B-HORIZON GEOCHEMICAL SURVEY OF AN ARCHEAN VMS PROSPECT AT BIRCHDALE, NORTHERN KOOCHICHING COUNTY, MINNESOTA, UTILIZING SELECTIVE LEACH METHODS

by E. H. Dahlberg, A.W. Klaysmat, T. L. Lawler and R. W. Ruhanen

Two selective leach methods, Enzyme Leach™ and Mobile Metal Ion (MMI) were tested in a B-horizon geochemical survey near Birchdale, MN to determine their usefulness for mineral exploration in areas where bedrock is covered by glacial overburden. These methods are based on selective removal of weakly attached cations to the sample media and are supposedly capable of identifying buried metal deposits underneath allochthonous overburden.

Overburden thickness in the study area varies between 0 and 88 feet. It includes northeast-derived Rainy lobe till and outwash rich in crystalline Precambrian rock fragments and northwest to west-derived glacial sediments with Paleozoic carbonate and granite fragments separated by calcareous lacustrine deposits. The major portion of the grid is located over high ground with a few scattered bedrock outcrops piercing shallow water lacustrine sediments. Peat - rich soils are developed over the southwestern part.

The bedrock in the survey area comprises a northeast trending sequence of steeply dipping amphibolite facies mafic and felsic volcanic flows and tuffs, as well as metasediments including oxide facies iron formation. These lithologies are intruded by monzonite and gabbro-pyroxenite stocks and sills (?). Massive pyrrhotite intercalations were intersected by exploration drill holes. Additional sulfides in decreasing abundance include: pyrrhotite, pyrite, chalcopyrite, sphalerite, pentlandite, marcassite and cubanite.

208 soil samples were collected at 50 foot intervals along five lines 400 feet apart. The B-horizon soil sample depths were based on profiles prepared by Natural Resource Conservation Service staff from Koochiching County.

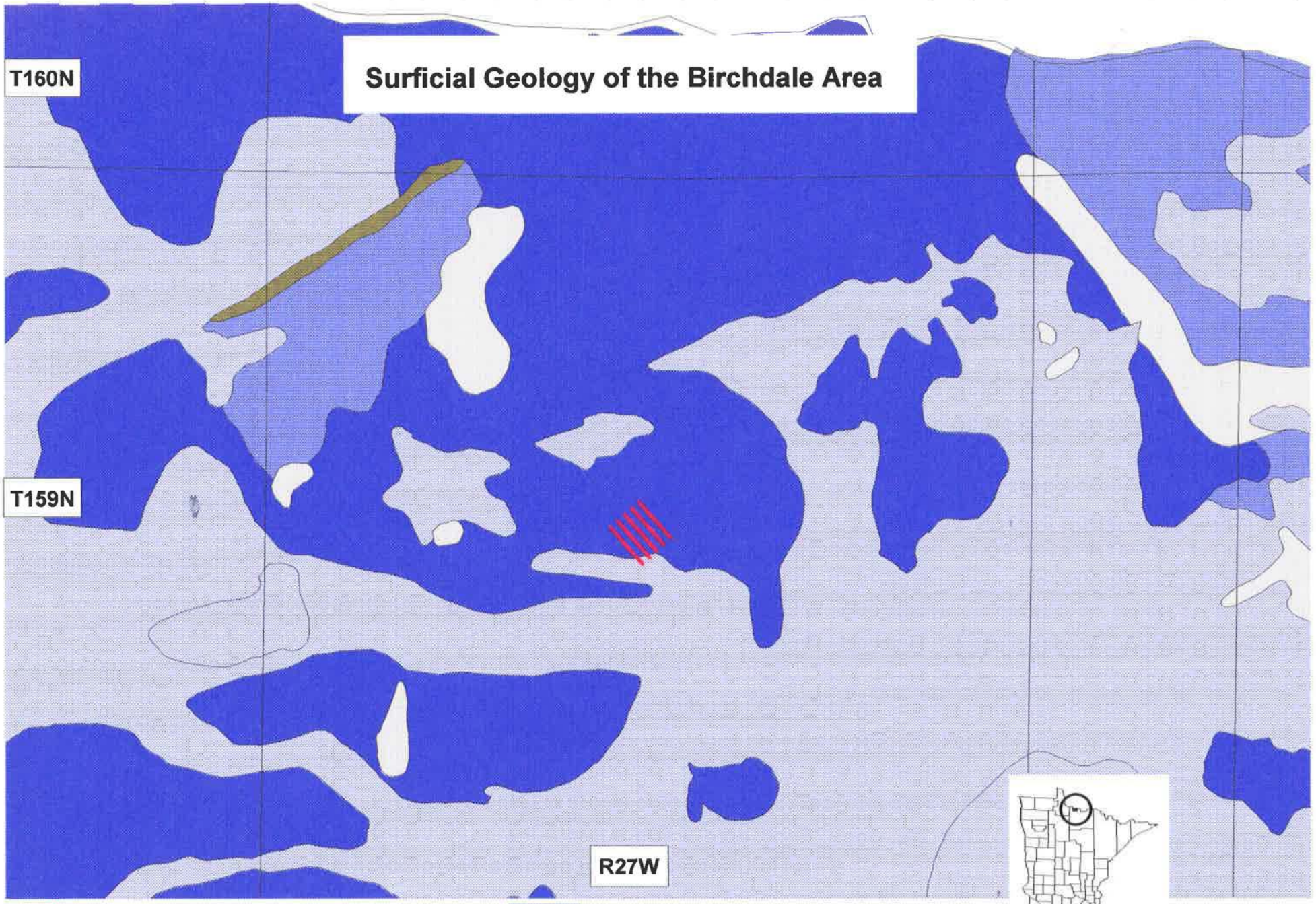
Enzyme Leach™ samples were analyzed by Neutron Activation laboratories utilizing instrumental neutron activation analysis, while the MMI samples were analyzed by XRAL Laboratories, Toronto, ONT. Information provided to the contractors before the first draft of the report excluded any specific reference to known mineralization and nature of the overburden.

Metal values from DNR assessment files include a 2.5 foot interval assaying 4.06% zinc and 0.25 oz/ton silver. Ground geophysical surveys established northeast trending conductors of about 200 feet and 400 feet within a similarly trending 1,650 foot magnetic anomaly. The conductors are open to the northeast and the magnetic anomaly is open at both ends.

Both data sets were statistically evaluated, kriged, contoured and interpreted by contractors. These interpretations established anomalous zinc values trending north and east from line 44 along the baseline, with a small anomaly on line 48 just southeast of the baseline which may reflect the values reported in drill core above. The anomaly is open to the northeast.


SASKATCHEWAN
MANITOBA
ONTARIO
Winnipeg
Birchdale Area
International Falls
Thunder Bay
Duluth
MINNESOTA

Surficial Geology of the Birchdale Area



Geochemical Test Lines

Koochiching Lobe - lake washed till

Scoured Bedrock Uplands

Lacustrine - shallow water (sandy)

Beach

Peat

Surficial geology from Moores, H. D.,Sharkey,John, Madigan, T. M., and Partch, G. M., 1996. Geomorphology of Northern Minnesota, Digital coverage: Minnesota Department of Natural Resources - Division of Forestry

LEGEND

Fault

NEOARCHEAN (2800 - 1500 Ma)

LATE OROGENIC PLUTONIC ROCKS

Wg — Granite, granodiorite, undivided

Wy — Syenite, monzonite, diorite

EARLY OROGENIC AND SYNVOLCANIC PLUTONIC ROCKS

Wt — Tonalitic and granodioritic orthogneiss; tonalite, trondhjemite, and granodiorite intrusions

Wma — Mafic, ultramafic and anorthositic intrusions

SUPRACRUSTAL ROCKS

Ws2 — Early successor basin sequences. Turbiditic and alluvial-fluvi sedimentary and calc-alkalic volcanic rocks

Ws1 — Accretionary complexes. Turbiditic sedimentary rocks and related gneiss and diatexite

Wvb — Arc volcanic sequences. Differentiated and bimodal mafic-felsic calc-alkaline and tholeiitic volcanic rocks, subvolcanic intrusions, volcanogenic sedimentary rocks, and iron formation

