2.2292

Report No. D65

DIGHEM SURVEY

OF

ST. ANTHONY LAKE AREA

SKEAD TOWNSHIP, ONTARIO

FOR

SUPERIOR NORTHWEST INC.

BY

DIGHEM LIMITED

Toronto, Ontario
May 18, 1976

D. C. Fraser
President

LOCATION MAP

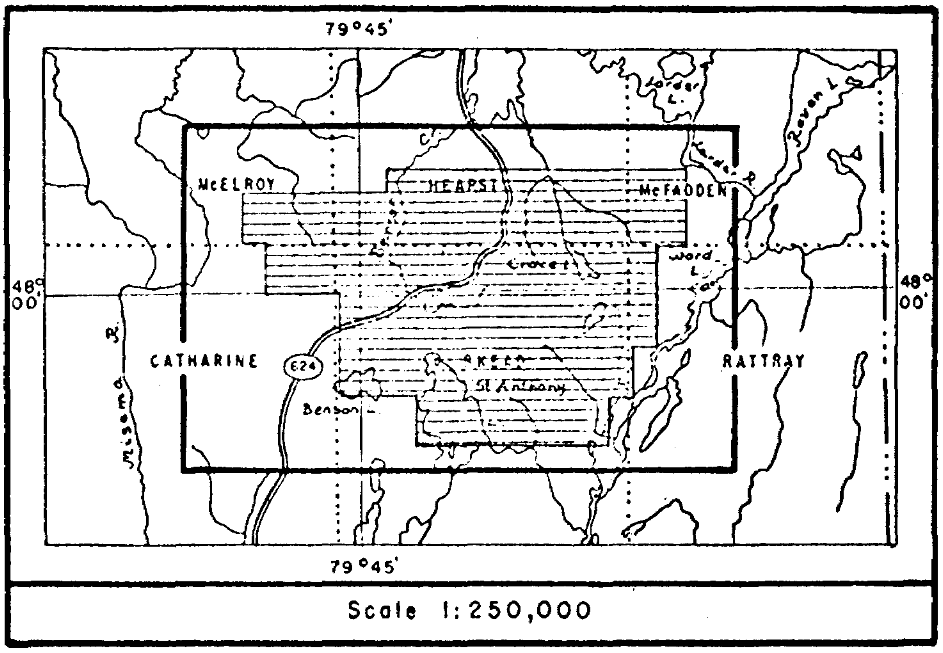

FIGURE 1. The survey area.

S U M M A R Y

A DIGHEM survey of 318 line-miles was flown for Superior Northwest Inc. in April 1976 in the St. Anthony Lake area of Skead Township, Ontario. A total of 190 anomalous EM responses were recorded, 107 of which were of the first (or lowest) conductance grade. The majority of the latter probably are surface effects, as indicated by the interpretation on the EM maps.

Many anomalies were located which represent bedrock conduction. Some have weak to strong magnetic correlation. The enhanced magnetic map often provides a clearer portrayal of these correlations than the standard total field map.

INTRODUCTION

A DIGHEM survey of 318 line-miles was flown with a 1/8th mile line-spacing for Superior Northwest Inc. in the interval from April 14th to 20th, 1976, in the St. Anthony Lake area of Skead Township, Ontario (Figure 1). This includes 18 line-miles of flight-line extensions which were flown at no charge. The Gazelle jet helicopter C-FGCE flew with an average airspeed of 60 mph and EM bird height of 110 feet. Ancillary equipment consisted of a Barringer Research AM-104 magnetometer with its bird at an average height of 160 feet, a Bonzer radaraltimeter, Geocam sequence camera, sferics monitor, 60 hz monitor, MFE 8-channel hot pen analog recorder, and a Geometrics G-704 digital data acquisition system with a Facit 4070 punch paper tape recorder. The analog equipment recorded five channels of EM data at 918 hz, and one of sferics, magnetics and radaraltitude. The digital equipment recorded the magnetic field to an accuracy of one gamma.

The Appendix provides details on the analog data channels, their respective noise levels, and the data reduction procedure. The quoted noise levels are generally valid for wind speeds up to 20 mph. Higher winds may cause the system to be grounded because excessive bird swinging produces control difficulties in piloting the helicopter. The swinging results from the 50 square feet of area which is presented by the bird to broadside gusts. The DIGHEM system nevertheless can be flown under wind conditions that seriously degrade other AEM systems.

DATA PRESENTATION

The Three Conductor Models

DIGHEM anomalies are interpreted according to three conductor models, as follows:

1. Vertical dike (half plane)

   The vertical dike is the most suitable representation of steeply-dipping bedrock conductors. All anomalies plotted on the DIGHEM map are interpreted according to this model. The three receiver coils of DIGHEM allow correction for the response when the flight line crosses a conductor at an oblique angle. The following section entitled, "Electromagnetics; vertical dike interpretation", describes this model in detail, including the effect of using it on anomalies caused by conductive overburden.

2. Horizontal sheet (whole plane)

   The horizontal sheet is suitable for flatly dipping thin bedrock conductors and thin layers of conductive clay or lake silt. The conductance and depth values are given in the anomaly list appended to the rear of this report, but do not appear on the DIGHEM map. These values should be viewed with caution unless it is known that a horizontal sheet is a fair representation of the conductors. It is a highly specialized model with a limited application.

3. Conductive earth (half space)

The conductive earth model is suitable for flatly dipping thick bedrock conductors, saline water-saturated sedimentary formations, thick conductive overburden, and geothermal zones. The resistivity and depth values are given in the anomaly list, but do not appear on the DIGHEM map. A depth value of approximately zero in an area of deep cover is evidence that the anomaly is caused by conductive overburden. The minimum and maximum values of resistivity which can be recognized are 1 and approximately 1000 ohm-meters, respectively.

Electromagnetics; vertical dike interpretation

The EM anomalies appearing on a DIGHEM map are interpreted by computer according to the conductivity-thickness product in mhos of an oblique-striking vertical dike model. DIGHEM anomalies are divided into six grades of conductivity-thickness product, as shown in Table I. This product in mhos is the reciprocal of resistance in ohms. The mho is a measure of conductance, and is a geological parameter. Most swamps yield grade 1 anomalies but highly conducting clays can give grade 2 anomalies. The three-dimensional anomaly shapes often allow surface conductors to be recognized, and these are indicated by the letter S on the map. The remaining grade 1 and 2 anomalies could be weak bedrock conductors. The higher grades indicate increasingly higher conductances. Examples: the ore bodies of the Magusi River camp (Noranda, Quebec) yield grade 4 anomalies, while Mattabi (Sturgeon Lake, Ontario) and Whistle (Sudbury, Ontario) give grade 5. 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.

TABLE 1. EM Anomaly Grades

Anomaly Grade	Mho Range
6	≥ 100
5	50 - 99
4	20 - 49
3	10 - 19
2	5 - 9
1	≤ 4

Strong conductors (i.e., grades 5 and 6) are characteristic of massive sulfides or graphite. Moderate conductors (grades 3 and 4) typically reflect sulfides of a less massive character or graphite, 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 conductivity-thickness products. As an example, the three million ton lead-zinc deposit of Restigouche Mining Corporation near

Bathurst, New Brunswick, 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.

