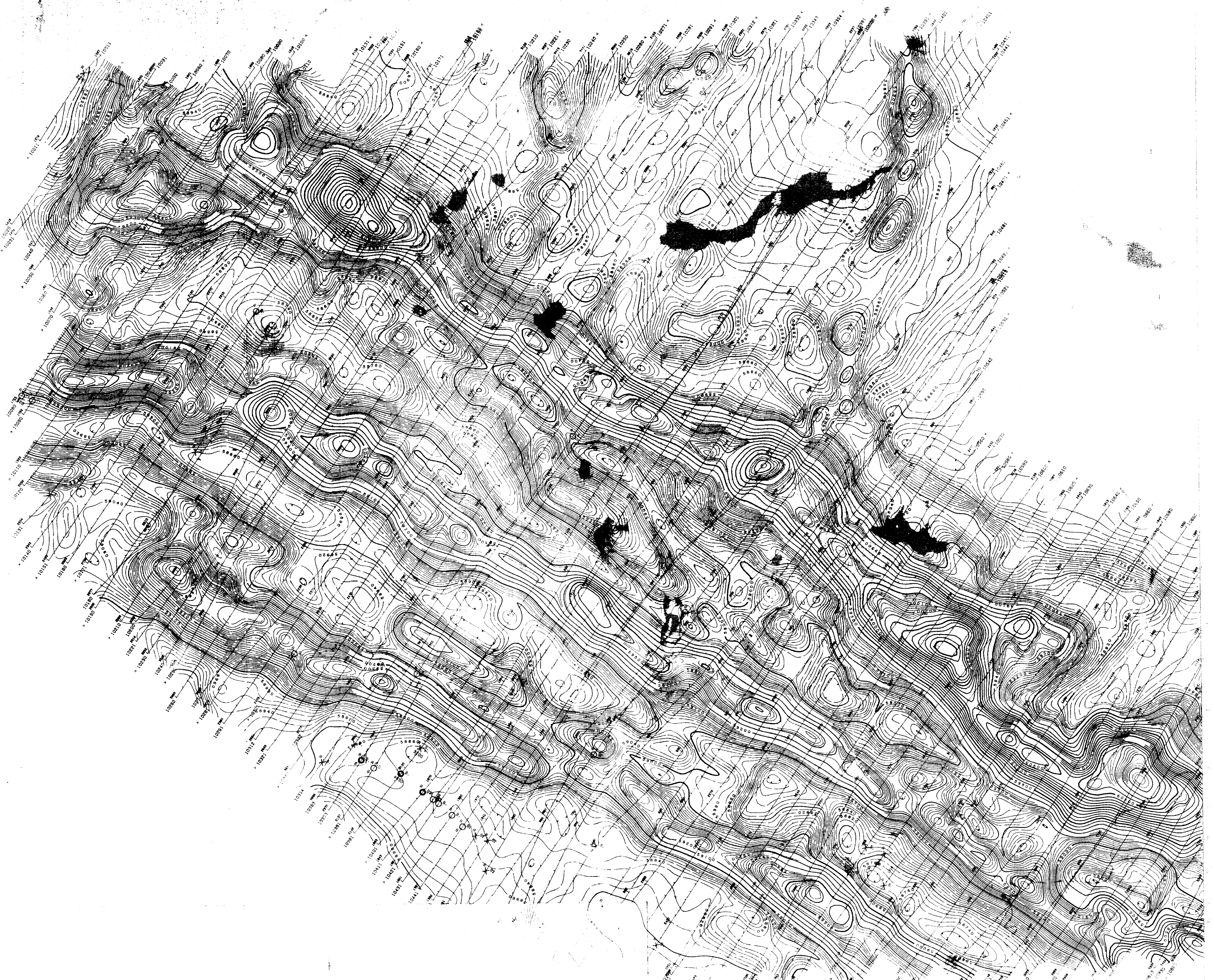
Scale: 1" = 1/2 mile

RAR

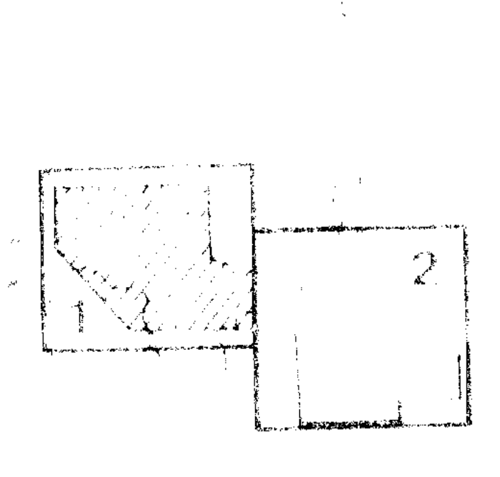
NOV 1987

42A02SW0119 2.10593 ARGYLE

230



LOCATION MAP

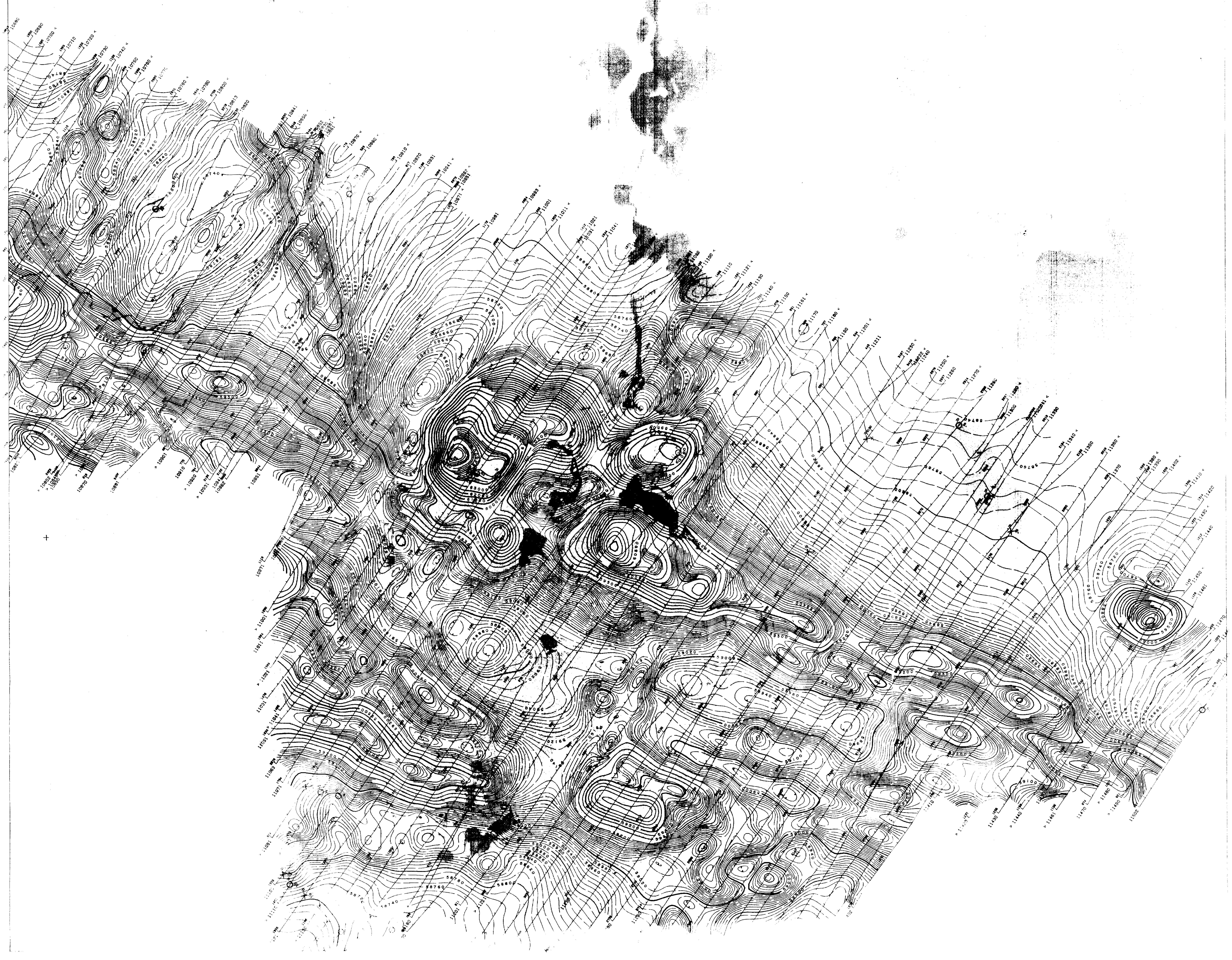