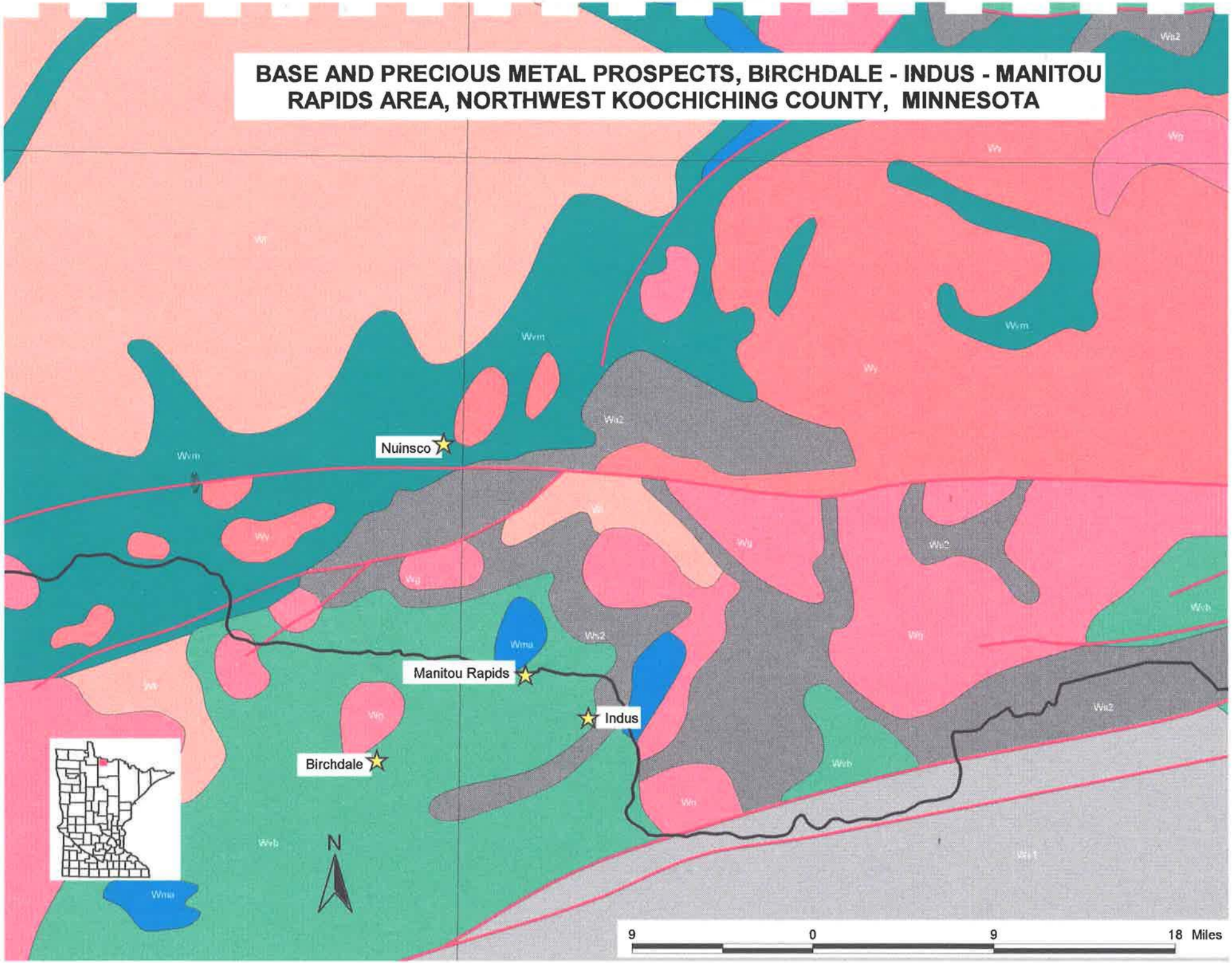
Wvm — Submarine mafic plain sequences. Tholeiitic-komatiitic volcanic rocks, subvolcanic maffic-ultramafic intrusions, minor volcanoeginc sedimentary rocks, and iron formation

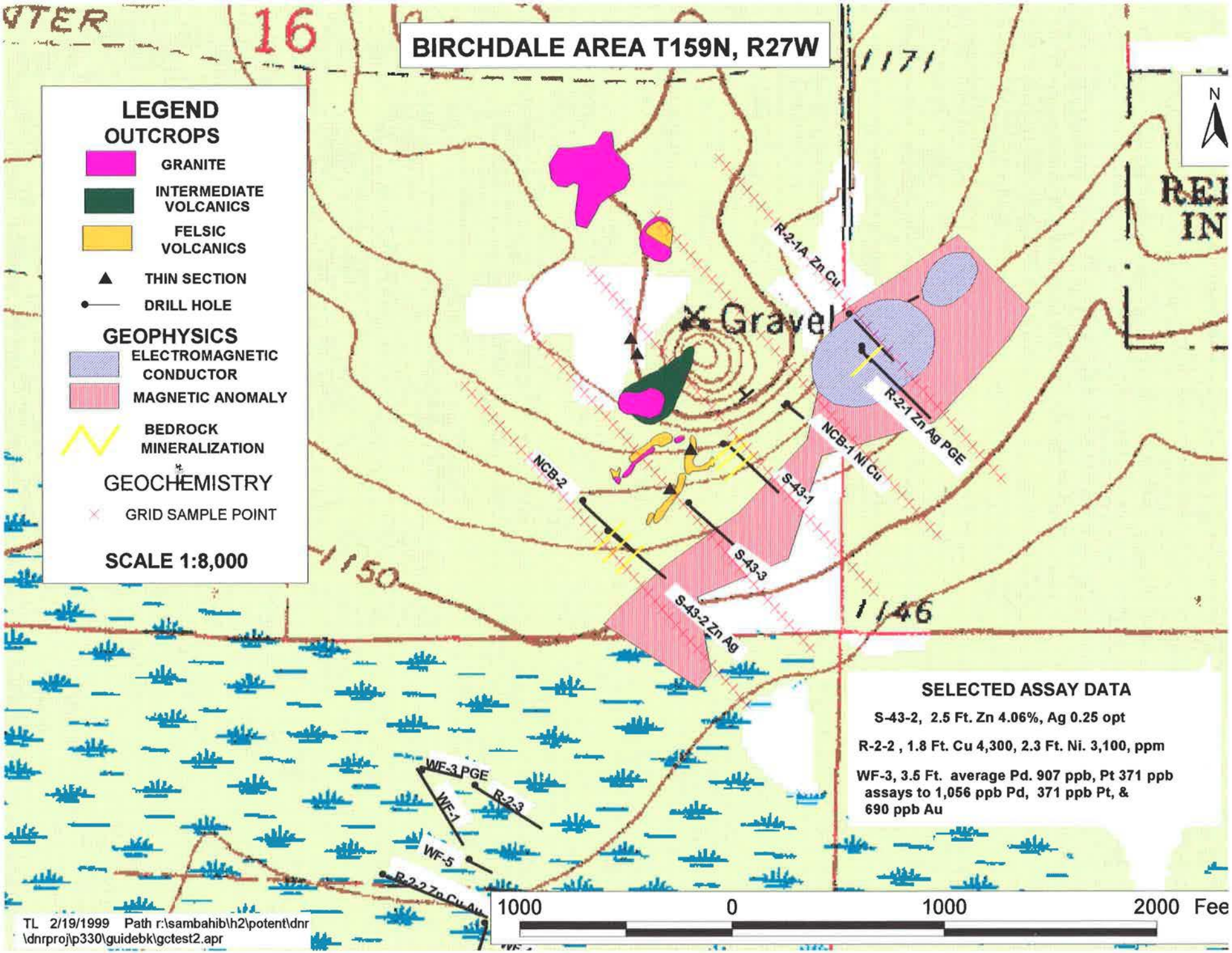
Cover: portion of the Compilation Superior Province, K.D.H. Card (in preparation) courtesy Geological Survey of Canada