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

On the DIGHEM map, the actual mho value and a letter are plotted beside the EM grade symbol. The letter is the anomaly identifier. The horizontal rows of dots, beside each anomly symbol, indicate anomaly amplitude on the flight record. The vertical column of dots gives the estimated depth. In areas where anomalies are crowded, the identifiers, dots and mho values 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 conductivity-thickness calculation. Thus, a conductivity-thickness value obtained from a large ppm anomaly (3 or 4 dots) will be accurate whereas one obtained from a small ppm anomaly (no dots) could be inaccurate.

The absence of amplitude dots indicates that the anomaly from the standard (maximum-coupled) coil 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 mho value and depth estimate will illustrate which of these possibilities best fits the recorded data. The depth estimate, however, can be erroneous. The anomaly from a near-surface conductor, which exists only to one side of a flight line, will yield a large depth estimate because the computer assumes that the conductor occurs directly beneath the flight line.

Flight line deviations occasionally yield cases where two anomalies, having similar mho values but dramatically different depth estimates, occur close together on the same conductor. Such examples confirm that the mho value measurement of conductance is quite reliable whereas 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, conductive overburden responses, 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 further interpretation is presented on the EM map by means of the line-to-line correlation of anomalies. This provides conductor axes which may define the geological structure over portions of the survey area.

The majority of massive sulfide ore deposits have strike lengths of a few hundred to a few thousand feet. Consequently, it is important to recognize short conductors which may exist in close proximity to long conductive bands. The high resolution of the DIGHEM system, and the line-to-line correlation given on the data maps, are especially important for a proper strike length evaluation.

DIGHEM 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 followup program. The actual mho values are plotted 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 direction, conductance and depth. The accuracy is comparable to an interpretation from a ground EM survey having the same line spacing.

The attached EM anomaly list provides a tabulation of all anomalies in ppm, and in mhos and estimated depth for the vertical dike model. The anomalies are listed from top to bottom of the map for each line. The list also includes an interpretation according to the horizontal sheet and conductive earth models, as described earlier.

Magnetics

The existence of a magnetic correlation with an EM anomaly is indicated directly on the EM photomosaic. 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., Kidd Creek near Timmins, Ontario) as well as magnetic (e.g., Mattabi).

The magnetometer data are digitally recorded in the aircraft to an accuracy of one gamma. The digital tape is processed by computer to yield a standard total field magnetic map contoured at 25 gamma intervals. The magnetic data also are treated mathematically to enhance the magnetic response of the near-surface geology, and an enhanced magnetic map is produced with a 100 gamma contour interval. The response of the enhancement operator in the frequency domain is shown in Figure 2.

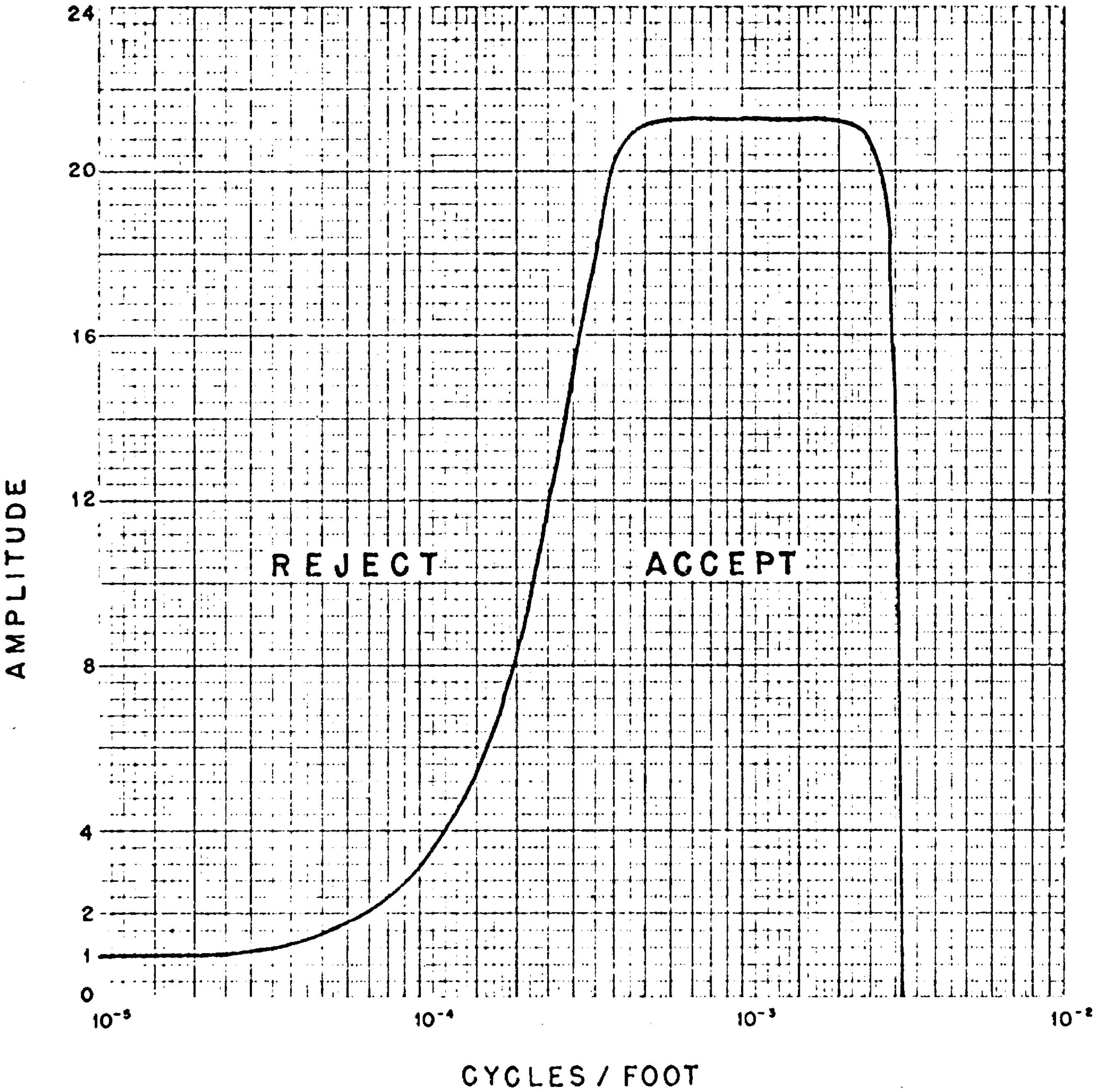

Figure 2 Frequency response of magnetic operator

The enhanced magnetic map bears a resemblance to a ground magnetic map. It therefore simplifies the recognition of trends in the rock strata and the interpretation of geological structure. The contour interval of 100 gammas is suitable for defining the near-surface local geology while de-emphasizing deep-seated regional features.

Apart from the difference in the contour interval, the enhanced magnetic map and the standard magnetic map are identical when magnetic basement rocks underlie several thousand feet of non-magnetic cover. The difference between the two maps increases with the amount of magnetization of the near-surface geology.

The presence of a magnetic coincidence with an EM anomaly can result because the conductor is magnetic or because a magnetic body occurs in juxtaposition with the conductor. The majority of magnetic conductors represent sulfides containing pyrrhotite or magnetite. However, graphite and magnetite in close association can provide coinciding EM-magnetic anomalies. The truly magnetic conductors tend to follow closely the contoured magnetic highs. Such coincidence may be more evident on the enhanced magnetic map than on the standard magnetic map because of less disturbance from regional magnetic features. The enhancement, therefore, provides data maps which contribute to the evaluation of EM anomalies.