Scale 1:250,000

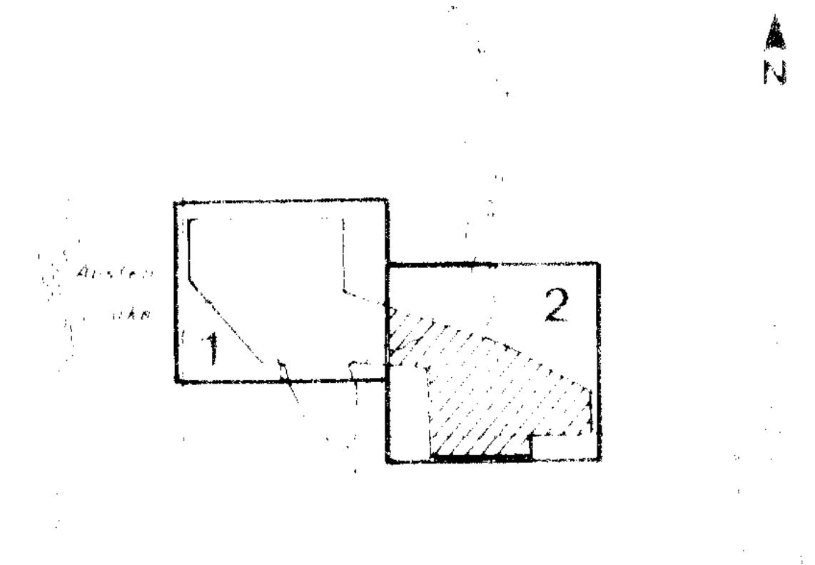
## WILZEL RESOURCES LTD
## MATACHEWAN AREA ONTARIO

## TOTAL FIELD MAGNETICS
BY DIGHEM SURVEYS & PROCESSING INC