International Boundary

March 1999

BASE AND PRECIOUS METAL PROSPECTS, BIRCHDALE - INDUS - MANITOU RAPIDS AREA, NORTHWEST KOOCHICHING COUNTY, MINNESOTA

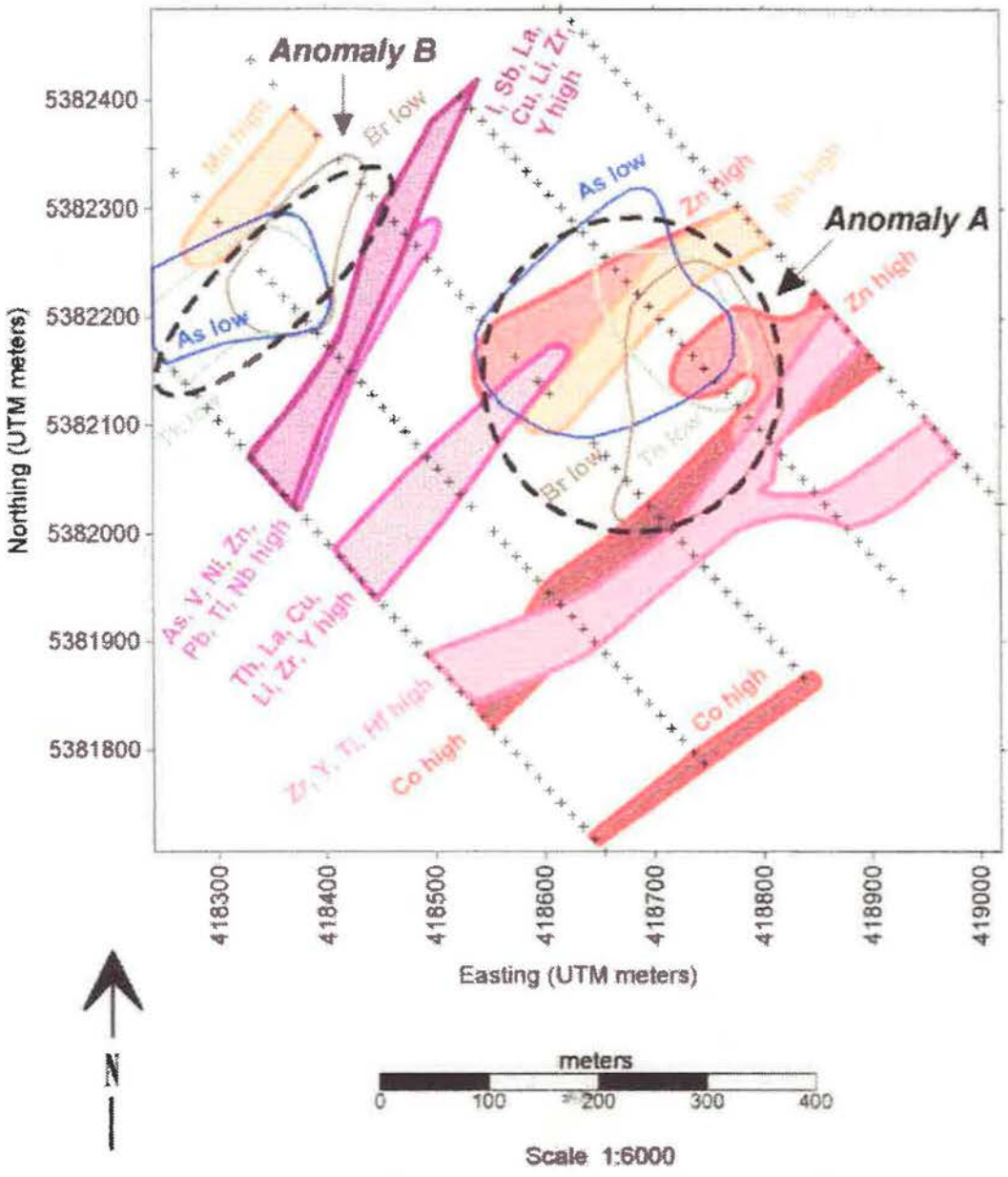



BIRCHDALE AREA T159N, R27W
LEGEND
OUTCROPS
GRANITE
INTERMEDIATE VOLCANICS
FELSIC VOLCANICS
THIN SECTION
DRILL HOLE
GEOPHYSICS
ELECTROMAGNETIC CONDUCTOR
MAGNETIC ANOMALY
BEDROCK MINERALIZATION
GEOCHEMISTRY
GRID SAMPLE POINT
SCALE 1:8,000
16
1171
1150
1146
Gravel
N
R-2-1A Zn Cu
R-2-1 Zn Ag PGE
NCB-1 Ni Cu
NCB-2
S-43-1
S-43-3
S-43-2 Zn Ag
WF-3 PGE
R-2-3
WF-1
WF-5
R-2-2 Zn Cu Au
SELECTED ASSAY DATA
S-43-2, 2.5 Ft. Zn 4.06%, Ag 0.25 opt
R-2-2 , 1.8 Ft. Cu 4,300, 2.3 Ft. Ni. 3,100, ppm
WF-3, 3.5 Ft. average Pd. 907 ppb, Pt 371 ppb assays to 1,056 ppb Pd, 371 ppb Pt, & 690 ppb Au
1000 0 1000 2000 Fee
TL 2/19/1999 Path r:\sambahib\h2\potent\dnr \dnrproj\p330\guidebk\gctest2.apr

Enzyme Laboratories, Inc.

Minnesota DNR - Project 330 - Enzyme Leach Orientation Survey
Enzyme Leach℠ Data
Interpretive Overlay

Drawn by: Greg Hill Date: February 16, 1999

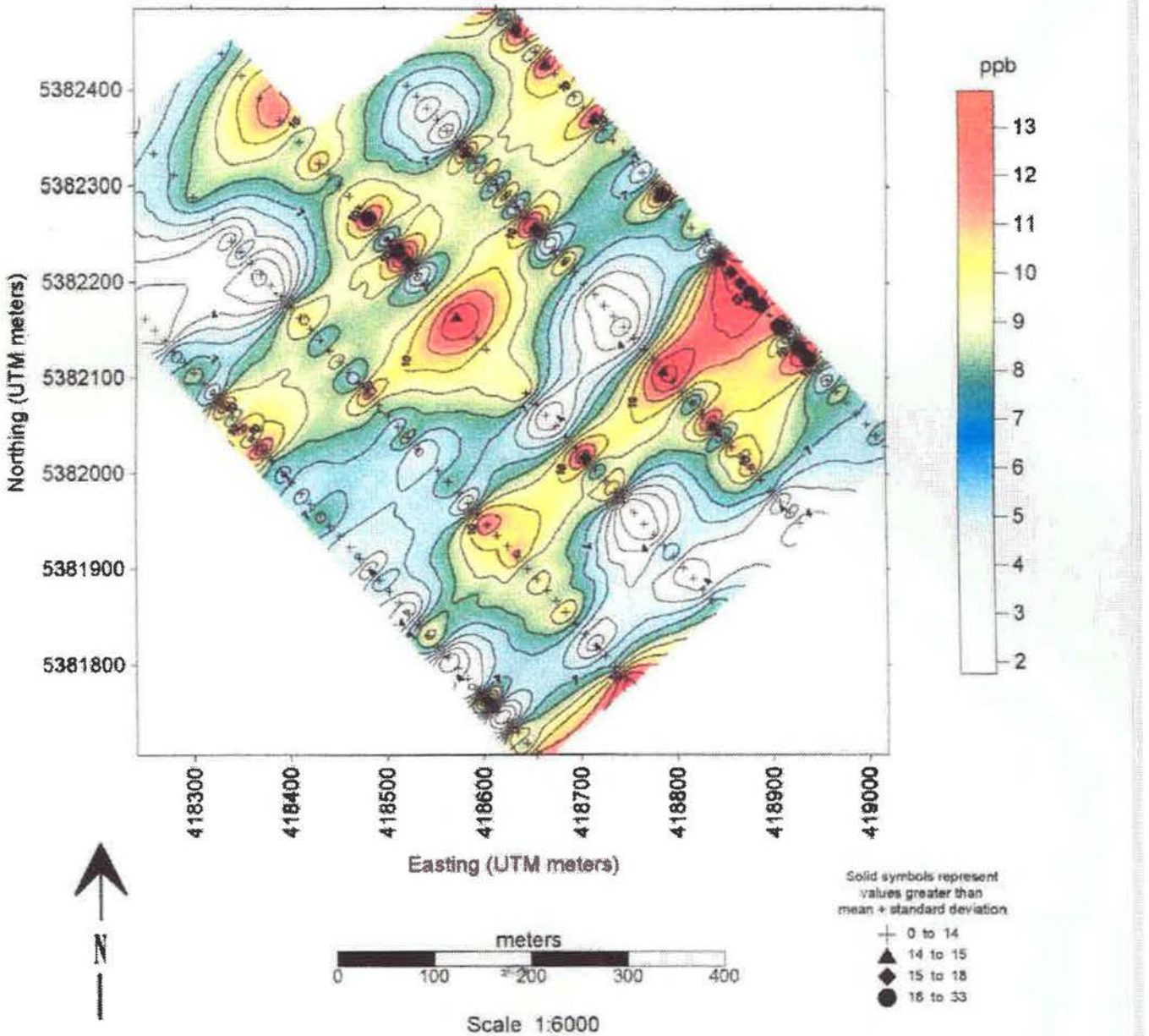


Enzyme Laboratories, Inc.