CONDUCTORS IN THE SURVEY AREA

The DIGHEM map provides an interpretation of conductors, as to their length, strike direction, depth, and conductance quality or conductivity-thickness product in mhos. There remains only to correlate these conductors with the known geology to provide the next step in the exploration program.

When studying the EM map for followup planning, consult the anomaly listings appended to this report to ensure that none of the conductors are overlooked. Conversely, the original map may be printed with topography burned out, leaving only the anomalies which then will be clearly visible.

A total of 190 conductive anomalies were detected, as shown in Table II, of which 107 are of the first (or lowest) conductance grade. Many of the latter are likely to be surface effects.

TABLE II. Distribution of EM Anomalies

Anomaly Grade	Number of Anomalies
6	0
5	3
4	15
3	34
2	31
1	107
Total	190

The EM map indicates which anomalies are believed to be caused by conductive surface material. Generally, such anomalies are not commented on below, as the discussions are directed to identifying bedrock conductors. Refer to the Reference map for the location of the following conductor groups.

GROUP 1 The anomalies of group 1 consist mainly of poor or questionable conductors. Conductive overburden may have caused many of the grade 1 responses. The fourth grade anomaly 4B (i.e., anomaly B on line 4) may have been caused by aerodynamic noise. The second grade anomaly 2E is very weakly magnetic as can be seen on the enhanced magnetic map.

GROUP 2 These anomalies consist of two single-line conductors and a possible two-line conductor, with conductances of only grades 1 and 2. The enhanced magnetic map suggests the existence of a weak magnetic correlation with 9C and, possibly, 10A.

GROUP 3 Group 3 consists of a moderately wide conductive zone having conductances up to grade 4. The zone terminates at its south end against the ultrabasic intrusive which is outlined by the magnetics. The conductors are non-magnetic.

GROUP 4 The anomalies of this group are all of conductance grade 1. This weakly conductive zone continues throughout the length of the group 1 outline, but the zone is very weak in the central area where anomalies are not plotted. The zone coincides with high magnetism, and the conductivity could reflect either serpentine or disseminated sulfides in ultrabasics.

GROUP 5 This grouping consists of several scattered conductors, many of which are of conductance grade 1 and could reflect conductive overburden. Anomalies 19C and 20D-22D are moderately conductive and are on the flanks of magnetic highs. Conductor 15B-16E may be a continuation of 20D-22D as suggested by the enhanced magnetic map.

GROUP 6 The southern conductive zone has conductances up to grade 3, and clearly reflects bedrock. The anomalies to the north are of conductance grade 1, and could be caused by conductive overburden.

GROUP 7 This seven-line bedrock conductor, of grades 1 and 2, occurs in a magnetic low.

GROUP 8 — This grouping consists of a series of conductors with conductances as high as grade 5. The grade 5 anomaly 18F is noteworthy as it is a single-line response which is satellitic to a long conductor; it reflects either an isolated short conductor or a thickening of the long conductor.

GROUP 9 — These two strong single-line conductors occur at the edge of the survey grid. They are non-magnetic.

GROUP 10 — Several conductors of moderate conductance occur in this grouping. Note especially 5D-6D; it has a direct magnetic correlation which may be seen clearly on the enhanced magnetic map. Conductors 10F-11F and 14I-15I are short, reasonably strong conductors.

Respectfully submitted,

Toronto, Ontario
May 18, 1976
/ap

D. C. Fraser
President
* Qualifications 63.2278 V.1

Four maps accompany this report.

Electromagnetics	1	map sheet
Magnetics	1	map sheet
Enhanced magnetics	1	map sheet
Reference for report	1	map sheet

APPENDIX

THE FLIGHT RECORD AND PATH RECOVERY

The flight record is a roll of chart paper which moves through the recorder console at a speed of 1.5 mm/sec. This provides a ground scale on the flight record in feet/mm which is approximately equal to the helicopter flight speed in mph. Thus, for example, the ground scale of the flight record is approximately 70 feet/mm when the helicopter flies at 70 mph.

The flight record consists of eight channels of information, where the label on the record illustrates which of the following ten selections were recorded:

Channel	Time Constant	Scale units/mm	Noise
Standard whaletail quadrature	4 sec	2 ppm	2 ppm
Standard fishtail quadrature	4 sec	2 ppm	2 ppm
Standard coil-pair (Max) inphase	1 sec	5 ppm	5 ppm
Standard coil-pair (Max) inphase	4 sec	2 ppm	2 ppm
Standard coil-pair (Max) quadrature	1 sec	5 ppm	5 ppm
Standard coil-pair (Max) quadrature	4 sec	2 ppm	2 ppm
Sferic monitor	1 sec	5 ppm	
Radaraltitude	1 sec	10 feet	
Magnetometer: 1 gamma/step	1 sec	2.5 gammas	
Magnetometer: 10 gamma/step	1 sec	25 gammas	

The sferic monitor responds to electromagnetic signals having a frequency close to the transmitted frequency. Its purpose is to identify anomalies which are caused by environmental EM noise, e.g., distant lightning discharges and power line harmonics.

Several fiducial markers are used between the channels, as follows:

Fiducial	Occurrence
60-hz fiducials	occur only over power lines
camera fiducials	occur regularly at 3 mm intervals on every line
navigator fiducials	occur discontinuously on every line.

The 60-hz fiducials identify anomalies generated by power lines, allowing them to be either flagged on, or deleted from, the EM map.

The navigator fiducial marks represent points on the ground which were recognized by the aircraft navigator. These are the initial base points for flight path recovery. The flight line begins with an encircled navigator fiducial mark. This is followed by a series of unevenly-spaced fiducial marks moving right-wards along the record, which is in the direction of flight. The end of the line is flagged by a second encircled navigator fiducial mark.

The camera fiducial marks indicate each point where a photograph was taken. These photographs are used to provide accurate photo-path recovery locations for the navigator fiducials, which are then plotted on the geophysical maps to provide the track of the aircraft.

The navigator fiducial locations on both the flight records and flight path maps are examined by a computer for unusual helicopter speed changes. Such changes often denote an error in flight path recovery. The resulting flight path locations therefore reflect a more stringent checking than is provided by standard flight path recovery techniques.

