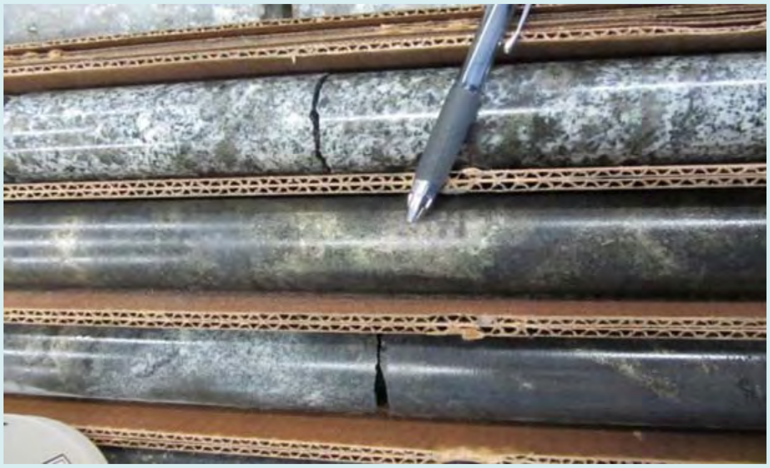
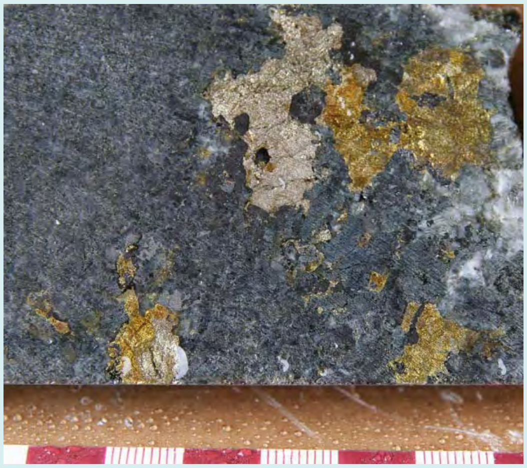
Duluth Metals Limited

Maturi, Birch Lake, and Spruce Road Cu-Ni-PGE Projects
Ely, Minnesota USA
NI 43-101 Technical Report





Prepared for:
Duluth Metals Limited

Prepared by:
Harry Parker, Ph.D., SME-RM
Ted Eggleston, Ph.D., SME-RM

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168052

CERTIFICATE OF QUALIFIED PERSON

Harry Parker, Ph.D., RM SME
AMEC E&C Services Inc.
780 Vista Boulevard
Sparks, NV, 89434
Tel (775) 331 2375
Fax (775) 331 4153.
harry.parker@amec.com

I, Harry Parker, Ph.D., RM SME., am employed as a Technical Director with AMEC E&C Services, Inc. (AMEC).

This certificate applies to the technical report titled "NI 43-101 Technical Report on the Maturi, Birch Lake, and Spruce Road Copper-Nickel-PGE Projects, Ely, Minnesota, USA" that has an effective date of June 15, 2012 (the "Technical Report").

I am a Fellow of the Australian Institute of Mining and Metallurgy (#113051), and a Registered Member of the Society for Mining, Metallurgy and Exploration (#2460450RM). I am licensed in the State of Minnesota (#49606). I graduated from Stanford University with BSc and PhD degrees in Geology in 1967 and 1975 respectively. I graduated from Harvard University in 1969 with an AM degree in Geology. I graduated from Stanford University with an MSc degree in Statistics in 1974.

I have practiced my profession for 45 years during which time I have been involved in the estimation of mineral resources and mineral reserves for various mineral exploration projects and operating mines. I have either estimated or audited Ni, Cu and PGE resources for a number of mineral deposits, including the Platreef deposit (South Africa), Area 5 deposit (Maine), Stillwater (Montana); McCreedy East (Ontario), and Voiseys Bay (Labrador).

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101).

I visited the Twin Metals Mining Project (the "Project") most recently between 6 and 16 September 2011.

I am responsible for Section 14 of the Technical Report.

I am independent of Duluth Metals Limited as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Twin Metals Mining Project since 2011 during which time I have prepared or supervised mineral resource estimates on the Project.

I have read NI 43–101 and those sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument.

As of the date of this certificate, to the best of my knowledge, information and belief the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

“Signed and sealed”

Harry Parker, Ph. D., RM SME

Dated: 27 July 2012

CERTIFICATE OF QUALIFIED PERSON

Ted Eggleston, Ph.D., RM SME
AMEC E&C Services Inc.
780 Vista Boulevard
Sparks, NV, 89434
Tel (775) 331 2375
Fax (775) 331 4153.
ted.eggleston@amec.com

I, Ted Eggleston, Ph.D., RM SME., am employed as a Principal Geologist with AMEC E&C Services, Inc. (AMEC).

This certificate applies to the technical report titled "NI 43-101 Technical Report on the Maturi, Birch Lake, and Spruce Road Copper-Nickel-PGE Projects, Ely, Minnesota, USA" that has an effective date of June 15, 2012 (the "Technical Report").

I am a Registered Member of the Society for Mining, Metallurgy and Exploration (#4115851RM) and licensed as a Professional Geologist in the States of Wyoming (PG-1830) and Georgia (PG002016). I graduated from Western State College of Colorado with a BA degree in 1976 and from the New Mexico Institute of Mining and Technology with MSc and PhD degrees in Geology in 1982 and 1987 respectively.

I have practiced my profession for 35 years during which time I have been involved in the exploration for, and estimation of, mineral resources and mineral reserves, for various mineral exploration projects and operating mines. I have explored for, provided technical assistance for, or audited Ni, Cu and PGE resources for a number of mineral deposits, including Munali (Zambia); Niquelândia and Fortaleza (Brazil); Stillwater (Montana); McCreedy East, McCreedy West, Levack, Thunder Bay North (Ontario); Bucko Lake (Manitoba); and Kabanga (Tanzania).

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 Standards of Disclosure for Mineral Projects (NI 43–101).

I visited the Twin Metals Mining Project (the "Project") several times during preparation of this report, most recently on 6 - 16 from September 2011 with subsequent visits as to 6-22 June 2012. These visits were made under the supervision of Dr Harry Parker.

I am responsible for sections 1 through 13 and 15 through 27 of the Technical Report.

I am independent of Duluth Metals Limited as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Twin Metals Mining Project since 2011 during which time I have supervised data collection and geological modeling leading mineral resource estimates on the Project.

I have read NI 43–101 and those portions of the Technical Report for which I am responsible have been prepared in compliance with that Instrument.

As of the date of this certificate, to the best of my knowledge, information and belief the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

"Signed and sealed"

Ted Eggleston, Ph. D, RM SME

Dated: 27 July 2012

IMPORTANT NOTICE

This report was prepared as National Instrument 43-101 Technical Report for Duluth Metals Limited (Duluth) by AMEC E&C Services, Inc. (AMEC). The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC's services, based on i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This report is intended for use by Duluth subject to terms and conditions of its contract with AMEC. Except for the purposed legislated under Canadian provincial and territorial securities law, any other uses of this report by any third party is at that party's sole risk.

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1.0 SUMMARY

Twin Metals Minnesota LCC (TMM) requested on behalf of Duluth Metals Limited (Duluth) that AMEC E & C Services Inc. (AMEC) provide an independent Technical Report (the Report) summarizing the information supporting updated Mineral Resource estimates for the Maturi, Birch Lake, and Spruce Road deposits on the Twin Metals Minnesota Project (the Project) located near Ely Minnesota, USA.

TMM is a limited liability company that, since 2010, has been operated as a joint venture between Antofagasta PLC (Antofagasta) and Duluth, under a Participation and Limited Liability Company Agreement ("Participation Agreement"). TMM is 35% owned by Duluth, 25% owned by Twin Metals (USA) LLC (which is indirectly owned by Duluth) and 40% owned by Northern Minerals Holding Co. (which is indirectly owned by Antofagasta). Accordingly, Duluth holds, directly or indirectly, a 60% controlling interest in TMM.

The Technical Report supports disclosure of an updated Mineral Resource estimate for the Project in the Duluth press release dated 13 June 2012, entitled "Duluth Metals Announces New AMEC NI 43-101 Technical Report Confirming Significant Increases to Twin Metals' Copper-Nickel-Palladium-Platinum-Gold Resource".

1.1 Key Outcomes

The Mineral Resource estimates for the three deposits are as follows:

Deposit	Cut-off Cu (%)	Tons (Million)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
Maturi (Indicated)	0.3	726	0.55	0.17	0.150	0.342	0.078	0.004	0.010	0.002
Maturi (Inferred)	0.3	651	0.53	0.18	0.118	0.328	0.075	0.003	0.01	0.002
Birch Lake (Inferred)	0.3	242	0.52	0.16	0.230	0.490	0.110	0.007	0.014	0.003
Spruce Road (Inferred)	0.3	480	0.43	0.16						

Note: All tonnages are in million short tons (Mt)

Exploration of the deposits has been completed primarily with drilling because of the depth of the deposits. Geophysical and geochemical exploration has met with limited success. Approximately 930 core holes have been drilled in the area of the deposits for a total of 1,939,914 feet (591,287 m) of drilling.

The Project database was extensively audited and checked and found to be adequate to support resource estimation.

Metallurgical testwork is very preliminary, but is adequate to demonstrate that the mineralization at all three deposits is amenable to concentration using conventional concentration methods. Recoveries are adequate, but the best recoveries result in moderate concentrate grades. Those concentrates are believed to be saleable, but onsite processing using Platsol™ or CESL™ technologies was investigated and found to be a possible alternative to conventional smelting for final extraction of metals. Metallurgical testwork is adequate to support preliminary resource estimation.

Geotechnical evaluation of the deposits is minimal but adequate to indicate that underground mining is possible. Conceptual mine and process design identified a number of scenarios that indicate reasonable prospects for economic extraction of the deposits.

AMEC recommends work that will allow the completion of a prefeasibility study with the focus of the study to be the development, initially of the Maturi and Birch Lake deposits.

Prior to prefeasibility study, approximately 492,000 ft (149,960 m) of drilling is recommended, with samples collected from the mineralized intervals. This drilling should focus on validation of legacy data and conversion of Inferred Mineral Resources to Indicated Mineral Resources. Approximately 5,000 ft (1,524 m) of drilling may be required for geotechnical evaluation of the deposits. Metallurgical testwork should be aimed at defining the flowsheet and estimating approximate capital and operating costs associated with production. Environmental baseline data collection should also be a priority. Mine planning, combining all of the above data, should be completed in order to estimate the capital and operating costs associated with mining the deposits. When the above work is completed, an economic evaluation of the deposit should be completed.

1.2 Property Description and Ownership

Land in Minnesota is held by a combination of private, state and federal owners and land is subject to typical United States split-estate holdings, where the surface owner(s) may be different from the sub-surface owner(s).

Duluth, through its joint venture ownership in Twin Metals Minnesota LCC (TMM) has the benefit of various mineral interests including state leases, federal leases, private leases and federal prospecting permits, federal prospecting permit applications, a preference right lease application, and fee or option for fee interests, as summarized in Table 1-1. When not held in TMM's own name, TMM's mineral interests are held by its wholly owned subsidiary, Franconia Minerals (US) LLC or through the Birch Lake Joint Venture. The mineral interests of the Birch Lake Joint Venture are, in turn, held by

Lehmann Exploration Management, Inc., Beaver Bay, Inc., Lehmann Trust, or Beaver Bay Joint Venture Trust. For simplicity of reference, the mineral interests held by TMM in its own name as well as the mineral interests held by Franconia Minerals (US) LLC or through the Birch Lake Joint Venture are referred to in this report as TMM's mineral interests. (For a description of Duluth's ownership in TMM and TMM's company structure, see Section 4.4.)

Subject to certain exceptions, TMM's mineral interests under state and federal leases and federal prospecting permits are insured pursuant to title insurance policies issued by First American Title Insurance Company on August 4, 2010 and August 31, 2011 as policy nos., NCS-428640 (Nokomis) and NCS-471210 (Franconia) (note that TMM's mineral interests lying beneath the beds of reservoirs or other bodies of water are not insured by the above-referenced title polices).

Table 1-1: Summary of TMM Mineral Interests

Type	Number	Acres	Hectares
Federal Mineral Leases	2	4,944.78	2,001.09
Federal Prospecting Permits	3	1,818.46	735.91
Federal Prospecting Permit with Preference Rights Lease Application	1	13.75	5.56
Federal Prospecting Permit Applications	10	7,935.41	3,211.35
State Mineral Leases	27	6,012.84	2,433.31
Private Mineral Leases	13	5,562.93	2,251.24
Fee Minerals	N/A	1,047.75	424.01
Total	56	27,335.92	11,063.3

*In some instances, TMM holds undivided fractional mineral interests. See Tables 4-6, 4-8, and 4-10.

TMM has filed applications for federal prospecting permits pending before the United States Bureau of Land Management ("BLM"), which are not insurable. TMM has the benefit of Federal Preference Rights Lease Application # 50264, which is pending with the BLM.

Expert reports provided to AMEC support Duluth's description of their mineral right ownership covering the areas of exploration and the mineral resource estimates.

1.3 Geology and Mineralization

Mineralization at Maturi, Birch Lake, and Spruce Road are hosted by the Duluth Complex, a composite intrusion comprising 12 sub-intrusions emplaced over a period of 10 to 12 million years. These bodies include the South Kawishiwi Intrusion, Bald Eagle Intrusion, Partridge River Intrusion, Logan Sills, Greenwood Lake Intrusion, Power Line Gabbro, Silver Bay Gabbro, and the Sonju Lake Intrusion. The basal portion of the South Kawishiwi intrusion (SKI) hosts all three deposits in what is locally known as the basal mineralized zone (BMZ) which is more than 1,000 ft thick locally. The BMZ is a complex zone comprising numerous small intrusive bodies ranging in composition from anorthosite to melatroctolite.

Mineralization comprises primarily chalcopyrite, cubanite, and talnakhite with numerous base and precious metals bearing minerals in trace quantities.

The geological setting is adequately known to support resource estimation and preliminary mine planning.

1.4 Exploration

Exploration work completed to date is adequate to support the current resource estimation effort and to guide additional exploration.

Exploration procedures, including drilling, are adequate to support resource estimation. Sampling, sample preparation, and assaying are done using industry-standard procedures. Analytical precision and accuracy are adequate to support resource estimation.

1.5 Mineral Resources

Mineral resources are summarized in the following sections. Mineral Resource estimation procedures for Maturi and Birch Lake are discussed in Section 14. These resources are estimated assuming underground mining as the preferred option. The mineral resource for Spruce Road is a re-tabulation of a 2007 resource estimate produced by Scott Wilson RPA using more current cost estimates and assuming an underground operation only. All tonnages are in million short tons (Mt).

The Qualified Person for the three estimates is Dr Harry Parker, Registered Member, Society for Mining, Metallurgy and Exploration (RM SME). Mineral Resources have an effective date of 23 April, 2012.

1.5.1 Maturi

Table 1-2 shows the base case Maturi Indicated Mineral Resource at a 0.3% copper cut-off grade, as well as sensitivity of the mineral resource to cut-off grade. Table 1-3 shows the Maturi Inferred Mineral Resources at the base case 0.3% copper cut-off grade, as well as the sensitivity of the mineral resource to cut-off grade.

Table 1-2: Maturi – Indicated Mineral Resources by Copper Cut-off Grade

Cut-off Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	836	0.51	0.16	0.139	0.317	0.073	0.004	0.009	0.002
0.3	***726***	***0.55***	***0.17***	***0.150***	***0.342***	***0.078***	***0.004***	***0.010***	***0.002***
0.4	607	0.59	0.18	0.162	0.367	0.083	0.005	0.011	0.002
0.5	430	0.64	0.20	0.180	0.408	0.091	0.005	0.012	0.003
0.6	248	0.71	0.22	0.205	0.464	0.101	0.006	0.014	0.003

Notes: Base case is 0.3% Cu cut-off. Mt = million short tons.

Table 1-3: Maturi – Inferred Mineral Resources by Copper Cut-off Grade

Cut-off Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	748	0.49	0.17	0.110	0.306	0.070	0.003	0.009	0.002
0.3	***651***	***0.53***	***0.18***	***0.118***	***0.328***	***0.075***	***0.003***	***0.010***	***0.002***
0.4	531	0.57	0.19	0.124	0.350	0.079	0.004	0.010	0.002
0.5	354	0.63	0.21	0.132	0.389	0.088	0.004	0.011	0.003
0.6	190	0.70	0.24	0.135	0.434	0.098	0.004	0.013	0.003

Notes: Base case is 0.3% Cu cut-off. Mt = million short tons.

1.5.2 Birch Lake

Birch Lake Inferred Mineral Resources are summarized in Table 1-4.

Table 1-4: Birch Lake Inferred Mineral Resources by Copper Cut-off Grade (Main Zone + Lower Unit)

Cut-off Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	346	0.44	0.14	0.18	0.39	0.09	0.005	0.011	0.003
0.3	***242***	***0.52***	***0.16***	***0.23***	***0.49***	***0.11***	***0.007***	***0.014***	***0.003***
0.4	196	0.57	0.17	0.26	0.55	0.13	0.007	0.016	0.003
0.5	141	0.61	0.18	0.28	0.60	0.14	0.008	0.018	0.004
0.6	65	0.68	0.20	0.32	0.68	0.16	0.009	0.020	0.004

Notes: Base case is 0.3% Cu cut-off. Mt = million short tons.

1.5.3 Spruce Road Resources

Spruce Road resources are summarized in Table 1-5.

Table 1-5: Spruce Road Inferred Mineral Resources by Copper Cut-off

Cut-off Cu (%)	Tons (Mt)	Cu (%)	Ni (%)
0.2	674	0.38	0.14
0.3	***480***	***0.43***	***0.16***
0.4	254	0.5	0.18
0.5	101	0.57	0.21
0.6	24	0.66	0.24

1.6 Recommendations

AMEC recommends that work be completed to allow preparation of a prefeasibility study as the next step in development of the TMM properties. Scoping level studies indicate that mining should begin at Maturi and Birch Lake. The prefeasibility study should be restricted to those two deposits.

Preparations for the prefeasibility study should include approximately 564,000 ft (171,900 m) of drilling with samples collected from the mineralized intervals. This drilling should focus on validation of legacy data and to allow conversion of Inferred Mineral Resources to Indicated Mineral Resources. Approximately 5,000 ft (1,524 m) of drilling may be required for geotechnical evaluation of the deposits to support prefeasibility level mine planning. Metallurgical testwork aimed at defining the flowsheet and estimating approximate capital and operating costs associated with mineral processing, as well as continuing environmental baseline data collection is included. A summary of the estimated cost of the recommendations is shown in Table 1-6.

Table 1-6: Estimated Cost of Recommendations

Budget Item	Units		Cost/unit	Estimated Cost (US$)
Exploration Drilling	492,000	ft	40	18,680,000
Drill Support				1,250,000
Assays	14,300	ea	55	786,500
Geotechnical Drilling	5,000	ft	70	350,000
Geotechnical Drill Support				25,000
Geotechnical Testwork				1,000,000
Metallurgical Drilling	15,000	ft	70	1,050,000
Metallurgy Drill Support				250,000
Metallurgical Testwork				1,500,000
Environmental Baseline Work				1,500,000
Updated Resource Estimate				365,000
Mine Planning				500,000
Prefeasibility Study				2,500,000
Total				29,756,500

2.0 INTRODUCTION

2.1 Terms of Reference

Twin Metals Minnesota LCC (TMM) requested on behalf of Duluth Metals Limited (Duluth) that AMEC E & C Services Inc. (AMEC) provide an independent Technical Report (the Report) summarizing the information supporting updated Mineral Resource estimates for the Maturi, Birch Lake, and Spruce Road deposits on the Twin Metals Minnesota Project (the Project) located near Ely Minnesota, USA.

The Technical Report supports disclosure of an updated Mineral Resource estimate for the Project in the Duluth press release dated 13 June 2012, entitled “Duluth Metals Announces New AMEC NI 43-101 Technical Report Confirming Significant Increases to Twin Metals' Copper-Nickel-Palladium-Platinum-Gold Resource”.

The Report was prepared to support updated mineral resource estimates on the Maturi, Birch Lake, and Spruce Road deposits. The new estimates are considered by Duluth to represent a material change with respect to the affairs of Duluth. The increase in tonnage and contained metal is approximately double the estimates used in Duluth's Preliminary Economic Assessment (PEA) of January 8, 2009. The Prefeasibility Study underway will review the scale, timing, and development of the Project appropriately for the latest resource estimate. The results of the January 8, 2009 PEA study were considered when assessing reasonable prospects of economic extraction of the Project’s mineral resources, but they are otherwise considered no longer relevant to the Project.

2.2 Qualified Persons

Dr. Harry Parker is the Qualified Person that takes responsibility for preparing or supervising the preparation Section 14 Mineral Resources of the Technical Report. Dr Ted Eggleston is the Qualified Person that takes responsibility for preparing or supervising the preparation of all other sections of the Technical Report.

Other AMEC staff have provided input to the QPs in their areas of relevant expertise.

2.3 Property Inspections by AMEC

Dr Parker visited the Project site from 26 to 30 April, 2011 and again from 6-16 September 2011. Under the supervision of Dr Parker, Dr Eggleston visited site on 26 to 30 April, 2011, 6-18 June 2011, and again from 6-16 September 2011.

During the site visits, AMEC personnel reviewed the current and historical drill hole database, core handling, logging and cutting procedures, density measurements, preparation procedures, assaying quality assurance and quality control (QA/QC), collar surveys and down hole surveys. Discussions on geology and mineralization were held with Duluth and TMM personnel, and field site inspections were performed.

2.4 Effective Dates

The effective date of the mineral resource estimates presented herein is 23 April 2012, which represents the cut-off date in the database for the completed drill assays and completion of the geological models.

The effective date of the technical report is 15 June 2012, which represents the cut-off date for the scientific and technical information used in the technical report.

The authors of the technical report are not aware of any material change in the scientific and technical information between the effective date and date of signing of the technical report.

2.5 Previous Technical Reports

The following Technical Reports were previously prepared for the various projects and were used during preparation of this report.

Maturi

Carghill, D.G., 2005, Technical Report on the Maturi Extension Property, Minnesota, U.S.A.; 30 December 2005, NI 43-101 Technical Report Prepared by Roscoe Postle Associated, Inc. for Wallbridge Mining Company Limited, 90 p.

Clow, G.G. and Routledge, R.E., 2005, Preliminary Assessment of the Mineral Resources of the Birch Lake Property; 19 November 2005, NI 43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Mineral Corporation, 90 p.

Routledge, R.E., 2006, Technical Report on the Maturi Extension Property, Minnesota, U.S.A.; 31 May 2006, NI 43-101 Technical Report Prepared by Roscoe Postle Associated, Inc. for Duluth Metals Limited, 68 p.

Routledge, R.E. and Greenough, G.F., 2006, Technical Report on the Mineral Resource Estimate for the Maturi Property, Minnesota, U.S.A.; 30 June 2006, NI

43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Mineral Corporation, 96 p.

Routledge, R.E., 2007, Technical Report on the Resource Estimate for the Nokomis Deposit on the Maturi Extension Properties, Minnesota, U.S.A.; 8 August 2007, NI 43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 112 p.

Routledge, R.E., 2008, Technical Report on the Resource Estimate for the Nokomis Deposit on the Maturi Extension Properties, Minnesota, U.S.A.; 18 July 2008, NI 43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 107 p.

Clow, G.G., Hwozdyk, L.R., Routledge, R.E., McCombe D.A. and Scott, K.C., 2008, Technical Report on the Preliminary Assessment on the Nokomis Project, Minnesota, U.S.A.; NI 43-101 Technical Report prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 184 p.

Cox, J.J., Routledge, R.E., and Krutzlemann, H., 2009, Preliminary Assessment of the Nokomis Project, Minnesota, U.S.A.; 8 January, 2009, NI 43-101 Technical Report prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 182 p.

Moreton, C., and Routledge, R.E., 2009, Technical Report on the Mineral Resource Estimate for the Nokomis Deposit on the Nokomis Property, Minnesota, U.S.A.; 10 December 2009, NI 43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 115 p.

Birch Lake

Routledge, R.E., 2004, Review of the Mineral Resources of the Birch Lake Property, Minnesota, U.S.A.; 22 January 2004, NI 43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 92 p.

Caracle Creek International Consulting Inc, (CCIC), 2004, Independent Technical Report: San Francisco Zinc (Utah), Mahoney Zinc (New Mexico), and Birch Lake PGE (Duluth Complex, Minnesota) Properties, United States of America; 16 April 2004, NI 43-101 Report Prepared by Caracle Creek International Consulting Inc. for Franconia Minerals Corp., 360 p.

Clow, G., and Routledge, R.E., 2005, Preliminary Assessment of Mineral Resources of the Birch Lake Property, Minnesota, U.S.A.; 19 November 2005, NI 43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 93 p.

Clow, G.G., Cox, J.J., Routledge, R.E., and Hayden, A.S., 2006, Technical Report on the Preliminary Assessment of the Birch Lake and Maturi Deposits, Minnesota, U.S.A.; 20 October 2006, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 175 p.

Routledge, R.E., 2008, Technical Report on the Resource Estimate for the Birch Lake Property, Minnesota, U.S.A.; 22 August 2008, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 139 p.

Routledge, R.E., 2009, Technical Report on the Resource Estimate for the Birch Lake Property, Minnesota, U.S.A.; 18 September 2009, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 164 p.

Routledge, R.E. and Galyen, R., 2010, Technical Report on the Resource Estimate Update for the Birch Lake Property, Minnesota, U.S.A.; NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 151 p.

Spruce Road

Routledge, R.E. and Cox, J.J., 2007, Technical Report on the Resource Estimate for the Spruce Road Deposit, Minnesota, U.S.A.; 15 November 2007, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 130 p.

Comment

The resource estimates in this report supersede resource estimates reported in the previous NI 43-101 reports. The Spruce Road resource estimate in Routledge and Cox (2007) was accepted by AMEC as current, but that estimate was re-tabulated by AMEC using cut-off grades based on current cost and metal value parameters.

Cox et al (2009) produced a preliminary economic assessment for the Nokomis (aka Maturi Extension) deposit. Since that report was issued, TMM acquired both the Maturi and Nokomis deposits which had previously been treated as separate deposits because of mineral tenure patterns. The preliminary economic assessment of the Nokomis deposit did not include the Maturi deposit and is not considered relevant by

AMEC and the likely revised mine development plans that will be used in the prefeasibility study being prepared.

2.6 References

Previous Technical Reports and the reports and documents listed in Section 3.0 (Reliance on Other Experts) and Section 27.0 (References) of this Technical Report were used to support the preparation of the Technical Report.

3.0 RELIANCE ON OTHER EXPERTS

The QPs have relied upon, and believe there is a reasonable basis for this reliance, the following reports that provided information regarding mineral tenure, surface rights, company incorporation and ownership details, inter-company agreements relating to the Project, environmental obligations, permitting requirements and applicable mining act data relevant to the Project in sections of this Technical Report as noted below.

3.1 Project Ownership and Agreements

The QPs have not independently reviewed ownership of the Project area and the underlying property agreements. The QPs have fully relied upon, and disclaim responsibility for, information derived from TMM and legal experts retained by TMM for this information through the following documents:

Morel, J.A., 2012: Twin Metals Minnesota, LLC Mineral and Surface Interest Holdings: opinion letter on company structure prepared for Dr Ted Eggleston, AMEC, by Mr J.A. Morel, Chief Executive Officer, TMM, dated 26 July 2012.

The information is used in the introduction to Section 4 and in Section 4.5 of the Report.

Dorsey & Whitney LLP, 2012: Letter Re Certain Matters Relating To The Company's Existence And Ownership: opinion letter prepared for Dr Ted Eggleston, AMEC, and Twin Metals Minnesota by Dorsey & Whitney LLP, dated 26 July 2012.

The information is used in the introduction to Section 4 and in Section 4.5 of the Report.

3.2 Mineral Tenure and Surface Rights

The QPs have not independently reviewed the Project mineral tenure and the underlying surface rights. The QPs have fully relied upon, and disclaim responsibility for, information derived from legal experts retained by TMM for this information through the following documents:

Starnes B., 2012a: Twin Metals Minnesota, LLC Mineral and Surface Interest Holdings: opinion letter on relevant federal legislation, surface rights and access, and exploration rights and permits prepared for Dr Ted Eggleston, AMEC, and Twin Metals Minnesota by Leonard, Street and Deinard, dated 26 July 2012.

Starnes, B., 2012b: Twin Metals Minnesota, LLC - 43-101 Report: authorization letter from Leonard, Street and Deinard to use opinion letter prepared for TMM, dated 26 July 2012.

This information is used in Sections 4.2.1, 4.5 and 4.6 of the Report.

Lorass, P., 2012a: Twin Metals Minnesota, LLC Mineral and Surface Interest Holdings: opinion letter on examination of title and acquisition of certain mineral rights held by TMM in the State of Minnesota prepared for Dr Ted Eggleston, AMEC, and Twin Metals Minnesota by Fryberger, Buchanan, Smith & Frederick, dated 26 July 2012.

Lorass, P., 2012b: Twin Metals Minnesota, LLC Mineral and Surface Interest Holdings: authorization letter from Fryberger, Buchanan, Smith & Frederick to use opinion letter prepared for TMM, dated 26 July 2012.

This information is used in Sections 4.2.2, 4.3 and 4.4 of the Report.

3.3 Environment

The QPs have not independently reviewed the environmental studies status or environmental liabilities status for the Project. The QPs have fully relied upon, and disclaim responsibility for, information derived from TMM for this information through the following document:

Williamson, A., 2012: Opinion on Environmental Items for Use in Duluth Metals Ltd NI 43-101 Report July 2012: opinion letter prepared for Dr Ted Eggleston, AMEC, by Ms A. Williamson, Vice President - Environment & Sustainability, TMM, dated 20 July 2012.

This information is used in Sections 4.8 and 4.9 of the Report.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 Location

4.1.1 General Location

The Maturi, Birch Lake, and Spruce Road deposits are located east to southwest of Ely Minnesota (Figure 4-1).

The Maturi deposit is located in Lake County, Townships 61N and 62N, Range 11W in the Kangas Bay and Bogberry Lake quadrangles (Figures 4-1 and 4-2). The properties are centered at approximately:

- North latitude 47° 47′ 0″; west longitude 91° 42′ 30″
- UTM coordinates Zone 15, 595,516E, 5,295,082N (NAD 27 CONUS).
- UTM coordinates Zone 15, 595,500E, 5,295,300N (NAD 83 CONUS).

The Birch Lake deposit is in Lake and St. Louis counties approximately 125 km north-northeast of Duluth, Minnesota (Figure 4-1). The property is centered approximately at:

- North latitude 47o 41’ 49”; west longitude 91o 47’ 30”
- UTM coordinates Zone 15, 589,700E, 5,285,200N (NAD 27 CONUS)
- UTM coordinates Zone 15, 589,684E, 5,285,418N (NAD 83 CONUS).

The Spruce Road deposit lies for the most part on Federal Lease US ES01353 located in northern Minnesota, Lake County, Townships 62N and Range 10W and 11W in the Bogberry Lake quadrangle (Figures 4-1 and 4-2; Table 4-1). The property is centered approximately at:

- North latitude 47o 50’ 09”; west longitude 91o 40’ 00”
- UTM coordinates Zone 15, 599,800E, 5,298,700N (NAD 27 CONUS)
- UTM coordinates Zone 15, 599,784E, 5,298,918N (NAD 83 CONUS).