Minnesota DNR - Project 330 - Enzyme Leach Orientation Survey
Enzyme Leach™ Data

Element Group: Metals **Element: Cobalt**

Drawn by: Greg Hill Date: February 16, 1999

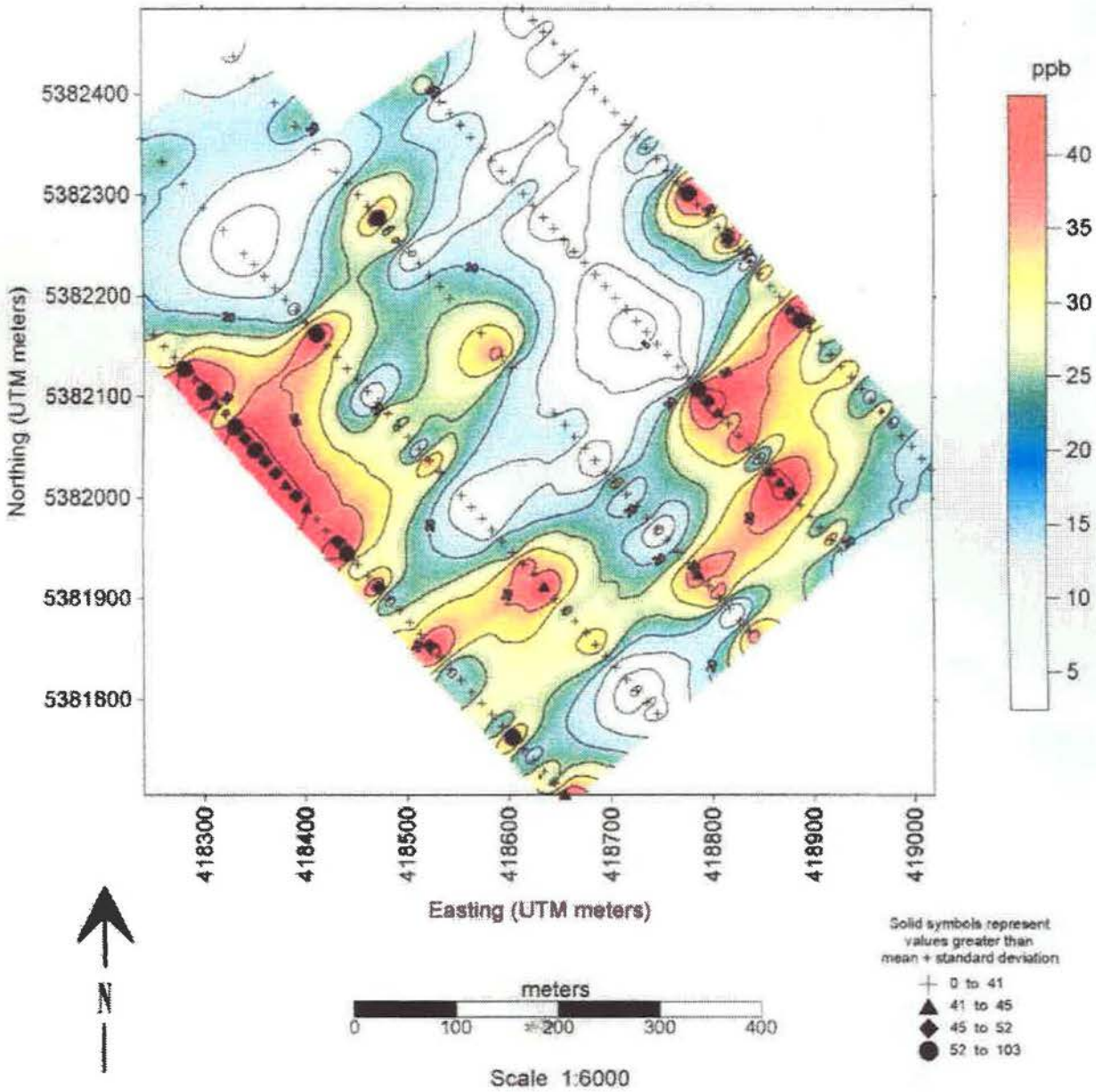


Enzyme Laboratories, Inc.

Minnesota DNR - Project 330 - Enzyme Leach Orientation Survey
Enzyme Leach™ Data

Element Group: Metals **Element: Copper**

Drawn by: Greg Hill **Date: February 16, 1999**

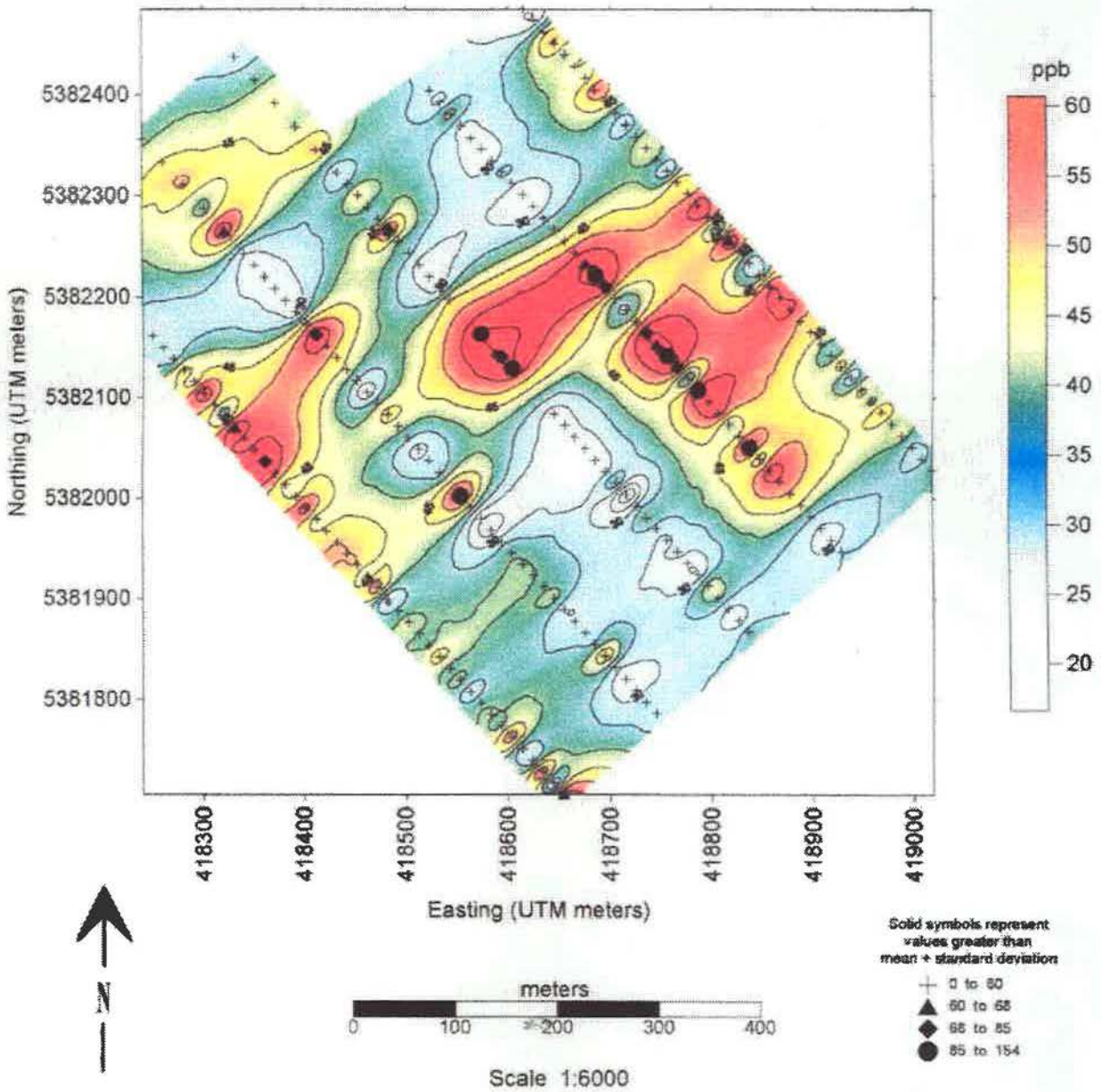


Enzyme Laboratories, Inc.