/ap

LINE & ANOMALY	STANDARD COIL REAL PPM	STANDARD COIL QUAD PPM	NULL-COILS FISH QUAD PPM	NULL-COILS WHALE QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* FEET	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH FEET	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH FEET
1A	2	12	1	7	1	0	1	81	281	0
1B	0	11	-1	3	1	0	1	0	686	0
1C	44	21	5	8	31	16	8	159	3	113
1D	35	10	3	7	57	25	13	185	1	147
2A	0	4	0	2	1	0	1	0	1007	0
2B	0	8	0	3	1	0	1	0	1007	0
2C	6	11	0	5	4	52	1	219	63	101
2D	9	20	2	9	3	3	1	133	61	26
2E	9	8	3	5	8	83	2	288	26	191
2F	6	23	2	10	2	0	1	96	142	0
2G	1	4	2	4	1	5	1	197	311	61
2H	14	14	6	6	9	6	3	183	22	99
2I	7	11	2	10	4	44	1	210	59	95
3A	2	15	3	5	1	0	1	45	300	0
3B	6	15	3	7	3	13	1	155	83	38
3C	1	21	0	6	1	0	1	0	871	0
3D	0	17	0	3	1	0	1	0	1007	0
3E	29	24	5	10	13	0	4	141	10	76
3F	14	11	3	4	12	39	3	230	13	151
3G	0	3	-1	4	1	0	1	0	1007	0
4A	2	6	0	2	2	49	1	248	127	102
4B	8	0	0	2	27	141	6	400	0	397
4C	2	10	4	4	1	0	1	95	326	0
4D	3	1	-1	1	6	173	2	473	1007	0
5A	0	17	0	6	1	0	1	0	1007	0
5B	3	15	0	4	1	0	1	87	246	0
5C	2	9	0	3	1	0	1	104	314	0
5D	14	6	1	7	25	121	6	327	4	263
6A	3	4	4	6	4	82	1	381	72	251
6B	9	6	2	4	13	77	3	311	12	230
6C	8	5	1	2	12	81	3	316	13	231
6D	7	9	0	2	5	77	2	260	50	154
6E	5	7	-1	2	4	69	1	271	62	154

* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

LINE & ANOMALY	STANDARD COIL REAL PPM	STANDARD COIL QUAD PPM	NULL-COILS FISH WHALE QUAD PPM	NULL-COILS FISH WHALE QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* FEET	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH FEET	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH FEET
7A	22	19	3	5	12	32	3	186	13	114
7B	18	17	2	3	9	32	3	191	18	112
7C	40	48	0	15	10	0	3	104	14	42
7D	51	34	1	16	21	4	6	129	5	79
7E	0	6	0	2	1	0	1	0	1007	0
7F	1	10	1	6	1	0	1	12	663	0
8A	1	8	2	0	1	13	1	152	302	23
8B	17	17	0	2	8	2	3	158	21	78
8C	10	9	1	4	8	76	3	275	23	181
8D	19	14	1	7	13	29	4	197	11	126
8E	9	13	0	5	4	45	2	206	50	99
8F	27	27	-3	11	10	17	3	151	14	82
8G	1	7	-1	2	1	0	1	156	280	24
9A	5	10	2	4	3	36	1	197	88	71
9B	3	3	3	2	8	134	2	471	1007	0
9C	2	2	0	2	3	215	1	505	1007	0
9D	8	7	-1	3	8	82	2	294	24	195
9E	4	0	-1	4	10	183	3	479	0	500
9F	7	4	-2	3	10	69	3	315	18	218
9G	0	7	0	4	1	0	1	0	1007	0
9H	7	4	1	10	17	168	4	422	8	337
9I	2	3	1	2	4	149	1	423	66	288
10A	6	11	2	3	3	38	1	199	80	75
10B	4	3	2	2	6	145	2	442	44	316
10C	7	4	0	0	17	145	4	399	8	314
10D	8	11	0	5	5	73	2	248	47	144
10E	7	2	-1	2	27	139	6	399	3	340
10F	10	4	-2	2	21	117	5	354	6	278
11A	3	5	0	2	3	121	1	339	92	202
11B	3	7	1	2	2	60	1	248	116	106
11C	0	9	0	2	1	0	1	0	1007	0
11D	3	5	0	2	3	101	1	320	92	183
11E	0	8	0	2	1	0	1	0	1007	0
11F	20	10	2	4	22	29	6	212	5	152

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LINE & ANOMALY	STANDARD COIL REAL PPM	STANDARD COIL QUAD PPM	NULL-COILS FISH QUAD PPM	NULL-COILS WHALE QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* FEET	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH FEET	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH FEET
12A	4	3	-1	2	10	187	3	484	19	379
12B	15	5	2	1	28	98	7	306	4	244
12C	2	4	1	1	3	132	1	369	96	232
12D	4	3	0	2	6	181	2	448	34	328
12E	0	9	0	6	1	0	1	0	1007	0
12F	2	7	-1	1	1	33	1	193	280	61
12G	5	3	1	3	16	175	4	458	9	363
12H	4	3	0	2	12	163	3	455	14	351
13A	2	8	0	2	2	41	1	207	167	68
13B	3	4	2	2	4	123	1	369	72	239
13C	7	6	4	2	8	73	2	311	28	207
13D	13	11	0	2	9	42	3	222	18	136
13E	0	8	2	3	1	0	1	0	1007	0
13F	0	7	-1	5	1	0	1	0	1007	0
13G	19	24	-2	3	8	15	3	153	23	75
13H	62	22	0	6	51	60	12	188	1	152
14A	0	3	0	6	1	0	1	0	1007	0
14B	8	8	1	4	8	85	2	288	26	190
14C	14	11	0	6	10	50	3	233	16	150
14D	0	7	2	2	1	0	1	0	1007	0
14E	0	6	0	2	1	0	1	0	1007	0
14F	2	5	2	2	1	79	1	278	219	133
14G	7	8	0	3	6	97	2	296	39	191
14H	7	8	0	2	6	61	2	260	39	155
14I	61	30	4	7	33	24	9	150	2	109
15A	4	14	-1	3	2	0	1	101	149	0
15B	6	12	1	4	3	65	1	218	79	97
15C	0	15	1	10	1	0	1	0	1007	0
15D	4	5	0	3	4	138	1	363	74	236
15E	5	5	0	2	6	108	2	343	38	229
15F	49	29	1	7	23	2	6	132	4	86
15G	10	14	0	3	5	60	2	220	42	122
15H	7	5	1	2	11	68	3	313	15	222
15I	5	1	0	0	12	59	3	351	2	333

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LINE & ANOMALY	STANDARD COIL REAL PPM	STANDARD COIL QUAD PPM	NULL-COILS FISH QUAD PPM	NULL-COILS WHALE QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* FEET	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH FEET	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH FEET
16A	0	10	0	0	1	0	1	0	1007	0
16B	7	5	3	0	8	104	2	351	25	247
16C	1	8	1	0	1	20	1	121	405	1
16D	4	11	3	0	2	25	1	177	144	48
16E	19	11	1	0	16	54	4	232	8	167
16F	4	5	0	0	4	110	1	335	75	210
16G	8	14	0	0	4	19	1	175	56	64
17A	4	8	2	0	3	48	1	232	95	98
17B	6	16	0	0	2	28	1	158	111	42
17C	4	5	-1	0	4	92	1	317	75	192
17D	9	4	0	0	20	107	5	348	7	270
17E	4	11	0	0	2	32	1	189	102	61
17F	7	16	-1	0	3	31	1	169	79	54
17G	4	10	3	0	2	23	1	187	132	55
18A	3	3	1	0	3	151	1	405	83	271
18B	5	15	3	0	2	0	1	137	105	18
18C	19	15	4	0	12	57	4	227	12	154
18D	5	1	1	0	12	190	3	483	2	465
18E	38	12	0	0	47	31	11	183	1	142
18F	28	7	0	0	58	60	13	226	1	188
18G	12	13	2	0	8	14	2	189	25	100
19A	5	8	0	0	4	31	1	226	66	106
19B	5	6	0	0	4	66	1	280	61	161
19C	12	9	-2	0	12	85	3	284	13	203
19D	2	3	0	0	3	146	1	410	97	271
19E	5	5	-1	0	5	28	2	262	47	143
19F	37	24	6	0	20	1	5	144	5	91
19G	13	7	1	0	18	74	5	279	7	209
20A	4	7	0	0	3	66	1	259	84	127
20B	10	19	2	0	4	41	1	177	54	71
20C	17	28	1	0	5	26	2	151	34	62
20D	20	37	9	0	5	0	2	104	34	18
20E	4	11	3	0	2	39	1	196	120	66
20F	5	10	5	0	3	11	1	190	84	63
20G	6	4	4	0	12	61	3	368	17	271
20H	15	15	4	0	9	9	3	177	21	94
20I	6	4	0	0	10	91	3	346	17	250

* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

LINE & ANOMALY	STANDARD COIL REAL PPM	STANDARD COIL QUAD PPM	NULL-COILS FISH QUAD PPM	NULL-COILS WHALE QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* FEET	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH FEET	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH FEET
21A	32	25	3	0	15	14	4	155	8	93
21B	39	45	5	0	10	0	3	104	14	42
21C	6	12	3	0	3	21	1	182	76	60
21D	19	12	0	0	16	24	4	200	8	134
21E	1	10	1	0	1	0	1	27	651	0
22A	39	33	10	0	15	11	4	143	8	84
22B	31	17	15	0	29	15	6	203	4	150
22C	11	21	8	0	4	0	1	113	52	10
22D	38	15	4	0	37	8	9	163	2	118
22E	4	1	2	0	10	193	3	490	3	479
22F	28	25	6	0	12	0	4	135	12	68
23A	27	40	3	0	7	0	2	111	23	35
23B	26	26	3	0	10	34	3	170	15	101
23C	4	22	-2	0	1	0	1	48	189	0
23D	4	15	0	0	2	0	1	95	166	0
24A	5	7	0	0	4	71	1	272	62	156
24B	4	2	2	0	10	178	3	474	12	397
24C	11	17	4	0	4	15	2	162	47	59
24D	8	6	3	0	11	103	3	347	16	256
24E	4	15	2	0	2	0	1	96	164	0
25A	0	45	4	0	1	0	1	0	1007	0
25B	31	53	10	0	6	0	2	88	25	13
26A	1	27	3	0	1	0	1	0	624	0
26B	10	19	0	0	3	0	1	125	60	18
27A	0	5	-1	0	1	0	1	0	1007	0
27B	3	5	0	0	2	84	1	282	127	136
28A	0	6	1	0	1	0	1	0	1007	0
28B	3	8	1	0	2	16	1	183	139	45
29A	0	12	2	0	1	0	1	0	1007	0

* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

	STANDARD COIL		NULL-COILS FISH	WHALE	VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
LINE & ANOMALY	REAL PPM	QUAD PPM	QUAD PPM	QUAD PPM	COND MHOS	DEPTH* FEET	COND MHOS	DEPTH FEET	RESIS OHM-M	DEPTH FEET
30A	3	3	0	0	6	198	2	498	1007	0
30B	4	4	0	0	8	158	2	426	26	313
30C	5	4	0	0	6	98	2	354	33	238
31A	2	8	-2	0	1	0	1	120	302	0
31B	0	8	3	0	1	0	1	0	1007	0
31C	1	6	0	0	1	0	1	59	553	0
32A	1	44	6	0	1	0	1	0	553	0
32B	0	31	1	0	1	0	1	0	1007	0
33A	0	20	3	0	1	0	1	0	1007	0
34A	0	16	4	0	1	0	1	0	1007	0
34B	1	7	0	0	1	21	1	137	386	12
35A	2	17	2	0	1	0	1	58	390	0
38A	2	16	2	0	1	0	1	73	304	0
41A	1	20	5	1	1	0	1	0	848	0
42A	0	5	0	0	1	0	1	0	1007	0
42B	0	11	0	0	1	0	1	0	1007	0
42C	0	15	0	0	1	0	1	0	1007	0
43A	1	23	-3	0	1	0	1	0	585	0
43B	1	25	0	0	1	0	1	0	607	0
44A	2	17	1	0	1	0	1	13	390	0
44B	0	18	0	0	1	0	1	0	1007	0
45A	2	10	-1	0	1	0	1	99	321	0
45B	1	21	0	0	1	0	1	0	566	0

* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

Ministry of Natural Resources
Ontario

32D04SE0102 2.2292 MCFADDEN SKEAD

900

Assessment ts

File 2.2292

2.2292

Recorded Holder
Mr. Lucien Lacasse and Mr. R. A. MacGregor

Township or Area
Catharine, Hearst and Skead Townships

Type of survey and number of Assessment days credit per claim	Mining Claims
Geophysical	
Electromagnetic 21 days	L. 396263 - 64 2
Magnetometer ____ days	396274 to 87 inclusive 14
Radiometric ____ days	400707 to 10 " 4
Induced polarization ____ days	400713 - 14 2
Section 86 (18) ____ days	400717 - 18 2
Geological ____ days	400720 - 21 2
Geochemical ____ days	401396 - 97 2
Man days ☐ Airborne ☒	415023 to 25 inclusive 3
Special provision ☐ Ground ☐	442035 to 63 " 29
	442070 to 74 " 5
	447535 to 50 " + Cath.

Notice of Intent to be issued:

☐ Credits have been reduced because of partial coverage of claims.

☐ Credits have been reduced because of corrections to work dates and figures of applicant.

☐ No credits have been allowed for the following mining claims as they were not sufficiently covered by the survey:

The Mining Recorder may reduce the above credits if necessary in order that the total number of approved assessment days recorded on each claim does not exceed the maximum allowed as follows: Geophysical — 80; Geological — 40; Geochemical — 40;

2.2292

Airborne Certificate data:

Dates of Flight - April 14 to 20/1976

Mining Claims (Staked) - June 19/1976 to Jan. 4/1977
(Recorded) - July 19/1976 to Jan. 5/1977

Received in Projects Unit - January 18/1977

Six months period from recording of mining claims - January 20/1977

PGW ->
Please ADD
this map to
file

2.22.92.