Figure 4-1: General Location of the Properties (modified from Cox et al, 2009)

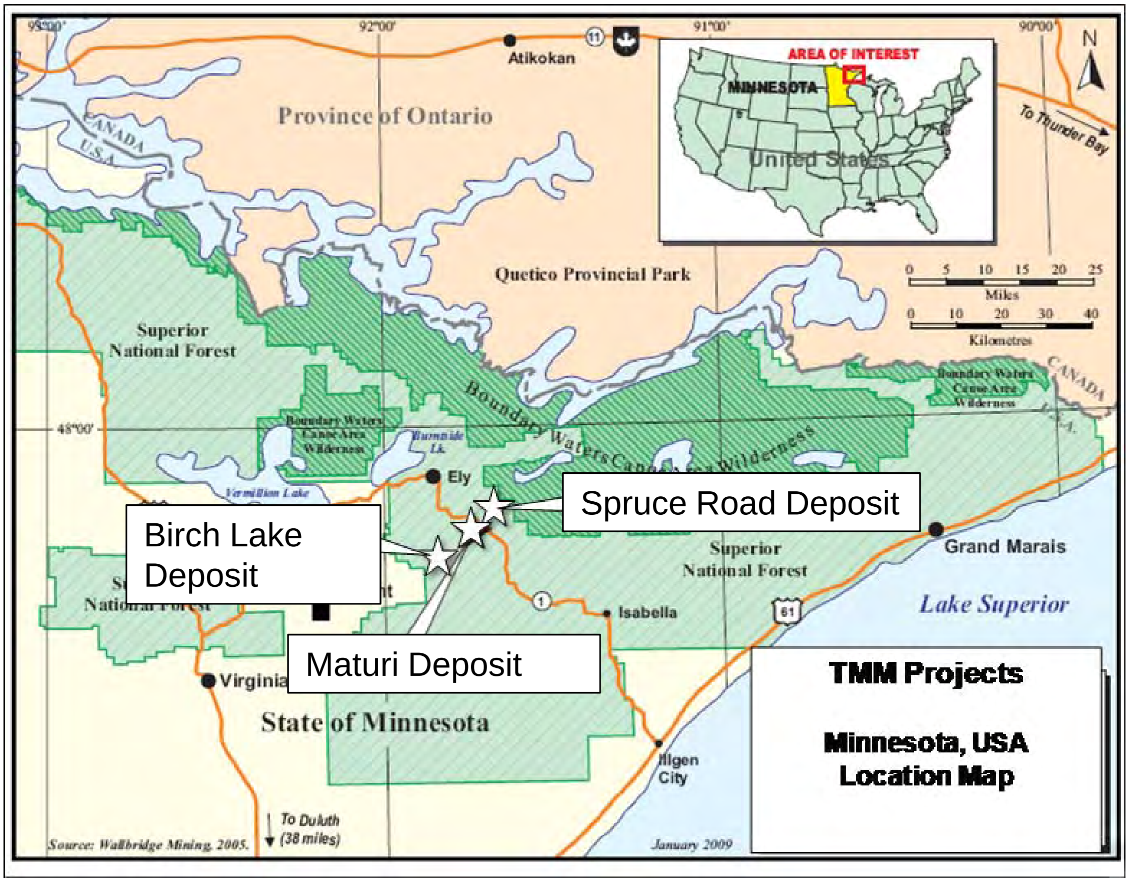
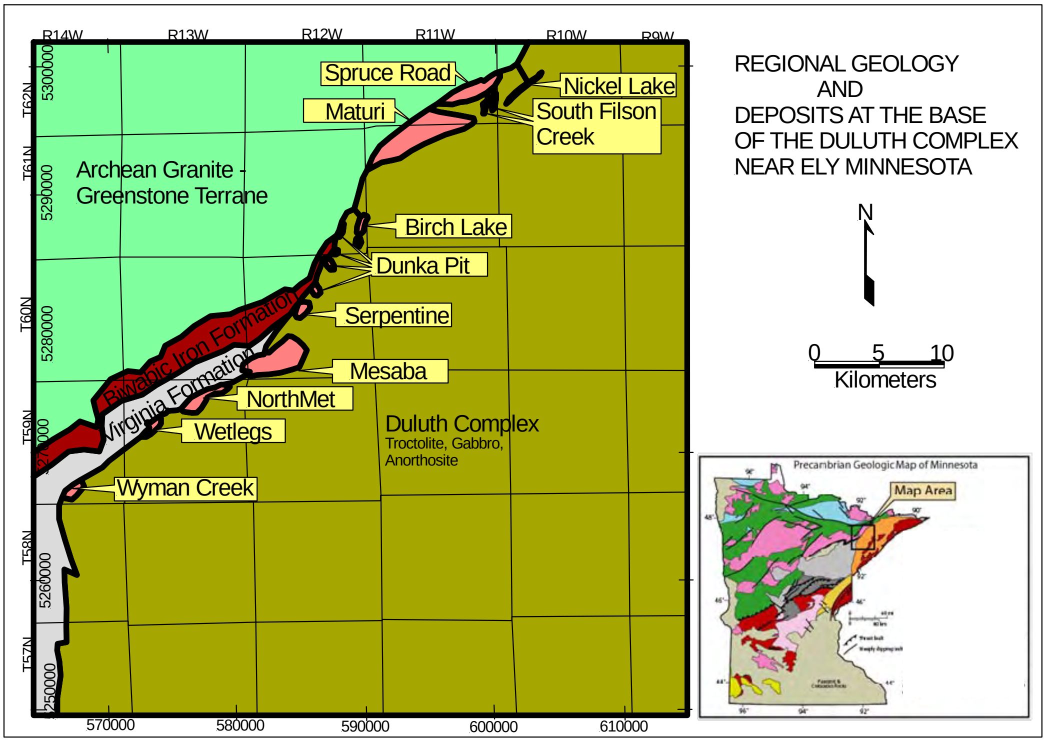


Figure 4-2: Sketch Regional Geological Map with Named Deposits at the Base of the Duluth Complex near Ely, MN (adapted from Peterson, 2010)



4.1.2 Coordinate System and Topographic Data

Several coordinate systems have been employed for these projects. The most common are UTM Mercator Projection coordinates, but both NAD 83 and NAD 27 data have been used. INCO used a local grid at Spruce Road and Maturi that was converted to UTM NAD 27. In order to avoid confusion, all coordinates were converted to Minnesota State Plane which parallels the NAD 27 coordinate system but is in Imperial units.

4.2 Relevant Mining Law

4.2.1 Relevant Federal Legislation

Originally established from public domain lands, the Superior National Forest was designated and approved by Presidential Proclamation No. 848 in 1909 by President Theodore Roosevelt. It encompasses more than 3 million acres of land in northeast Minnesota. Subject to applicable laws and regulations, the Superior National Forest is open to commercial development, including mining. The proclamation establishing the Superior National Forest "reserved" the public domain lands from the General Mining Law of 1872. While the General Mining Law of 1872 provides for a claim system for mineral tenure acquisition, the Superior National Forest is regulated under laws providing for a permitting and leasing system. Pursuant to 16 U.S.C. § 508b, section 402 of the Federal Reorganization Plan No. 3 of 1946 and the Weeks Act (36 Stat. 961), hardrock mineral leasing is available on both public domain and acquired lands in the Superior National Forest. The Bureau of Land Management is the agency primarily responsible for overseeing this permitting and leasing system and promulgated regulations (43 C.F.R. § 3500 et. seq.) to establish its regulatory guidelines.

Under the Bureau of Land Management regulations, a mining company may apply for prospecting permits, which have an initial two year term and may be renewable for up to an additional four years. (43 C.F.R. § 3505.10, .60, .61) These can be converted to Preference Rights Leases, a type of federal mineral lease, upon satisfying all regulatory requirements. (43 CFR § 3507, et. seq.) The initial term for Preference Rights Leases is 20 years with the possibility of successive 10-year renewals. A Preference Rights Lease includes the right to develop and construct a mine under the terms thereof, but additional permits are required before work can commence.

4.2.2 Relevant State Legislation

State leases for nonferrous metallic mining are issued by the Minnesota Department of Natural Resources and may be held for up to fifty years. **(**Minn. Stat. § 93.25.**)** These leases allow a mining company to engage in mineral exploration and mineral development located on the state-owned property, subject to compliance with all laws and issued permits. An operating mining company must pay a production royalty in addition to lease payments.

At the mineral development stage, a "Permit to Mine" is required for any new nonferrous metallic mineral mine in addition to the mining lease. (Minn. Stat. § 93.481; Minn. R. 6132.0100-.5300.) This is required for mining of all nonferrous metallic mineral interests, irrespective of whether the ownership is state, federal, or private. A Permit to Mine may be issued for whatever term the Minnesota Department of Natural Resources deems necessary for the completion of the proposed mining operation, including reclamation or restoration.

4.3 Mineral Tenure

4.3.1 Introduction

Land in Minnesota is held by a combination of private, state and federal owners and land is subject to typical United States split-estate holdings, where the surface owner(s) may be different from the sub-surface owner(s).

TMM has the benefit of various mineral interests including state leases, federal leases, private leases and federal prospecting permits, federal prospecting permit applications, a preference right lease application, and fee or option for fee interests, as summarized in Table 4-1 and shown in Figure 4-3. When not held in TMM's own name, TMM's mineral interests are held by its wholly owned subsidiary, Franconia Minerals (US) LLC or through the Birch Lake Joint Venture. The mineral interests of the Birch Lake Joint Venture are, in turn, held by Lehmann Exploration Management, Inc., Beaver Bay, Inc., Lehmann Trust, or Beaver Bay Joint Venture Trust. For simplicity of reference, the mineral interests held by TMM in its own name as well as the mineral interests held by Franconia Minerals (US) LLC or through the Birch Lake Joint Venture are referred to in this report as TMM's mineral interests. (For a description of TMM's company structure, see Section 4.4.)

Subject to certain exceptions, TMM's mineral interests under state and federal leases and federal prospecting permits are insured pursuant to title insurance policies issued by First American Title Insurance Company on August 4, 2010 and August 31, 2011 as policy nos., NCS-428640 (Nokomis) and NCS-471210 (Franconia) (note that TMM's mineral interests lying beneath the beds of reservoirs or other bodies of water are not insured by the above-referenced title polices).

Table 4-1: Summary of TMM Mineral Interests*

Type	Number	Acres	Hectares
Federal Mineral Leases	2	4,944.78	2,001.08
Federal Prospecting Permits	3	1,818.46	735.91
Federal Prospecting Permit with Preference Rights Lease Application	1	13.75	5.56
Federal Prospecting Permit Applications	10	7,935.41	3,211.35
State Mineral Leases	27	6,012.84	2,433.31
Private Mineral Leases	13	5,562.93	2,251.24
Fee Minerals	N/A	1,047.75	424.01
Total	56	27,335.92	11,063.3

*In some instances, TMM holds undivided fractional mineral interests. See Tables 4-6, 4-8, and 4-10.

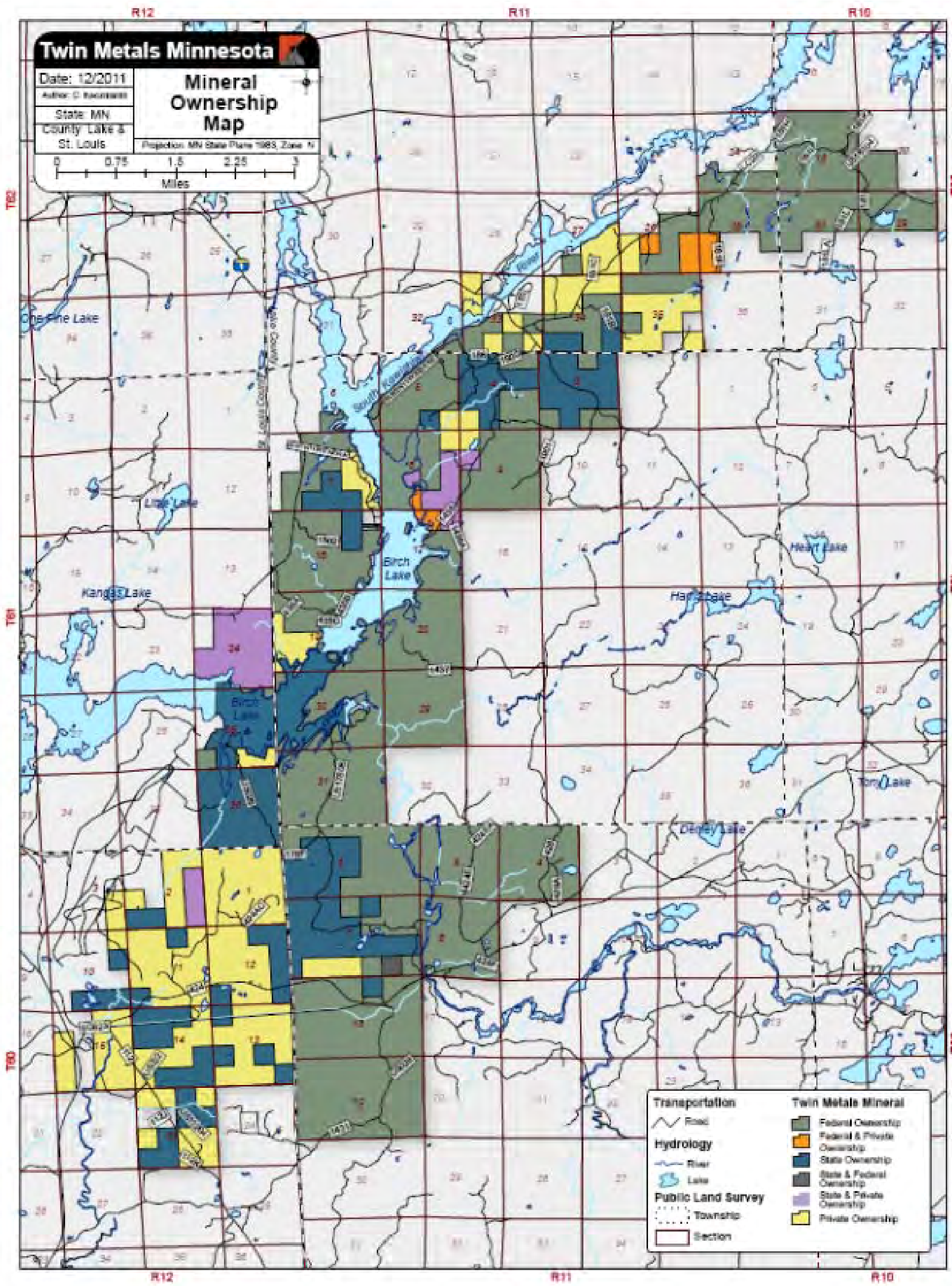
TMM has filed applications for federal prospecting permits pending before the United States Bureau of Land Management ("BLM"), which are not insurable. TMM has the benefit of Federal Preference Rights Lease Application # 50264, which is pending with the BLM.

Note that all of the locations for mineral leases and other property locations are described in the United States Public Land Survey System of Township, Range, Section, and Section subdivisions.

The following abbreviations are used in the accompanying tables:

ACNC	American Copper and Nickel Company Inc
BBJV	Beaver Bay Joint Venture
BLM	U.S. Bureau of Land Management
DNR	Minnesota Department of Natural Resources
FRA	Franconia Minerals Corporation Inc.
LEM	Lehmann Exploration Management
USFS	U.S. Forest Service

Figure 4-3: TMM Mineral Interest Map showing Mineral Ownership



4.3.2 Current Mineral Interests Status

Federal Mineral Leases

TMM holds rights to Federal Lease Nos., ES-01352 and ES- 01353, dated June 1, 1966, as part of the Birch Lake Joint Venture Agreement dated June 18, 2008. Figure 4-4 shows the location of these leases and Table 4-2 summarizes the locations of the two leases which total 4,944.78 acres (2,001.09 hectares).

Table 4-3 summarizes the royalties, and carrying costs. The base royalty for the Federal Mineral Leases is 4.8% for Cu and Ni. There is an additional royalty of 0.03% of gross value of "associated products" payable to the United States if the value of such products exceeds 20% of aggregate value of copper and nickel.

AMEC recommends that TMM should consider obtaining a formal legal opinion prior to any future production to determine the extent and applicability of any additional production royalties that may be due to third parties.

No annual work requirements exist, but periodic reporting (monthly) of results to the BLM is required.

Figure 4-4: Federal Mineral Interest Map

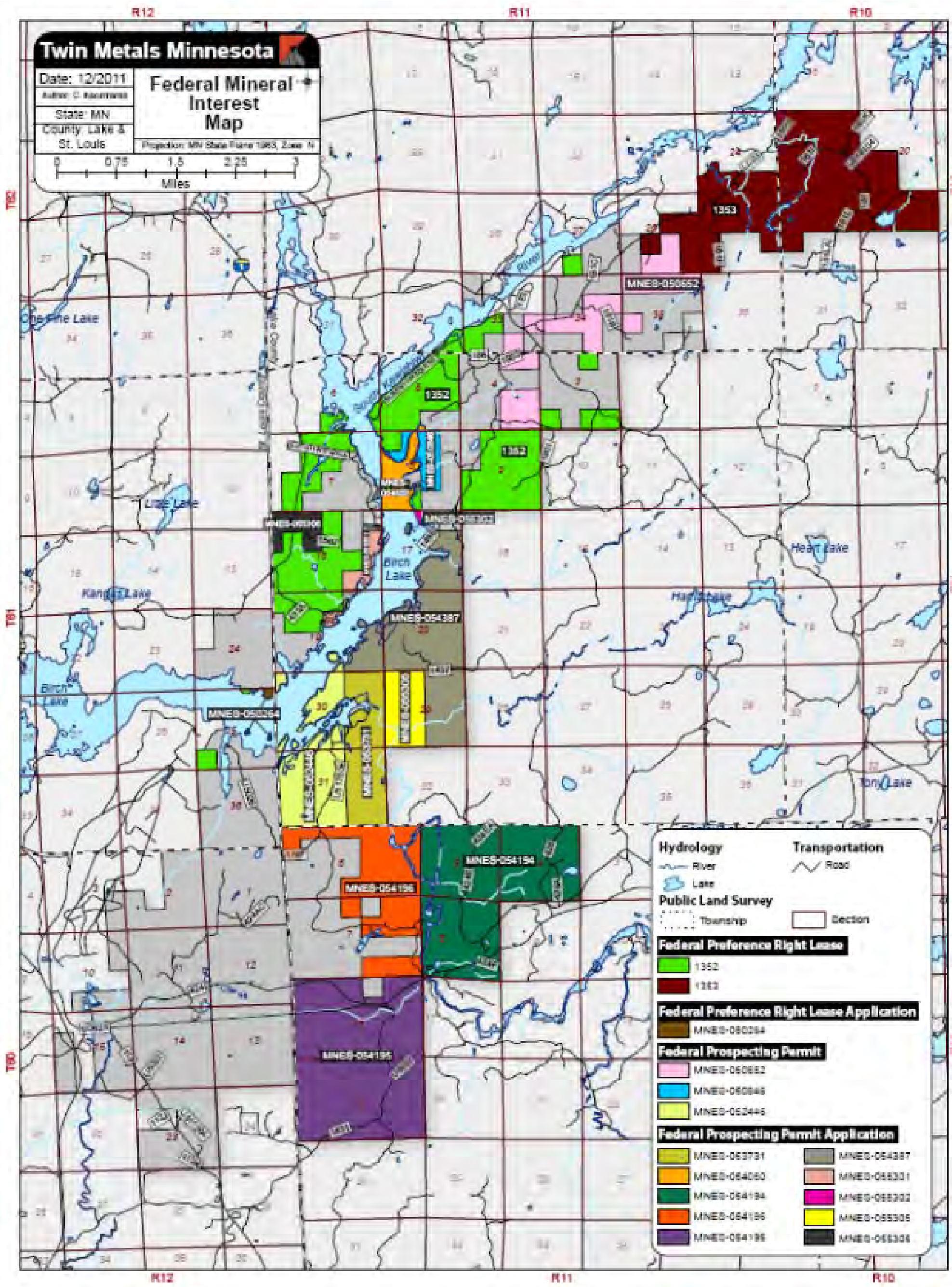


Table 4-2: Location of Federal Mining Leases

Lease Number	Permitting Or Leasing Authority	Surface Owner	Legal Description: County	Section	TWP	Range	Section Subdivision	Acres
MNES-01352	USA (BLM)	USA; South Kawishiwi Association LLC; Allete, Inc.	Lake	3	61	11	Lot 2	2,610.07 (Although MNES-01352 indicates a total of 2,610.07 acres, title searches indicate that the total acres held by USA under MNES-01352 are 2,444.12)
							SW-SW	
							S1/2-SE	
				5	61	11	Lots 1and 2	
							S1/2-NE	
							Lots 6-7	
							NE-SW	
							S1/2-SW	
							N1/2-SE	
				6	61	11	Lot 13	
							Lots 22-24	
				7	61	11	Lots 1-4	
							Lots 9-10	
							Lot 12	
							Lots 15-16	
							Lot 19	
				8	61	11	Lot 2	
							Lot 6	
				9	61	11	All EXCEPT W1/2-NW	
				18	61	11	Lot 2	
							Lot 7	
							Lot 9	
							Lots 12-20	
				19	61	11	Lots 2-5	
							Lots 7-8	
				27	62	11	SE-SW	
				32	62	11	Lot 4	
				33	62	11	Lots 6-7	
				34	62	11	NW 1/4	
			St. Louis	25	61	12	Lot 2	
							SW-SW	
MNES-01353	USA (BLM)	USA	Lake	19	62	10	All	2,334.71
				20	62	10	SW 1/4	
				29	62	10	N 1/2	
				30	62	10	N 1/2	
							Lot 3 (NW-SW)	
				24	62	11	Lot 7	

Lease Number	Permitting Or Leasing Authority	Surface Owner	Legal Description					Acres
			County	Section	TWP	Range	Section Subdivision	
							SE-SW	
							S1/2-SE	
				25	62	11	N 1/2	
							W1/2-SW (undiv 1/2)	
							NE-SE	
				26	62	11	S1/2-NE	
							NE-SW	
							E1/2-SE (undiv 1/2)	

Table 4-3: Terms of Federal Mining Leases

Lease Number	Expiry Date	Renewal	Initial Agreement Date	ROYALTIES			CURRENT ANNUAL CARRYING COSTS			
				Base Royalty (NSR)	Additional Royalty (NSR)	Rental or Advance Min. Royalty	Rental	Minimum Advanced Royalty	Total	
							2011-13	2011-13	2011-13	2014
MNES-01352	End of second renewal term 12/31/2013	Initial 20-year period followed by three 10-year renewal terms, with the possibility of additional 10-year renewal terms under BLM regulations	1-Jun-66	4.8% of Cu and Ni	May be an additional Royalty" of 0.03% of gross value of "associated products" if value of such products exceeds 20% of aggregate value of copper and nickel.	Rent of $1/acre/year until production; Min. Royalty of $10/acre/year	$2,610.07	$26,107.00	$28,717.07	Unknown

MNES-01353	End of second renewal term 12/31/2013	Initial 20-year period followed by three 10-year renewal terms, with the possibility of additional 10-year renewal terms under BLM regulations	1-Jun-66	4.8% of Cu and Ni	May be an additional Royalty "of 0.03% of gross value of "associated products" if value of such products exceeds 20% of aggregate value of copper and nickel.	$1.00 per acre per year until production Minimum royalty $10.00/acre/year.	$2,254.71	$22,550.00	24,804.71	Unknown

Federal Prospecting Permits

TMM has the benefit of 13 prospecting permits and permit applications as well as one preference right lease application (Table 4-4) for a total of 9,767.62 acres (3,952.82 hectares). Figure 4-4 shows the location of these permits and permit applications. TMM's federal prospecting permits have been held for their initial period of two years and have been extended as described in Table 4-5.

Per the standard property advancement procedures for federal prospecting permits, TMM is required to convert its federal prospecting permits to a Preference Rights Lease in order to retain and further explore and develop the properties. According to federal regulations, in order to obtain a Preference Rights Lease, the applicant must hold a federal prospecting permit for the area it wants to lease, apply for a preference rights lease, submit the first year annual lease payment, provide information required as stated in the U.S. Code of Federal Regulations ("CFR") § 3507.17, including maps, a proposed mining and processing approach, a description of salable products and markets, utilities, and infrastructure in the area, and the applicant must demonstrate that it has discovered a valuable deposit covered by its prospecting permit. A valuable deposit is principally determined by the geologic assessment of the mineral deposit, detailing the type and extent of exploration, including drill log and other exploration results, that has occurred on the lands covered by the Federal Prospecting Permit as well as the exploration on adjacent lands both before and during the prospecting permit term.

As appropriate, Twin Metals will submit its applications for Preference Rights Leases on its federal prospecting permits in accordance with federal regulations and specific application dates.

Royalties on Federal Prospecting Permits are negotiated at the time the permits are advanced to Preference Rights Leases. The minimum royalty is anticipated to be 4.8% of copper and nickel with an "Additional Royalty" of at least 0.03% of gross value of "associated products" if value of such products exceeds 20% of aggregate value of copper and nickel.

Table 4-4: Location of Federal Prospecting Permits

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
MNES 050652 (Permit)	Bureau of Land Management	Federal	Lake	4	61	11	SE 1/4 and N 1/2-NE (Lots 1 and 2)	865.78	12/1/2003
				26	62	11	SE-SW		
				26	62	11	W 1/2-SE		
				33	62	11	SW-SE		
				33	62	11	NE-SE		
				34	62	11	N 1/2-SW		
				34	62	11	W 1/2-SE		
				34	62	11	S 1/2-NE		
				35	62	11	N 1/4 (being the N 1/2-NW and the N 1/2-NE)		
				35	62	11	NW-SW		
MNES 050846 (Permit)	Bureau of Land Management	Federal	Lake	8	61	11	Lot 1 (includes NE-NW)	178.5	12/1/2003
				8	61	11	Lot 3		
				8	61	11	Lot 4		
				8	61	11	NW-NE		
				8	61	11	SW-NE		
				8	61	11	NW-SE		
MNES-53731 (Application)	Bureau of Land Management	Federal	Lake	30	61	11	N1/2 - NE1/2	596.23	Unknown
							SW1/4-NE1/4 (Lot 6)		
							SE1/4-NE1/4 (Lot 7)		
							NE1/4-SE1/4 (Lot 8)		
							NW1/4-SE1/4 (Lot 9)		
							S1/2-SE1/4		
				31	61	11	NE1/4		
							N1/2-SE1/4		
							SW1/4-SE1/4 (Lot 14)		
							SE1/4-SE1/4 (Lot 15)		
MNES-54387	Bureau of	Federal	Lake	17	61	11	Lot 3	1294.53	Unknown

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
(Application)	Land Management						Lot 6		
							Lot 7		
							Lot 8		
							Lot 9		
							Lot 10		
							SE - NE		
							SE - SE		
				19	61	11	Lot 1		
							SE - NW		
				20	61	11	NE		
							S2		
				29	61	11	E2		
MNES-52446 (Permit)	Bureau of Land Management	Federal	Lake	19	61	11	Lot 17	774.18	Unknown
							Lot 18		
				30	61	11	Lot 19		
							Lot 20		
							Lot 21		
							Lot 28		
							Lot 29		
							Lot 30		
							Lot 31		
							Lot 32		
							Lot 33		
							Lot 34		
							Lot 35		
							Lot 36		
							Lot 37		
							Lot 38		
							Lot 39		

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							Lot 40		
							Lot 41		
							Lot 42		
							Lot 43		
				31	61	11	Lot 1		
							Lot 2		
							Lot 3		
							Lot 4		
							Lot 5		
							Lot 6		
							Lot 7		
							Lot 8		
							Lot 9		
							Lot 10		
							Lot 11		
							Lot 12		
							Lot 13		
MNES-50264 (Preference Application Filed)	Bureau of Land Management	USA	St. Louis	25	61	12	NE 1/4 - NE 1/4 (Lot 1), all unsurveyed islands	13.75	Original permit expired in 2006, Application for preference right lease filed.
MNES-55301 (Application)	Bureau of Land Management	USA	Lake	18	61	11	Lot 11	153.2	Unknown
							Lot 21		
							Lot 22		
				19	61	11	Lot 9		
MNES-55302 (Application)	Bureau of Land Management	USA	Lake	8	61	11	Lot 1	159.2	Unknown
							Lot 3		
							Lot 4		
							W1/2-NE1/4		
				17	61	11	Lot 2		

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							Lot 4		
							Lot 5		
MNES-55305 (Application)	Bureau of Land Management	USA	Lake	29	61	11	W 1/2	320	Unknown
MNES-55306 (Application)	Bureau of Land Management	USA	Lake	18	61	11	Lot 3	165.05	Unknown
							Lot 4		
							Lot 5		
							Lot 6		
							Lot 8		
MNES-54050 (Application)	Bureau of Land Management	USA	Lake	5	61	11	All land under water in the S1/4	227	Unknown
							All land under water in Lot 5 (NE1/4 of SW1/4)		
				8			All land under water		
MNES 054194 (Application)	Bureau of Land Management	Federal	Lake	4	60	11	All	1,780.20	Unknown
				5	60	11	All		
				8	60	11	All		
MNES 054195 (Application)	Bureau of Land Management	USA	Lake	18-19	60N	11W	All of Sections 18 and 19	2,080 (includes 40 acres that are part of State Lease 10157)	Unknown
MNES 054196 (Application)	Bureau of Land Management	USA	Lake	6	60N	11W	1	1,160	Unknown
							2		
							3		
							4		
							5		

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							6		
							7		
							8		
							12		
							13		
							21		
							22		
							NE 1/4		
							SE 1/4		
							2		
							10		
							20		
							NE 1/4		
							SE 1/4		

Table 4-5: Terms of Federal Prospecting Permits and Permit Applications

Permit Name	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		ANNUAL CARRYING COSTS	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011-2016	
MNES 050652 (Permit)	BLM's 9/1/2011 Decision: 577 days remain	12/1/2001	N/A	To be Negotiated				No	Quarterly	$433.00	
MNES 050846 (Permit)	BLM's 9/1/2011 Decision: 577 days remain	12/1/2001	N/A	To be Negotiated				No	Quarterly	$89.50	
MNES-53731 (Application)	Unknown	Application 8/23/2005	N/A	To be Negotiated				No	Per CFR	$298.50	Pending until completion of USFS EIS on mineral exploration.
MNES-54387 (Application)	Unknown	4/10/2006	N/A	To be Negotiated				No	Per CFR	$647.50	Formerly #50163. Pending until completion of USFS EIS on mineral exploration.
MNES-52446 (Permit - See Remarks)	Unknown	11/1//2004	N/A	To Be Negotiated				No	Per CFR	$387.50	This permit is on hold until USFS EIS on mineral exploration is completed. Former Permit 49258.
MNES-50264 (Preference Application Filed)	Original permit expired in 2006, current application pending.	11/1/2000	N/A	To be Negotiated				No	Per CFR	$20.00	Preference Right Lease application filed 12/13/2006.
MNES-55301 (Application)	Unknown	Application 04/02/2008	N/A	To be Negotiated				No	Per CFR	$77.00	Pending until completion of USFS EIS on mineral exploration.
MNES-55302 (Application)	Unknown	Application 04/08/2008	N/A	To be Negotiated				No	Per CFR	$80.00	Pending until completion of USFS EIS on mineral exploration.

Permit Name	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		ANNUAL CARRYING COSTS	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011-2016	
MNES-55305 (Application)	Unknown	4/22/2008	N/A	To be Negotiated				No	Per CFR	$160.00	Pending until completion of USFS EIS on mineral exploration.
MNES-55306 (Application)	Unknown	Application 04/17/2008	N/A	To be Negotiated				No	Per CFR	$83.00	Pending until completion of USFS EIS on mineral exploration.
MNES-54050 (Application)	Unknown	Application 05/01/2006	N/A	To be Negotiated				No	Per CFR	$138.50	Pending until completion of USFS EIS on mineral exploration.
MNES 054194 (Application)	Unknown	Application 04/25/2006	N/A	To be Negotiated				Unknown	Unknown	$960	Pending until completion of USFS EIS on mineral exploration.
MNES 054195 (Application)	Unknown	Application: April 25, 2006		To be Negotiated					Quarterly	$1,040	Pending until completion of USFS EIS on mineral exploration.
MNES 054196 (Application)	Unknown	Application April 25, 2006		To be Negotiated					Quarterly		Pending until completion of USFS EIS on mineral exploration.