DIGHEM SURVEY
DRAFTING BY V.S.
SHEET 1



LOCATION MAP



Scale 1:250,000

42A02SW0119 2.10593 ARGYLE
260

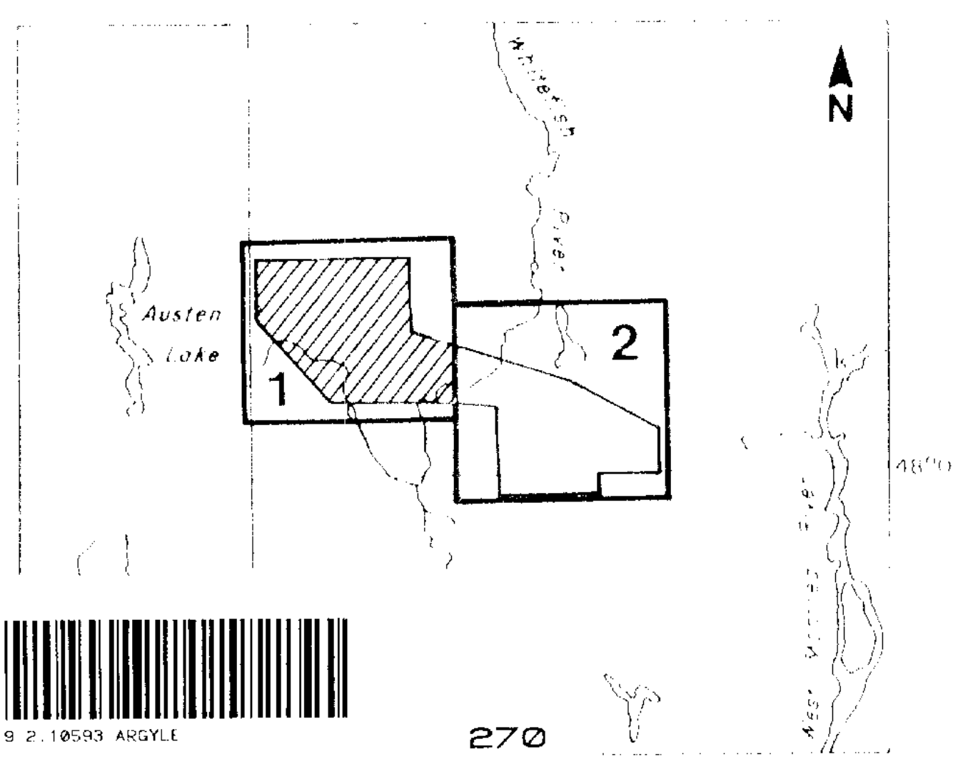
## WILZEL RESOURCES LTD
## MATACHEWAN AREA, ONTARIO