JM

NOTES

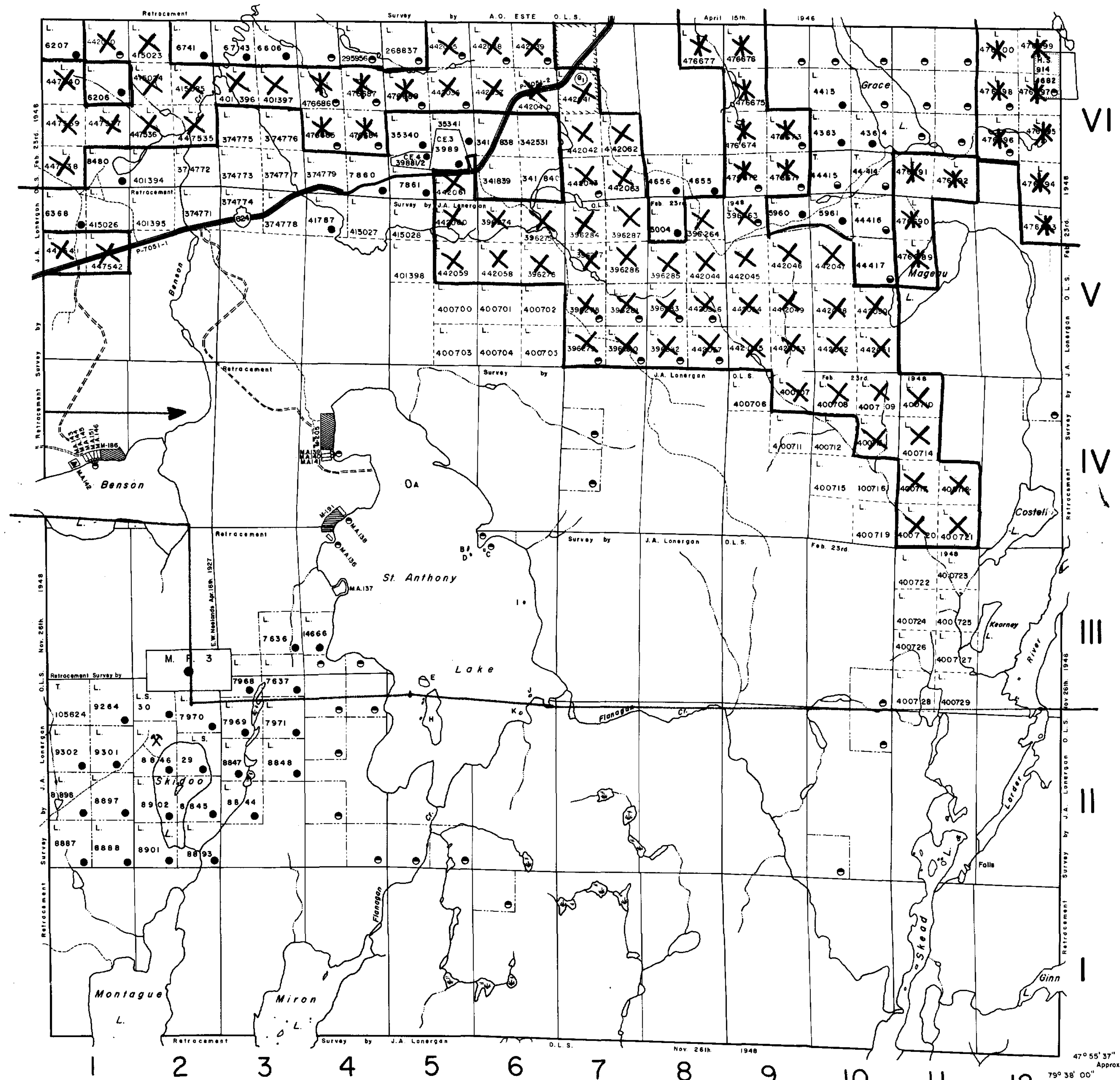
400' surface rights reservation along the shores of all lakes and rivers.

All unpatented mining claims accepted subject to survey, Section 118 of the Mining Act (R.S.O. 1970).

SAND and GRAVEL

(G) M.T.C. PIT No. 1230

DATE OF ISSUE
JAN 20 1977
SURVEYS AND MAPPING BRANCH



Certificate *

LEGEND

HIGHWAY AND ROUTE No.	
OTHER ROADS	
TRAILS	
SURVEYED LINES:	
TOWNSHIPS, BASE LINES, ETC.	
LOTS, MINING CLAIMS, PARCELS, ETC.	
UNSURVEYED LINES:	
LOT LINES	
PARCEL BOUNDARY	
MINING CLAIMS ETC.	
RAILWAY AND RIGHT OF WAY	
UTILITY LINES	
NON-PERENNIAL STREAM	
FLOODING OR FLOODING RIGHTS	
SUBDIVISION	
ORIGINAL SHORELINE	
MARSH OR MUSKEG	
MINES	

DISPOSITION OF CROWN LANDS

TYPE OF DOCUMENT	SYMBOL
PATENT, SURFACE & MINING RIGHTS	●
" SURFACE RIGHTS ONLY	◓
" MINING RIGHTS ONLY	◒
LEASE, SURFACE & MINING RIGHTS	■
" SURFACE RIGHTS ONLY	⬒
" MINING RIGHTS ONLY	⬓
LICENCE OF OCCUPATION	▼
CROWN LAND SALE	C.S.
ORDER-IN-COUNCIL	OC
RESERVATION	(R)
CANCELLED	(X)
SAND & GRAVEL	(G)