State Leases

State leases to explore for, mine and remove metallic minerals are held for a period of 50 years. Rights conveyed in these leases exclude the extraction of iron ore, taconite ores, coal, oil, gas, and other liquid or gaseous hydrocarbons, which are either reserved by the State of Minnesota or are covered under separate state leases involving third parties. Twin Metals has the benefit of 27 state leases ("State Leases") for a total of 6,012.84 acres (2,433.31 hectares; Figure 4-5) as indicated in Table 4-6.

In Minnesota, an operating mining company pays a production royalty in addition to lease payments and applicable taxes. The base royalty consists of a base rate and an additional bid rate which are indicated in Table 4-6. State Leases also contain a royalty escalation clause that increases the base royalty as the net return value per ton of raw ore increases.

Table 4-7 summarizes the terms of the state leases. The State of Minnesota has an option to cancel a mineral lease after the end of the 20th year if, by that time, a lessee is not actively engaged in mining ore under the lease from the mining unit, a mine within the same government township as the mining unit or an adjacent government township and has not paid at least $100,000 to the State in earned royalty under a metallic mineral lease in any one calendar year. The State must exercise that option within the 21st year of the lease. If the State does not cancel within the 21st year, the lessee has until the end of the 35th calendar year to meet the conditions. If the lessee has not met the conditions by the end of the 35th year, the State has another window to cancel the lease during the 36th calendar year of the lease. Two state leases are beyond their 21st calendar year, but the State of Minnesota did not exercise its right to cancel and TMM now has until the end of the 35th calendar year to commence production and pay royalties.

Figure 4-5: TMM State of MN Mineral Lease Map

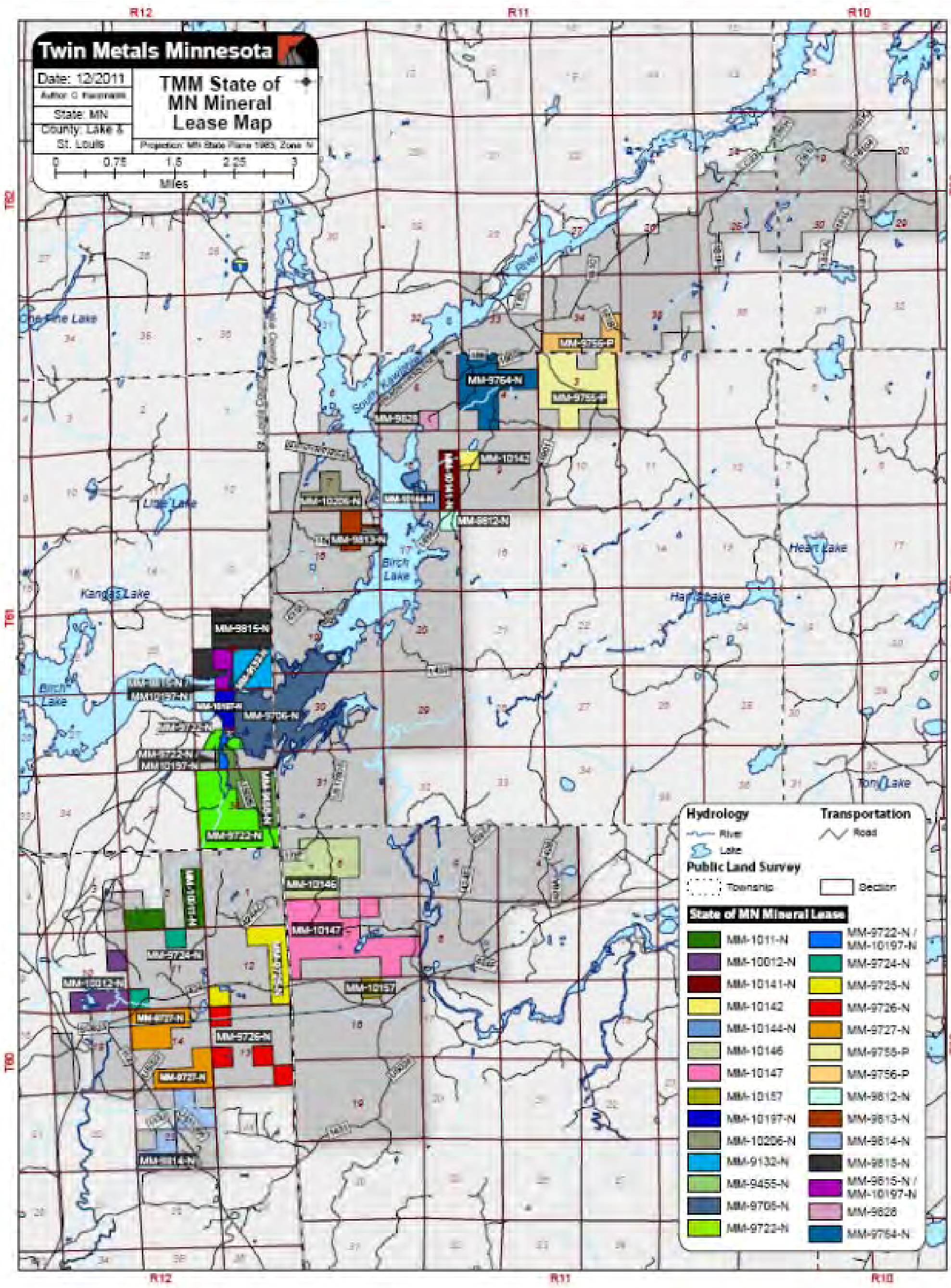


Table 4-6: Location of Minnesota State Mineral Leases

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
MM-9132	State of Minnesota	USA	St. Louis	24	61	12	2/3 Interest in N 1/2 of SE 1/4 2/3 Interest in Lot 3 2/3 Interest in Lot 4	159.25	12/21/2038
MM-9455-N	State of Minnesota	Minnesota Power and Light & State	St. Louis	25	61	12	<u>Mineral only</u> SE1/4-SW1/4	242	6/7/2040
				36	61	12	<u>Surface and Mineral Rights</u> NE1/4 NE1/4-SE1/4 <u>Mineral only</u> That part of the NE1/4-NW1/4 lying east of the current natural ordinary high water mark of the Birch Lake Reservoir, more or less, but excepting and excluding the lands, minerals, and mineral rights lying in and directly under the bed of the Birch Lake Reservoir below the current natural ordinary high water mark		
MM-9706-N	State of Minnesota	USA and MN	Lake	19	61	11	S 1/2 of S 1/2 of W 1/2	614.96	10/4/2047
				30			West 1/2		
				31			N 1/2 of N 1/2 of W 1/2		
			St. Louis	24	61	12	S 1/2 of SE 1/4		
				25	61	12	E 1/2		
MM-9722-N	State of Minnesota	Rendfield Land Co. (Lots 3 and 4, SE 1/4 of SW 1/4, part of NW 1/4 of SW 1/4 and part of SW 1/4 of SW 1/4); USA (Lot 5); TMM (Part of NW 1/4 of SW 1/4 and part of	St. Louis	25	61	12	<u>Mineral only</u> Lot 4, including the lands, minerals, and mineral rights lying in and directly under the bed of the Birch Lake Reservoir below the current natural ordinary water mark thereof, Section 25; and the lands, minerals, and mineral rights lying in and directly under the bed of the Birch Lake Reservoir below the current natural ordinary high water mark thereof, in SE1/4-SW1/4, Section 25;	480.25	6/16/2049

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
		SW 1/4 of SW 1/4)							
		Rendfield Land Co. (NE 1/4 of NW 1/4 and part of NW 1/4 of NW 1/4); TMM (SW 1/4 of NW 1/4, SE 1/4 of NW 1/4, SW 1/4, and part of NW 1/4 of NW 1/4); MN (E/12)	St. Louis	36	61	12	Surface and Mineral rights NW1/4-SE1/4; and S 1/2- SE 1/4; Mineral only NE1/4-NW1/4, except that part lying east of the current natural ordinary high water mark of the Birch Lake Reservoir; and NW1/4-NW1/4; and S1/2-NW1/4; and SW1/4 each of which include the lands, minerals, and mineral rights lying in and directly under the bed of the Birch Lake Reservoir below the current natural ordinary high water mark.		
MM-9724	State of Minnesota	USA & Cliffs	St. Louis	11	60	12	Mineral only SW1/4-SW1/4 Mineral and Surface NW1/4-NE1/4	80	6/16/2049
MM-9725	State of Minnesota	MN	St. Louis	12	60	12	N1/2-NE1/4 SE1/4-NE1/4 SW1/4-SW1/4 E112-SE1/4	240	6/16/2049
MM-9726	State of Minnesota	USA and MN	St. Louis	13	60	12	NW1/4-NW1/4 NW1/4-SW1/4 SE1/4-SE1/4 NW1/4-SE1/4	160	6/16/2049
MM-9727	State of Minnesota	MN and Minnesota Power & Light	St. Louis	14	60	12	NW1/4-NE1/4 NE1/4-NW1/4 S1/2-NW1/4 SE1/4-SW1/4 NE1/4-SE1/4)	360	6/16/2049

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							S1/2-SE1/4 NW1/4-NW1/4		
MM-9755	State of Minnesota	MN	Lake	3	61	11	Lots 1, 3 and 4 SE 1/2 of NE 1/4 S 1/2 of NW 1/4 N 1/2 of SW 1/4 SE 1/4 of SW 1/4 N 1/2 of SE 1/4	457.58	6/8/2050
MM-9756	State of Minnesota	MN	Lake	34	62	11	S 1/2 of SW 1/4 E 1/2 of SE 1/4	160	6/8/2050
MM-9764	State of Minnesota	MN	Lake	4	61	11	S 1/2 of NE 1/4 Lots 3 and 4 S 1/2 of NW 1/4 N 1/2 of SW 1/4 SE 1/4 of SW 1/4	348.2	9/7/2050
MM-9812	State of Minnesota	USA	Lake	17	61	11	Undivided 1/2 Interest in NE 1/4 - NE 1/4	40	12/14/2050
MM-9813	State of Minnesota	County & private	Lake	18	61	11	Lot One, except north 1.063 feet and except south 250 feet; W 1/2 - NE 1/4	80.3	12/14/2050
MM-9814	State of Minnesota	USA and MN	St. Louis	23	60	12	NW 1/4 - NE 1/4 (Mineral & Surface, if any) NE 1/4 - SW 1/4 (Mineral & Surface, if any) S 1/2 SW 1/4 (Mineral & Surface, if any) S 1/2 - NE 1/4 (Mineral only)	240	12/14/2050
MM-9815	State of Minnesota	USA	St. Louis	24	61	12	Mineral only: undivided interest, as follows: 8568/16128 in NE1/4-NE1/4; 106-5/16128 in NE1/4-NE1/4; 5210/16128 in NE1/4-NE1/4; 204120/435456 in NW1/4-NE1/4; 32589/435456 in NW1/4-NE1/4; 159426/435456 in NW1/4-NE1/4;204120/435456 in SW1/4-NE1/4; 32589/435456 in SW1/4-NE1/4; 159426/435456 in SW1/4-NE1/4;	377.25	12/14/2050

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							1065/16128 in SE1/4-NE1/4; 5210/16128 in SE1/4-NE1/4; 32589/435456 in NE1/4-NW1/4;159426/435456 in NE1/4-NW1/4; 204120/435456 in SE1/4-NW1/4;32589/435456 in SE1/4-NW1/4; 159426/435456 in SE1/4 NW1/4; 9072/60480 in NE1/4-SW1/4, ex easement 1.10 acres; 3291/60480 in NE1/4-S W1/4, ex easement 1.10 acres; 43458/60480 in NE1/4-SW1/4, ex easement 1.10 acres; 3291/60480 in NW1/4-SW1/4; 52530/60480 in NW1/4-SW1/4; 3291/60480 in Lot 1, ex easement 8.54 acres; 52530/60480 in Lot 1, ex easement 8.54 acres; 3291/60480 in Lot 2, ex easement 14.90 acres; 52530/60480 in Lot 2, ex easement 14.90 acres; -Mineral and surface: undivided interest, as follows: 25/40 in NE1/4-SW1/4, ex easement, 25/40 in Lot 1, ex easement, 173/200 in Lot 2, ex easement.		
MM-9828	State of Minnesota	MN	Lake	5	61	11	SW 1/4-SE 1/4	40	2050
MM-10011-N	State of Minnesota	TMM (SE 1/4 of SW 1/4 and SE 1/4 of NE 1/4); Erie Mining Company (SW 1/4 of SW 1/4); Allete, Inc. (SE 1/4 of NE 1/4); USA (NE 1/4 of SE 1/4)	St. Louis	2	60	12	S 1/2-SW 1/4 undivided 19/1080 of SE 1/4-NE 1/4 undivided 19/1080 of NE 1/4-SE 1/4	200	2054
MM-10012-N	State of Minnesota	Erie Mining Co. (SE 1/4	St. Louis	10	60	12	SE 1/4-NE 1/4 SE 1/4-SW 1/4	160	2054

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
		of NE 1/4); Northshore Mining Co. (SE 1/4 of SW 1/4 and SW 1/4 of SE 1/4); Allete, Inc. (SE 14 of SE 1/4)					S 1/2-SE 1/4		
MM-10141-N	State of Minnesota	TMM	St. Louis	8	61	11	Undivided 1/2 interest SE 1/4-NE 1/4 Undivided 1/2 interest NE 1/4-SE 1/4 Undivided 1/2 interest SE 1/4-SE 1/4	120	2057
MM-10142-N	State of Minnesota	TMM	Lake	9	61	11	Undivided 1/2 interest SW 1/4-NW 1/4	40	2057
MM-10144-N	State of Minnesota	Thomas Arendshorst and Sharon Arendshorst, husband and wife (Lot 5) and State of MN (SW 1/4 of SE 1/4)	Lake	8	61	11	Undivided 1/2 interest in Lot 5 and SW 1/4-SE 1/4	69	2057
MM-10146-N	State of Minnesota	USA and State of MN (Lots 17 & 18)	Lake	6	60	11	Lot 17 Lot 18 Lot 11 Lot 14 Lot 9 Lot 10 Lot 15 Lot 16 Lot 19 Lot 20	384.35	2057

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
MM-10147	State of Minnesota	MN	Lake	7	60	11	Lot 1 (surface and mineral)	619.3	12/6/2057
							Lot 9 (surface and mineral)		
							Lot 12 (surface and mineral)		
							Lot 3 (surface and mineral)		
							Lot 4 (surface and mineral)		
							Lot 7 (surface and mineral)		
							Lot 8 (surface and mineral)		
							Lot 5 (surface and mineral)		
							Lot 6 (surface and mineral)		
							Lot 13 (surface and mineral)		
							Lot 14 (surface and mineral)		
							Lot 15 (surface and mineral)		
							Lot 16 (surface and mineral)		
							Lot 11 (minerals only)		
							NE-SE (mineral Only)		
							NW-SE (minerals only)		
							Undivided 1/2 interest SW-SE (minerals only)		
MM-10157	State of Minnesota	USA	Lake	18	60	11	Lot 1	40	12/6/2057
MM-10197-N	State of Minnesota	USA (E 1/2 of S 1/2 of W 1/2); RendField Land Co. (E 1/2 of W 1/2)	Lake	24	61	12	E 1/2-S 1/2-W 1/2	91.65	6/21/2058
				25	61	12	E 1/2-W 1/2		
MM-10206-N	State of Minnesota	USA	Lake	7	61	11	Lot 14	160	9/11/2058
							Lot 20		
							Lot 21		
							SW-SE		
MM-10229	State of		St. Louis	6	59	12	Lot 10	48.75	3/12/2059

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
	Minnesota								

Table 4-7: Terms of Minnesota State Leases

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-9132	12/21/2038	12/21/1988	Lessee	3.50%	2.70%	Yes	Yes	No	Monthly reports required.	$2,654.25	$2,654.25	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 29). Subject to Minn. Stat. § 93.55, Subd. 2.
MM-9455-N	6/7/2040	6/7/1990	Lessee	3.50%	2.60%	Yes	Yes	No	Monthly reports required.	$6,050.00	$6,050.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 29). Subject to special review of exploration plans by DNR.
MM-9706-N	0/4/2047	10/4/1997	Lessee	3.50%	2.60%	Yes	Yes	No	Monthly reports required.	$18,448.8	$18,448.8	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Lake bottom lease.
MM-9722-N	6/16/2049	6/16/1999	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly reports required.	$14,407.50	$14,407.50	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20.
MM-9724	6/16/2049	6/16/1999	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly reports required.	$2,400.00	$2,400.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Excludes lake beds 60-1288P and 69.51P.

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-9725	6/16/2049	6/16/1999	Lessee	3.95%	0.16%	Yes	Yes	No	Monthly reports required.	$7,200.00	$7,200.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Excludes lake beds 69-51P, 69-52P.
MM-9726	6/16/2049	6/16/1999	Lessee	3.95%	0.11%	Yes	Yes	No	Monthly reports required.	$4,800.00	$4,800.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Excludes lake beds 69-51P, 69-52P.
MM-9727	6/16/2049	6/16/1999	Lessee	3.95%	0.11%	Yes	Yes	No	Monthly reports required.	$10,800.00	$10,800	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Excludes lake bed 69-51P.
MM-9755	6/8/2050	6/8/2000	Lessee	3.95%	None	Yes	Yes	No	Monthly reports required.	$6,863.70	$13,727.40	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9756	6/8/2050	6/8/2000	Lessee	3.95%	None	Yes	Yes	No	Monthly reports required.	$4,800.00	$4,800.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9764	9/7/2050	9/7/2000	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly reports required.	$10,446.00	$10,446.61	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9812	12/14/2050	12/14/2000	Lessee	3.95%	0.07%	Yes	Yes	No	Monthly reports required.	$600.00	$600.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Subject to Minn. Stat. 93.55.

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-9813	12/14/2050	12/14/2000	Lessee	3.95%	0.07%	Yes	Yes	No	Monthly reports required.	$2,409.00	$2049.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9814	12/14/2050	12/14/2000	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly reports required.	$7,200.00	$7,200.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9815	12/14/2050	12/14/2000	Lessee	3.95%	0.04%	Yes	Yes	No	Monthly reports required.	$9,063.60	$9063.60	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Subj. to MN Statute 93.55, subd. 2
MM-9828	2050	12/14/2000	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly reports required.	$1,200.00	$1,200.00	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10011-N	2054	6/3/2004	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly reports required.	$1,231.65	$1,231.65	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10012-N	2054	6/3/2004	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly reports required.	$2,400.00	$2,400.00	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10141-N	2057	3/21/2007	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly reports required.	$300.00	$900.00	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10142-N	2057	3/21/2007	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly reports required.	$100.00	$300.00	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10144-N	2057	10/16/2007	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly reports required.	$172.50	$517.50	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-10146-N	2057	12/6/2007	Lessee	3.95%	0.66%	Yes	Yes	No	Monthly reports required.	$1,921.75	$5,765.25	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Lease excepts and excludes the lands, minerals, and mineral rights lying in and directly under the bed of Stony River below the natural ordinary high water mark thereof
MM-10147	12/6/2057	12/6/2007	Lessee	3.95%	0.66%	Yes	Rent.	No	Monthly reports required.	$3,096.50	$9,289.50	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20
MM-10157	12/6/2057	12/6/2007	Lessee	3.95%	0.66%	Yes	Yes	No	Monthly reports required.	$200.00	$600.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10197-N	6/21/2058	6/21/2008	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly reports required.	$458.25	$1,374.75	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-10206-N	9/11/2058	9/11/2008	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly reports required.	$800.00	$2400.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-10229	3/12/2059	3/12/2009	Lessee	3.95%	0.57%	Yes	Yes	No	Monthly reports required.	$243.75	$731.25	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).

Private Leased Lands

TMM currently has benefit of 13 mineral leases with private parties that cover 5,562.93 acres (2,251.24 hectares; Table 4-8; Figure 4-6). The provisions and terms of each lease are specific to the individual leases (Table 4-9). The terms, including initial and renewal terms, range from 40 to 50 years. The surface rights are owned either by TMM, its affiliates, the state or federal government, or private parties. The private leased lands are leased in an "as is" condition to TMM for the purposes of exploring, prospecting, drilling and test pitting the properties and grants TMM the sole and exclusive right to mine and extract and to carry on mining, milling and refining operations with respect to all mineral substances of a metalliferous nature.

Royalties are variable by lease and are summarized in Table 4-8. Some of these properties contain a royalty escalator that increases royalties as the net return value per ton of raw ore increases.

Figure 4-6: TMM Private Mineral Lease Map

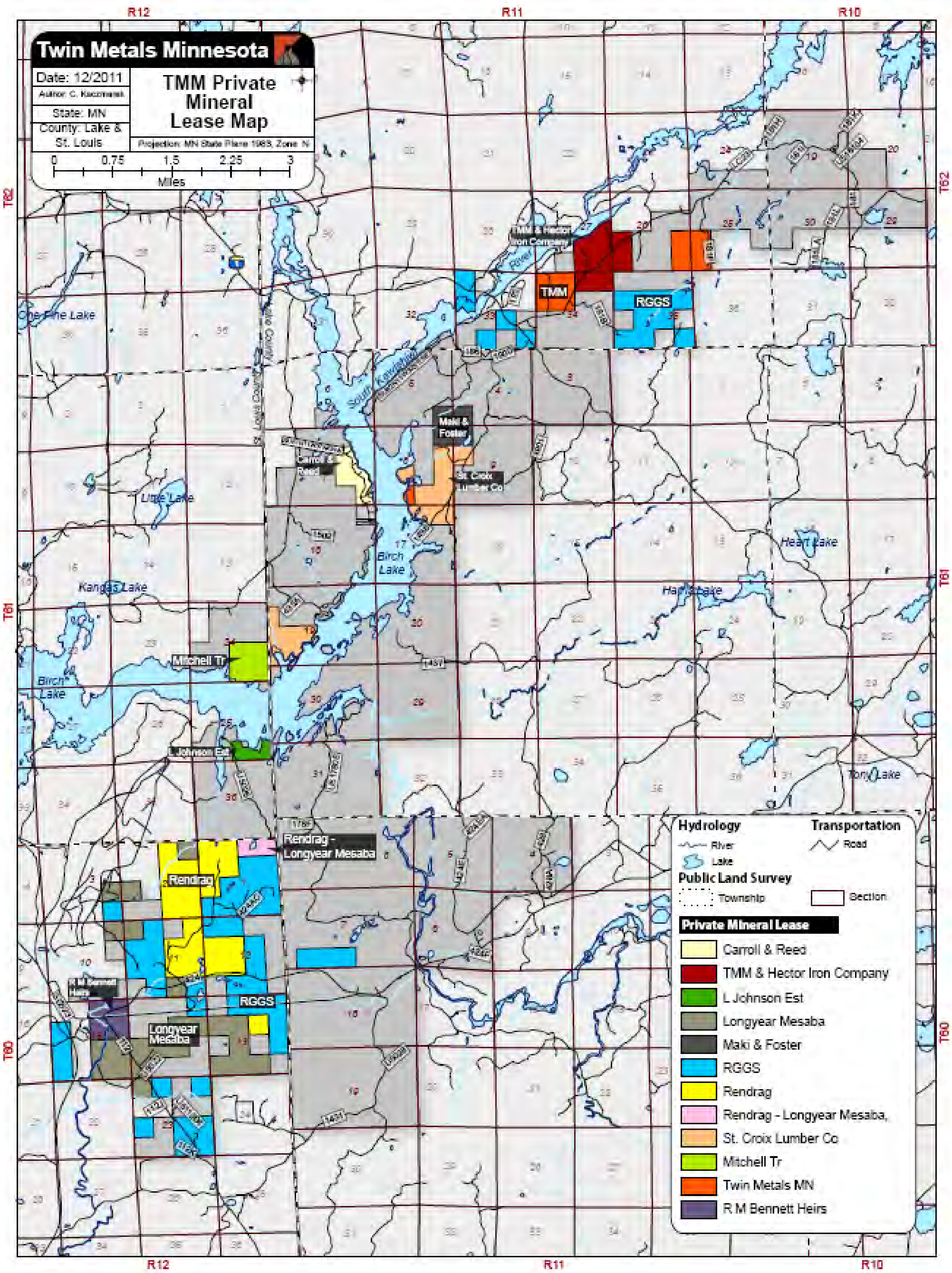


Table 4-8: TMM Private Leased Lands Locations

Lease Name	Mineral Lessor/Owner	Surface Owner	County	Legal Description				ACRES	Expiration Date
				Section	Twp	Range	Section Subdivision		
RGGS/Wallbridge 01/01/2006	RGGS Land & Minerals, Ltd.,		Lake	33	62	11	NW 1/4 - NW 1/4	40	1/1/2026
							SE 1/4 - SW 1/4	40	
							NW 1/4 - SE 1/4	40	
							SE 1/4 - SE 1/4	40	
							Government Lot 5	41.75	
				35	62	11	SW 1/4 NE 1/4	40	
							SE 1/4 - NE 1/4	40	
							SW 1/4 - NW 1/4	40	
							SE 1/4 - NW 1/4	40	
							NE 1/4 - SW 1/4	40	
							SW 1/4 - SW 1/4	40	
							SE 1/4 - SW 1/4	40	
							NW 1/4 - SE 1/4	40	
							SE 1/4 - SE 1/4	40	
Foster DMC Lease 02/12/08	Goldi I Foster and Walter B. Foster		Lake	4	61	11	Undivided 17/81 of SW 1/4 - SW 1/4	40	2/12/2028
				5	61	11	Undivided 17/81 of SE 1/4 - SE 1/4	40	
				8	61	11	Undivided 17/81 of NE 1/4 - NE 1/4	40	
				9	61	11	Undivided 17/81 of NW 1/4 - NW 1/4	40	
Maki DMC Lease 03/17/2007	Richard A. and Lavonne Maki; James K. and Linda Maki; Diane J. and Brian Manuszak; and Jean Maki		Lake	4	61	11	Undivided 4/9 in SW-SW	40	3/17/2027
				5	61	11	Undivided 4/9 in SE-SE	40	
				8	61	11	Undivided 4/9 in NE-NE	40	
				9	61	11	Undivided 4/9 in NW-NW	40	

St. Croix Lumber Co. DMC Lease 12/15/2006	St. Croix Lumber Company, Inc.		Lake	9	61	11	SW 1/4 - NW 1/4	40	12/15/2026
				8	61	11	SE 1/4 - NE 1/4	40	
				8	61	11	NE 1/4 - SE 1/4	40	
				8	61	11	SE 1/4 - SE 1/4	40	
				8	61	11	SW 1/4 - SE 1/4	40	
				8	61	11	NE 1/4 - SW 1/4	40	
St. Croix LEM Lease 04.09.1987	St. Croix Lumber Company, Inc	USA and Private	Lake	19	61	11	Lot 6	160.22	4/9/2012, 4/9/2037 or as long as commercial production (see remarks)
				19	61	11	Lot 12		
				19	61	11	Lot 13		
				19	61	11	Lot 14		
				19	61	11	Lot 15		
				19	61	11	Lot 16		
				30	61	11	Lot 2		
				17	61	11	NE 1/4 - NE 1/4	40	
				17	61	11	Lot 1	45.3	
				17	61	11	Lot 2		
WF Mitchell LEM 06.01.1987	Wells Fargo Bank, MN	USA	St. Louis	24	61	12	N 1/2 SE 1/4	159.25	6/1/2012; 6/1/2037 or as long as commercial production. See remarks.
							Lot 3 (SW 1/4 SE 1/4)		
							Lot 4 (SE 1/4 SE 1/4)		
Rendrag LEM 7/31/1999	Rendrag, Inc.	USA, MPL and Cliffs	St. Louis	1	60	12	Lot 1	39.8	8/1/2049
							Lot 3	39	
							Lot 4	38.6	
							NW/SW	40	
							SE/NW	40	
							SW/NW	40	
				2	60	12	Lot 2	39.7	
							NE/SE	40	
							NW/SE	40	
							SE/NE	40	
							SE/SE	40	
							SW/NE	40	
							SW/SE	40	

				11	60	12	NE/NE	40	
							NE/SE	40	
							NW/SE	40	
							SE/NE	40	
							SW/NE	40	
				12	60	12	NE/SW	40	
							NW/SW	40	
							SE/NW	40	
							SW/NW	40	
				13	60	12	SW/NE	40	
RM Bennett LEM Lease 1.1.2001	R.M. Bennett Heirs L.P.	Mesabi Trust	St. Louis	15	60	12	NE 1/4	160	12/31/2051
RGGS LEM Lease 08.30.2001	RGGS Lands & Minerals Ltd.	USA, MPL, Mesabi Trust, Cliffs, County	St. Louis	1	60	12	SW 1/4 NE 1/4	1,560.00	8/29/2021; continues indefinitely if minerals are produced (see Section 4).
							SE 1/4 NE 1/4		
							NE 1/4 SW 1/4		
							SW 1/4 SW 1/4		
							SE 1/4 SW 1/4		
							NE 1/4 SE 1/4		
							NW 1/4 SE /14		
							SW 1/4 SE 1/4		
							SE 1/4 SE 1/4		
			St. Louis	3	60	12	SE 1/4 SE 1/4		
			St. Louis	11	60	12	NE 1/4 NW 1/4		
							SW 1/4 NW 1/4		
							SE 1/4 NW 1/4		
							NE 1/4 SW 1/4		
							NW 1/4 SW 1/4		
							SE 1/4 SW 1/4		
							SE 1/4 SE 1/4		
			St. Louis	12	60	12	SW 1/4 NE 1/4		
							NE1/4 NW 1/4		
							NW 1/4 NW 1/4		

							SE 1/4 SW 1/4		
							NW 1/4 SE 1/4		
							SW 1/4 SE 1/4		
			St. Louis	13	60	12	NE 1/4 NE 1/4		
							NW 1/4 NE 1/4		
							SE 1/4 NE 1/4		
							NE 1/4 NW 1/4		
							NE 1/4 SE 1/4		
			St. Louis	14	60	12	NE 1/4 NE 1/4		
			St. Louis	15	60	12	SW 1/4 NW 1/4		
							NW 1/4 SW 1/4		
							SW1/4 SW 1/4		
			St. Louis	23	60	12	NE 1/4 NE 1/4		
							NE 1/4 NW 1/4		
							NW 1/4 SW 1/4		
							NE 1/4 SE 1/4		
							NW 1/4 SE 1/4		
							SW 1/4 SE 1/4		
							SE 1/4 SE 1/4		
Johnson LEM Lease 06.10.1986	J. Thomas Johnson Mr. Darryl E. Coons, Lorrie Jams, Mr. Harold A. Knutson	USA	St. Louis	25	61	12	Lot 5 (SW 1/4 SE 1/4)	62.75	6/09/2016; 06/09/2026 if merchantable ore discovered by 6/09/2016; indefinite if commercial production from the premises
							Lot 6 (SE 1/4 SE 1/4)		
Longyear Mesaba LEM Lease 10/01/2000	Longyear Mesaba Co., dba LMC Minerals	USA, Cliffs, Mesabi Trust Company	St. Louis	1	60	12	NW 1/4 NE 1/4	1000	9/30/2050 (9/30/2059 if min. earned royalty paid. Section 27)
			St. Louis	2	60	12	NE 1/4 NE 1/4		
							NW 1/4 SW 1/4		
			St. Louis	3	60	12	NE 1/4 SE 1/4		
			St. Louis	10	60	12	NE 1/4 NE 1/4		
			St. Louis	11	60	12	NW 1/4 NE 1/4		

							NW 1/4 NW 1/4		
							SW1/4 SE 1/4		
			St. Louis	13	60	12	SW 1/4 NW 1/4		
							SE 1/4 NW 1/4		
							NE 1/4 SW 1/4		
							SW 1/4 SW 1/4		
							SE 1/4 SW 1/4		
							SW 1/4 SE 1/4		
			St. Louis	14	60	12	SW 1/4 NE 1/4		
							SE 1/4 NE 1/4		
							NE 1/4 SW 1/4		
							NW 1/4 SW 1/4		
							SW 1/4 SW 1/4		
							NW 1/4 SE 1/4		
			St. Louis	15	60	12	SE 1/4		
			St. Louis	23	60	12	NW 1/4 NW 1/4		
FMC Reed Lease 04/15/2010	Dayton Reed		Lake	7	61	11	NW 1/4 SE 1/4	168.28	4/15/2060
							Lot 11		
							Lot 13		
							Lot 22 (Conflict in legal description. See remarks.)		
				18	61	11	Lot 1		
FMC Carroll Lease 04/15/2011	Robert Carroll		Lake	7	61	11	NW 1/4 SE 1/4	168.28	4/15/2060
							Lot 11		
							Lot 13		
							Lot 22 (Conflict in legal description. See remarks.)		
				18	61	11	Lot 1		

Table 4-9: TMM Private Leased Lands Terms

Lease Name	Expiry Date	Renewal Notice (if option exists)	Initial Agreement Date	Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011	Minimum Advanced Royalty 2011	2011	2012	2013	2014	2015	2016	Comments
RGGS / Wallbridge 01/01/2006	1/1/2026	7/5/2025 (180 days prior to expiration)	1/1/2006	5%	none	no	200,0000 after start of commercial production	$25,000 in years 1-2; $25,000/year after. Yearly report required, see Section 46.	Monthly: See Section 15.	Rent: Greater of $5/acre or $5,000	Only if commercial production starts	Rent: Greater of $5/acre or $5,000	Rent: Greater of $10/acre or $7,500.00	Rent: Greater of $10/acre or $7,500.00	Rent: Greater of $10/acre or $7,500.00	Rent: Greater of $10/acre or $7,500.00	Rent: Greater of $10/acre or $7,500.00	Renewal terms for 5 years, max of four for a total extension to 01/01/2046. Rent ceases when commercial production begins.
Foster DMC Lease 02/12/08	2/12/2028	06/15/2028 (180 days prior to expiration)	2/12/2008	3%	none	No	Yearly minimum royalty (Section 13); no rent	No	Monthly. See Section 15.	None	$2,500.00	Adv. Royalty: $2500.00	Adv. Royalty: $2,500.00	Adv. Royalty: $2,500.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Renewal terms for 5 years, max of four for a total extension to 02/12/2048.
Maki DMC Lease 03/17/2007	3/17/2027	9/18/2026	3/17/2007	3%	none	No	Yearly minimum royalty (Section 13); no rent	No	Monthly. See Section 15.	None	$2,500.00	Adv. Royalty: $2500.00	Adv. Royalty: $2500.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Renewal terms for 5 years, max of four for a total extension to 03/17/2047.
St. Croix Lumber Co. DMC Lease 12/15/2006	12/15/202 6	6/24/2026	12/15/2006	3%	none	No	Yearly minimum royalty (see 2007 amendment) ; no rent	No.	Monthly, See Section 15	None	$3,500	Adv. Royalty: $3,500.00	Adv. Royalty: $7,500.00	Adv. Royalty: $7,500.00	Adv. Royalty: $7,500.00	Adv. Royalty: $7,500.00	Adv. Royalty: $7,500.00	Renewal terms for 5 years, max of 4 for a total extension to 12/15/2046.
St. Croix LEM Lease 04.09.1987	4/9/2012, 4/9/2037 or as long as commercia l production (see remarks)	See remarks	4/9/1987	4% by undergro und; 5% by pit	none	Yes	Yes	No	Yearly reports. See Section 7.	0	$3,069.00	Adv. Royalty: $3,069.00 (before PPI Adjustmen t per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustment per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustment per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustmen t per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustmen t per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustmen t per section 5)	5% Royalty on open pit ores. Initial term automatically extends for an additional 25 years if merchantable ore is discovered, giving an expiration date of 2037. If there is commercial production on the premises by the expiration date in 2037, the lease extends as long as there is commercial production.
WF Mitchell LEM 06.01.1987	6/1/2012; 6/1/2037 or as long as commercia l production. See remarks.	See remarks.	6/1/1987	4% by undergro und; 5% by pit	none	Yes	Yes	No	Yearly reports. See section 7.	0	$1,327.00 (before PPI adjustment per Section 5)	Adv. Royalty: $1,327.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	5% Royalty on open pit ores. Initial term automatically extends for an additional 25 years if merchantable ore is discovered, giving an expiration date of 2037. If there is commercial production on the premises by the expiration date in 2037, the lease extends as long as there is commercial production.