## TOTAL FIELD MAGNETICS
BY DIGHEM SURVEYS & PROCESSING INC.

DIGHEM SURVEY
DATE OCT 1987
GEOPHYSICIST DM
JOB 1006
DRAFTING BY V.S.
SHEET 2

Scale 1:10,000

## LOCATION MAP



Scale 1:250,000

42A02SW0119 2.10593 ARGYLE

270

| ANOMALY GRADE | EM GRADE SYMBOL | CONDUCTANCE RANGE (MHOS) |
|---|---|---|
| 6 | ● | >99 |
| 5 | ● | 50-99 |
| 4 | ● | 20-49 |
| 3 | ○ | 10-19 |
| 2 | ○ | 5-9 |
| 1 | ( ) | <5 |
|  | ✕ | Indeterminate |

DIGHEM anomalies are divided into six grades of conductivity-thickness product. This product in mhos is a measure of conductance.

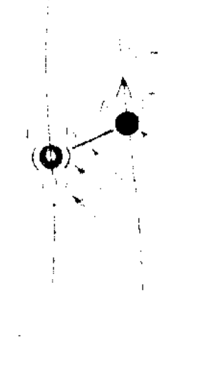
anomaly "name" — interpretive symbol

Depth is greater than: 15 m, 30 m, 45 m, 60 m

Inphase and Quadrature of Coaxial Coil is greater than: 5 ppm, 10 ppm, 15 ppm, 20 ppm

| Interpretive symbol | Conductor ("model") |
|---|---|
| B, | Bedrock conductor |
| D, | Narrow bedrock conductor ("thin dike") |
| S, | Conductive cover ("horizontal thin sheet") |
| H, | Broad conductive rock unit, deep conductive weathering, thick conductive cover ("half space") |
| E, | Edge of broad conductor ("edge of half space") |
| L, | Culture, e.g. power line, building, fence |

### FLIGHT LINES WITH EM ANOMALIES



- Flight direction
- Flight line number
- Fiducials identified on profiles
- Dip direction
- EM anomaly (see EM legend)
- Conductor axis (on EM maps only)
- Arcs indicate the conductor has a thickness >10 m
- Magnetic correlation in nT (gammas)