SCALE: 1 INCH — 40 CHAINS

FEET 0 500 1000 2000 4000 6000 8000

METRES 0 200 400 600 800 1 KM 2 KM

ACRES	HECTARES
40	16

TOWNSHIP 2.2292

SKEAD

DISTRICT

TIMISKAMING

MINING DIVISION

LARDER LAKE

Ministry of Natural Resources
Ontario
Surveys and Mapping Branch

Date 10/4/74

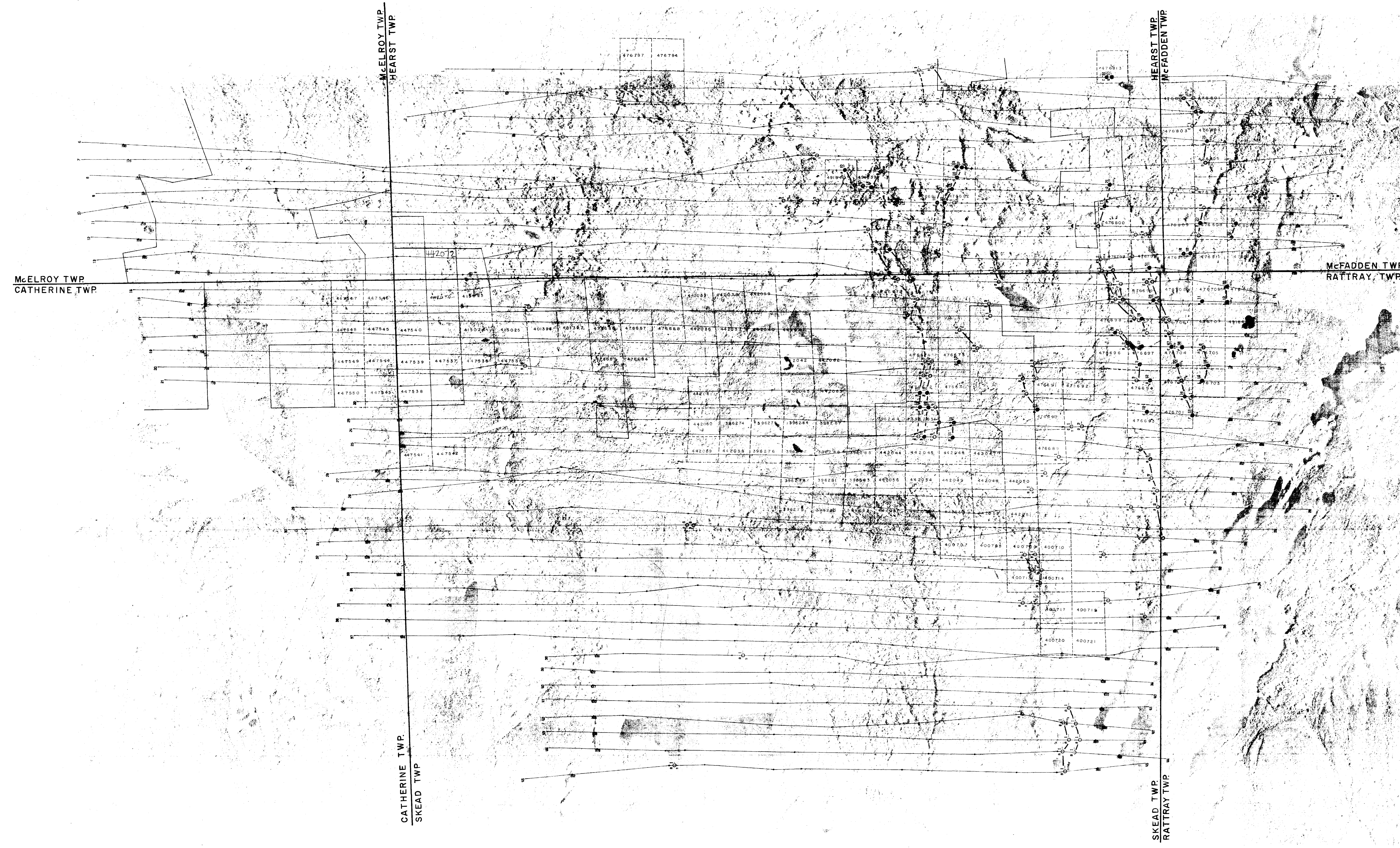
Whitney Block
Queen's Park, Toronto

Plan No. M.387

32D04SE0102 2.2292 MCFADDEN SKEAD

200

A.T.V.



DIGHEM SURVEY

ELECTROMAGNETICS

FOR

SUPERIOR NORTHWEST INC.

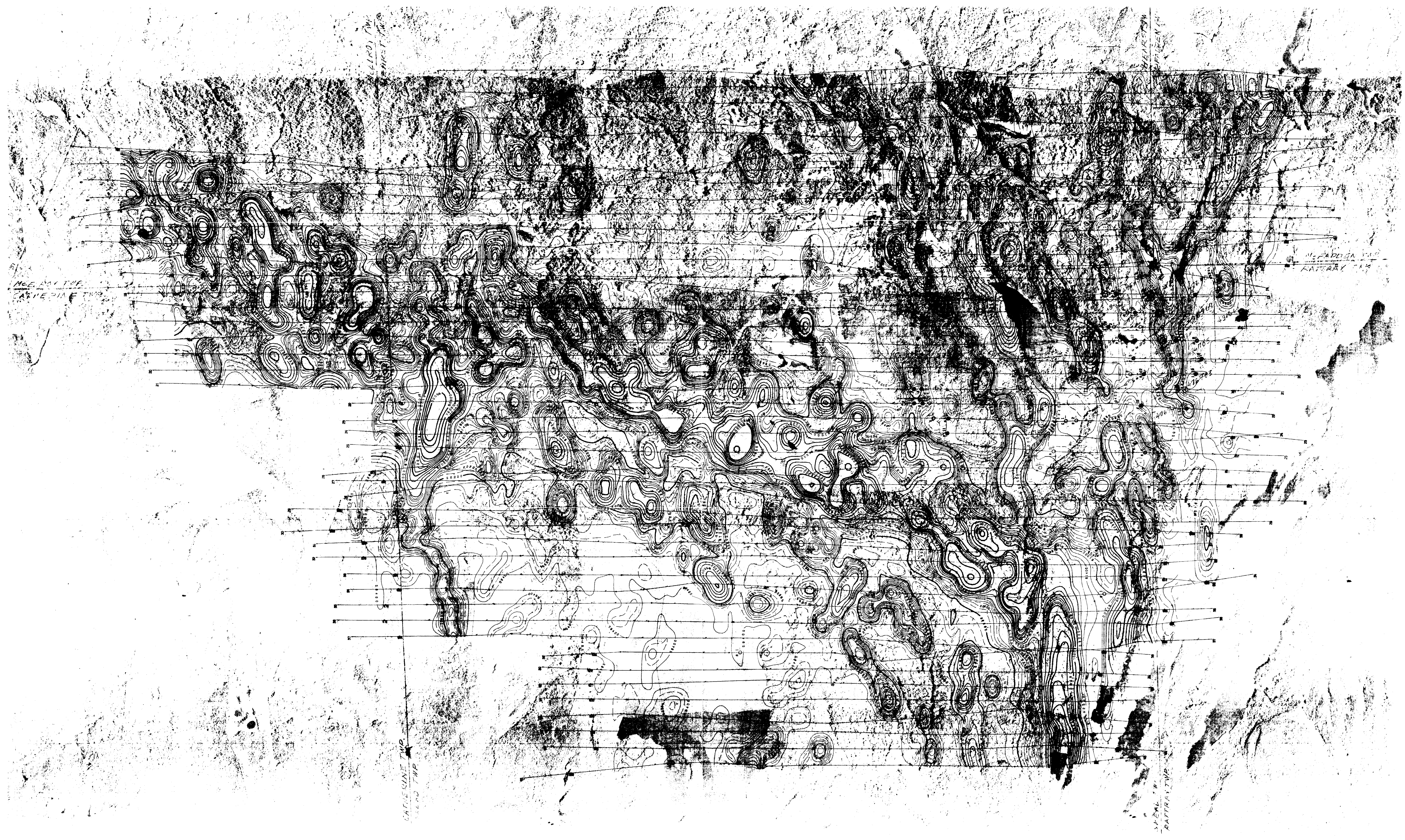
SKEAD TWP., ONTARIO

LOCATION MAP

Scale 1:250,000

210

2.22 12



DIGHEM SURVEY

ENHANCED MAGNETICS

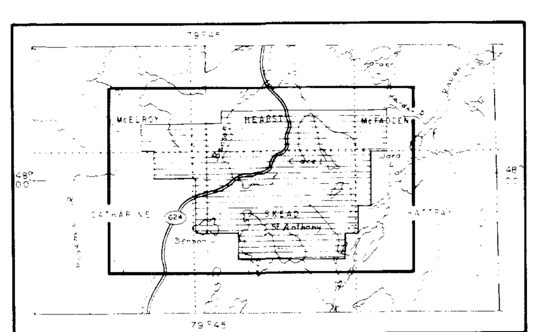
FOR

SUPERIOR NORTHWEST INC.