Lease Name	Expiry Date	Renewal Notice (if option exists)	Initial Agreement Date	Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011	Minimum Advanced Royalty 2011	2011	2012	2013	2014	2015	2016	Comments
Rendrag LEM 7/31/1999	8/1/2049		7/31/1999	3.95% (Varies by Net Return Value, See Section 6)	0.1525% of Net Return Value (See Section 6 a)	Yes.	Rent	$100,000	Quarterly report of ore removed (Section 9); Detailed monthly report (Section 13); Additional monthly and annual reports with samples (Section 14)	25,713	0	Rent: $25,713.00	Rent: $25,713.00	Rent: $25,713.00	Rent: $25,713.00	Rent: $25,713.00	Rent: $25,713.00	Work commitment can be met on adjacent lands. Lessor has the right to cancel in years 26 and 36 if no development or production.
RM Bennett LEM Lease 1.1.2001	12/31/2051		1/1/2001	3.95% (varies by PPI, see Section 7)	0.23%	Yes	Yes (Section 5)	$50,000	Quarterly reports with royalty (section 11); Monthly reports (section 14); Additional annual and monthly reports (Section 15)		$1,600 (before adjustment per Section 5)	Adv. Royalty: $1,600.00 (before adjustment per Section 5)	Adv. Royalty: $1,600.00 (before adjustment per Section 5)	Adv. Royalty: $1,600.00 (before adjustment per Section 5)	Adv. Royalty: $1,600.00 (before adjustment per Section 5)	Adv. Royalty: $4,000.00 (before adjustment per Section 5)	Adv. Royalty: $4,000.00 (before adjustment per Section 5)	Lessor can terminate if minimum earned royalty payments not made by 2024, 2039, 2049 or 2059. Work commitment can be met on adjacent lands.
RGGS LEM Lease 08.30.2001	8/29/2021; continues indefinitely if minerals are produced (see Section 4).	N/A	8/30/2001	5.00%	none	No	Yes (section 7)	$25,000	Monthly (section 11); Annual report re exploration (Section 12); Annual minimum work commitment report (section 8).	15,600	0	Rent: $15,600.00	Rent: $39,000.00	Rent: $39,000.00	Rent: $39,000.00	Rent: $39,000.00	Rent: $39,000.00	20-yr term and so long thereafter as mining is occurring on a deposit wholly or partially leased lands. This lease is between United States Steel and LEM. United States Steel is now RGGS.
Johnson LEM Lease 06.10.1986	6/09/2016; 06/09/2026 if merchantable ore discovered by 6/09/2016; indefinite if commercial production from the premises	N/A	6/10/1986	Precious mineral royalty varies by depth of minerals; see remarks	none	No	Yes, Adjusted per PPI (Section 5 and 1998 Amendment)	No	Annual Reports (Section 7)	0	6,275	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $12,550.00 (Before PPI Adjustment)	Precious minerals (gold, silver, platinum group) and uranium royalties vary by depth: 7% if within 1,000 feet of the surface; 6% if between 1,000 and 2,000 feet of the surface and 5% if greater than 2,000 feet. USFS ownership of surface restricts use without notification and approval. Commercial production" for purpose of lease duration requires production of at least 10,000 short tons per annum.

Lease Name	Expiry Date	Renewal Notice (if option exists)	Initial Agreement Date	Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011	Minimum Advanced Royalty 2011	2011	2012	2013	2014	2015	2016	Comments
Longyear Mesaba LEM Lease 10/01/2000	9/30/2050 (9/30/2059 if min. earned royalty paid. Section 27)	N/A	10/1/2000	3.95% (adjusted. See section 7 and Exhibit A)	0.23%	Yes	Advanced Minimum Royalty	$100,000 per year	Quarterly statements (section 11); monthly reports (section 14) and additional monthly and annual reports (section 15)	0	10,000	Adv. Royalty: $10,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $10,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $10,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $25,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $25,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $25,000.00 (Adjusted for CPI-U. See section 5)	Work commitment can be met by work on adjoining lands. Conflict as to ownership with state of NWNE Section 11-60-12. Lessor has right to cancel in years 26 and 36 if no development or production occurring.
FMC Reed Lease 04/15/2010	4/15/2060		4/15/2010	3.95% (adjusted per section 6)	0.25%	Yes	Rent: $750.00	No	Monthly reports (section 13); Quarterly reports with royalty (Section 10); Additional monthly and annual reports (section 14)	Rent: $750.00	N/A	Rent: $750.00	Rent: $750.00	Rent: $240.40	Rent: $240.40	Rent: $240.40	Rent: $360.60	
FMC Carroll Lease 04/15/2011	4/15/2060	N/A	4/15/2010	3.95% (adjusted per section 6)	0.25%	Yes	Rent: $750.00	No	Monthly reports (section 13); Quarterly reports with royalty (Section 10); Additional monthly and annual reports (section 14)	Rent: $750.00	N/A	Rent: $750.00	Rent: $750.00	Rent: $240.40	Rent: $240.40	Rent: $240.40	Rent: $360.60	Legal description of Lot 22 is unclear.

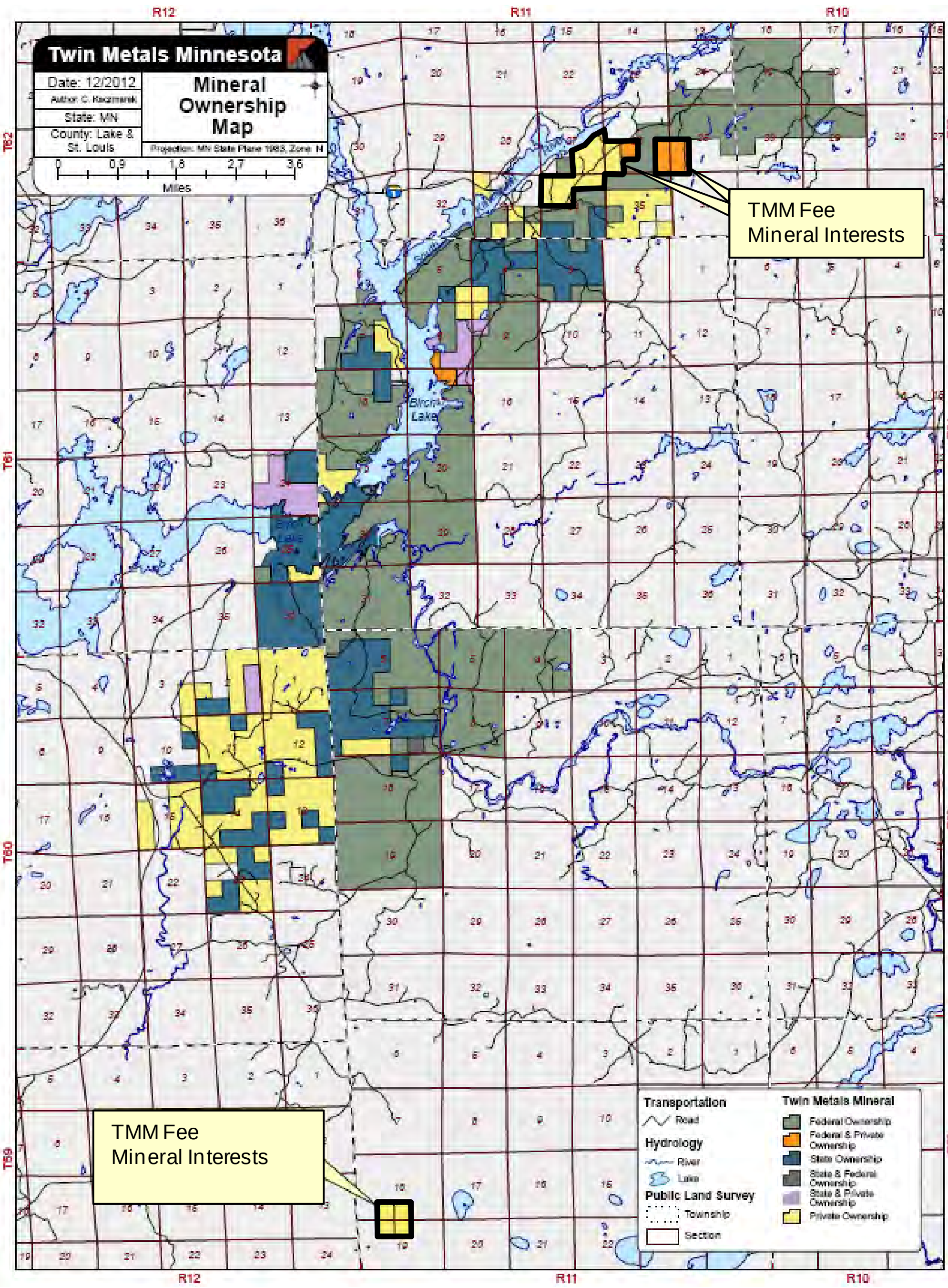
Fee Mineral Interests and Fee Surface Interests

TMM has the benefit of fee mineral ownership of approximately 400 acres (161.9 hectares) and an undivided one-half (1/2) interest in an additional 647.75 acres (262.1 hectares) (Table 4-10). Additionally, TMM has the benefit of fee ownership of or an option to acquire approximately 10,962.70 acres (4,436.4 hectares) of surface lands that do not include mineral rights. Locations of fee mineral interests are shown in Figure 4-7.

Table 4-10: Summary of TMM Fee Mineral Interests

County	Section	Twp	Range	Surface Owner	Total Acres	Comments
Lake	18	59	11	Franconia Minerals (US) LLC	160	
	19	59	11	Franconia Minerals (US) LLC		
Lake	25	62	11	USA	160	Fee mineral interest indicated is an undivided ½ interest
	26	62	11	USA		
Lake	34	62	11	USA	160	Fee mineral interest indicated is an undivided ½ interest
Lake	26	62	11	USA	327.75	Fee mineral interest indicated is an undivided ½ interest
	27	62	11	USA/Private		
	34	62	11	USA		
Lake	7	60	11	Franconia Minerals (US) LLC	240	

Figure 4-7: TMM Fee Mineral Interests



4.4 Company Structure

4.4.1 TMM

Twin Metals Minnesota LLC (TMM) is a limited liability company that, since 2010, has been operated as a joint venture between Antofagasta PLC[1] (Antofagasta) and Duluth Metals Limited (Duluth).

TMM is 35% owned by Duluth, 25% owned by Twin Metals (USA) LLC (which is indirectly owned by Duluth) and 40% owned by Northern Minerals Holding Co. (which is indirectly owned by Antofagasta). Accordingly Duluth holds, directly or indirectly, a 60% controlling ownership interest in TMM.

Antofagasta PLC is a Chilean copper mining company that owns and operates three copper mines in Chile, with a fourth mine, Esperanza, currently being commissioned. It is listed on the London Stock Exchange and has been a constituent of the FTSE-100 index since 2004.

Duluth is a Canadian exploration mining company searching for copper, nickel and platinum group metal deposits. Duluth is listed on the Toronto stock exchange (TSX).

Under the terms of the agreement, Antofagasta has the option to acquire an additional 25% of the joint venture from Duluth at an exercise price calculated on a pro rata share of 1.0x Net Asset Value, which will be determined by a bankable feasibility study. Antofagasta was required to provide US$130 million in direct funding to the project as its initial contribution to the joint venture. Upon making such contribution and completing a bankable feasibility study, and after certain other requirements are met, Antofagasta has the option to acquire an additional 25% equity interest in TMM based on an exercise price calculated in a pro-rata share of 1.0 times Net Present Value of the project, which will be determined by the bankable feasibility study. Under the terms of the PA, Antofagasta has agreed to provide Duluth additional loan and financing facilities of up to US$30 million (of which US$20 million has already been advanced) to cover Duluth's share of subsequent project expenditures, which will ultimately be repayable in cash, Duluth shares or offset against the 25% option exercise price. Full draw down by Duluth of the additional loan and financing facilities totaling US$30 million, together with the commensurate Antofagasta spending contribution, would make available an additional US$85 million of potential funding to the project for expenditures beyond the $130 million commitment by Antofagasta. In addition, Antofagasta has undertaken to organize a common project financing for the large capital cost financing requirements of the project.

Duluth has retained approximately 31,000 acres of mineral interests on exploration properties adjacent to and near-by the joint venture holdings. In addition to actively participating in the joint venture on Nokomis, Duluth will undertake a large scale exploration program on its retained exploration properties. Because of the early stage of evaluation of these exploration properties, and the size of the properties covering the Project, these exploration properties were not considered a part of the Project.

4.4.2 Franconia Minerals (US) LLC and Birch Lake Joint Venture

Franconia Minerals (US) LLC (Franconia) is a wholly owned subsidiary of TMM. Franconia Minerals (US) LLC holds a 70% participating interest in the Birch Lake Joint Venture. The other 30% participating interest is held by Beaver Bay, Inc., an independent third-party entity. Under the terms of the Birch Lake Joint Venture agreement, Franconia may exercise an option to acquire a further 12% participating interest in the Birch Lake Joint Venture, which would result in Franconia holding an 82% participating interest and Beaver Bay, Inc. holding an 18% participating interest.

As described in Section 4.3.1, various mineral interests are held by Franconia and through the Birch Lake Joint Venture.

4.5 Surface Rights and Access

Use of the surface on federal land is provided for in the federal prospecting permits and preference rights leases where the surface and mineral estates are held by the federal government. Surface rights on state land are provided for in the state leases where the surface and mineral estates are held by the state government. Use of the surface of federal or state lands is subject to approval by the applicable regulatory agencies. Surface access to federal prospecting permits and preference rights leases for drilling in certain areas is subject to seasonal restrictions (drilling from November 1 to April 30) and/or periods of frozen ground conditions. Additionally, use of the surface on many federal lands is subject to stipulations imposed by the U.S. Forest Service through the National Environmental Policy Act process to protect surface resources

In the case of private mineral leases where there has been no severance of the surface and mineral estates, surface use is provided as part of the lease. Where the mineral and surface estates are severed and where surface rights are held privately, surface access is typically negotiated with the surface owner.

Use of fee lands owned by TMM is subject to regulatory approval by various federal, state, and local regulatory agencies.

Access to federal, state, and private lands may require additional agreements with other land owners if those lands are not accessible except by crossing other lands.

4.6 Exploration Permits & Approval

In addition to the mineral interests described above, prospecting and exploration programs may require permits and approvals from federal, state and/or local government agencies. Table 4-11 lists some of the most common permits and approvals that may be required, but is not an exhaustive list. In particular, decision notices from the U.S. Forest Service may require additional approvals in certain circumstances. The ultimate scope of permits and approvals required will depend on the proposed scope of activities, the type(s) of activities, and/or the particular location of proposed activities.

Table 4-11: Permits that May be Required for Exploration Activities

Federal Agency	Approval
Bureau of Land Management / US Forest Service	Plan of Operations
Bureau of Land Management / US Forest Service	National Environmental Policy Act Environmental Review
US Forest Service	Road/ Special Use Permit
Army Corps of Engineers	Clean Water Act § 404 Permit
US Fish & Wildlife Service	Threatened and Endangered Species Review
Advisory Council on Historic Preservation	Historic Preservation Review
State Agency	**Approval**
Department of Natural Resources	Operations/Exploration Plan
Department of Health	Explorer's License and boring notification
Department of Health	Temporary and Permanent Sealing Reports
Department of Natural Resources	Minnesota Environmental Policy Act Review
Pollution Control Agency	NPDES/SDS Construction Stormwater Permit (General Permit)
Pollution Control Agency	NPDES/SDS Industrial & Storm Water Discharge Permit (General Permit)
Pollution Control Agency	Storm Water Pollution Prevention Plan
Department of Natural Resources	Permit to Work in Public Waters, including Public Waters Wetlands
Department of Natural Resources	Water Appropriation Permit
Department of Natural Resources	Wetland Conservation Act approvals for activities on state land
Department of Natural Resources	Threatened and Endangered Species Review
Historic Preservation Office	Historic Preservation Review
Local Agency	**Approval**
County/Township	Grading, building and other land use permits and approvals
County/Township	Conditional use permit
County/Soil and Water Conservation District	Wetland Conservation Act approvals for activities on private land

4.7 Royalties and Encumbrances

Royalties and encumbrances are discussed in Section 4.3.2.

4.8 Environmental Studies

As part of the ongoing work, TMM has initiated baseline studies to support environmental review and permitting of the Project. Studies commenced to date include stream and lake water quality sampling, wild rice surveys, wetlands surveys, and sensitive species surveys.

Stream and water quality samples have been collected since 2008. Samples were collected during regularly scheduled events from Birch Lake, South Kawishiwi River, White Iron Lake, and a number of tributaries in the hydrologic system. Monitoring parameters include general chemistry, metals, and field parameters. The majority of the samples were collected in the spring and summer season with one season of winter sampling completed.

Wild rice studies have been conducted since 2009 in Birch Lake, White Iron Lake, South Kawishiwi River, and a number of tributaries. Because wild rice populations oscillate over an approximate 4- to 6-year period, ongoing studies are planned.

Surveys to document sensitive plants protected by State of Minnesota statutes have been conducted in various project locations. Thus far 14 sensitive species have been recorded, including two listed by the State of Minnesota as endangered. Lynx is listed as threatened under the Endangered Species Act (ESA). An existing lynx study within â portion of TMM properties identified lynx in the area.

Wetland studies have been conducted over approximately 5,400 acres of the project site to delineate wetland locations. Wetland boundaries were identified in the field, wetland descriptions were assigned, and functional assessments were conducted. Approximately 1,500 acres of wetlands have been delineated. Publicly available maps and aerial photographs have been used to make preliminary delineations throughout the entire project area.

TMM anticipates that the current studies will need to be expanded, and additional studies will be required prior to commencement of environmental review and permitting. The additional studies are expected to include material characterization, hydrogeology, air quality and meteorology, indicator species and forest health, cultural resources, socioeconomics, noise, light, and viewsheds.

4.9 Environmental Liabilities

Liabilities associated with the mineral exploration program are related to abandonment of boreholes and drill pad and road reclamation (Williamson, 2012). Twin Metals

Minnesota has posted reclamation bonds with the US Bureau of Land Management and the Minnesota Department of Transportation.

Historical mine features on the project site include two former bulk sample sites; an underground shaft and workings developed in 1968 and a surface excavation developed in 1974. Both were developed by the former lease-holder. The shaft is approximately 1,100 feet deep with approximately 700 feet of drifts. Reclamation work at the shaft site was done by the former lease holder after completion of the sampling, and included removal of all surface structures and installation of a concrete cap in the shaft. An uncapped development rock stockpile is present near the shaft collar. The stockpile is sparsely vegetated, and no indication of impacted surface runoff is present (Williamson, 2012). Excavations used for settling ponds during the bulk sample operations have not been backfilled.

The surface excavation bulk sample site is approximately 20 yards in diameter and 10 feet deep. The former lease holder reclaimed the site by capping it via backfilling and grading it to mimic the original topography. Several subsidence areas are present in the capped area. Seepage emanating from the site contains elevated concentrations of sulfate, copper, and nickel. In 2010 the U S. Forest Service studied water quality in the seep and surrounding surface waters. That study concluded that background loading of surface waters in the area is naturally high in sulfate, copper and nickel, and that the seep has no measurable negative impact on the watershed and that no additional management action or testing is needed.

TMM has reclamation responsibilities under applicable leases, and may be responsible for additional reclamation of the bulk samples sites if required, however no specific reclamation has been requested by any agencies to TMM's knowledge and no reclamation plans have been developed by TMM. No bonding requirements are associated with the historical activities.

Ongoing liabilities at the adjacent Cliffs-Erie Dunka property include permitted discharges from a sulfide-bearing rock stockpile and wetland treatment system, and permitted discharges of untreated mine pit water.

4.10 Social License

Although the project is in its early stages, TMM is actively pursuing local community involvement in the project. That work includes open house meetings at the office in Ely, MN as well as other community meetings in the area. Native American groups have been contacted and their involvement with the project sought.

4.11 Significant Risk Factors

Permitting is possibly the most significant risk factor for the project. Although there is a clear legal path forward for permitting a mine on the property, proximity to the Boundary Waters Canoe Wilderness Area (BWCWA) will certainly be cause for comment on the project and possibly generate significant opposition to the project. Comment and challenges based on proximity to the BWCWA will likely add significantly to the time required for permitting of a mining operation.

Federal Prospecting Permit Applications were suspended pending issuance of an environmental impact statement (EIS) by the United States Forest Service (USFS). While those applications have little impact on the resource estimate reported in this report, that process indicated that noise, air and water quality, and quality of life will be important aspects of any permit process. The EIS has been published, but is expected to be challenged in the courts which poses a risk to the project in that mineral tenure on lands required to expand the project is uncertain.

4.12 Comments

Mineral tenure to the lands on which the resources reported here is secure and TMM has the right to explore, develop, and mine any valuable mineral resources located on those lands. Tenure arises from a combination of federal mineral leases and prospecting permits and state mineral leases.

Although there is a clear legal path forward, permitting may be challenging and poses a significant risk to the project.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

5.1 Introduction

The Project is located at the east end of the Mesabi Iron Range which has been a major center for iron ore mining for over 100 years. Today the region has six large operating taconite mines and associated process plants. As a result of mining activity, an extensive network of railroads and paved roads has developed throughout the region that today provides excellent transport communications.

5.2 Physiography

Elevations on the Project leases range from 435 m to 470 m. Topographic relief is generally low and controlled by bedrock. The properties are poorly drained and are part of the Kawishiwi River/Birch Lake watershed.

Wisconsinan continental glaciation scoured and shaped bedrock into low, north-northeast trending hills thinly mantled by till. Rock exposures are generally less than 5%.

Drift is deposited up to 20 m thick in low areas occupied by swamps, which are prominent in the north central and northeast portions of the main block of the Maturi Extension Properties.

The upland areas of the Project leases are forested by second growth mixed conifers and deciduous trees including white, red and jack pines, spruce, balsam, poplar and birch. Treed swamps and open marshes support reeds, sedges, and sphagnum mosses.

5.3 Climate

The northern Minnesota climate is mid-continental. The average annual temperature is 3°C (38°F), with local temperatures averaging -16°C (4°F) in January and 19°C (66°F) in July. Annual rainfall averages approximately 710 mm (28 in.), with 30% occurring from November to April and 70% from May to October. Annual snowfall averages 152 cm, with accumulation on the ground of 60 cm to 90 cm.

5.4 Accessibility

From the city of Duluth, the Project can be accessed by US Highway 53 north for 103 km (64 mi.) to its juncture with State Highway 169 north of the town of Virginia, thence 68 km (42 mi.) northeast on 169 to the town of Ely. The Project is readily accessible by road from the town of Babbitt, a planned mining community of 1,200 inhabitants located approximately 16 km (10 mi.) to the southwest. From Babbitt, take route 70 west for 5 km (3 mi.) to the Ely-Babbitt Highway 21, north 12 km (7.5 mi.) to Highway 120, north and east on 120 for 8 km (5 mi.) to Highway 1, thence south and east to cross the Kawishiwi River just north of the Project, a distance of 11 km (7 mi.).

From the town of Ely, the Project can be reached by taking Highway 1 south, which crosses the Kawishiwi River just north of the Property, a distance of 20 km (12 mi.).

Forest service roads provide access on the individual properties.

5.5 Local Resources

A major asset of the area is the engineering and technical resources supporting the iron mining operations which are accessible to TMM. Similarly, there is a large pool of skilled and unskilled labor in the region that is available to TMM.

5.6 Infrastructure

The local infrastructure related to mining is excellent. Low cost electric power, railroad networks, paved state highways, mine equipment suppliers, mining professionals, and relatively low cost labor are available locally to service the six operating Mesabi Range iron ore mines to the west. The region has an extensive and reliable power supply network with two coal-fired thermal power stations located 8 and 85 miles from the Project. Power is supplied to the plant site by 138 kV overhead transmission line linked to the regional power grid. The nearest rail access for the Project is at Babbitt and connects to the port of Duluth. The port of Duluth on Lake Superior is linked to the rail system and provides worldwide shipping access via the Great Lakes and St. Lawrence Seaway.

5.7 Sufficiency of Surface Rights

The prefeasibility that is currently underway will determine the requirements and preferred location for mine openings, plant, waste dumps and infrastructure to support mining operations. The large size of the property should allow flexibility in selecting the most suitable location and be sufficient to support future development of the deposits.

6.0 HISTORY

6.1 General

The region has been prospected for iron since the mid-1880s. Iron ore mines opened in the Biwabik Iron Formation of the Mesabi Range in 1884. The Duluth Complex has been explored for copper-nickel deposits since the 1950s. The Minnesota Department of Natural Resources (DNR) reports more than 1,900 diamond drill holes and 310 miles (500 km) of core have been drilled to explore the base of the Duluth Complex for copper and nickel (Cargill, 2005b). In 1985, the DNR re-analyzed core from the copper-nickel exploration and found significant PGEs, which has prompted the re-evaluation of a number of known deposits in the western portion of the Duluth Complex.

Each of the three properties that comprise the Project has a somewhat different history and is discussed separately below.

6.2 Maturi

Until combined into the Maturi project, by TMM, the Nokomis and Maturi projects were separate and had somewhat separate histories. The combined histories are summarized in Table 6-1. What was known as Nokomis was not well explored prior to about 2007 when Duluth began drilling the area. Maturi, on the other hand, was well explored by INCO with a combination of drilling and underground exploration.

Table 6-1: Summary of Maturi History (from Routledge and Greenough, 2006)

Year	Exploration
1954-1957	Surface exploration only. Exploration suspended when Federal Department of the Interior would not issue mining permits pending Congress enacting proposed wilderness legislation.
1966	ACNC granted two federal leases at Maturi and Spruce Road deposits.
1967	153 diamond drill holes for 81,699.23 ft (24,902 m) drilled at Maturi and Spruce Road. Exploration shaft sinking started at Maturi and Bechtel completed a scoping study for Maturi.
1968	Shaft sunk to 1,090 ft (332 m), a 634.9 ton (576 tonne) bulk sample taken and underground exploration carried out on the 1,000 ft (305 m) level at Maturi. 2,689.6 tons (2,440 tonnes) from the drift were stockpiled on surface and the shaft capped. Fifteen holes were drilled from surface (21,400.85 ft / 6,523 m).
1969	ACNC drilled 16 holes for 17,473.7 ft (5,326 m).
1973	Maturi buildings and head frame removed and site restored; exploration focused on Spruce Road.
1975-1979	All ACNC work suspended because of State moratorium on copper-nickel exploration and mining.
1985	DNR samples 1970-1975 Duval core from Birch Lake area and discovers 2 m of PGE mineralization associated with chromite rich oxides.
1986	Since earlier drilling had not assayed for PGM and Au, ACNC investigates Maturi drill core and assays for PGM and gold; only anomalous values found.
1988	ACNC Joint venture with Lehmann Exploration Management Inc. and BHP Utah to explore for PGM mineralization; one hole diamond drilled.
1989	Joint venture dissolved and a new ACNC joint venture with Lehmann Exploration Management Inc. (LEM) was formed.
1990	LEM drilled one hole on ACNC property; seven others in the area (14,150.22 ft / 4,313 m total).
1992	LEM unable to obtain financing, LEM joint venture with INCO (ACNC) dissolved.
2000	1,400 coarse reject samples from 8,000 m in 26 holes were assayed by Wallbridge for Cu, Ni, Co, Pt, Pd, Au and S. prepares a resource estimate under JORC code and assessment (scoping study) of the potential for economic mineralization. Hole 11526R (355.62 m) drilled to twin INCO hole 11526.
2005	In May, Franconia acquired from ACNC, through its Beaver Bay Joint Venture partner, an interest in 2,105 hectares (5,201 ac) covering the Spruce Road and Maturi deposits.
2006	Preliminary assessment of the Birch Lake and Maturi projects completed.