Minnesota DNR - Project 330 - Enzyme Leach Orientation Survey
Enzyme Leach℠ Data

Element Group: Metals **Element: Zinc**

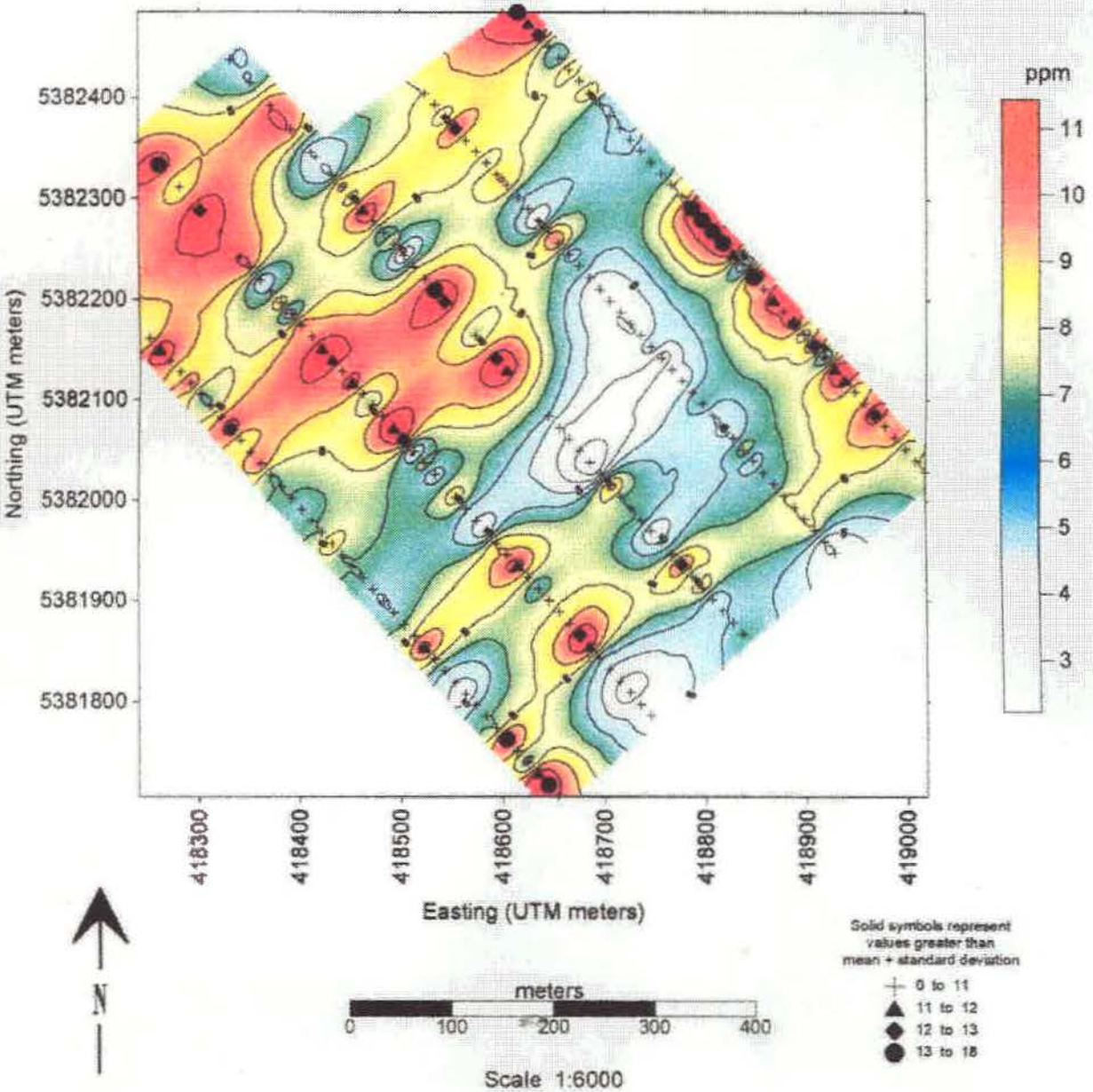
Drawn by: Greg Hill Date: February 16, 1999



Enzyme Laboratories, Inc.

Minnesota DNR - Project 330 - Enzyme Leach Orientation Survey
Soils Data (INAA + 4 acid ICP-OES)
Element: Cobalt

Drawn by: Greg Hill Date: February 17, 1999



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Soils Data (INAA + 4 acid ICP-OES)
Element: Copper
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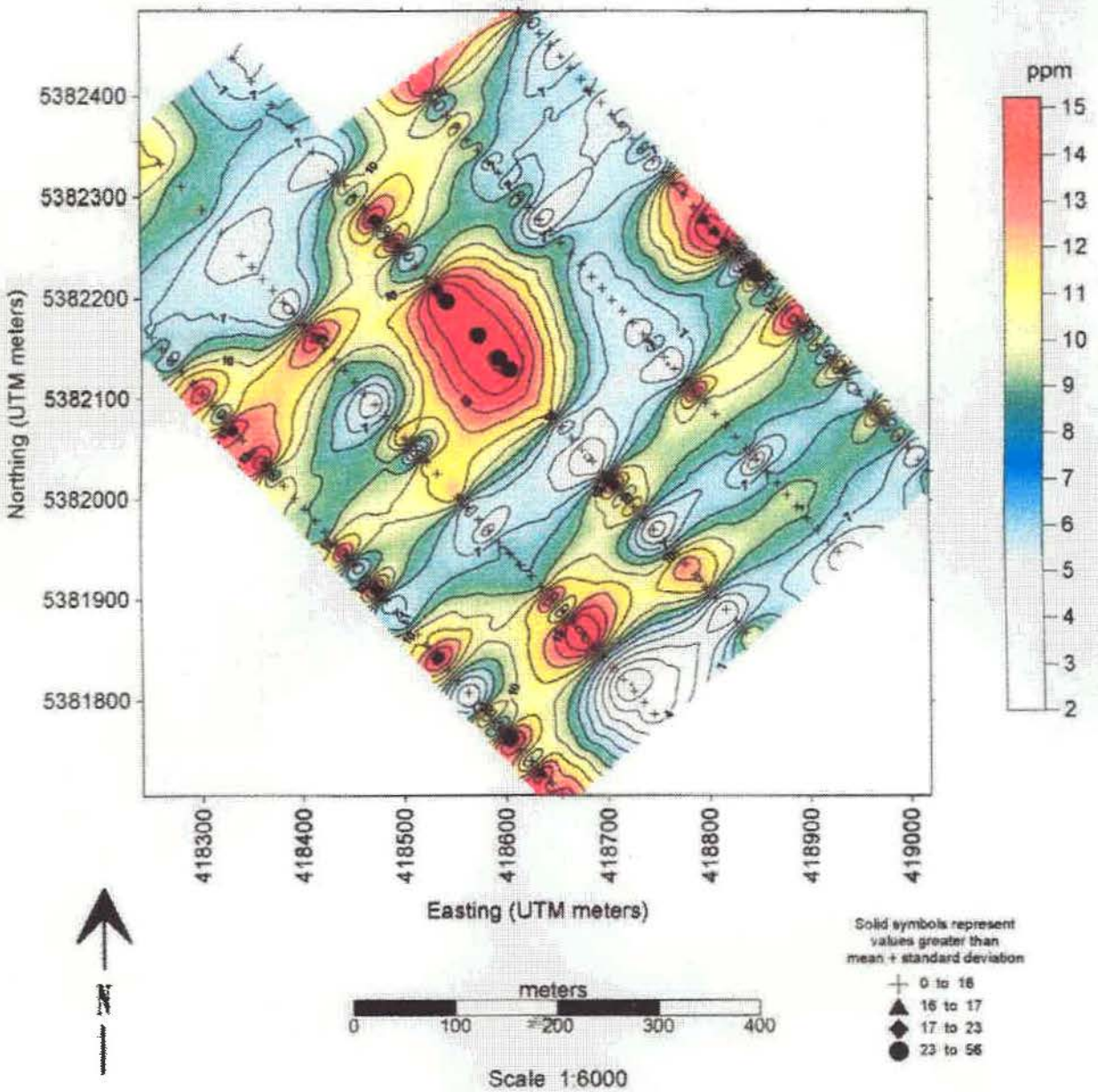