# WILZEL RESOURCES LTD.
## MATACHEWAN AREA, ONTARIO

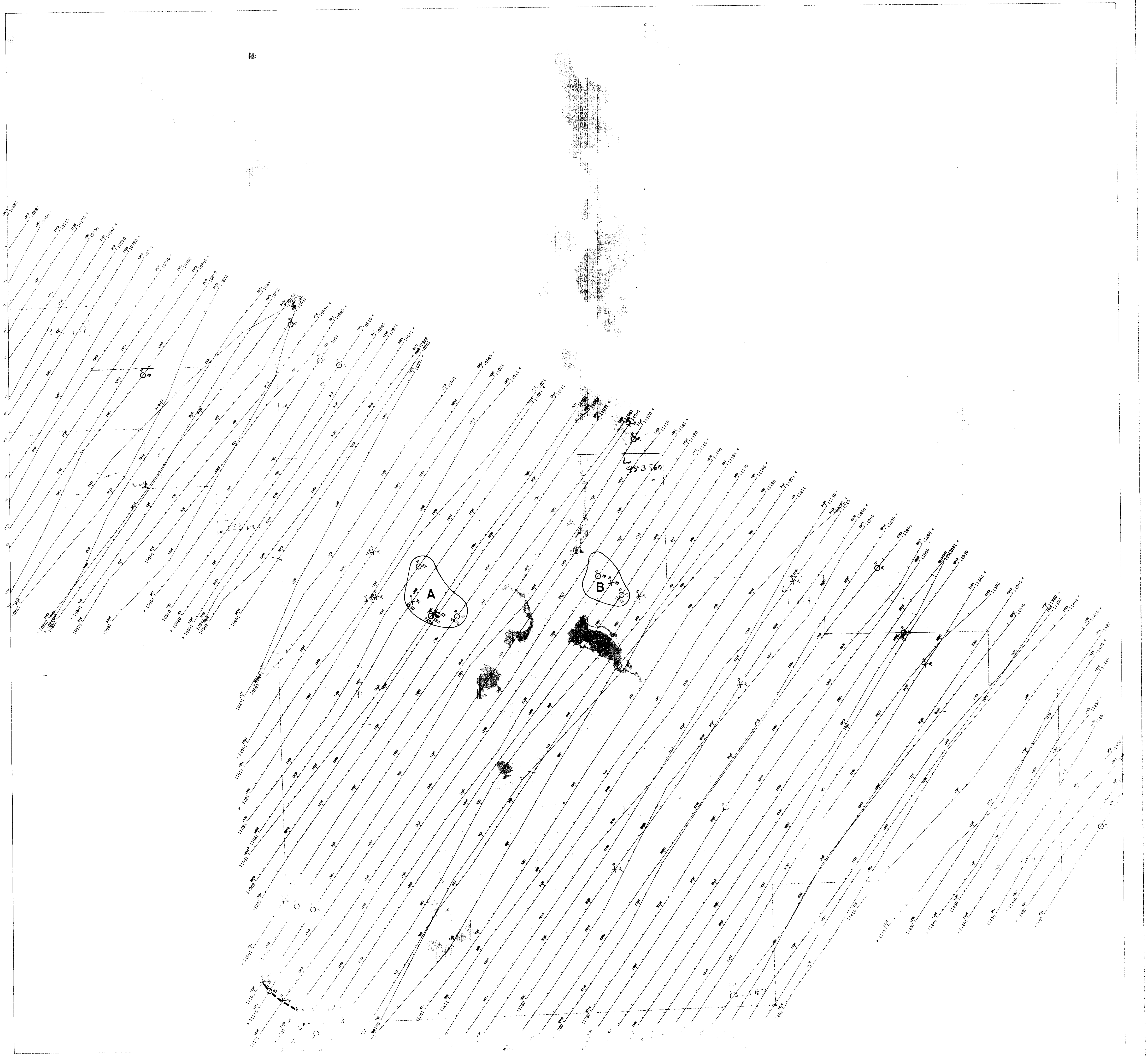
# ELECTROMAGNETIC ANOMALIES
## BY DIGHEM SURVEYS & PROCESSING INC.

| | | |
|---|---|---|
| DIGHEM$^{III}$ SURVEY | GEOPHYSICIST: D.M. | DRAFTING By: V.S. |
| DATE: OCT. 1987 | JOB: 1008 | SHEET: 1 |