6.3 Birch Lake

Birch Lake was explored by a series of operators between 1955 and now. Duval did a significant amount of work in the 1970-1975 period (Table 6-2). In 2000, the Beaver Bay Joint Venture began serious drill exploration of the area. In 2002, Franconia Minerals Corporation optioned the property and continued exploration drilling of the known mineralization. In 2010, TMM was formed and acquired the property. No exploration was completed after acquisition by TMM.

Table 6-2: Summary of Birch Lake History

Year	Exploration
1970-1975	Duval Corporation diamond drilled a fence of wide spaced holes to the base of the Duluth Complex
1985	BBJV undertakes prospecting in vicinity of property and acquires initial mineral permits for property. Under an earn-in agreement with Utah International Inc. to explore for PGM in Duluth Complex, BBJV carries out data compilation and stream sediment survey extending to the shore of Lake Superior. MNDNR samples Duval core and discovers 2 m of PGE mineralization in DU-15 associated with chromite rich oxides. LEM leased ground for Cascade Joint Venture and drilled wedged offset hole to confirm PGEs.
1985-1987	Mapping and geophysical surveys; BBJV joint venture with Utah and INCO on land under option from INCO north of Birch Lake.
1988	Hole C88-1 drilled west of Duval hole DU-15 intersected copper mineralization but no PGEs. Utah and INCO terminated their earn-in agreements with the BBJV. Joint venture earn-in agreement signed with International Platinum Company Inc. (IPCO).
1989	Holes 89-1 and 2 drilled under IPCO agreement.
1990	BL90-1 and 2 drilled south of Birch Lake and 90-3 to north for assessment on lands sub-leased from INCO. IPCO earn-in agreement terminated.
1995	BBJV reorganized with new partners; BL-95-1and BL95-1W drilled to test magnetic anomaly at the north edge of Birch Lake, no encouragement.
1997	MN Natural Resources Research Institute (NRRI) work suggests PGE's associated with Birch Lake fault zone; BBJV acquires State Lease for lake bottom, obtains funding from State and Amplats.
1998	BL98-1 and 1W from south shore west into Birch Lake and intersects PGE values. Preliminary metallurgical tests by Amplats. Earn-in joint venture agreement signed with Altoro Gold Corporation.
1999	BL99-1 and 2 and wedges drilled and property land package expanded. Altoro abandoned agreement with BBJV.
2000	Earn-in joint venture agreement signed with Impala Platinum Holding Ltd. Eleven holes and 25 wedges of BL00 series drilled (10,301 m) to delineate Cu-Ni-PGE mineralization.
2001	6,956 m in seven drill holes and 19 wedges drilled, five holes collared from barge in Birch Lake as step outs to further delineate mineralization. Drilled wedge hole off old Exxon hole D-5 south west of Birch Lake deposit.
2002	A wild cat hole drilled on boundary of property 600 ft. SW of old Exxon hole. Resource estimates by Snowden and LEM. Impala drops option late in year; property optioned to Franconia Minerals Corporation.
2004	Flotation and pilot plant PLATSOL hydrometallurgical testwork on Birch Lake core composites performed at SGS Lakefield Research.
2005	Four holes and four wedge offset holes (3,969 m) diamond drilled on the Birch Lake property. Agreement to use PLATSOL technology arranged by BBJV on behalf of Franconia.
2006	Preliminary assessment of the Birch Lake.

6.4 Spruce Road

Disseminated sulfide mineralization was discovered at Spruce Road in 1951 (Table 6-3). Between 1954 and 1974 INCO performed intensive exploration and applied for a mining license in 1975 which was put on hold because of the moratorium on copper and nickel exploration. Since then, only three holes have been drilled.

Table 6-3: Summary of Spruce Road History

Year	Exploration
1951	Discovery of disseminated sulfide mineralization by Fred Childers and Roger Whiteside. Drilled one hole (188 ft).
1951 - 1954	INCO (via subsidiary ACNC) acquired the property and performed ground magnetometer and vertical loop electromagnetic surveys (VLEM), geological mapping and sampling.
1954-1957	INCO drilled a total of 17,930.2 ft (5,45.06 m) of AX core in 17 holes.
1957	Exploration suspended pending passage of wilderness legislation
1966 - 1968	INCO granted Federal Leases ES-01352 and ES-01353. 100,714 ft (30,900.29 m) of drilling completed in 166 holes and a 1,300 ton (1,180 tonne) bulk sample was collected. Geological mapping and geophysical surveys including Ronka EM 16 (VLF), ground magnetometer and induced polarization (IP) were completed.
1969	Additional private and Federal leases obtained by INCO
1972	Horizontal Loop electromagnetic surveys, IP surveys, and magnetometer surveys completed.
1973	INCO drilled a total of 769 ft (234.4 m) in 26 holes to test a bulk sample area.
1974	A 10,000 ton (9072 tonne) bulk sample was collected and processed at the Creighton Mill in Sudbury, Ontario.
1975	INCO submitted a formal mining proposal
1975	Minnesota declared a moratorium on copper-nickel exploration until 1979. The project was put on hold.
1988	INCO (ACNC) entered joint venture with Lehman Exploration Management (LEM) and BHP Utah to explore for PGE mineralization (the Beaver Bay Joint Venture - BBJV). The JV dissolved in 1989 after one hole was drilled.
1989	JV between INCO (ACNC) and LEM reformulated the BBJV.
1990	Eight holes drilled
1992	INCO and LEM JV dissolved
1997	Downhole Crone PEM Survey completed
1999	Wallbridge optioned the properties from INCO
1999-2000	Wallbridge drilled 4,054.04 ft (1,235.67 m) in two holes
2002	Franconia Minerals Corp. enters into agreement with Beaver Bay Joint Venture to acquire the Spruce Road deposit and other properties.
2010	Antofagasta Minerals and Duluth form Twin Metals Minnesota LLC, a joint venture company.
2011	Duluth and Antofagasta Minerals acquired all of the common shares of Franconia Minerals Corporation.

6.5 Historical Resource Estimates

All three properties have previous resource estimates that were superseded by resource estimates summarized in the various Technical Reports referenced in Section 2.4.

The current mineral resource estimates presented in this report, Section 14, replace all previous estimates on the Project.

7.0 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Introduction

Cu-Ni-PGE mineralization within the Duluth Complex is hosted by mafic to ultramafic intrusive rocks that are part of the overall complex. Because some of the lithologies that host mineralization are now well known, Table 7-1 summarizes the lithologies that typically host mineralization and Figure 7-1 shows the lithologies in the system olivine-plagioclase-clinopyroxene. Minerals (and their formulae) reported from the various deposits are summarized in Table 7-2.

Table 7-1: Lithologies Discussed in this Report

Lithology	Description
Anorthosite	A group of essentially monomineralic plutonic igneous rocks composed almost entirely of plagioclase feldspar, which is usually labradorite but may be as calcic as bytownite or as sodic as andesine or oligoclase, and little or no dark-colored minerals
Dunite	A plutonic rock consisting almost entirely olivine with accessory magnetite and/or ilmenite are almost always present. Chromite is an important accessory at Birch Lake but rare at Maturi and Spruce Road.
Gabbro	A group of dark-colored, basic intrusive igneous rocks composed principally of basic plagioclase (commonly labradorite or bytownite) and clinopyroxene (augite), with or without olivine and orthopyroxene. It is the approximate intrusive equivalent of basalt.
Gabbronorite	A plutonic rock satisfying the definition of gabbro, in which pl/(pl+px+ol) and pl/(pl+px+hbl) are between 10 and 90, and ol/(pl+px+ol) and hbl/(pl+px+hbl) are less than 5.
Norite	A coarse-grained plutonic rock containing basic plagioclase (labradorite) as the chief constituent and differing from gabbro by the presence of orthopyroxene (hypersthene) as the dominant mafic mineral.
Melatroctolite	A dark-colored, generally plutonic to hypabyssal rock containing abundant olivine along with pyroxene, biotite, possibly amphibole, and less than 10 percent plagioclase.
Troctolite	A gabbro composed chiefly of calcic plagioclase (e.g. labradorite) and olivine with little or no pyroxene.
Anorthositic Troctolite	A gabbro composed of 70-80% plagioclase with 20-30% olivine and pyroxene. ol>py

ol – olivine; pl – plagioclase; px – pyroxene; hbl - hornblende

Figure 7-1: Mafic Intrusive Rock Ternary Classification Diagram (after Severson and Hauck, 1990)

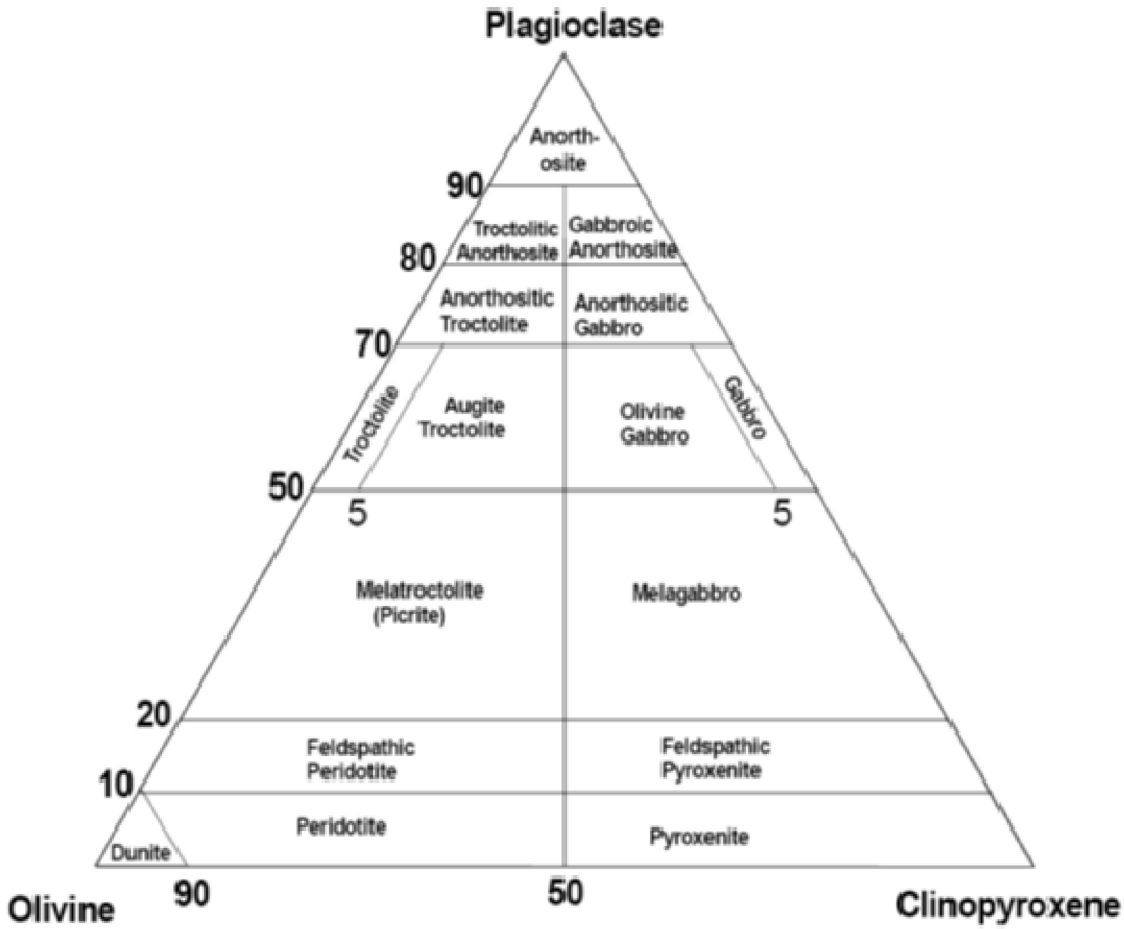


Table 7-2: Minerals Identified at Maturi, Birch Lake, or Spruce Road

Cu Minerals	Formula
native copper	Cu
bornite	Cu_5FeS_4
chalcocite	Cu_2S
chalcopyrite	$CuFeS_2$
covellite	CuS
cubanite	$CuFe_2S_3$
cuprite	Cu_2O
digenite	Cu_9S_5
haycockite	$Cu_4Fe_5S_8$
mooihoekite	$Cu_9Fe_9S_{16}$
neodigenite	Cu_9S_5
putoranite	$Cu_9Fe_9S_{16}$
talnakhite	$Cu_9(Fe,Ni)_8S_{16}$
tenorite	CuO

Ni Minerals	Formula
heazlewoodite	Ni_3S_2
mackinawite	$(Fe, Ni)_9S_8$
millerite	NiS
pentlandite	$(Fe,Ni)_9S_8$
violarite	Ni_2FeS_4

PM Minerals	Formula
native silver	Ag
electrum	$Au(Ag)$
froodite	$PdBi_2$
hessite	Ag_2Te
insizwaite	$Pt(Bi,Sb)_2$
irarsenite	$(Ir,Ru)As_2$
michenerite	$PdBiTe$
moncheite	$(Pt,Pd)(Te,Bi)_2$
paolovite	Pd_2Sn
polarite	$Pd(Bi,Pb)$
silver telluride	AgTe?
sobolivskite	$PdBi$
sperrylite	$PtAs_2$

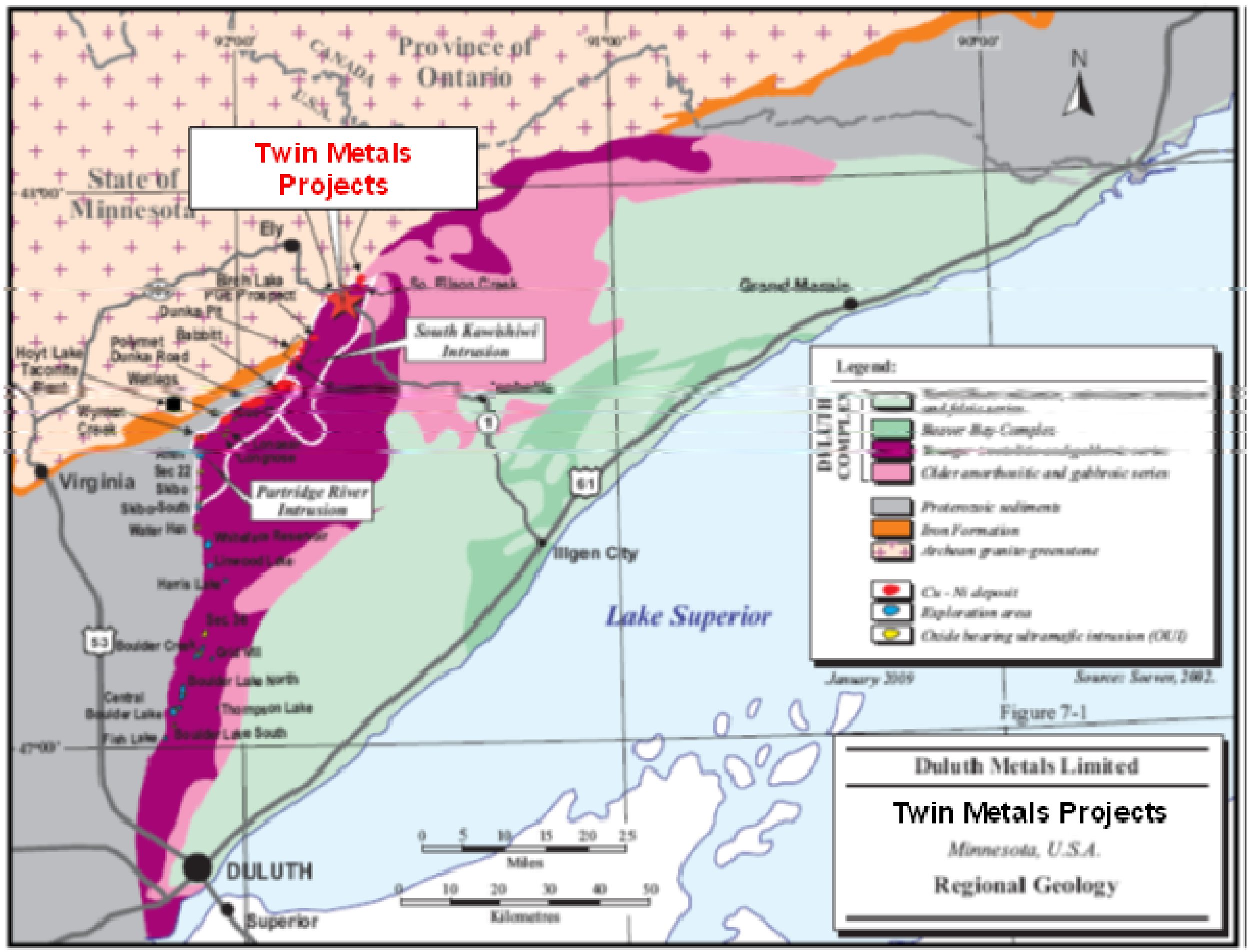
Gangue Minerals	Formula
altaite	$PbTe$
frobergite	$FeTe$
galena	PbS
pyrite	FeS_2
pyrrhotite	$Fe_{1-x}S_x$
sphalerite	$(Zn,Fe)S$
troilite	FeS
chromian spinel	$Mg(Al,Cr)_2O_4$
chromite	$(Fe, Mg)(Cr, Al)_2O_4$
ilmenite	$FeTiO_3$
magnetite	Fe_3O_4

7.2 Regional Geology

The Maturi, Birch Lake, and Spruce Road properties lie within the Superior Province that is composed of Precambrian shield rocks that are exposed in central and northeastern Minnesota and extend north into Ontario (Routledge, 2004). The shield rocks include Early Precambrian (Archean >2,600 Ma) mafic to felsic volcanic rocks, graywackes and granitic intrusives and older ortho- and paragneisses; Middle Precambrian (2,600 Ma to 1,800 Ma) clastic and carbonate sedimentary rocks and iron formations; and Late Precambrian clastic sedimentary rocks, mafic lava flows, pyroclastics and interbedded sedimentary rocks (1,800 Ma to 600 Ma). The Algoman Orogeny circa 2,700 Ma and the Penokean Orogeny circa 1,850 Ma resulted in deformation and weak metamorphism of the Early Precambrian and Middle Precambrian rocks, respectively, and the intrusion of granitic plutons.

In eastern Minnesota, the Midcontinent Rift System developed during crustal scale extension in the Middle Precambrian (mid-Proterozoic). The rift system is traceable, as exposures of mantle-derived tholeiitic to subalkaline Keweenawan mafic lava flows, intrusives, and rift-filling fluvial sedimentary rocks, and in the subsurface as a gravity anomaly (high), from the south shore of Lake Superior south-southwest to the State of Kansas. Intrusion of the Duluth Complex circa 1,120 ±15 Ma was related to the mid continental rifting and is cogenetic with the Keweenawan North Shore mafic volcanic rocks that form its hanging wall on the east (Figure 7-2).

Figure 7-2: Regional Geological Map (after Soever, 2002)



7.3 District Geology

The Duluth Complex is a composite intrusion comprising 12 sub-intrusions emplaced over a period of 10 to 12 million years. These bodies include the South Kawishiwi Intrusion, Bald Eagle Intrusion, Partridge River Intrusion, Logan Sills, Greenwood Lake Intrusion, Powder Line Gabbro, Silver Bay Gabbro, and the Sonju Lake Intrusion.

The intrusive complex occupies an area of approximately 6,500 km^2. It extends some 240 km northeast-southwest from the City of Duluth almost to the Ontario border and attains a width of up to 50 km on surface (Figure 7-2).

Footwall contacts on the west and north sides of the intrusive are sharply defined with the metagreywackes and slates of the Middle Precambrian Virginia Formation, the Biwabik Iron Formation of the Mesabi Range, and the Early Precambrian monzonites of the Giants Range Batholith. The contact and base of the complex dips shallowly to moderately to the southeast (-10° to -35°). On the east and south flanks, contact with the coeval North Shore basalts is gradational.

Anorthositic, troctolitic, gabbroic to granodioritic, and granitic/granophyric rocks compose the Duluth Complex (the Complex) and have been grouped into an Anorthositic Series, a Troctolitic Series and a late stage, differentiated Felsic Series.

Field relations indicate that the Anorthositic Series in the upper part of the Complex is older than the Troctolitic Series that occupies the lower two thirds of the Complex. However; identical age dates of 1,099 Ma for both series supports rapid intrusion. The Felsic Series rocks, and late stage basalts and aplite dikes, cut the anorthosites and troctolites. Inclusions of footwall rocks, magnetite-enriched (iron formation) material, and hornfels material, are found in the troctolites near the base of the Complex.

Weiblen and Morey (1980) proposed a half graben model for the emplacement of the Complex intrusives in which step and rise normal faults, with steep southeast dips, occurred in a northeasterly direction parallel to the trend of the Complex's basal contact.

Magma was subsequently injected along these structures and coalesced to form the complex. A later series of northwesterly strike-slip faults offset the intrusive-controlling northeast faults.

7.4 Local Geology

7.4.1 Maturi

Lithology

Mineralization at Maturi is in the lower South Kawishiwi Intrusion (SKI) in what is locally called the Basal Mineralized Zone (BMZ; BH, U3, and BAN Units of Severson, 1994; Cox et al, 2009). SKI is bordered on the southwest by the Partridge River body and on the southeast by the Bald Eagle pluton. SKI extends approximately 40 km northeast-southwest and is as wide as 4.3 miles (7 km). Exposed footwall consisting of Giants Range Granite lies approximately 1,600 ft (500 m) northwest of the Maturi deposit. The exposed SKI-granite contact trends northeast and generally dips 20° southeast but dips at depth range from 20 to 52° based on interpretation of the drill data. Figure 7-3 shows the property geology.

SKI is composed of an upper sulfide-free troctolite with anorthosite layers and lower sulfide-enriched troctolite, picrite, dunite, anorthosite, oxide cumulates and hornfels. Rock units and mineralization at the base of the SKI are planar and sub-parallel to the lower contact. In the vicinity of the Maturi property, there is a middle series of interlayered troctolite and/or picrite, and/or hornfels and Spruce Road Breccia separating upper and lower troctolites. Rock units and mineralization at the base of the SKI are planar and sub-parallel to the lower contact. The contact strikes 60° and dips 35° to 52° southeast (Figure 7-4). The lower 200 to 300 ft (60 m to 100 m) of the SKI at Maturi is described as troctolite topped by a mafic troctolite or picrite. Hangingwall to the BMZ is dominantly troctolite to anorthositic troctolite or augite troctolite. Olivine gabbros and anorthosite are mainly found within the An-Series/Upper Gabbro.

The Basal Mineralized Zone (BMZ) is a heterogeneous mixture of troctolite, augite troctolite, melatroctolite/picrite, olivine gabbro, anorthositic gabbro, norite, and gabbronorite. The BMZ is as thick as 865 ft (260 m) at Maturi and averages 215 ft (65 m) thick. BMZ is as much as 1,350 ft (411.5 m) at Spruce Road. Mafic intrusive rocks (troctolite and anorthosite) dominate with minor ultramafic rocks (melatroctolite, picrite). Textures range from very fine grained to coarse pegmatite. All of the textural variations can be seen in a single outcrop which makes mapping of individual units within the BMZ difficult. The BMZ is capped by a coarse pegmatitic unit (PEG) comprising all of the lithologies in the BMZ, but dominated by anorthositic troctolite. PEG occurs at the top of the BMZ in most of the holes drilled at Maturi and is used as a marker horizon for that reason. Thickness of PEG is extremely variable, but averages about 60 ft (20 m) thick with a maximum thickness of 216 ft (65 m).

The Duluth Complex has not been significantly deformed since magma consolidation, but it has been subjected to displacements along reactivated basement faults as well as cross faults. Structures are mostly subvertical north-northeasterly faults and fault zones that are evident as linear features on air photos and topographic maps. These faults have been active pre-, syn- and post-emplacement of SKI. Where exposed in parts of SKI and footwall rocks, movement on these faults ranges from 10 to 400 ft (3 m to 120 m). Stepping or terracing of the granite contact by faults has provided favorable structures that localized mineralization. The Maturi deposit appears to occupy a gentle flexure in the contact that has formed a broad, easterly plunging embayment in the base of the SKI (Soever, 2000).

Figure 7-3: Local Geological Map of the Maturi and Spruce Road Deposits

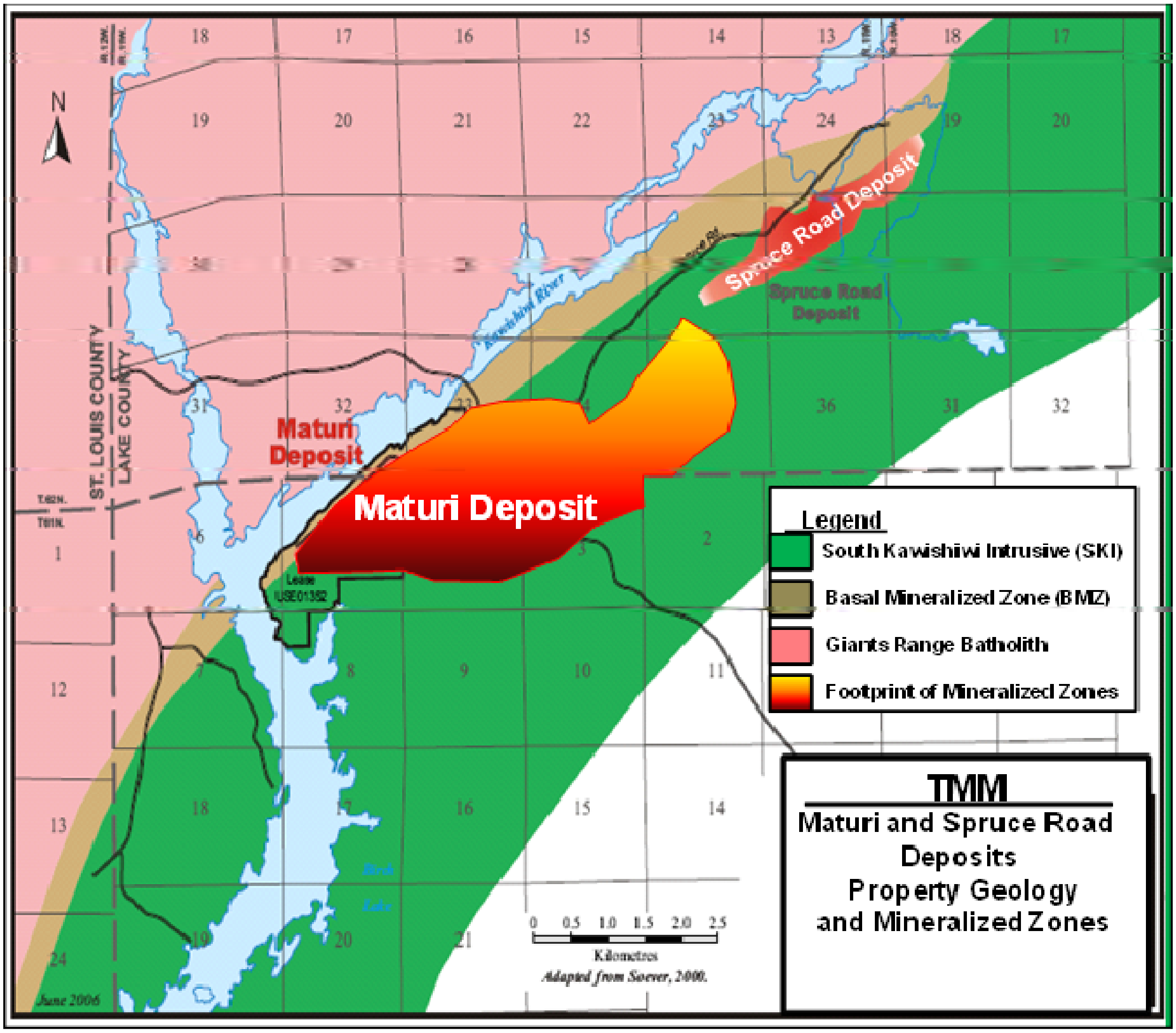
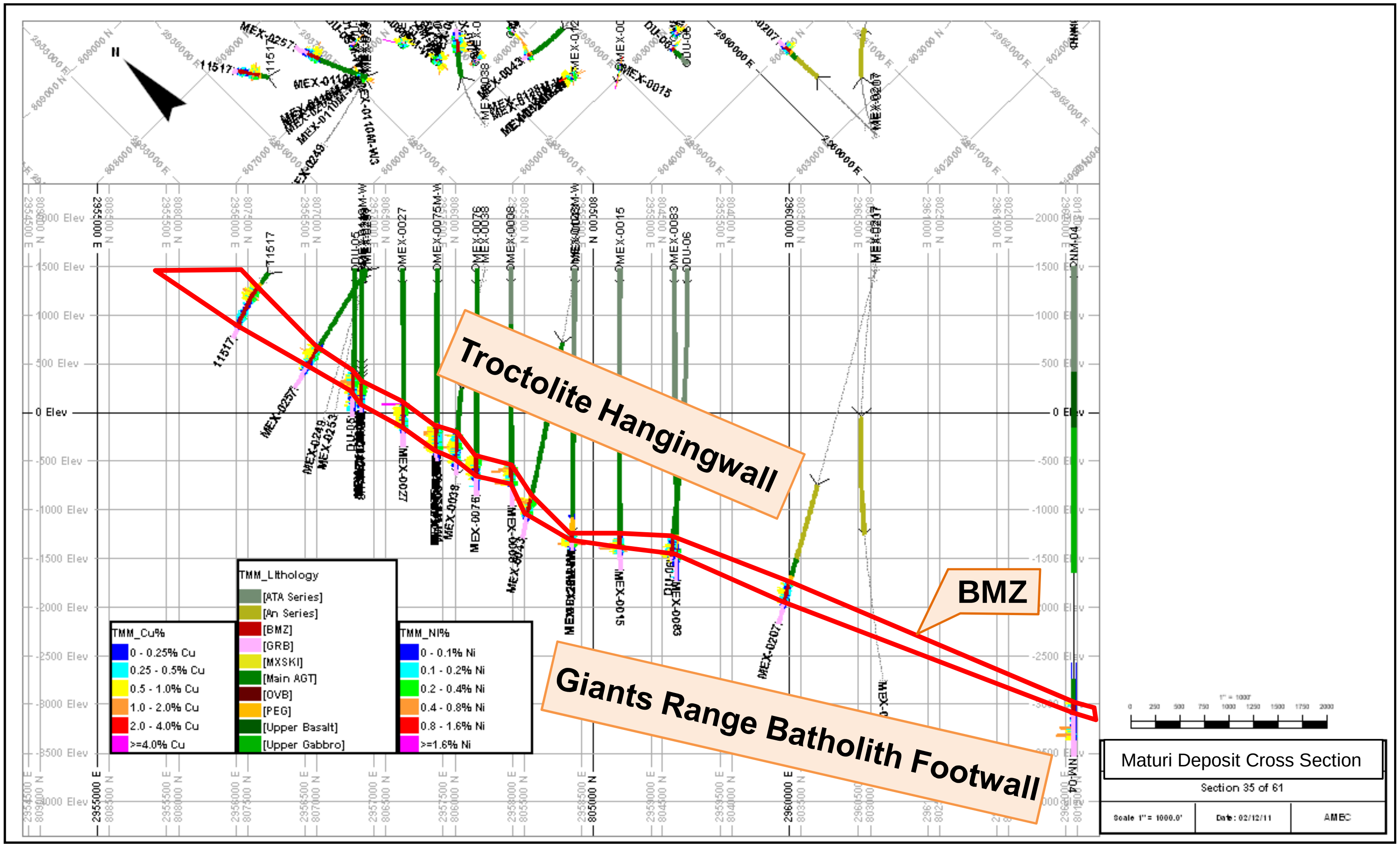


Figure 7-4: Typical Cross Section at Maturi



Alteration

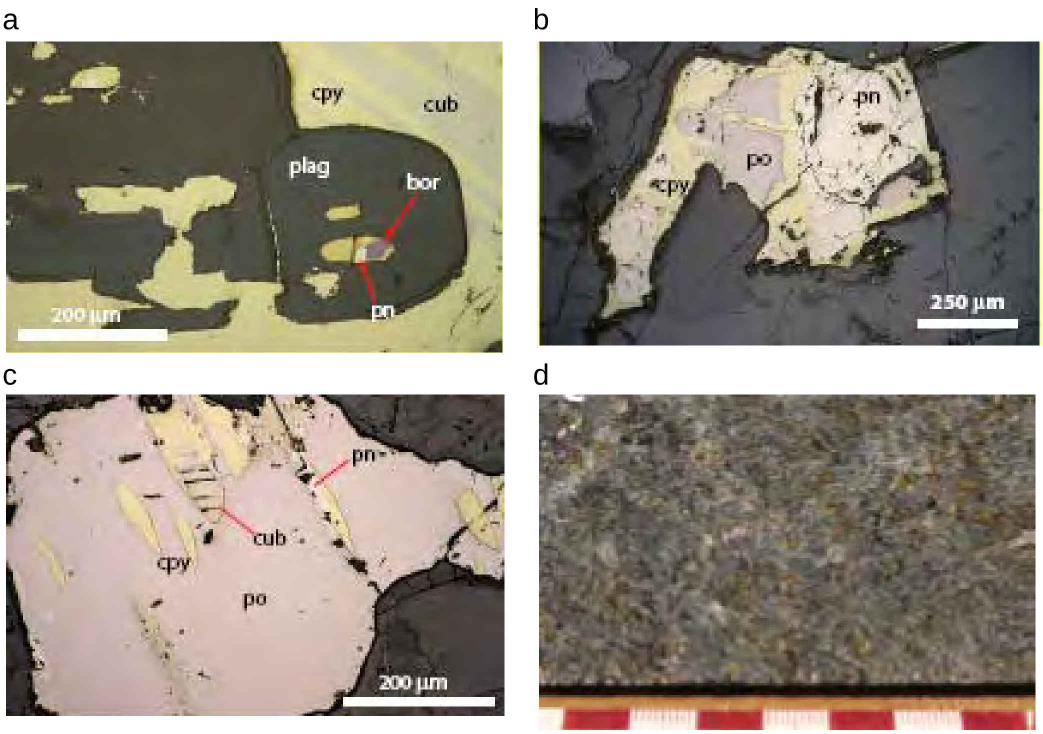
Saussuritization (replacement of plagioclase by fined grained aggregates of zoisite, epidote, albite, calcite, sericite, and zeolites) and serpentinization (replacement of olivine by serpentine) are logged. Serpentinization is common and is noted where present. Uralitization (the alteration of an igneous rock in which pyroxene is changed to amphibole) is commonly encountered and is also logged. These alterations exhibit no obvious relationship to mineralization but are logged so that those relationships can be identified if they are present.