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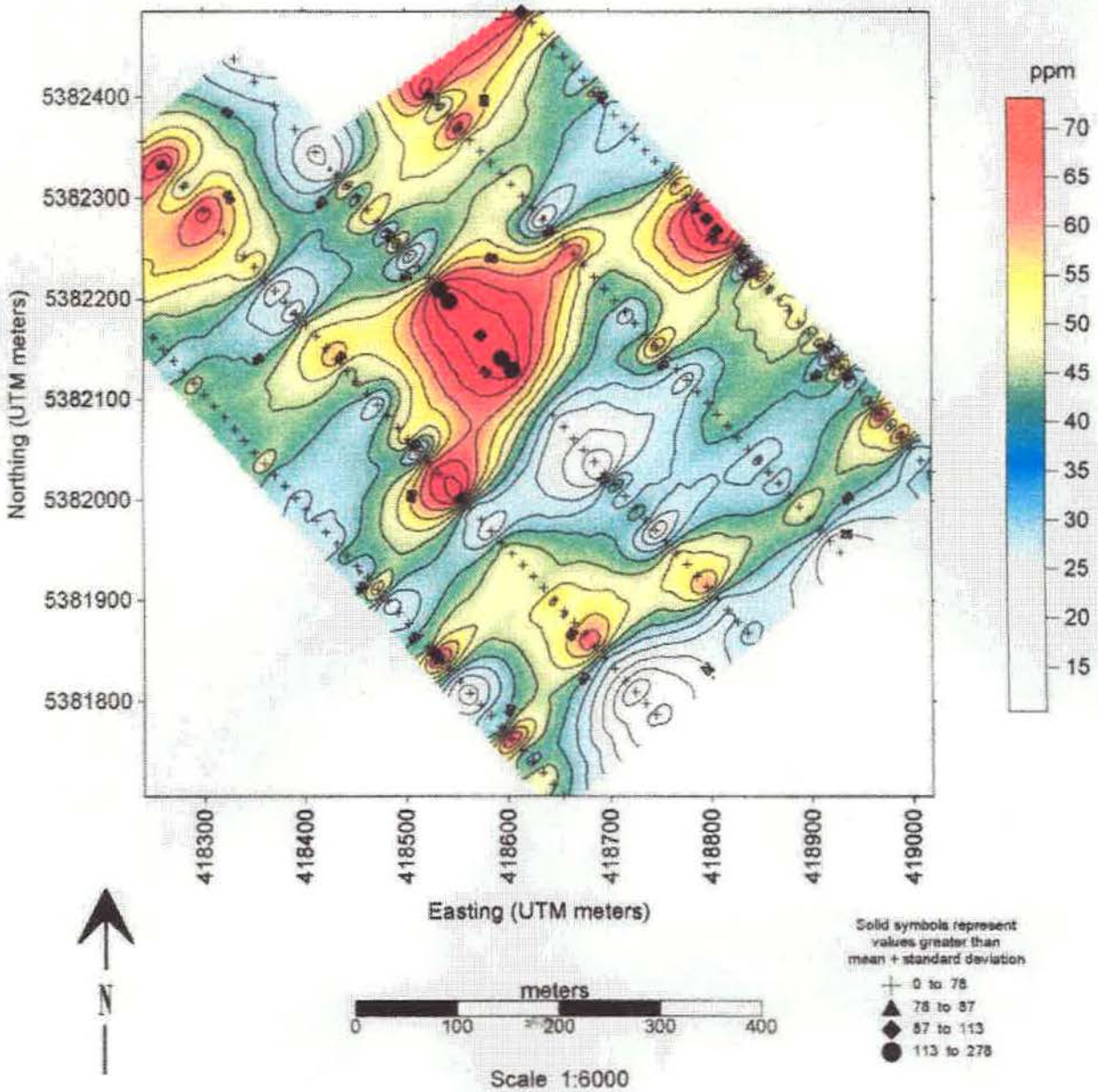
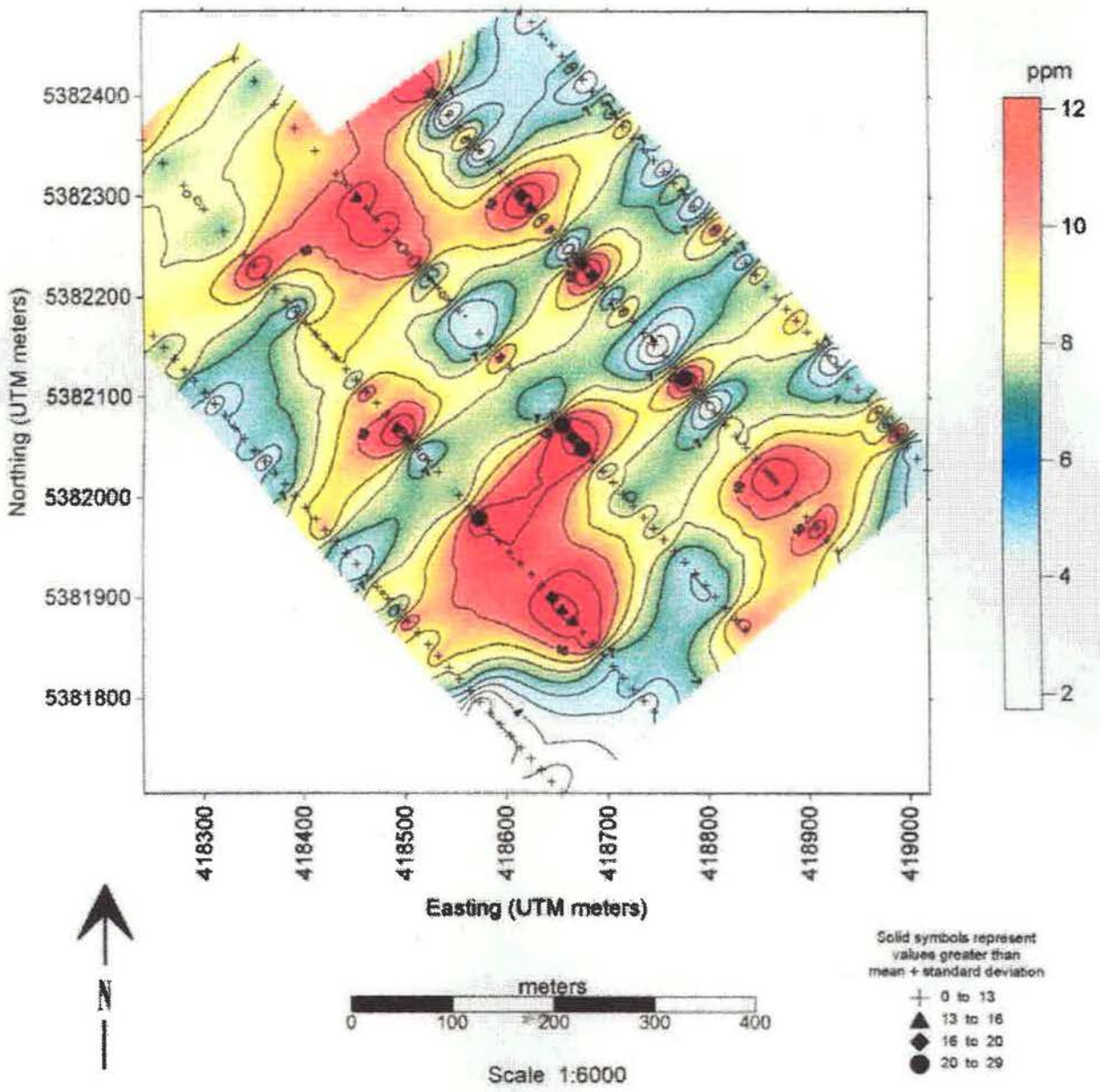


Enzyme Laboratories, Inc.