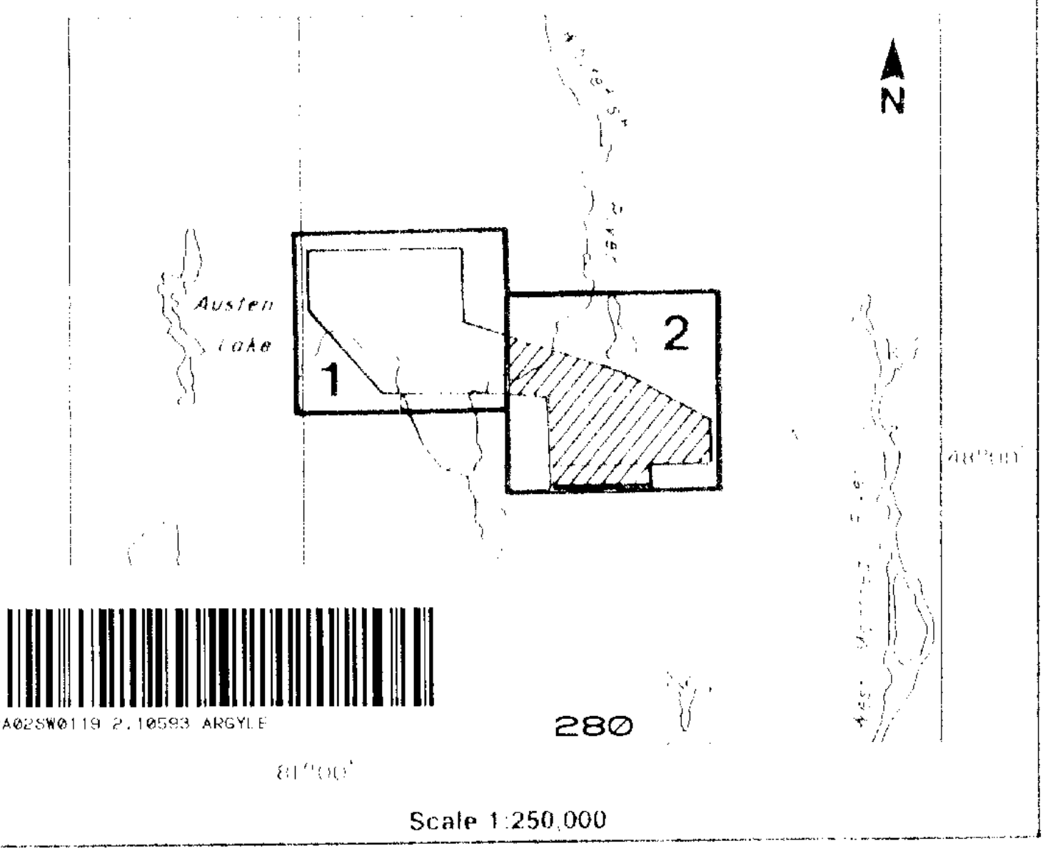
Scale 1:10,000

0 — 1 Km

0 — 0.5 Mi



## LOCATION MAP



Scale 1:250,000

42A02SW0119 2.10583 ARGYLE

280

| ANOMALY GRADE | EM GRADE SYMBOL | CONDUCTANCE RANGE (MHOS) |
|---|---|---|
| 6 | ● | 99 |
| 5 | ● | 50 - 99 |
| 4 | ● | 20 - 49 |
| 3 | ◉ | 10 - 19 |
| 2 | ○ | 5 - 9 |
| 1 | ( ) | 5 |
|  | × | Indeterminate |

anomaly "name"

interpretive symbol

Depth is greater than 25 m 30 m 40 m 60 m

Inphase and Quadrature of coaxial coil greater than 5 ppm 10 ppm 15 ppm 20 ppm

| Interpretive symbol | Conductor ("model") |
|---|---|
| B | Bedrock conductor |
| D | Narrow bedrock conductor ("thin dike") |
| S | Conductive cover ("horizontal thin sheet") |
| H | Broad conductive rock unit, deep conductive weathering, thick conductive cover ("half space") |
| E | Edge of broad conductor ("edge of half space") |
| L | Culture, e.g. power line, fencing, etc. |

FLIGHT LINES WITH EM ANOMALIES

- Flight direction
- Flight line number
- Fiducials identified on profiles
- Dip direction
- EM anomaly (see EM legend)
- Conductor axis (on EM maps only)
- Arcs indicate the conductor has a thickness >10 m
- Magnetic correlation in gammas

# WILZEL RESOURCES LTD.
## MATACHEWAN AREA, ONTARIO

# ELECTROMAGNETIC ANOMALIES
## BY DIGHEM SURVEYS & PROCESSING INC.

DIGHEM$^{III}$ SURVEY
DATE: OCT. 1987

GEOPHYSICIST: DM
JOB: 1008

DRAFTING By: V. S.
SHEET: 2

Scale 1:10,000

0 — 1 Km
0 — 0.5 Mi