SKEAD TWP., ONTARIO

MILES

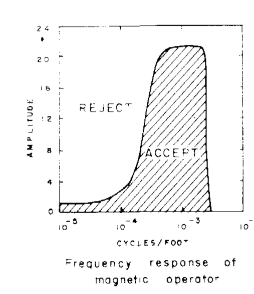
LOCATION MAP



Scale 1:250,000

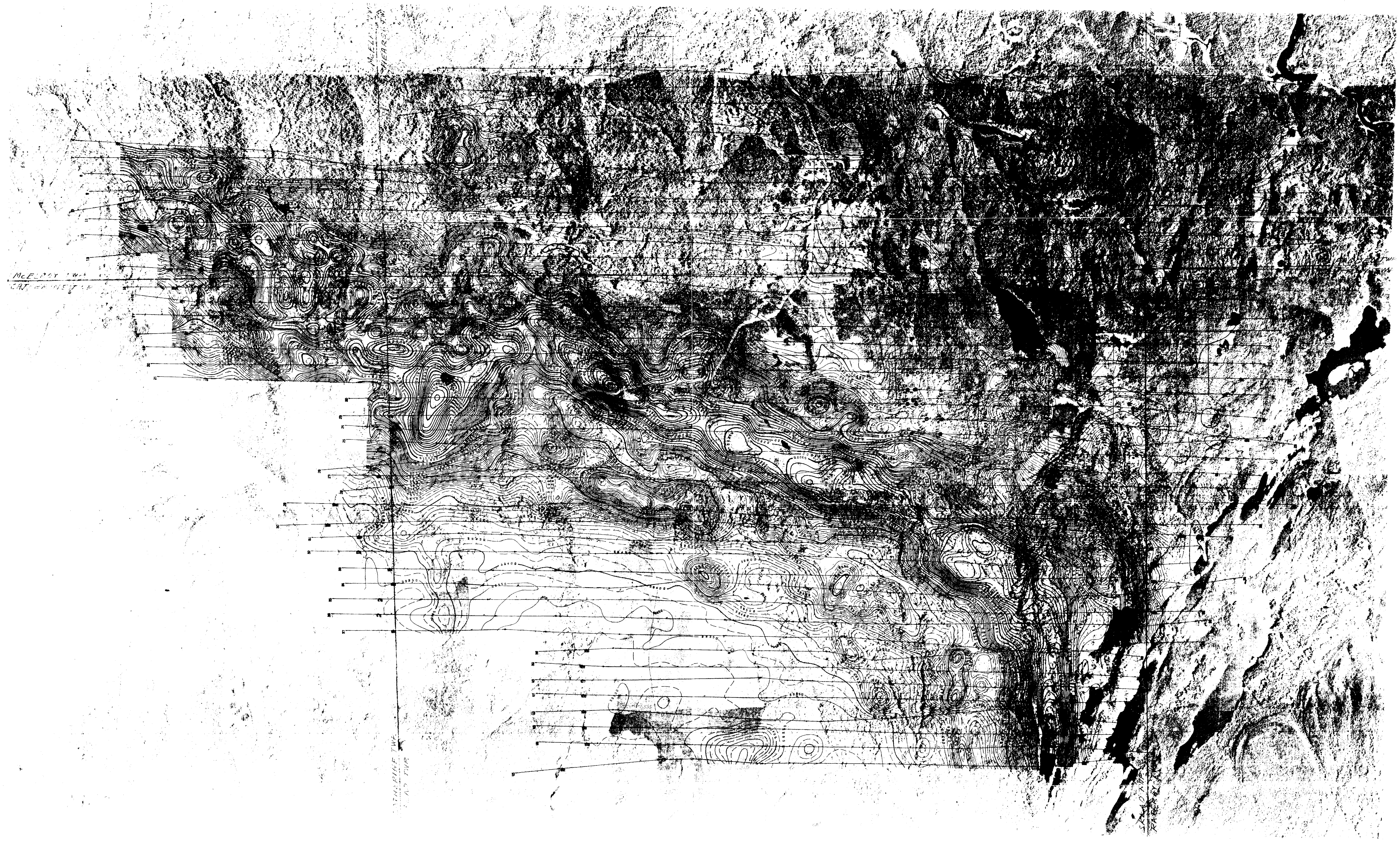
ISOMAGNETIC LINES
(enhanced field)

5000 gammas
1000 gammas
200 gammas
100 gammas
magnetic depression



Frequency response of magnetic operator

220



DIGHEM SURVEY

MAGNETICS

FOR

SUPERIOR NORTHWEST INC.

SKEAD TWP., ONTARIO

MILES

ISOMAGNETIC LINES

(total field)

1000	1000 gammas
200	200 gammas
	50 gammas
	25 gammas
	magnetic depression

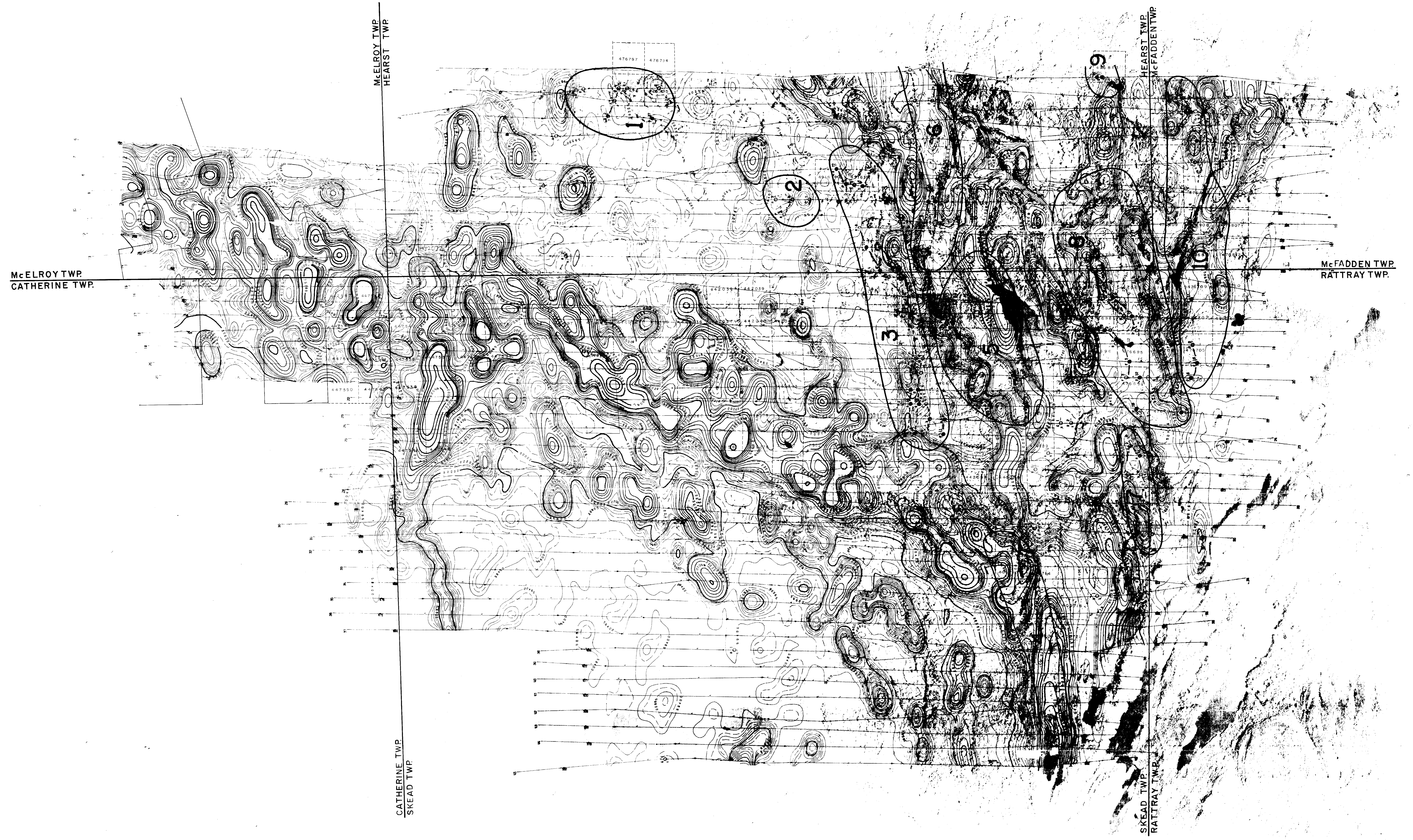
Flight line

Fiducials and numbers

LOCATION MAP

230

22212



DIGHEM SURVEY

REFERENCE FOR REPORT

FOR

SUPERIOR NORTHWEST INC.

Electromagnetics
&
Enhanced Magnetics

240

2.2212