Minnesota DNR - Project 330 - Enzyme Leach Orientation Survey
Humus Data (INAA)
Element: Cobalt

Drawn by: Greg Hill Date: February 16, 1999



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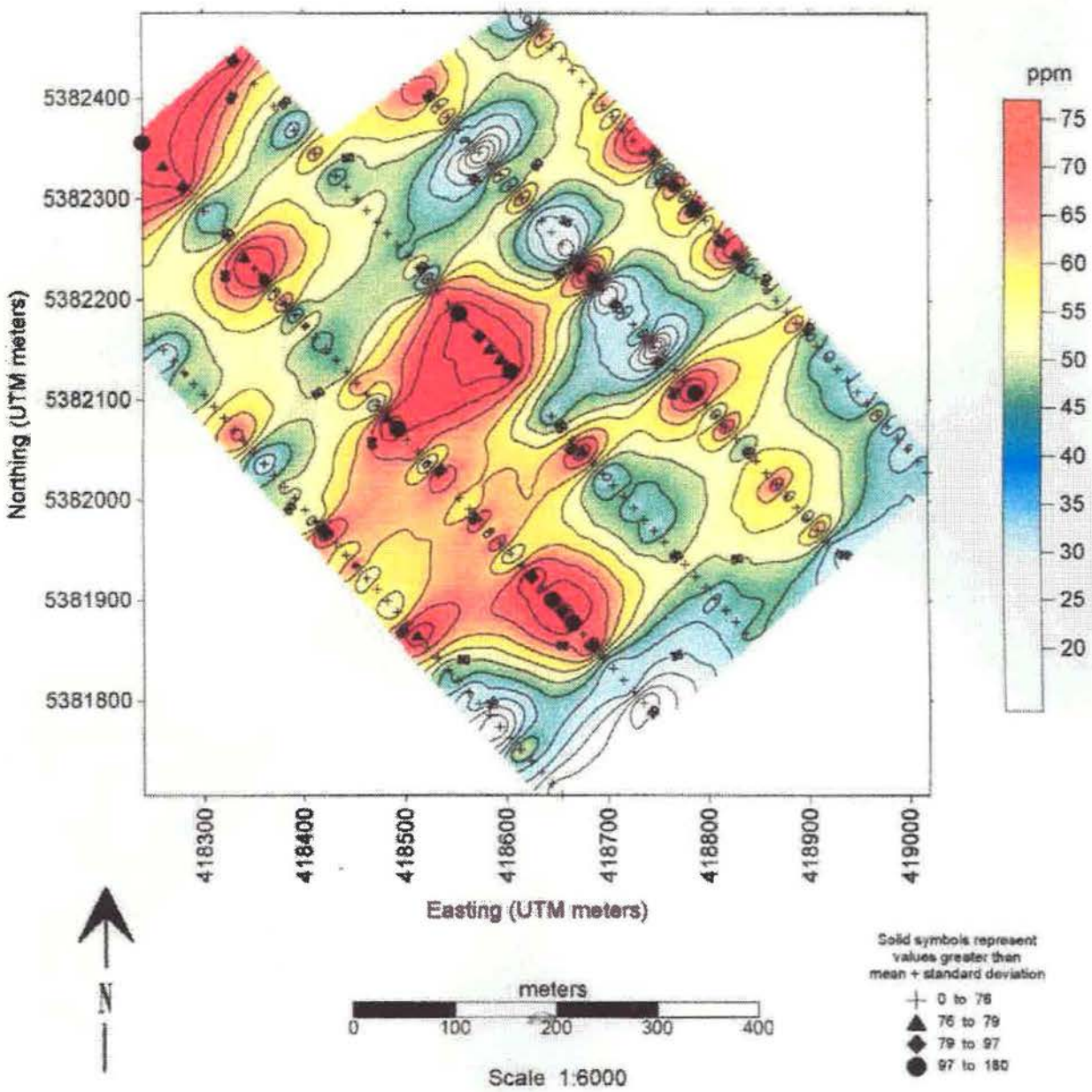
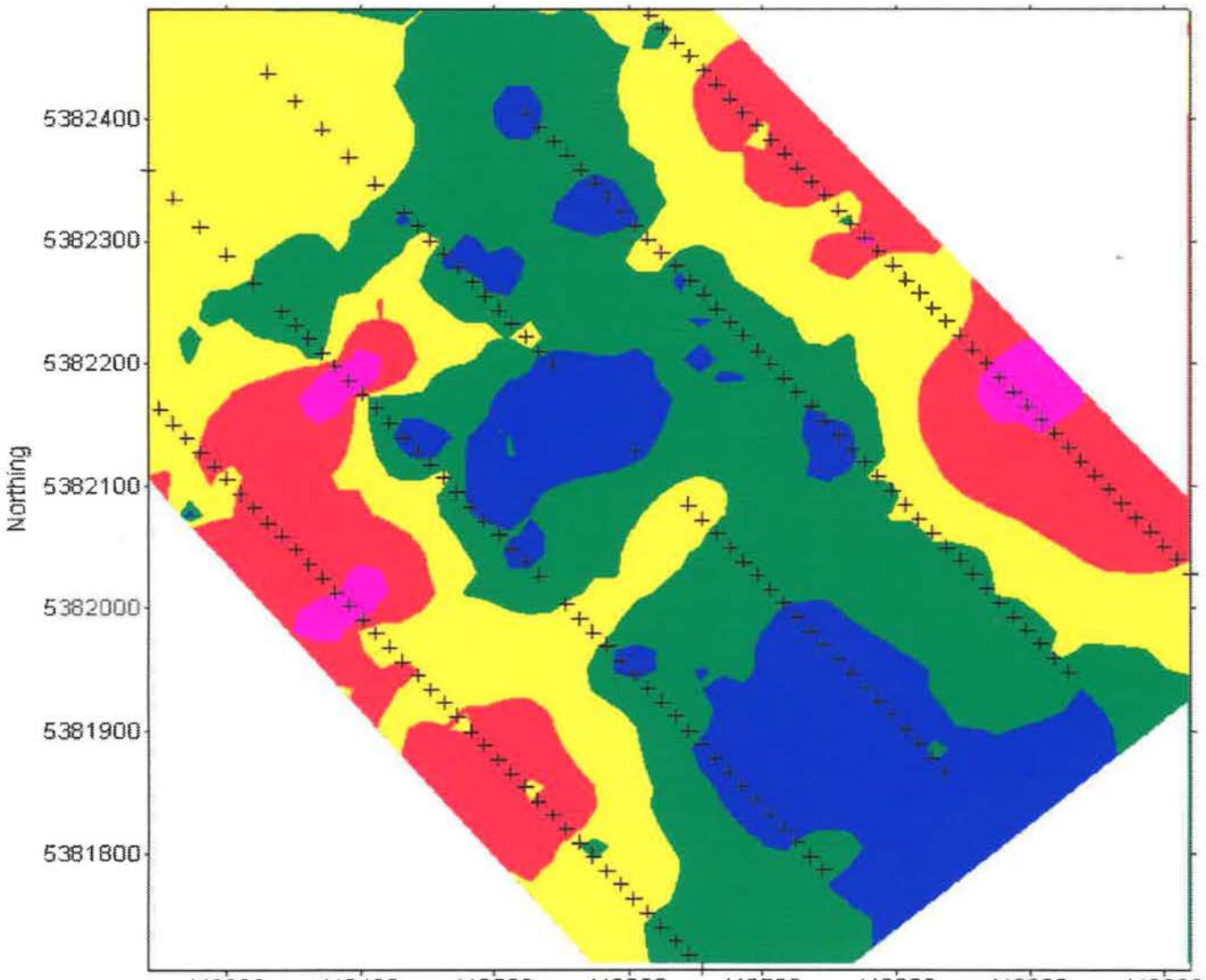
Minnesota DNR - Project 330 - Enzyme Leach Orientation Survey
Humus Data (INAA)
Element: Zinc