Mineralization

The Maturi deposit consists of a tabular sheet of disseminated copper-nickel-iron sulfide mineralization 5 ft (1.5 m) to 865 ft (260 m) thick (average - 215 ft (65 m)) that rests on or close to the SKI-granite contact (the Basal Mineralized Zone (BMZ)). The mineralized zone is in, and immediately above, the footwall contact of the SKI. It consists of 1% to 5% disseminated chalcopyrite, talnakhite, cubanite, pyrrhotite, and pentlandite in a tabular zone, parallel to the contact. Better grades of copper, nickel and PGEs are associated with more mafic units near the top of the mineralized zone, and there is excellent continuity of widths and values from hole to hole and section to section.

Magmatic sulfide mineralization in the South Kawishiwi Intrusion is restricted to the BMZ and rarely can be found in the overlying PEG (including ultramafic) units and in the footwall granitoids as well (Gál et al, 2010). Sulfides are usually disseminated-patchy and interstitial to the host silicates (Figure 7-5). The most common sulfide minerals are chalcopyrite, pyrrhotite, pentlandite and cubanite which form irregular shaped patches consisting of multiple intergrown minerals (Figure 7-5a, b, c).

Figure 7-5: Photo Micrographs (from Gál et al, 2010)



cpy – chalcopyrite; cub – cubanite; bor – bornite; plag – plagioclase; pn – pentlandite; po - pyrrhotite

Pyrrhotite forms anhedral grains often showing oriented lamellae of different Fe:S ratios (Gál et al, 2010; Figure 7-5c). Pyrrhotite is usually intergrown with rounded pentlandite grains.

Pentlandite is also abundant as flame-like exsolution lamellae in pyrrhotite (Gál et al, 2010).

Chalcopyrite occurs as interstitial patches between silicates, replacing pyrrhotite, pentlandite and silicates (pyroxene and plagioclase) as well (Gál et al, 2010; Figure 7-5d). Chalcopyrite also forms rounded primary inclusions in plagioclase and very rarely in clinopyroxene. Oriented star-shaped exsolution lamellae of sphalerite in chalcopyrite are abundant.

Cubanite is always present in the form of exsolution lamellae in chalcopyrite (Gál et al, 2010; Figure 7-5a).

Sulfide minerals often occur in micro-scale (1-5 µm thick) veinlets crosscutting all silicate phases and interconnecting interstitial sulfide patches (Gál et al, 2010). These veins are primarily filled with chalcopyrite and in a lesser extent, cubanite as exsolution lamellae, however some minor amount of pentlandite and pyrrhotite can also be found in such textural positions. The vein filling occurrences of sulfides implies that after the solidification of the silicate host rock, the immiscible sulfide melt, until a certain point, was still in liquid state and could migrate in the microcracks of the rock.

Bornite, covellite, talnakhite, and millerite occur in subordinate amounts and are products of late-stage differentiation of the crystallizing sulfide melt. These minerals occur as replacing phases of chalcopyrite and along grain boundaries in sulfide patches and silicates (Gál et al, 2010).

Significant Cu-Ni mineralization occurs at the top of the footwall Giants Range Batholith. The mineralization is hosted within the contact thermal aureole to the Duluth Complex and is interpreted to be directly derived from the Duluth Complex. Mineralization in the footwall occurs in approximately one-quarter of the holes drilled to date, with about eighty percent of these holes showing mineralization in the hanging wall and then continuing directly into the footwall with little or no breaks. The sulfide mineral assemblage in the footwall is the same as in the hanging wall, being dominated by chalcopyrite and pyrrhotite with lesser cubanite, pentlandite, bornite and talnakhite. Pentlandite is the principal nickel mineral, although trace amounts of nickel also occur in talnakhite and pyrrhotite. Chalcopyrite, cubanite, talnakhite and bornite are the principal copper-bearing minerals.

Platinum group minerals (PGMs) have been found in various textural positions (Gál et al, 2010) but most commonly occur as finely disseminated grains within sulfide patches. Pyrrhotite or pentlandite are the preferred hosts; however, chalcopyrite can host PGMs. Work by Gál et al, 2010 indicates that these grains are mostly Pt-Pd-bismuth-tellurides (michenerite, moncheite) or Pd-Sn-bearing phases (paolovite) in composition. Rare grains of Ir-arsenides (irarsenite) are enclosed in pyrrhotite.

The largest concentrations of PGMs occur along the grain boundaries of plagioclase and massive sulfide patches or in thin sulfide veinlets. In such places, Ca-alteration of plagioclase is almost always present with some amount of chlorite or serpentine. Grain boundaries of sulfides and biotite or apatite also host PGMs. Most of the Pt-Pd-bismuth-tellurides (michenerite, moncheite, polarite/sobolivskite) and sperrylite are located in such position.

In drillhole MEX-108, a zonation of PGMs has been observed: in the lower sample (108-26) only Pt-rich grains have been found while in turn in the higher sample (108-

25) only Pd-rich PGMs occur. This implies the different mobility capabilities of Pt and Pd, latter being the more mobile under late-stage magmatic/hydrothermal conditions.

PGMs not associated with sulfides are less abundant. Some of the grains were found along the boundary of K-feldspar and quartz in a granophyric blob near to the footwall contact, others have been identified in sericitized plagioclase or in K-feldspar in a felsic mass close to abundant apatite inclusions.

PGMs also occur in semi-massive, net-textured sulfide patches associated with felsic inclusions or quartz-pegmatite, clearly showing evidence that during mixing of felsic material originating from the footwall and the intruding troctolitic magma these metals are mobile and may be concentrated in the felsic material.

Dip varies from 35° to 55° and the zone plunges approximately N60°E along the contact. Higher grades are concentrated in the upper 100 ft (30 m) of the zone that is approximately 1.25 mi (2 km) along strike. Mineralization has been traced by drilling down dip approximately 2.2 mi (3.5 km) and is open a depth.

A QEMSCAN mineralogical study was conducted by SGS Lakefield Research Limited (SGS Lakefield) in 2007 in conjunction with the bench scale flotation test work on a composite sample of drill core from the Maturi deposit to determine the deportment of copper and nickel mineralization. A 4.4 lb (2 kg) sample was ground in a ball mill for 25 minutes and classified into four size fractions. A polished section from each fraction was prepared and submitted for QEMSCAN analysis. An important observation was that a significant portion of the nickel (about 22%) is non-sulfide. The distribution of chalcopyrite, cubanite, and pentlandite increases in the finer fractions. Pyrrhotite distribution remains almost constant in all fractions. About 80% of total copper in the ore is in chalcopyrite and 18% in cubanite. Pentlandite was the only nickel mineral detected in this study, but Ni also occurs in talnakhite.

7.4.2 Birch Lake

The Birch Lake property lies south of Maturi. The geology, while similar is distinct because SKI in this area includes numerous ultramafic and oxide (magnetite/ilmenite/chromite) layers which are not present at Maturi.

Lithology

The Birch Lake mineralization is hosted by the South Kawishiwi Intrusion (SKI) (Routledge, 2004) (Figure 7-6). SKI extends approximately 25 mi (40 km) northeast-southwest and is as wide as seven kilometers. It is bordered on the southwest by the Partridge River body and on the southeast by the Bald Eagle pluton. The footwall consists predominantly of Granites Range Batholith with minor Middle Precambrian metasediments which are exposed less than a kilometer west of the property boundary in the area of the Birch Lake deposit, and are exposed in the Dunka open pit area.

SKI ranges from 1,150 ft (350) m to 4,430 ft (1,347.5 m) thick as interpreted from drill intercepts of the footwall metasedimentary rocks or Giants Range monzonite. The lithology and igneous stratigraphy of SKI been has been simplified to seven principal units from top to bottom:

- Anorthositic troctolite and troctolite (very thick)
- Main augite troctolite (900 ft (275 m) thick)
- Ultramafic Units 2 and 3, anorthositic troctolite/troctolite (375 ft (115 m) thick)
- Pegmatitic Unit (PEG; 92 ft (28 m) thick)
- Basal Mineralized Zone (BMZ) which includes:
  - Ultramafic 3 (U3) mineralized zone (100 ft (30 m) thick)
  - Basal Heterogeneous Zone (BHZ; extremely variable thickness)
  - Basal augite troctolite/norite (400 ft (120 m) thick).
- Footwall Rocks – Biwabik Iron Formation and Giants Range Batholith.

Cu-Ni bearing sulfides and associated PGE mineralization at Birch Lake occur consistently in what is called the Basal Mineralized Zone (BMZ) below its contact with pegmatitic phases of sulfide-barren, hanging wall troctolites, gabbros, and anorthosites. The BMZ averages about 100 ft (30 m) thick, but is as thick as 515 ft (157 m). Figure 7-7 is a cross section across Birch Lake showing the BMZ.

The BMZ is mainly troctolite phases with compositions ranging to anorthosite. It is variable in modal mineralogy, composition and texture over short distances but can be distinguished by the presence of sulfides, cumulus olivine with interstitial plagioclase and olivine-rich ultramafic intervals (dunites, melatroctolites/picrites) ranging from less than 1 ft (0.3 m) to tens of feet thick. Relative to Maturi, Birch Lake contains significantly more ultramafic intrusive rocks. Late granitic and felsic dikes cut the SKI.

PGE enrichment is associated with late stage Cu-Ni sulfides, particularly with chalcopyrite, talnakhite, and bornite.

The Birch Lake area has not been significantly deformed since magma consolidation but it has been subjected to displacements along reactivated basement faults as well as cross faults. Mapped structures are mostly sub-vertical north-northeasterly faults and fault zones that are evident as linear features on air photos and topographic maps. Rowell (2002) believes that these faults have been active pre, syn and post emplacement of the SKI and offset the mineralized U3 unit. Where exposed in parts of the SKI and footwall rocks, movement on these faults ranges from 10 ft (3 m) to 400 ft (120 m).

West-northwest faults cut the northeasterly faults and show left lateral displacements in the south portion of the property and right lateral offsets under Birch Lake (Rowell, 2001; Pratt, 2010). These late faults have vertical displacements in the order of 30 ft (10 m) and may be akin to transform faults that accompany rifting elsewhere.

The Bob Bay Fault zone trends north through Bob Bay but northeasterly south and north of Bob Bay. This fault effectively cuts off the Birch Lake deposit on the west. Drill holes in this fault zone commonly intersect massive and disseminated sulfides in the footwall rocks and/or felsic dikes that cross-cut the intrusion. The sense of displacement between holes 88-1 and DU-15 is in the order of 200 ft (60 m) to 300 ft (90 m) down on the east side.

Figure 7-6: Birch Lake Property Geology

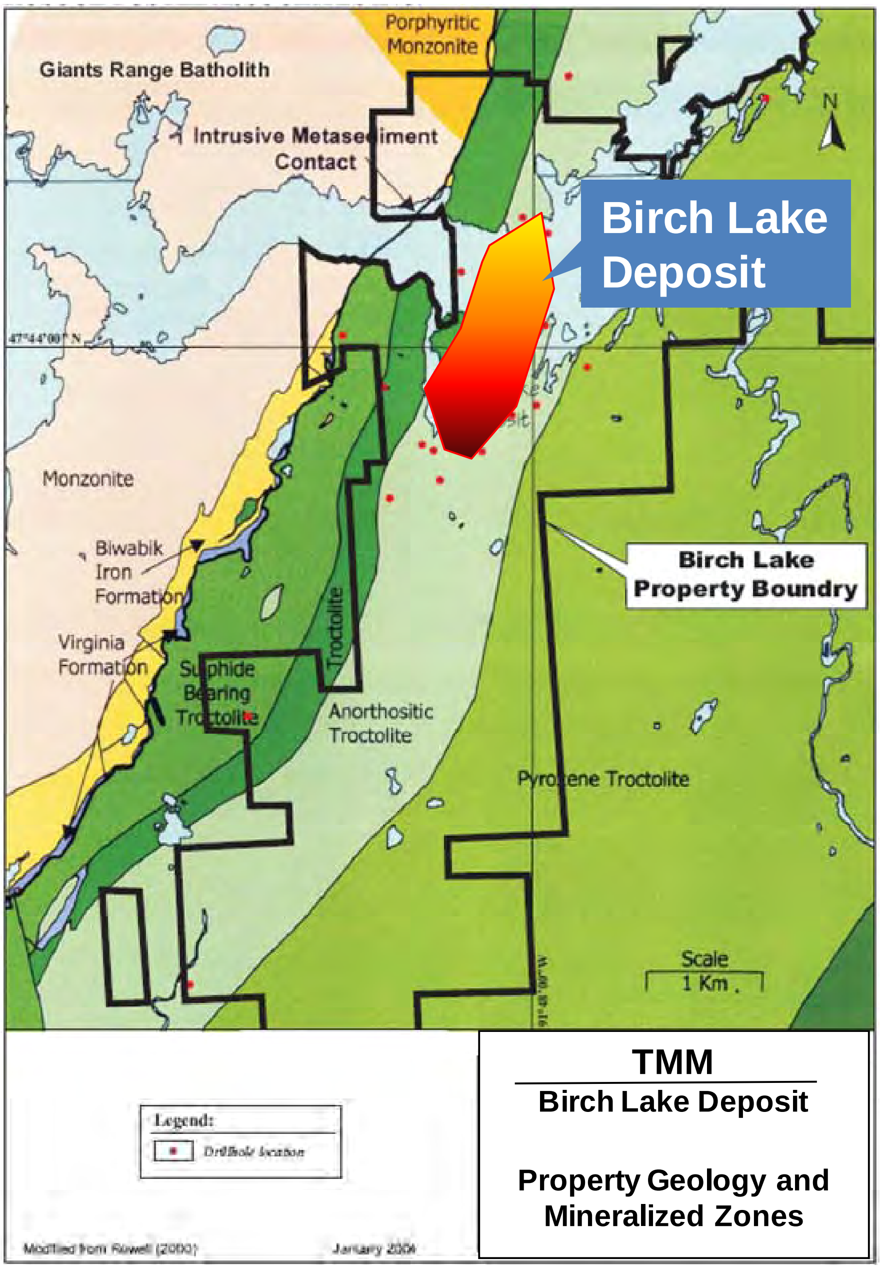
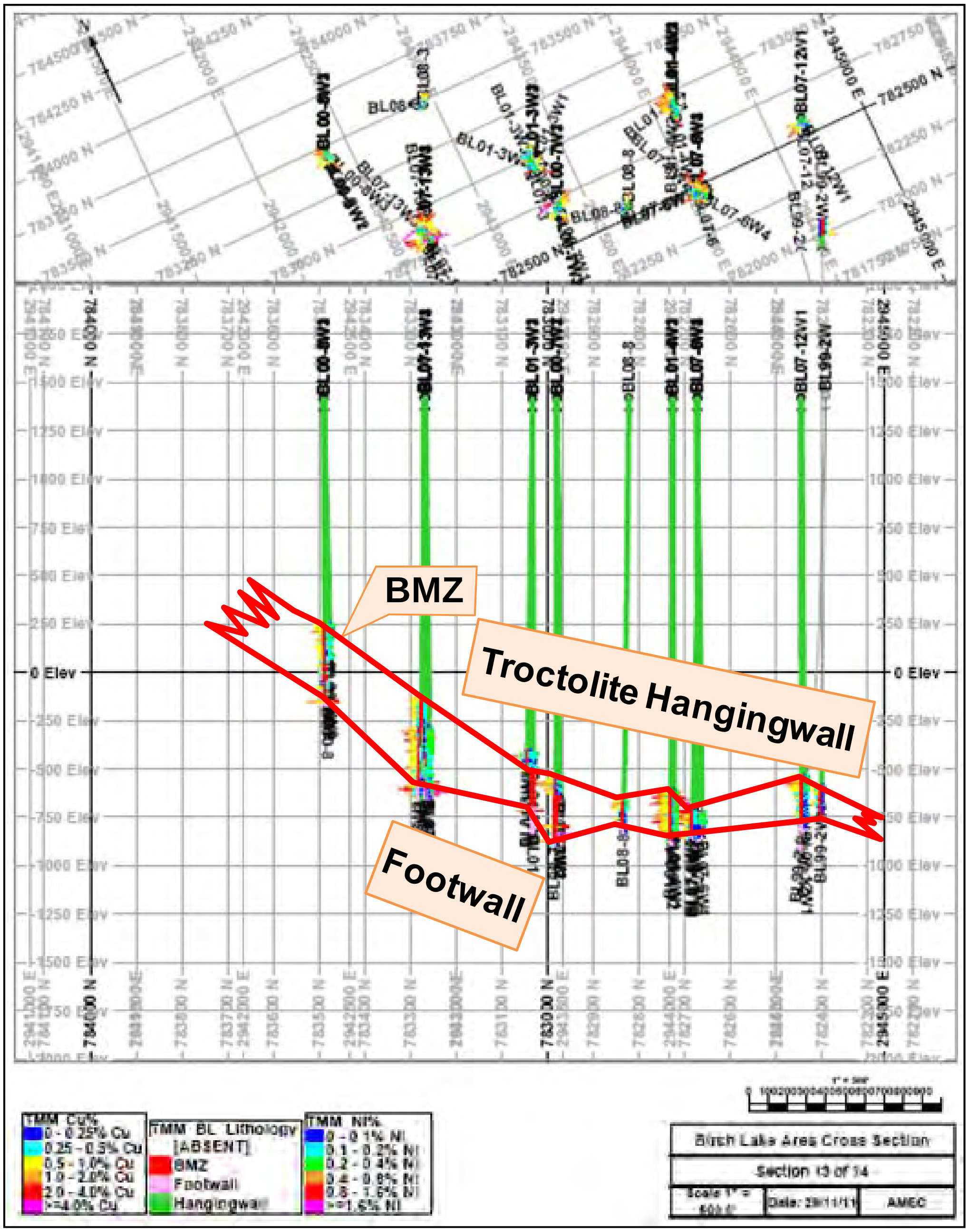


Figure 7-7: Birch Lake Cross Section



Alteration

Saussuritization (replacement of plagioclase by fined grained aggregates of zoisite, epidote, albite, calcite, sericite, and zeolites) and serpentinization (replacement of olivine by serpentine) are common deuteric alteration styles in the U3 unit.

Mineralization

Information on mineralization has been obtained from core logging by personnel of the BBJV, its partners and State geologists, laboratory analysis and the detailed mineralogical investigation of five core samples from five drill holes (Routledge, 2004). Mineralogical investigations consisted of reflecting light microscope and scanning electron microscope study of polished thin sections prepared from heavy minerals concentrated by heavy liquid separation of crushed and ground core (Cabri, 2002). These samples had relatively high PGE grades. Detailed petrography and electron microprobe work on drill core from four holes has also been done by the UMN and the NRRI (Marma et al, 2002).

Sulfides are disseminated interstitially in the rock matrix and mirror the size of rock forming mineral grains: coarser sulfides with coarse grained to pegmatoid fabrics, finer sulfides with medium grained rocks. The sulfides occur:

- intergrown as eutectic and replacement textures
- as triple point exsolution between rock mineral grains.
- intergrown with silicates
- rarely as sulfide seams or veinlets.

Microscope study by Cabri (2002) has identified the major ore minerals to be chalcopyrite and undefined members of the chalcopyrite family, possibly talnakhite, mooihoekite, putoranite, and/or haycockite. Oxide minerals include chromian spinel, ilmenite, magnetite, and chromite. Native copper and troilite occur locally. Other identified minerals include bornite, chalcocite, and cubanite as well as nickel sulfide minerals heazlewoodite and pentlandite. Trace amounts of altaite, digenite, frobergite, galena, mackinawite, millerite, sphalerite and unidentified PGM-bearing minerals, native silver, silver telluride and alloys of silver and gold have been identified. Pentlandite contains as much as 2.12% Co. Iron sulfide gangue is pyrrhotite and troilite.

Platinum group minerals (PGMs) occur as various fine grained Pd tellurides with other Pt, Os, Ru, Au, Ag, Te, and Bi minerals. Ninety percent of the PGMs are associated with copper sulfides (Cabri, 2002) as discrete grains attached to sulfides, as sulfide inclusions and at the margins between sulfides and gangue silicates. The PGMs may form halos around, or be included in, interstitial copper sulfides, pyroxenes, secondary amphiboles and biotite. PGMs are also remobilized in chlorite, serpentine, or secondary magnetite. Pd minerals occur at twice the frequency of Pt minerals.

7.4.3 Spruce Road

Lithology

Troctolitic rocks comprise much of the SKI at Spruce Road and carry abundant rafted basement inclusions of sedimentary hornfels and iron formation (Routledge and Cox, 2007) (Figure 7-3). Inclusions are mostly barren, but locally are mineralized. At Spruce Road, in contrast to the Maturi and Birch Lake deposits, there does not appear be to any specific correlation of mineralization to lithology and there is no key unit or hanging wall marker horizon, such as the pegmatite, that overlies the mineralized unit at Maturi. Mineralization is considered to be consistent with the Basal Mineralized Zone (BMZ) and is very similar to the thick Cu-Ni mineralization in the northwestern part of Maturi (Figure 7-8). Typical features of the rocks are discontinuous layering, variable textures and common inclusions and erratic disseminated copper-nickel mineralization. There is some uncertainty as to the attitude and geometry of the mineralization at progressively higher grades at Spruce Road but, for the purpose of resource estimation, mineralization trends are assumed to parallel intrusive layering and conform to the overall geometry of the SKI.

Alteration

No alteration is described at Spruce Road.

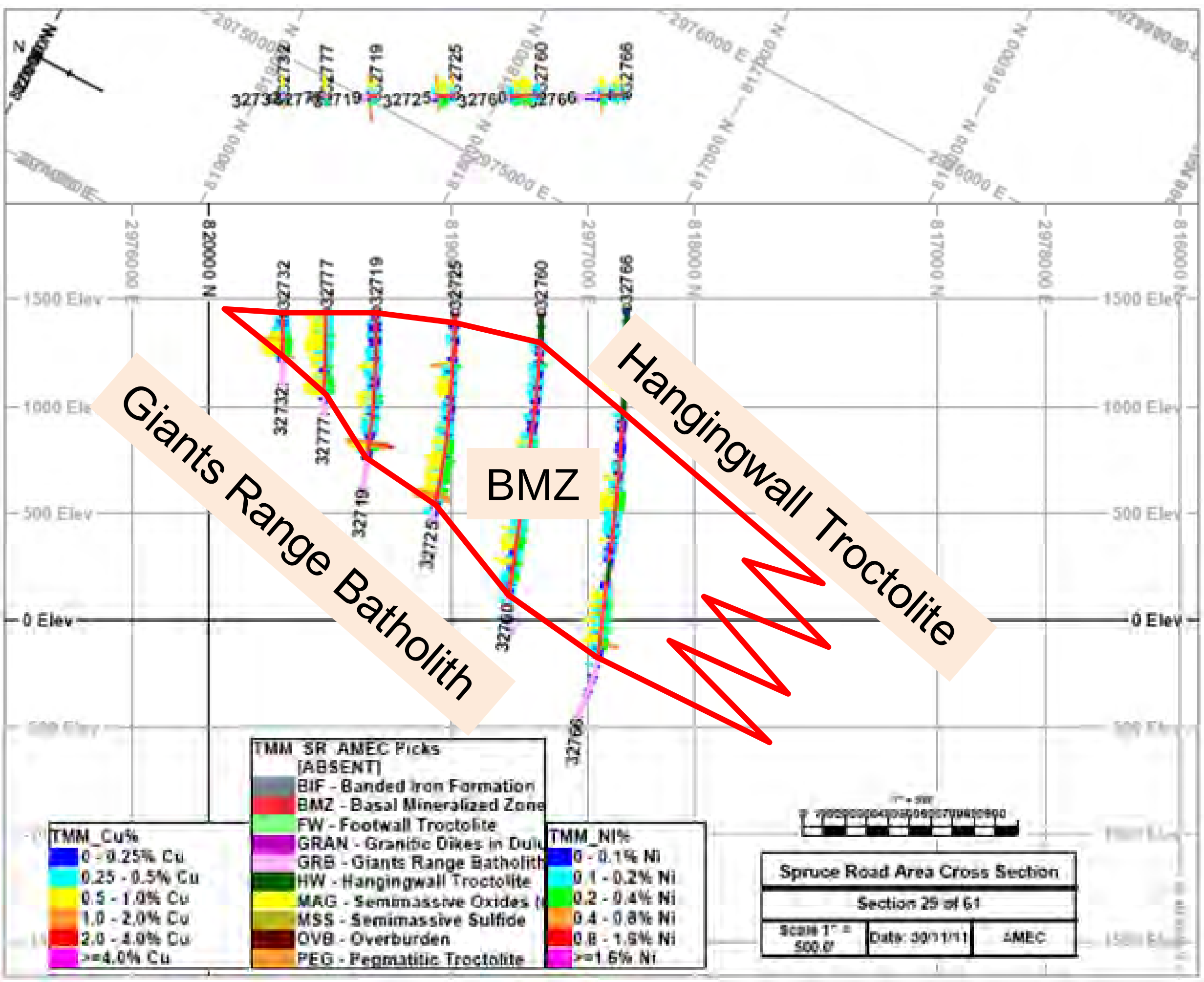
Mineralization

Sulfides occur as disseminated interstitial aggregates, irregular blebs, partially oriented inclusions in feldspar, biotite and amphibole and as thin stringers in fractures and cleavages in silicate minerals. Chalcopyrite, cubanite, pyrrhotite and pentlandite are the primary sulfide minerals. INCO identified minor to trace amounts of bornite, neodigenite (digenite), covellite, chalcocite, tenorite, cuprite, native copper, violarite, pyrite, mackinawite and sphalerite that occur locally in the deposit. Sulfides constitute 2% to 5% by volume and 3% to 4% by weight of the host rocks. Chalcopyrite is the primary copper sulfide with a >20:1 ratio with respect to cubanite.

Work by the University of Minnesota (INCO, 1966) on concentrates on behalf of INCO found that the “Minnesota ore” was a variety of gabbros carrying chalcopyrite, cubanite, pyrrhotite and pentlandite. About 70% of the chalcopyrite was present as individual grains or as compound grains with pyrrhotite. Compound grain size was 100 µm to 1,800 µm and averaged about 500 µm. The balance of the chalcopyrite occurs as minute inclusions in olivine corona structures or in pyrrhotite, magnetite, and olivine. Cubanite was not common but, when present, was always associated with chalcopyrite. Pyrrhotite was noted as having a similar mode of occurrence to chalcopyrite. Pentlandite was found as compound grains with pyrrhotite and chalcopyrite or included in pyrrhotite.

SGS Lakefield Research Limited (Lakefield) did a mineralogical study of core samples from Wallbridge's drill hole WM-001 (Soever, 2000). This work identified pentlandite, chalcopyrite, cubanite, bornite, mackinawite, violarite, pyrrhotite, pyrite, magnetite, and ilmenite. Soever (2007) notes that chalcopyrite and cubanite were identified as the main copper minerals with particle size ranges of 5 µm to 250 µm and 20 µm to 500 µm, respectively. Nickel was mainly present as pentlandite with grain sizes 2 µm to 250 µm and occurring as exsolution flames in pyrrhotite.

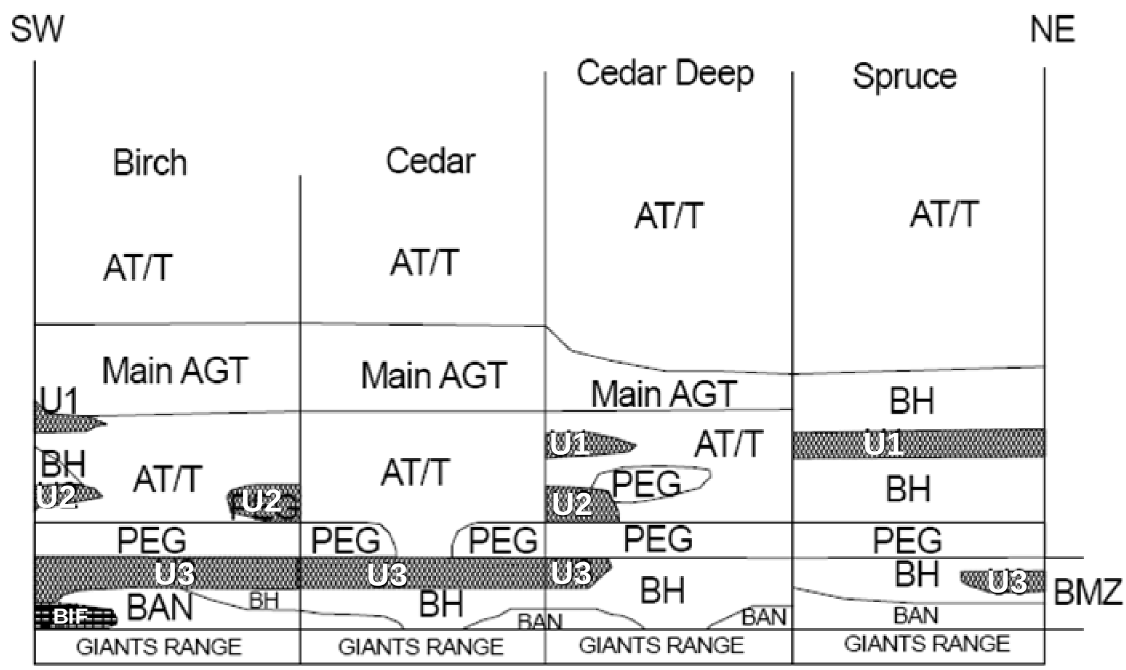
Figure 7-8: Spruce Road Cross Section



7.5 BMZ Definition

SKI consists of at least 17 igneous units that are correlatable along the 19 mile strike length that extends from the extreme eastern Babbitt Cu-Ni deposit through the Dunka Pit and Maturi to Spruce Road (Severson, 1994). Figure 7-9 summarizes the stratigraphy of the SKI from Birch Lake in the southwest to Spruce Road to the northeast. Severson (1994) recognized the fact that the rocks below the lower PEG unit typically contained sulfides and that rocks above the lower PEG unit were a monotonous sequence of anorthositic troctolite and troctolite (AT/T) and augite troctolite (Main AGT) two ultramafic zones (U1 and U2). The lower PEG unit locally contains minor sulfides, but is typically barren of sulfides.