Drawn by: Greg Hill Date: February 16, 1999





0 100 200 300 400

Scale 1:5,000

Mobile Metal Ion
mmi
TECHNOLOGY
MMI Imaging Service

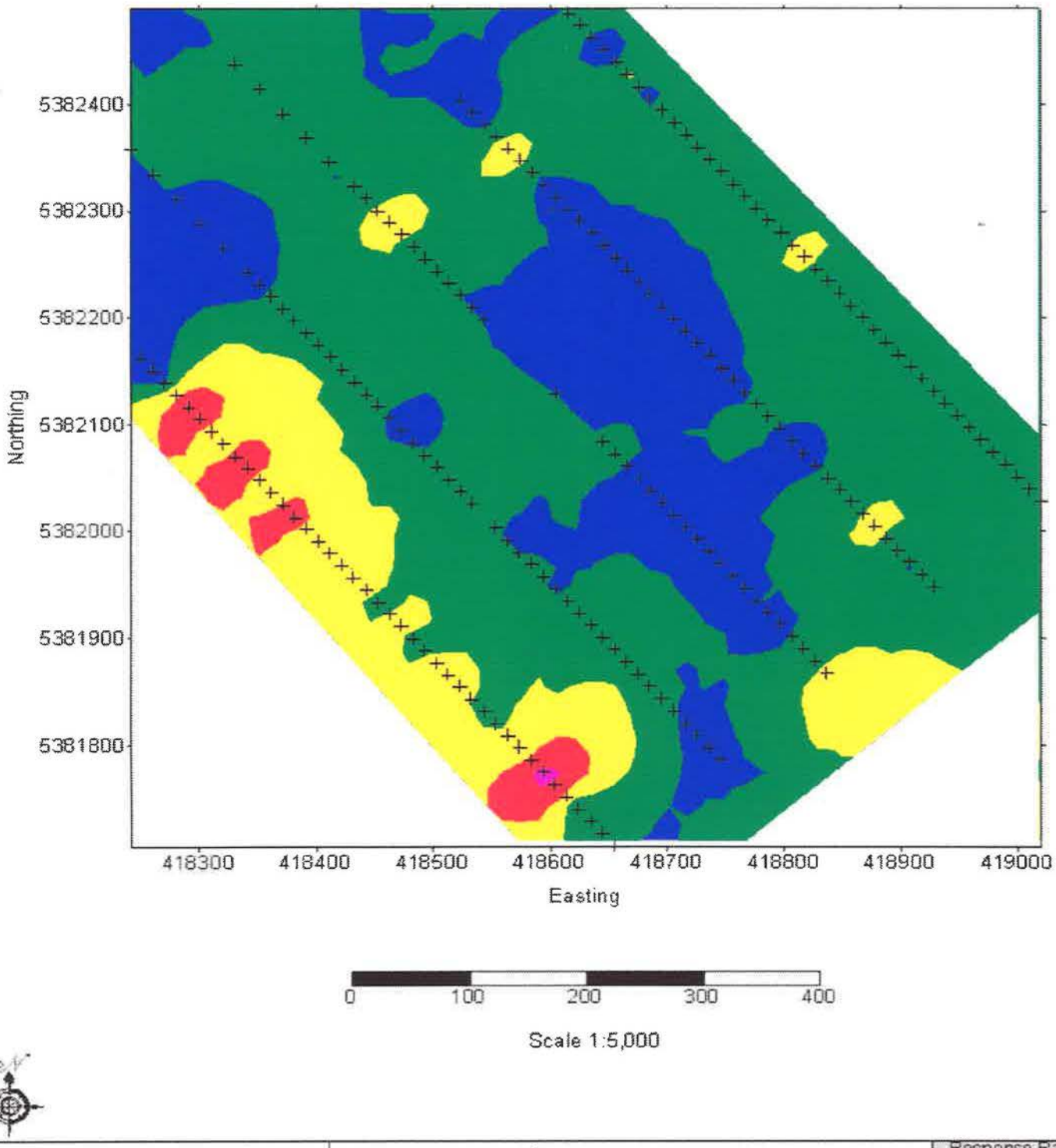
MMI Response Ratio Image for Co Kriging Interpolation

Project: 330 Birchdale Area, NWest Koochiching County, N. Minnesota
Company: Minnesota Department of Natural Resources, Division of Minerals

Drawn by: S. Staltari	Report: C323	Date: 30/06/99

Response Ratio Contour Intervals

Min	Max
20	
10	20
5	10
2	5
-	2



Mobile Metal Ion
mmi
TECHNOLOGY
MMI Imaging Service

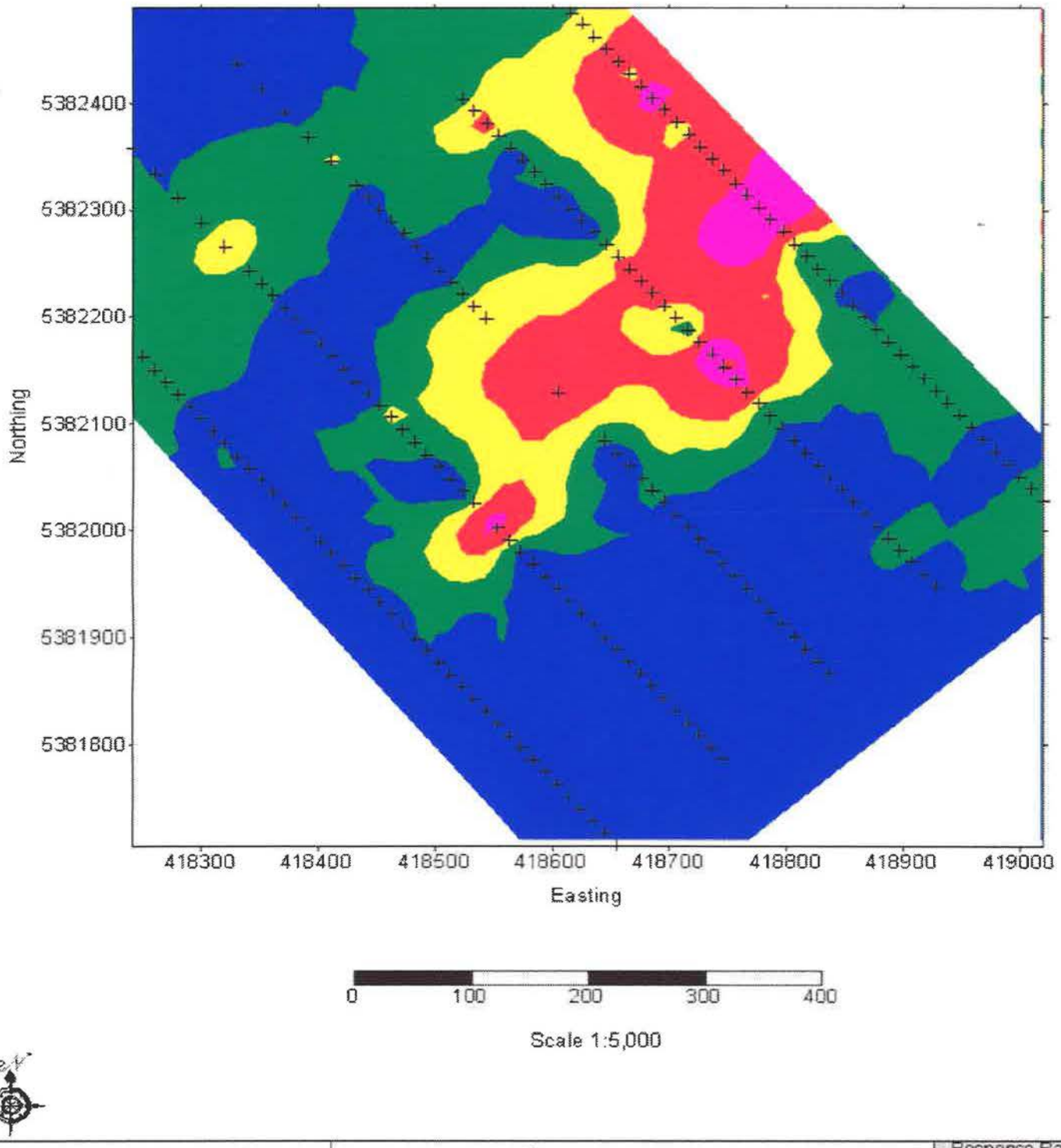
MMI Response Ratio Image for Cu Kriging Interpolation

Project: 330 Birchdale Area, NWest Koochiching County, N. Minnesota
Company: Minnesota Department of Natural Resources, Division of Minerals

Drawn by: S. Staltari	Report: C323	Date: 30/06/99

Response Ratio Contour Intervals

Min	Max
20	
10	20
5	10
2	5
-	2



Mobile Metal Ion
mmi TECHNOLOGY
MMI Imaging Service

MMI Response Ratio Image for Zn Kriging Interpolation

Project: 330 Birchdale Area, NWest Koochiching County, N. Minnesota
Company: Minnesota Department of Natural Resources, Division of Minerals

Drawn by: S. Staltari	Report: C323	Date: 30/06/99

Response Ratio Contour Intervals

Min	Max
20	
10	20
5	10
2	5
-	2