Figure 7-9: General SKI Stratigraphy (adapted from Severson, 1994)



AT/T	Anorthositic troctolite and troctolite
Main AGT	Augite troctolite
U1	Ultramafic 1; melatroctolite to peridotite with massive oxide zones
U2	Ultramafic 2; melatroctolite to peridotite with massive oxide zones
PEG	Troctolite to anorthositic troctolite pegmatite with local augite troctolite, olivine gabbro, and troctolitic anorthosite; sparse sulfide
U3	Ultramafic 3; melatroctolite to peridotite; olivine rich troctolite; massive oxide horizons are common; sulfide-bearing
BH	Basal heterogeneous zone; troctolite with lesser anorthositic and augite troctolite; extremely variable textures; sulfide-bearing
BAN	Bottom augite troctolite/norite. Norite is common at the base because of contamination by Giants Range Batholith; local massive sulfide deposits; sulfide-bearing.
BIF	Banded iron formation inclusions in Duluth Complex rocks
Giants Range	Giants Range Batholith

The basal portion of the SKI is mineralized at Birch Lake, Maturi, and Spruce Road. The basal mineralized zone (BMZ) is a combination of the BH, BAN, and U3 units of Severson (1994) and Hauck et al (1997). Lithologies are generally troctolitic with variable amounts of melatroctolite (U1) with variable textures. All of these lithologies contain sulfides with rare barren areas. The first appearance of sulfides in troctolite at Maturi and Spruce Road and melatroctolite at Birch Lake immediately below the lower PEG unit is considered to be the top of the BMZ. Where PEG is not present, the top of the BMZ can be difficult to distinguish other than the presence of sulfide minerals.

The base of the BMZ is invariably the unconformity between the Archean or Paleoproterozoic rocks that comprise the footwall rocks to the Mesoproterozoic (1.1 Ga) South Kawishiwi Intrusion (SKI). The vast majority of the footwall to the South Kawishiwi Intrusion is composed of the Giants Range Batholith (GRB), a 2.68 Ga granitoid batholith dominated by silica-poor rocks ranging from diorite to quartz monzonite in composition. Locally, in the far southwestern part of the SKI, the footwall is composed of Paleoproterozoic metasedimentary rocks (~1.9 Ga.) of the Biwabik Iron Formation (banded iron formation) or the Virginia Formation (shales to greywacke clastics).

Commonly this lower contact is very abrupt and easily defined. Locally, a high degree of contact metamorphism and metasomatism by the SKI has created hybrid rocks, commonly charnockite, at the contact resulting in a nebulous gradational contact. When the footwall is GRB in the Maturi area, the contact is easily picked geochemically by >750 ppm Ba and <0.4% Ti and an abrupt rise in Sr concentration.

The BMZ is characterized by the sum its subunits initially defined by Severson (1994) and Hauck et al (1997) consisting of the U3, BH, and BAN units. These units have all been lumped together into the singular BMZ unit due to the obvious contemporaneous genetic relationships of the three and the difficulty in tracing each individual subunit from drill hole to drill hole although the lump sum of the BMZ is extremely continuous.

The most basal subunit of the BMZ is the BAN unit which is commonly present but not ubiquitous. BAN is composed mostly of finer-grained gabbroic to noritic rocks. It is interpreted to be a combination of a zone of contamination by the assimilation of the low-temperature footwall rocks and a broad chilled contact.

The main and ubiquitous subunit of the BMZ is the Basal Heterogeneous (BH) unit. It is, as the name implies, highly heterogeneous, but is homogenous in its heterogeneity. Dominantly a troctolite of various forms, it can range from a melatroctolite to a troctolitic anorthosite of various textures ranging from fine grained to pegmatoidal. Although mainly intergranular, it can locally become subpoikiolitic. Autolithic inclusions of troctolites are common ranging from several centimeters to tens of centimeters in size. Pegmatoidal aspects of the BH tend to be slightly more feldspathic with slightly higher clinopyroxene content than surrounding rocks and are interpreted to be networked veins in morphology, likely the cause of migrating late-stage fluids.

As with the BAN subunit, the U3 is commonly present but not ubiquitous. This subunit usually occupies the uppermost portion of the BMZ and comprises a package of dominantly ultramafic rocks ranging from olivine-rich troctolite to feldspathic peridotite intercalated with more leucocratic phases like an anorthositic troctolite to troctolite. Autolithic inclusions identical to those seen in the BH are extremely common.

When present, the upper contact of U3 is coincident with the top of the BMZ and is usually a very sharp contact with the hanging wall rocks. If U3 is absent, the BH forms the upper contact of the BMZ. Although less apparent than the top of the U3, this contact is also usually quite easily discernible.

Hanging wall rocks to the BMZ fall into one of three main geologic units; PEG, Main AGT, or the An-Series. PEG is the most prevalent hanging wall unit consisting generally of a weakly to well-developed very coarse grained to pegmatoidal anorthositic troctolite to anorthositic gabbro and is mostly barren of sulfides. Although broadly considered a layer, on the smaller-scale it is most likely a tight anastomosing network of coarse-grained to pegmatoidal rock with a finer grained matrix with an indefinite upper contact.

Directly above PEG are the hanging wall rocks of the Main AGT. If PEG is not present, Main AGT directly overlies the top of the BMZ. Comprised of an homogenous augite troctolite to anorthositic troctolite, this unit is commonly very thick, sometimes exceeding 1,000 feet in thickness. Texturally and mineralogically, the Main AGT is distinct. Clinopyroxene oikiocrysts (dominantly 3-5 cm in length) with the presence of small amounts (1-2% each) of biotite and iron oxide are indicative and distinctive to this unit. The upper units of the BMZ very rarely contain more than trace amount of biotite or iron oxide, and small amounts of interstitial clinopyroxene aiding in the definition of the upper contact of the BMZ.

Within the central and eastern portions of the Maturi Deposit, if the PEG or Main AGT units do not comprise the hanging wall to the BMZ, a third possibility exists for the hanging wall: the An-Series. This unit is an extremely large inclusion of an earlier phase of the Duluth Complex measuring thousands of feet in lateral and as thick as several thousand feet. Dominantly anorthosite to anorthositic gabbro in composition, the lower portions of the inclusion that comprise the immediate hanging wall to the BMZ are usually a coarse to very coarse grained anorthosite. Although largely barren of sulfides, locally disseminated pyrrhotite and chalcopyrite may be present up to 1-2%. These sulfides are distinct from those of the BMZ such that they are very low in precious metal tenor and are dominated by pyrrhotite whereas the sulfides of the underlying BMZ are usually in larger quantities and contain significant amounts of cubanite and talnakhite with a very minor proportion of pyrrhotite. The sulfides present in the An-Series are interpreted to be unrelated to the mineralization event of the BMZ as there is strong evidence that limited sulfide mineralization occurred prior to the BMZ, likely related to the An-Series.

The BMZ is quite variable in its overall thickness ranging from tens of feet to hundreds of feet, but always occurs at the base of the SKI and is a continuous sheet-like body dipping to the southeast. The base of the BMZ is defined as the base of the SKI and the top is defined as the uppermost occurrence of the three comprising units: U3, BH, and BAN coincident with the first occurrence of sulfide mineralization. The BMZ is defined as the mineralized basal portion of the SKI. Although pervasively containing sulfide mineralization, locally the BMZ may have low-grade to barren portions that may occur at the top, middle, or bottom of the unit. Despite the lack of sulfides in these rare instances, it is apparent by the distinctive rock types, textures, and stratigraphic position that these rocks are part and parcel of the BMZ even though the mechanism resulting in the dearth of sulfides is not understood. Ergo, although generally the definition of the BMZ is hung on the presence of sulfides, it is in fact the hosting package or rocks that should define this unit.

7.6 Geotechnical Considerations

As part of the preparation for the pre-feasibility study (PFS) for Twin Metals Minnesota (TMM), Itasca Consulting Group, Inc. (ICG) has undertaken a geomechanical characterization of the Maturi and Birch Lake properties (DeGagné et al, 2012). The assessment is based principally on a combination of core logging, field and laboratory strength testing, empirical classifications, acoustic televiewer (ATV) logging, overcoring stress measurements and core photography. The main goal of the geomechanical assessment is to characterize the rock mechanical properties to differentiate between geotechnical units, to be used in geomechanical and mine hydrogeological modeling and to predict rock and rock mass behavior.

Approximately 13,000 ft of Maturi core and 10,000 ft of Birch Lake core has been logged in eight bore holes and samples collected for testing. Information collected included:

- Interval information, which includes:
  - Start/end depth along hole, natural feature type and rock unit;
  - *TCR* (total core recovered), fracture count and joint spacing;
  - Micro-defect intensity (if any);
  - *RQD, Jn, Jr and Ja* (Q' classification); and

  - Joint -separation, -roughness, -infill and -weathering ratings (RMR classification).

- Discrete feature information includes:
  - Start/end depth along hole, natural feature type/ID;
  - *Jr, Ja* and fracture mineral (if any);
  - Discontinuity mating and termination; and
  - Alpha and beta angles (for oriented core only).

- Point-load testing information includes:
  - Testing device, test type (axial or diametrical);
  - Sample start/end depth along hole;
  - Maximum pressure; and
  - Failure control (e.g., intact, vein, etc.).

- Laboratory sample information includes:
  - Sample start/end depth along hole and assigned ID; and
  - Rock unit, sample diameter and micro-defect intensity (if any).

- Laboratory testing includes the following:
  - Pre-loading elastic modulus (from P- and S-wave velocity);
  - Unloading and loading elastic modulus;
  - Poisson's ratio;
  - Peak uniaxial compressive strength; and
  - Triaxial strength (σ_3 = 1450, 2901, 5511 psi).

In addition, borehole televiewer logging tools were used to obtain oriented images of borehole cores when core recovery is difficult, costly or otherwise not available. Analysis of these data allows void and joint data to be presented in terms of depth, direction of dip (with respect to North), dip angle and strike.

Boreholes have been instrumented and are being monitored for hydrogeological purposes related to mine design.

Itasca has also completed a preliminary fault model for both the Maturi and Birch Lake deposits (Federowich, 2012).

7.7 Environmental Monitoring

AMEC is aware that TMM is actively monitoring environmental aspects of the project and is conducting base-line environmental studies in preparation for a pre-feasibility study to be conducted in 2012 and 2013. Williamson (2012) summarizes the ongoing environmental work and indicates that the environmental work is adequate to support preliminary resource estimation.

7.8 Comments on Geology

The geology of the TMM deposits is, overall, quite well known in general, that is, the location of the mineralization and the associated rock types. Details of the relationship between mineralization and host rocks are not so well understood, but are adequate for a preliminary resource estimate. Continuing exploration is providing insight into those relationships and will support significantly more detailed interpretations for future resource estimates. This is especially important at Maturi where the interrelationships of base metal mineralization and host rocks are complex. Geotechnical and environmental work are adequate to support preliminary resource estimation.

8.0 DEPOSIT TYPES

The Maturi, Birch Lake, and Spruce Road deposits are classified as magmatic nickel-copper-platinum group element (PGE) deposits which are a broad group of deposits containing nickel, copper, and PGEs occurring as sulfide concentrations associated with a variety of mafic and ultramafic magmatic rocks (Eckstrand and Hulbert 2007). The magmas originate in the upper mantle and contain small amounts of nickel, copper, PGE, and variable but minor amounts of S. The magmas ascend through the crust and cool as they encounter cooler crustal rocks. If the original S content of the magma is sufficient, or if S is added by assimilation of crustal wall rocks, a separate sulfide liquid forms as droplets dispersed throughout the magma. Because the partition coefficients of nickel, copper, and PGE as well as iron favor sulfide liquid over silicate liquid, these elements preferentially transfer into the sulfide droplets from the surrounding magma. The sulfide droplets tend to sink toward the base of the magma because of their greater density, and form sulfide concentrations. On further cooling, the sulfide liquid crystallizes to form the ore deposits that contain these metals.

The mafic and ultramafic magmatic bodies that host the Ni-Cu sulfide ores are diverse in form and composition, and can be subdivided into the following four subtypes (Eckstrand and Hulbert 2007):

1. A meteorite-impact mafic melt sheet that contains basal sulfide ores (Sudbury, Ontario is the only known example).
2. Rift and continental flood basalt-associated mafic sills and dike-like bodies (Noril'sk-Talnakh, Russia; Duluth Complex, Minnesota; Muskox, Nunavut).
3. Komatiitic (magnesium-rich) volcanic flows and related sill-like intrusions (Thompson, Manitoba; Raglan and Marbridge, Quebec;).
4. Other mafic /ultramafic intrusions (Voisey's Bay, Labrador; Lynn Lake, Manitoba; Giant Mascot, British Columbia; Kotalahti, Finland; Råna, Norway; and Selebi-Phikwe, Botswana).

The Duluth Complex is associated with the Midcontinent Rift and continental flood basalt-associated mafic sills and dike-like bodies (Eckstrand and Hulbert 2007). Ni-Cu deposits of the rift and continental flood basalt associated subtype are the products of the magmatism that accompanies intracrustal rifting events. These deposits are associated with large magma systems, and that within these systems the Ni-Cu sulfide ores tend to be associated with conduits or feeders to the larger igneous masses (in this last respect, the Duluth Complex is an exception in which the low-grade Ni-Cu sulfides may not be associated with conduits or feeders but rather lobes of sulfide-enriched magmas). Much of the sulfide has been derived by contamination of the magma through incorporation of S from adjoining wall rocks.

Magmatic PGE deposits and Ni-Cu sulfide deposits are the source of essentially all of the world's platinum group elements (Eckstrand and Hulbert 2007). In total there are 142 Ni-Cu-PGE deposits and districts in the world, for which grade and ore tonnage data have been reported, that contain more than 100,000 tonnes of resources and/or production.

Peterson (2004) divided the disseminated deposits associated with the base of the South Kawishiwi intrusion into two styles of mineralization; however, he points out that there is a small distinct zone of copper and PGE enriched mineralization thousands of feet above the base of the DC at the South Filson Creek deposit.

The basal contact associated mineralization styles are called "Open" and "Confined". The "Open" style is vertically extensive mineralization (more than 500 ft (150 m)) with low to moderate Cu-Ni grades and low gold and PGE grades. Cu-Ni grades increase towards the base, but mineralized zones are spatially erratic and interfinger with barren zones. Spruce Road and Maturi are somewhat typical of this type of deposit; however, grades at Maturi commonly increase toward the top. Restricted zones of massive sulfide locally occur at/or below the basal contact.

The "Confined" style is vertically restricted (less than 500 ft (150 m)) mineralization with moderate to high Cu-Ni grades. Grades are highest near the top of the zone and gradually decrease toward the base. Limited zones of massive sulfides occur at or immediately below the base. Examples of the confined style include the old Nokomis deposit as well as the Birch Lake deposits. Maturi may be a better fit as a "confined" style.

9.0 EXPLORATION

Exploration other than drilling from 1951 to about 1998 is not well documented. Records indicate that geological mapping and surface geochemical sampling were used to trace the exposed extent of mineralization. Various geophysical surveys were performed with the objective of defining down-dip extensions of known mineralization and discovery of new mineralization. Indications are that horizontal and vertical loop electromagnetic surveys, magnetometer surveys, induced polarization (IP), self potential (SP), gravity surveys, magnetotellurics surveys, and various downhole methods have been used with limited success for near surface exploration. Self Potential (SP) was successfully used to locate oxidized sulfides (gossan) below thin veneers of glacial till at the Filson Creek Occurrence.

Controlled source audio frequency magnetotellurics (CSAMT) was employed by Franconia at Birch Lake in 2008 to map major faults, depth and thickness of mineralization, and map subsurface structures (Routledge, 2008). The survey was conducted on the ice of Birch Lake in February 2008 with lines crossing the north portion of the deposit. Twenty two soundings were recorded on two lines 1.7 mi (2.75 km) long oriented east-southeast. Ten soundings at 820 ft (250 m) stations were run on line one, and 12 on line 2 located 1.1 mi (1.8 km) to the north. Data inversion 2D modeling was performed to produce 2D Bostick transform resistivity profiles. The method reasonably well mapped the basement granites and low resistivity above the contact (mineralization) as well as discontinuities as probable faults and low resistivity areas as possible intrusive bodies.

For the most part; however, mineralization is too deep to be successfully explored using these methods. For that reason, drilling has been the preferred method of exploration in all areas since about 1955 and is summarized in Section 10.

10.0 DRILLING

10.1 Drilling Summary

Table 10-1 summarizes the drilling on the TMM properties. All drilling was completed with diamond tipped core tools. Drilling is considered legacy if it was completed before 2000 at Maturi and Birch Lake, and for the drill holes completed prior to 1999 at Spruce Road. Much of the legacy drilling utilized A-sized (1.067 in/27.1 mm) core tools. Current drilling utilized P-, H-, and N-sized core tools. Most current holes were collared with H-sized tools (2.4 in/ 61 mm) and reduced to N (2.155 in/54.7 mm), and locally B (1.655 in/42 mm) where drilling conditions did not permit larger core. P-sized tools (3.245 in/85 mm) were used to collect metallurgical samples during the current exploration programs. Note that the core diameters noted above are nominal. In some cases small variations in core diameter occurred because of the use of different tooling with the same hole diameter were used. An example is N-sized core – NTW (2.44 in/57 mm), NQ (1.875 in/47.5 mm), NX (2.155 in/54.7 mm), and NQ2 (1.99 in/50.5 mm) were all used during the course of the project. Most of the current drilling at Maturi was collared with NQ2 (1.99 in/50.5 mm) tools. At Birch Lake, most of the current holes were collared with PQ diameter tools.

During the time of the site visits, drills were active only on the Maturi property where AMEC observed drilling procedures. All procedures observed were consistent with industry best practices.

Table 10-1: Summary of Drilling on the TMM Properties

Maturi			
	Holes	**Feet**	**Meters**
Current	349	1,087,511.9	331,474.63
Legacy	99	132,800.1	28,329.14
Total	448	1,220,312.0	371,952.22
Birch Lake			
	Holes	**Feet**	**Meters**
Current	213	501,735.7	152,929.50
Legacy	36	74,695.3	22,767.20
Total	250	578,118.0	176,210.90
Spruce Road			
	Holes	**Feet**	**Meters**
Current	2	4,054.1	1,235.68
Legacy	230	137,429.6	41,888.66
Total	232	141,483.6	43,124.34

Recent drilling at Maturi was completed by IDEA Drilling LLC, Virginia, MN, using a variety of different truck and skid mounted drill machines. Foraco (26 Plage de l'Estaque, 13016, Marseille, France) drilled a number of holes at Maturi in 2007-2008 using a variety of equipment. EJ Longyear is reported to have drilled some of the Duval holes in the 1990s as well as some of the later INCO holes. E.J. Longyear equipment is not documented. There is no record of the contractor for most of the legacy holes, but the record indicates that EJ Longyear was active in the area as early as 1955 and may have drilled most of the holes for INCO and the other contractors.

At both Birch Lake and Maturi, pilot holes and wedges from those holes were utilized to complete holes through the BMZ and/or to obtain sample for metallurgical testing.

10.2 Collar Surveying

10.2.1 Maturi

INCO collar surveys were originally in INCO's New Minnesota grid system and were converted by WMA to UTM NAD27 coordinates, which required a 20.4 m shift west and 42.0 m shift south, and a grid origin correction to 539,980.4E, 5,199,956.8N. Collars of legacy drill holes have been relocated in the field by the NRRI using GPS (Cox et al, 2009). Modern hole collars were initially located by hand held GPS units and recorded in UTM coordinates (Cox et al, 2009). Completed drill hole collars were then surveyed using survey grade GPS (Trimble Instruments).

10.2.2 Birch Lake

Duval early reconnaissance drilling exploring to the base of the Duluth Complex along fences of wide spaced holes relied on pace and compass collar locations (Routledge and Galyen, 2010). Later drilling to delineate Cu-Ni-PGE mineralization employed handheld Global Positioning System 12-channel instrumentation (GPS) for collar locations, accurate to ±5 m (Routledge and Galyen, 2010). In 2007, all pre-2006 drill collars that could be located in the field were surveyed by a land surveyor. All 2006 to 2010 drill collars have been surveyed by a land surveyor to an accuracy of one meter (Routledge and Galyen, 2010).

10.2.3 Spruce Road

INCO collar surveys were originally in INCO's New Minnesota grid system and were converted to UTM NAD27 coordinates, which required a 20.4 m shift west and 42.0 m shift south, and a grid origin correction to 539,980.4E, 5,199,956.8N. Instruments used for these surveys are not recorded but were likely theodolites. TMM converted the UTM coordinates to Minnesota State Plane Coordinates.

10.3 Downhole Surveying

10.3.1 Maturi

INCO performed downhole surveys using acid dip tests (Cox et al, 2009; Routledge and Greenough, 2006). The acid test only indicates the dip and not the azimuth of the hole. As a result, the position of the toe and mineralized intervals is somewhat uncertain because of the lack of azimuth deviation data. Dip tests were taken at intervals ranging from 15 m (50 ft) to 61 m (200 ft).

The Duval, Newmont, Kennecott, and US Steel holes were all vertical with no downhole azimuths recorded. The US Steel holes have acid dip tests and, of the others, only DU-03 and NM-03 have acid dip tests. The other historic holes have no downhole surveys.

Downhole surveys for the modern holes through MEX-045 were done using FLEXIT Smart Tool® Instrumentation by FLEXIT AB. Readings were generally taken at ±20 ft (6.1 m) intervals, coinciding with pulling drill rods in 20 ft. lengths at the end of drilling the hole when the survey is run. The tool is a magnetic field-based instrument that utilizes magnetometers and accelerometers to measure azimuth and dip. The tool records errors based on the fluctuation in magnetic field strength vectors that allows some internal correction by the tool itself and for the technician/geologist to review and do manual adjustments or omit spurious readings where appropriate. Spurious readings in the Duluth Complex rocks may be caused by their variability of magnetite content. After MEX-045, downhole surveys were performed by gyroscopic tools using the magnetic tools as quality control measures.

Review of the downhole survey data for the MEX series holes indicated that dips were generally reasonable but azimuth readings tended to be noisy and some obvious spurious readings needed to be rejected and adjustment made to the survey data (Cox et al, 2009). These were corrected by TMM. For vertical holes, noisy azimuth readings have small impact on the accuracy of the hole position in 3D space since dip is the critical reading and GEMS software smoothes the hole trace. For inclined holes, azimuth has a greater impact on spatial hole positioning despite the software smoothing.

For some inclined holes, the FLEXIT™ readings did not agree with the collar site orientation which was checked and confirmed in the field. For holes MEX-17, 22 and 23, the hole could not be or was not surveyed for various reasons, including drill rods lost down hole. Consequently, the downhole deviation for five inclined holes was modeled based on the collar azimuth and dip and the average deviation of other MEX series holes. The positioning of the hole toes and mineralized intervals in three dimensions is now reasonable for drill spacing greater than 200 m.

All of the angle holes and most of the vertical holes have been surveyed using a FLEXIT™ gyroscopic tool. A few of the vertical holes drilled before MEX-45 were not surveyed due to blockages in the holes or bad hole conditions.

10.3.2 Birch Lake

Duval early reconnaissance drilling to explore to the base of the Duluth Complex in fences of wide spaced holes relied acid dip tests for downhole deviation except where wedging was performed (Routledge and Galyen, 2010).

Later drilling to delineate Cu-Ni-PGE mineralization employed Flexit™ SmartTool® surveys to track azimuth and dip deviations downhole (Routledge and Galyen, 2010). The Flexit™ downhole survey system determines azimuth based on magnetometer readings and in areas of high magnetic susceptibility, readings are not reliable. Therefore, for magnetic pyrrhotite and magnetite enriched segments, readings are discarded. Where magnetic pyrrhotite and magnetite enriched segments are thick, details on azimuth deviation are lost where tracking of such detail is important. Gyroscope-based downhole surveys are unaffected by magnetics. Beginning in 2007 with drill hole BL07-5, all downhole surveys were performed with gyroscopic instruments.

Most of the pilot and wedge holes were surveyed from the bottom of the hole to the collar. AMEC noted a number of discrepancies with survey azimuths while verifying data. The azimuths were as much as 180^{o} different between the various pilot and wedges in a single location. The reasons for the discrepancies were not resolved. AMEC used the orientation of the pilot holes after field investigations indicated that the azimuth data for the pilot holes were likely more reliable than data for wedges.

10.3.3 Spruce Road

INCO holes were surveyed at the collar with only acid dip tests taken down hole (Routledge and Cox, 2007). Dip tests were taken at intervals ranging from 15 m (50 ft.) to 61 m (200 ft.) but generally at 30 m (100 ft.). The position of the hole toe and mineralized intervals is somewhat uncertain because of the lack of azimuth deviation data. In general dip deviation was plotted in the grid north direction (±331.6° Az.) for the purpose of geologic interpretation and wireframing the resources.

10.4 Drilling Data and Results

Drilling results are summarized for each of the three properties individually below.

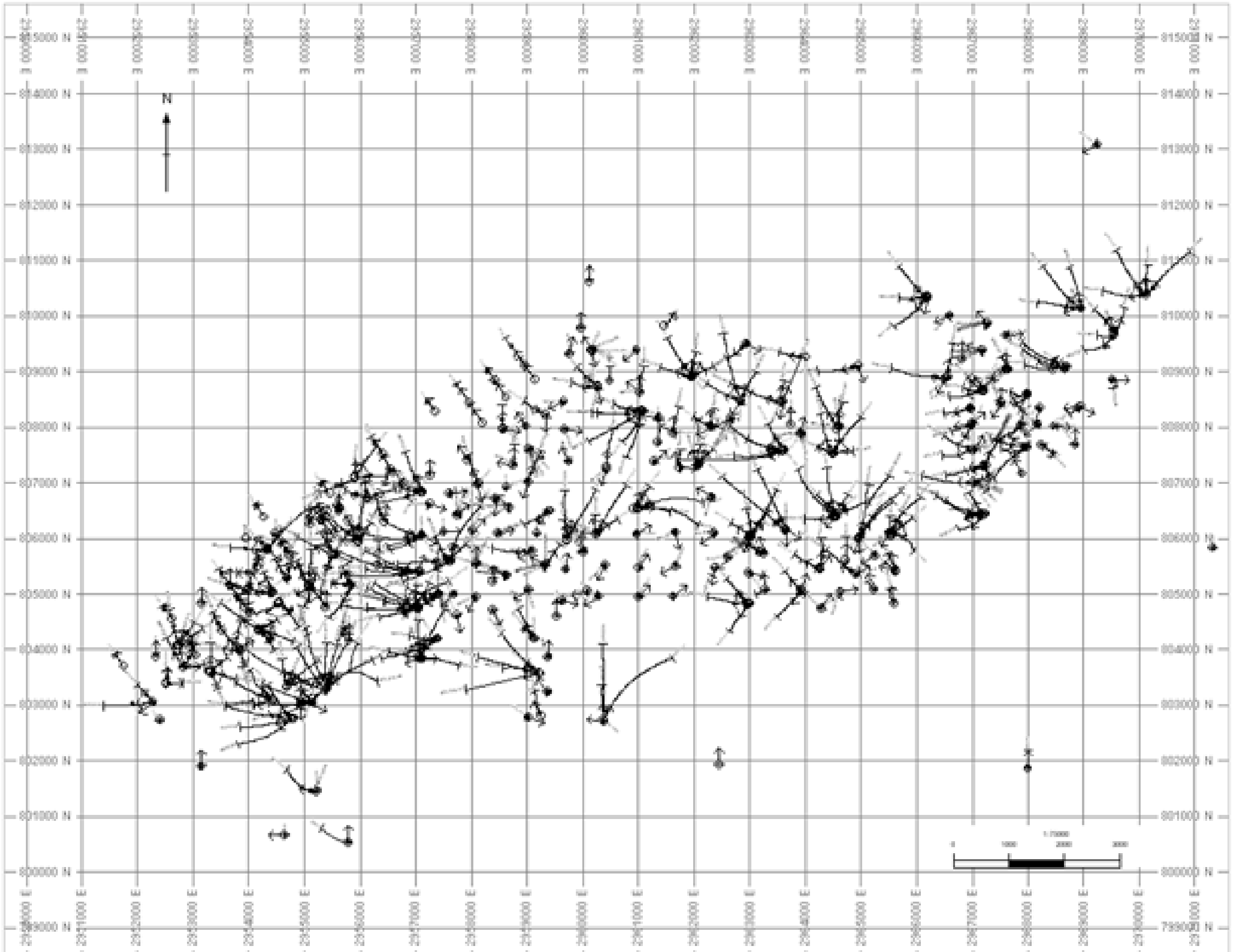
10.4.1 Maturi

Table 10-2 summarizes drilling at Maturi by year. A total of 448 holes (1,220,312.0 ft; 371,952.22 m) have been drilled in the area. Collar locations are shown on Figure 10-1. Figure 7-3 is a cross section across the main part of Maturi.

Table 10-2: Summary of Maturi Drilling by Year

Year	Number	Feet	Meters
1953	4	873.7	266.30
1954	16	14,473.0	4,411.38
1955	7	11,419.0	3,480.52
1957	8	5763.0	1,756.57
1966	8	6817.0	2,077.83
1967	17	32,728.5	9,975.68
1968	23	20,868.9	6,360.86
1969	7	14,327.0	4,366.88
1970	5	14,227.0	4,336.40
1971	1	4818.0	1,468.53
1977	3	6,485.0	1,976.63
2000	1	1,166.0	355.40
2006	10	30,922.0	9,425.05
2007	78	232,452.4	70,851.71
2008	132	380,271.5	115,907.10
2009	2	6,717.0	2,047.35
2010	51	202,633.0	61,762.72
2011	75	233,350.0	71,125.29
Total	448	1,220,312.0	371,952.22

Figure 10-1: Maturi Drill Hole Locations



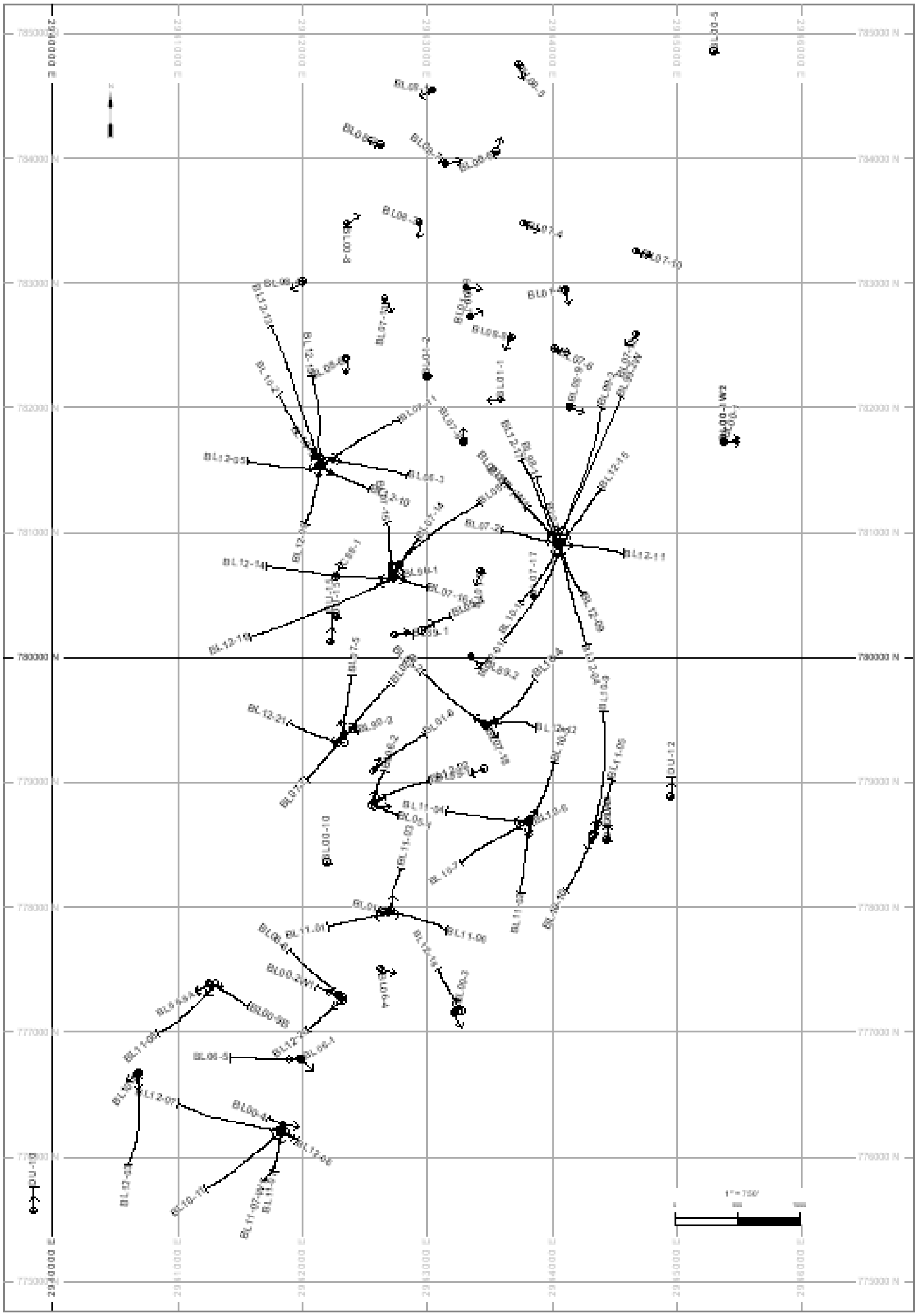
10.4.2 Birch Lake

At Birch Lake a total of 249 holes (578,118.0 ft; 176,210.90 m) were drilled to explore the property (Table 10-3; Figure 10-2; Figure 7-5). Of those, 154 were wedges from pilot holes that were drilled primarily to obtain sample for metallurgical testing.

Table 10-3: Summary of Drilling at Birch Lake by Year

Year	Number	Feet	Meters
1957	5	3,530.0	1,075.95
1967	1	-	-
1968	1	1,635.0	498.35
1969	7	14,558.0	4,437.29
1970	2	3,539.0	1,078.69
1971	1	2,800.0	853.44
1976	2	9,394.0	2,863.30
1978	1	1,944.0	592.53
1986	1	2,450.0	746.76
1988	1	2,402.0	732.13
1989	1	2,569.0	783.03
1990	5	10,530.0	3,209.55
1995	2	3,806.0	1,160.07
1998	2	5,062.3	1,542.99
1999	4	10,476.0	3,193.09
2000	34	70,829.0	21,588.74
2001	26	60,550.0	18,455.70
2002	1	1,687.0	514.20
2005	8	22,107.5	6,738.39
2006	27	64,950.0	19,796.82
2007	69	169,662.4	51,713.26
2008	38	84,399.3	25,724.98
2010	11	29,237.5	8,911.62
Total	249	578,118.0	176,210.90

Figure 10-2: Birch Lake Drill Hole Locations



10.4.3 Spruce Road

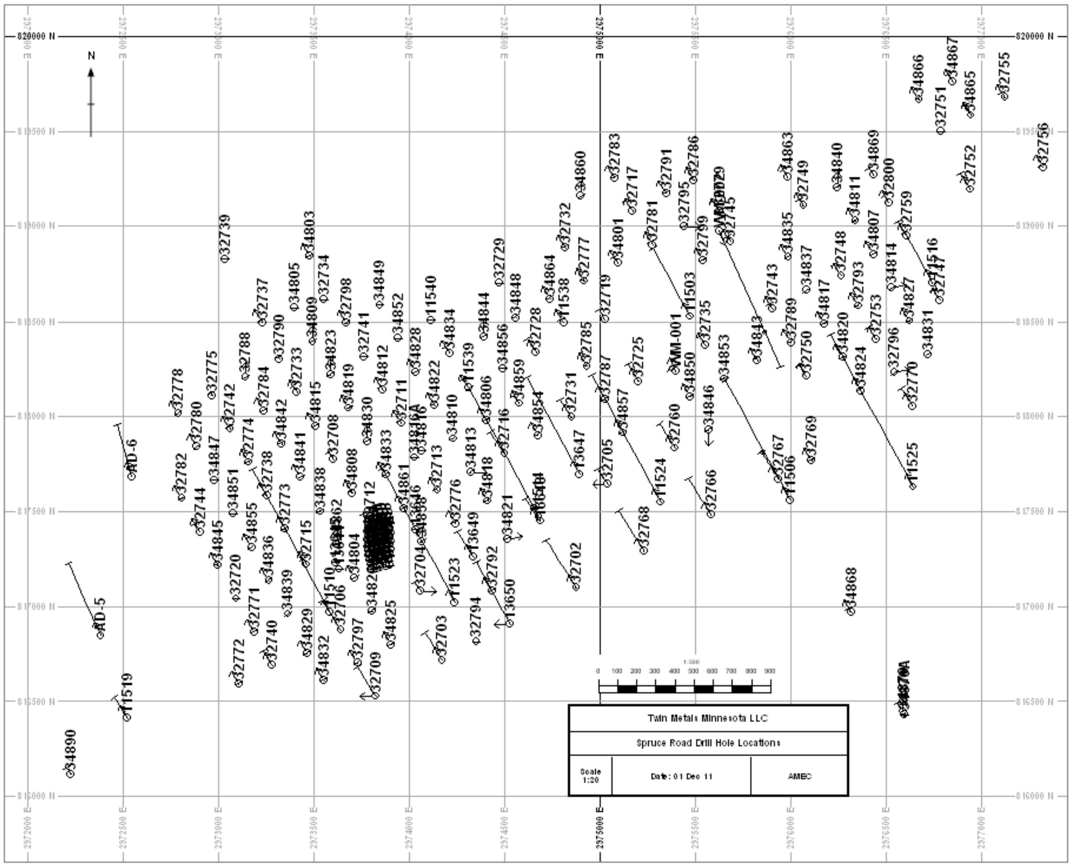
The Spruce Road database contains 232 holes (141,482.7 ft/ 43,124.06 m) (Table 10-4). The area included in the resource estimate contains 210 holes (118,303 ft, 36,058.68 m; Figure 10-3). Figure 7-6 is a representative cross section at Spruce Road.

Drill logs indicate most of the core was AX (27 mm diameter) and drilling by E. J. Longyear/Longyear Canada (Routledge and Cox, 2007). Two short PQ (85 mm diameter) holes were drilled in 1971.

Table 10-4: Summary of Drilling at Spruce Road by Year

Year	Number	Feet	Meters
1953	3	685.7	209.00
1954	14	16,261.0	4,956.37
1955	4	2,204.0	671.78
1957	9	6,334.0	1,930.61
1966	24	24,099.0	7,345.40
1967	135	68,292.0	20,815.46
1968	13	16,004.0	4,878.03
1969	2	2,780.0	847.35
1971	2	100.0	30.48
1973	24	669.0	203.91
1999	1	1,754.0	534.62
2000	1	2,300.0	701.04
Total	232	141,482.7	43,124.06

Figure 10-3: Spruce Road Drill Hole Locations



10.5 Recent Drilling

10.5.1 Maturi

The database for resource estimation was closed on 16 September 2011. Drilling continued at Maturi after closure of the database. A total of 164 holes (excluding wedge holes; 378,061.5 ft) were drilled as of 5 May 2012. In addition, 34 wedge holes were drilled to collect samples for metallurgical testing. Figure 10-4 shows the locations of recent drill holes, Table 10-5 summarizes the location and orientation data, and Table 10-6 summarizes the significant intercepts in those holes.

Those holes were largely infill holes designed to improve the resource classification and validate legacy data. These drill data have largely confirmed the existing geological interpretations and have provided significant data to enhance the geological understanding and allow improved geological interpretations for future resource estimates.

Figure 10-4: Locations of Recent Drill Holes (green – holes in resource estimate; red – holes completed after the database was closed)

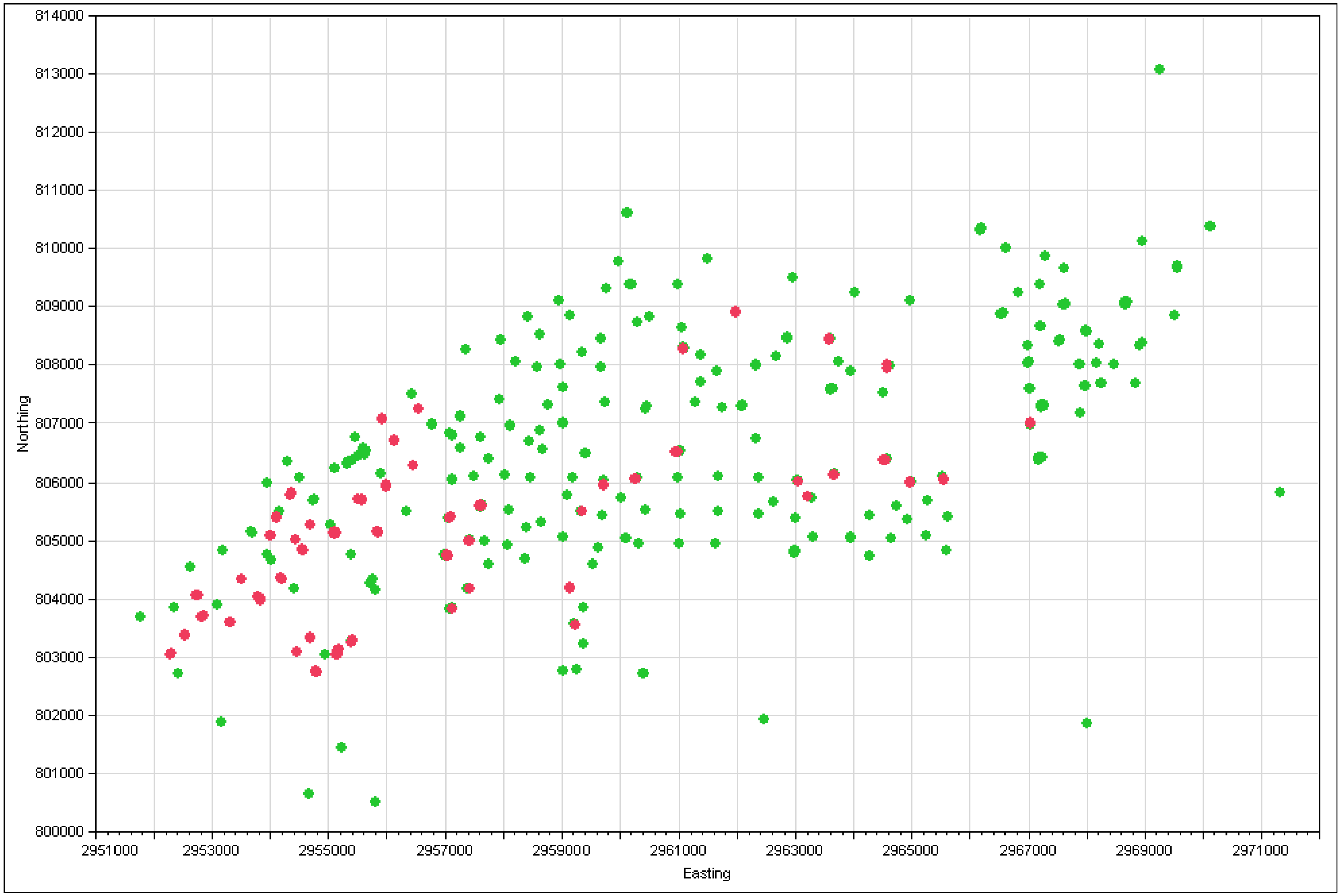


Table 10-5: Locations of Recent Maturi Drill Holes (as of 1 May 2012) (elevation and depths are in feet, azimuths and dips are in degrees)

Hole	Easting	Northing	Elevation	DEPTH	Azimuth	Dip
MEX-0270M	2957068	804745	1475.463	2606	280	-75
MEX-0270M-W1	2957068	804745	1475.463	2516	280	-75
MEX-0270M-W2	2957068	804745	1475.463	2517	280	-75
MEX-0271	2955411	803296	1459.577	2325.5	335	-60
MEX-0271-W1	2955411	803296	1459.577	2606	335	-60
MEX-0272	2957091	805396	1473.42	2566	258	-55
MEX-0273	2965553	806043.9	1511.228	4286.5	32	-74
MEX-0274M	2963046	806019.8	1496.1	3748	0	-90
MEX-0274M-W1	2963046	806019.8	1496.1	3748	0	-90
MEX-0274M-W2	2963046	806019.8	1496.1	3758	0	-90
MEX-0274M-W3	2963046	806019.8	1496.1	3748	0	-90
MEX-0274M-W4	2963046	806019.8	1496.1	3748	0	-90
MEX-0275	2957423	804997.8	1496.96	2699.5	250	-74
MEX-0276	2955386	803253.2	1460.329	3178	43	-72
MEX-0276-W1	2955386	803253.2	1460.329	3358	43	-72
MEX-0276-W2	2955386	803253.2	1460.329	1993.5	43	-72
MEX-0276-W3	2955386	803253.2	1460.329	2977	43	-72
MEX-0277	2957422	804995.2	1496.449	2852	234	-72
MEX-0278M	2967037	807005.2	1508.9	4214	0	-90
MEX-0278M-W1	2967037	807005.2	1508.9	4208	0	-90
MEX-0278M-W2	2967037	807005.2	1508.9	4208	0	-90
MEX-0278M-W3	2967037	807005.2	1508.9	4208	0	-90
MEX-0278M-W4	2967037	807005.2	1508.9	4204	0	-90
MEX-0279	2965545	806045.9	1511.617	4338	54	-82
MEX-0280	2957422	804189.6	1475	3287	239	-69
MEX-0281	2957067	804745.5	1476.239	2667	285	-65
MEX-0282	2957402	804980.6	1495.76	2698	273.5	-74
MEX-0283	2957030	804751.9	1474.61	2662	276.5	-57.6
MEX-0284	2957423	804189.9	1475.37	3196	239	-76
MEX-0285	2964967	806005	1511.99	4348	39	-76
MEX-0286	2957626	805590.3	1482.53	2568	275	-67
MEX-0287	2957028	804761.3	1475.83	2707	266	-66
MEX-0288	2957418	804183	1474.54	2938	269	-77
MEX-0289	2964504	806379.2	1499.78	3855	32	-77
MEX-0290	2957619	805594.6	1481.89	2608	240	-67
MEX-0291M	2963208	805747.5	1494.29	3858.5	0	-90
MEX-0291M-W1	2963208	805747.5	1494.29	3848	0	-90

Hole	Easting	Northing	Elevation	DEPTH	Azimuth	Dip
MEX-0291M-W2	2963208	805747.5	1494.29	3838	0	-90
MEX-0291M-W3	2963208	805747.5	1494.29	3846.67	0	-90
MEX-0291M-W4	2963208	805747.5	1494.29	3848	0	-90
MEX-0292	2964970	806009.7	1511.85	4208	36	-83
MEX-0293	2957584	805597.5		1208	33	-80
MEX-0294	2959142	804183.9	1475.1	3197.5	325	-77
MEX-0295	2964504	806381	1499.37	3871	47	-82
MEX-0296	2957617	805609.7	1483.26	2528	33	-80
MEX-0297	2964966	806002.9	1512.18	4438	29	-72
MEX-0298	2959242	803563.5	1487.14	3528	258	-66
MEX-0298-W1	2959242	803563.5	1487.14	3163.5	258	-66
MEX-0299	2954429	805026.2	1466.81	1748	0	-90
MEX-0300	2952530	803373.9	1453.08	1148	4	-77
MEX-0301	2964508	806385.3	1499.37	4158	63	-78
MEX-0302	2952527	803385.2	1452.53	2268	92	-81
MEX-0303	2955134	803031.4	1457.6	2174	326	-83
MEX-0303-W1	2955134	803031.4	1457.6	2817	326	-83
MEX-0304	2954432	805022.7	1466.92	1578	337	-74
MEX-0305	2964972	805999.6	1511.97	4248	13	-73
MEX-0305-W1	2964972	805999.6	1511.97	4198	13	-73
MEX-0306	2952721	804069.9	1444.82	1328	90	-78
MEX-0307	2954547	804836.1	1472.02	1919	119	-82
MEX-0308	2963657	806125.2	1501.05	3697	311	-68
MEX-0309	2959243	803563.3	1487.13	3365.5	285	-76
MEX-0310	2952737	804065.7	1444.88	1198	22	-75
MEX-0311	2964535	806381.2	1500.2	3778	350	-75
MEX-0312	2955134	803031.2	1457.65	3028	0	-90
MEX-0313	2952289	803055.8	1457.52	1229	316	-69
MEX-0314	2952730	804068.3	1445.12	1077	348	-52
MEX-0315	2952867	803707.3	1439.12	1426	25	-71
MEX-0316	2952290	803055.4	1457.4	1589	0	-90
MEX-0317	2955146	803041.1	1457.84	2806.5	262	-74
MEX-0318	2952842	803684.7	1438.98	1511	85	-74
MEX-0319	2952285	803047.2	1457.06	1430	262	-50
MEX-0320	2963662	806131.1	1500.62	3627	335	-69
MEX-0321	2964545	806382.2	1501.79	4588	316	-71
MEX-0322	2952841	803684.6	1439.15	1208	0	-90
MEX-0323	2955169	803127.5	1456.23	3909	232	-76
MEX-0324	2954103	805406.1	1471.83	1348	18	-78

Hole	Easting	Northing	Elevation	DEPTH	Azimuth	Dip
MEX-0325	2952820	803683.8	1439.35	1178	329	-59
MEX-0326	2954103	805396	1472.29	1169	267	-74
MEX-0327	2954563	804836	1472.69	2699	234	-80
MEX-0328	2954007	805089.2	1465.4	1339	234	-77
MEX-0329	2954687	805276.1	1462.86	1539	15	-70
MEX-0330	2955150	803041.8	1458.32	2694	284	-68
MEX-0331	2954553	804849.3	1472.6	2488	136	-74
MEX-0332	2954686	805274.6	1463.58	1683	0	-90
MEX-0333	2959346	805513.1	1486.79	3058	29	-80
MEX-0334	2955155	803114.3	1456.55	3138	56	-79
MEX-0335	2954337	805785.6	1461.11	1047	272	-51
MEX-0336	2960988	806531.6	1503.55	3208	87	-79
MEX-0337	2961984	808907.7	1501.24	2347	318	-67
MEX-0338	2954341	805785.4	1461.57	1194	0	-90
MEX-0339	2955841	805145.7	1480.97	2628	203	-72
MEX-0340	2955574	805700.3	1466.08	1688	320	-73
MEX-0341	2964586	808007.6	1512.52	3248	323	-73
MEX-0342	2956139	806734.9	1458.88	1228	350	-77
MEX-0343	2954693	803331.7	1457.02	2498	347	-76
MEX-0344	2961979	808907.3	1500.8	2377	359	-76
MEX-0345	2955574	805699.8	1465.95	1808	0	-90
MEX-0346	2955919	807086.9	1465.66	1167	244	-52
MEX-0347	2955853	805135.3	1481.32	2009	331	-77
MEX-0348	2963581	808427.7	1503.38	2991	287	-79
MEX-0349	2955921	807092.7	1465.67	1038	2	-77
MEX-0350	2954696	803327.8	1457.47	2610	16	-84
MEX-0351	2960250	806060.4	1505.59	2879	347	-81
MEX-0352	2955853	805134.8	1481.31	2188	0	-90
MEX-0353	2964574	807943.9	1510.12	3275.5	4	-77
MEX-0354	2960931	806518.7	1506.45	2998	22	-80
MEX-0355	2961976	808891.5	1500.88	2638	54	-80
MEX-0356	2955979	805939.6	1466.38	1618	335	-75
MEX-0357	2953316	803601.4	1427.47	2058	153	-81
MEX-0358	2963580	808427.8	1503.66	2948	291	-68
MEX-0359	2955979	805941.2	1466.65	1738	358	-84
MEX-0360	2954695	803341	1457.93	2737	44	-71
MEX-0361	2953515	804335.3	1444.1	1218	334	-72
MEX-0362	2960258	806054	1504.79	3078	25	-69
MEX-0363	2961082	808268	1519.77	1778	262	-64

Hole	Easting	Northing	Elevation	DEPTH	Azimuth	Dip
MEX-0363-W1	2961082	808268	1519.77	1975	262	-64
MEX-0364	2956554	807239.1	1439.33	1118	330	-61
MEX-0365	2955098	805117.1	1461.96	1808	333	-74
MEX-0366	2954784	802740.9	1431.17	2568	320	-73
MEX-0367	2959717	805962	1506.2	2957	26	-66
MEX-0368	2956557	807232.5	1439.3	1259	0	-90
MEX-0369	2963577	808444.5	1503.29	3068	1	-81
MEX-0370	2954695	803343.6	1458.05	3169	68	-72
MEX-0371	2955080	805128.3	1461.41	1969	115	-86
MEX-0372	2956448	806291.7	1448	1578	332	-70
MEX-0373	2954797	802745.2	1431.5	2637	276	-64
MEX-0374	2955088	805137.7	1461.73	2218	138	-77
MEX-0375	2960251	806069.7	1505.98	3090	49	-79
MEX-0376	2963573	808450.3	1502.23	3078	25	-73
MEX-0377	2956448	806291.7	1448	1778	4	-86
MEX-0378	2953841	803982.3	1452.39	1548	315	-69
MEX-0379	2954212	804347.7	1467.13	2358	139	-79
MEX-0380	2954795	802751.2	1431.45	2777	255	-71
MEX-0381	2959723	805954.3	1506.56	2587	357	-67
MEX-0382	2961073	808277.6	1520.2	2341	236	-62
MEX-0383	2953839	803963.5	1453.28	1699	273	-86
MEX-0384	2956139	806724.3	1459.54	1238	284	-66
MEX-0385	2954211	804348.1	1466.98	1858	0	-90
MEX-0386	2953329	803587.6	1427.34	1398	0	-64
MEX-0387	2956135	806717.7	1458.86	1496	67	-70
MEX-0388	2954771	802756.7	1432.35	2882	226	-74
MEX-0389	2953829	804013.2	1453.6	2227	158	-79
MEX-0390	2955979	805951.9	1466.54	1788	272	-77
MEX-0391	2959723	805953.6	1506.15	2861	356	-79
MEX-0392	2955910	807084.1	1465.67	1187	30	-52
MEX-0393	2953316	803589.4	1426.9	1736	45	-77
MEX-0394	2954199	804342.3	1467.68	2378	103	-74
MEX-0395	2955981	805959	1465.47	1588	306	-62
MEX-0396	2953289	803593.9	1427.08	2228	99	-77
MEX-0397	2955910	807075.3	1465.79	1348	78	-63
MEX-0398	2953828	804018	1453.95	1838	62	-81
MEX-0399	2954448	803083	1450	2368	320	-73
MEX-0400	2955105	805112.3	1461.91	1898	28	-75
MEX-0401	2961073	808277.7	1520.03	2418	0	-90

Hole	Easting	Northing	Elevation	DEPTH	Azimuth	Dip
MEX-0402	2954361	805827.6	1462.3	1498	38	-51
MEX-0403	2955979	805924	1465	1627	0	-58
MEX-0404	2954189	804360	1470	1902	64	-77
MEX-0405	2953793	804044	1455	1717	3	-72
MEX-0406	2955100	805126.9	1461.6	1837	359	-63
MEX-0407	2955979	805924	1465	1718	28	-73
MEX-0408	2954700	805269	1465	1469	323	-73
MEX-0409	2954448	803082	1450	2417	289	-72
MEX-0410	2954189	804360	1470	1488	300	-54
MEX-0411	2955829	805153	1470	2136	276	-78
MEX-0412	2955103	805149.3	1460.94	2177	181	-76
MEX-0413	2954428	805010	1493	1528	275	-74
MEX-0414M	2952759	804072	1476	1048	53	-60
MEX-0415M	2955500	805707	1465	1324	345	-46
MEX-0416	2955122	805125.2	1461.63	1917	237	-81
MEX-0417M	2954448	803082	1450	2357	255	-80
MEX-0417M-W1	2954448	803082	1450	2367	255	-80
MEX-0417M-W2	2954448	803082	1450	2367	255	-80
MEX-0417M-W3	2954448	803082	1450	2367	255	-80
MEX-0417M-W4	2954448	803082	1450	2387	255	-80
MEX-0418M	2952759	804072	1476	958	30	-60
MEX-0419M	2955500	805707	1465	1363	296	-55
MEX-0420M	2954001	805078	1476	978	279	-68
MEX-0421M	2954358	805813	1480	778	310	-74
MEX-0422M	2955500	805706	1465	1736	196	-79
MEX-0422M-W1	2955500	805706	1465	1736	196	-79
MEX-0423M	2954001	805078	1476	1158	13	-84
MEX-0424M	2954358	805813	1480	968	38	-70
MEX-0425M	2954001	805078	1476	1338	180	-80
MEX-0425M-W1	2954001	805078	1476	1348	180	-80
MEX-0426	2959139	804207	1476	1994	0	-90

Table 10-6: Significant Intercepts in Recent Maturi Drill Holes (as of 1 May 2012) (thickness is in feet; azimuth and dip in degrees)

Hole	From	To	Thickness	Cu %	Ni %	Au ppm	Pd ppm	Pt ppm	Ag ppm	Co ppm	Easting	Northing	Elevation	Azimuth	Dip	Vertical Thickness
MEX-0270M	2260	2296	36	0.41	0.15	0.055	0.175	0.088	1.1	105	2956514.0	804846.9	-713.1	285.8	-75.3	34.8
MEX-0270M-W1	2261	2306	45	0.34	0.13	0.029	0.145	0.070	1.0	97	2956513.5	804849.3	-713.8	291.1	-74.3	43.3
MEX-0270M-W1	2381	2406	25	0.42	0.14	0.042	0.155	0.096	0.8	78	2956483.3	804861.2	-829.3	292.4	-74.3	24.1
MEX-0270M-W2	2261.5	2287	25.5	0.37	0.15	0.030	0.157	0.093	1.1	119	2956516.0	804849.4	-714.9	289.7	-76.7	24.8
MEX-0270M-W2	2382	2407	25	0.33	0.11	0.031	0.141	0.061	1.1	80	2956490.3	804858.6	-832.3	289.8	-77.1	24.4
MEX-0271	2157	2317	160	0.57	0.23	0.062	0.267	0.122	1.8	129	2955074.5	804195.6	-468.5	349.5	-64.0	143.9
MEX-0271-W1	2160.5	2387	226.5	0.52	0.22	0.050	0.206	0.101	1.7	117	2955074.3	804197.1	-471.7	349.5	-64.0	203.8
MEX-0272	2004	2251	247	0.61	0.18	0.063	0.255	0.119	1.7	95	2955959.3	805320.1	-176.2	273.9	-56.5	205.6
MEX-0273	3935	4013	78	0.58	0.18	0.111	0.744	0.322	1.5	104	2965742.0	806446.9	-2395.5	50.0	-86.1	77.8
MEX-0275	2448	2528	80	0.46	0.14	0.071	0.250	0.103	2.0	65	2956892.8	804897.6	-889.1	277.2	-79.7	78.7
MEX-0276	2943	3038	95	0.62	0.32	0.087	0.386	0.144	2.0	91	2956162.8	803772.4	-1324.9	68.8	-73.6	91.1
MEX-0276-W1	3023	3139.5	116.5	0.52	1.06	0.051	0.315	0.133	1.4	372	2956238.0	803465.8	-1387.0	118.3	-74.5	112.3
MEX-0277	2659	2733	74	0.55	0.18	0.072	0.365	0.160	2.0	83	2956858.8	804713.1	-1084.5	262.8	-78.1	72.4
MEX-0278M	4038	4178	140	0.68	0.18	0.164	0.889	0.336	2.7	72	2967079.5	806968.6	-2528.7	134.9	-89.2	140.0
MEX-0278M-W1	4053	4208	155	0.89	0.20	0.189	1.049	0.368	2.6	78	2967079.3	806966.8	-2543.6	163.3	-89.1	155.0
MEX-0279	3978	4148	170	0.59	0.16	0.232	0.650	0.288	2.4	88	2965915.8	806354.8	-2436.8	58.1	-83.8	169.2
MEX-0280	2991	3048	57	0.58	0.22	0.150	0.384	0.158	1.5	96	2956479.0	803854.5	-1340.9	264.5	-71.9	54.2
MEX-0280	3083	3168	85	0.38	0.16	0.056	0.263	0.112	1.2	36	2956450.5	803852.2	-1428.4	265.8	-72.1	80.9
MEX-0281	2147.5	2300.5	153	0.69	0.22	0.120	0.428	0.175	2.1	112	2956287.5	805030.7	-501.8	296.9	-71.1	145.0
MEX-0281	2392	2442	50	0.61	0.21	0.079	0.234	0.115	2.3	89	2956218.5	805066.3	-733.7	297.8	-71.8	47.5
MEX-0282	2298	2388	90	0.49	0.16	0.072	0.310	0.132	1.6	94	2956908.3	805081.8	-744.5	296.2	-79.1	88.4
MEX-0283	2318	2488	170	0.33	0.13	0.039	0.143	0.078	0.9	70	2955828.8	804762.9	-503.3	280.1	-61.3	148.4
MEX-0284	2884	2950	66	0.35	0.13	0.041	0.261	0.096	1.2	83	2956897.8	803973.8	-1350.4	262.6	-81.1	65.2
MEX-0285	3953	4108	155	0.71	0.23	0.117	0.654	0.307	2.4	117	2965524.8	806622.0	-2350.3	58.4	-79.6	152.4
MEX-0286	2049.5	2203	153.5	0.45	0.14	0.073	0.245	0.100	1.8	100	2956874.5	805551.2	-423.2	261.9	-69.0	143.6
MEX-0287	2323	2492	169	0.50	0.16	0.083	0.275	0.120	1.7	91	2956223.5	804735.4	-699.3	276.5	-73.7	162.4
MEX-0288	2758	2833	75	0.46	0.16	0.105	0.285	0.127	0.8	63	2956924.5	804228.1	-1237.3	288.2	-82.4	74.3
MEX-0289	3433	3613	180	0.51	0.13	0.073	0.344	0.190	2.0	68	2964750.3	806754.8	-1902.3	39.9	-84.7	179.3

Hole	From	To	Thickness	Cu %	Ni %	Au ppm	Pd ppm	Pt ppm	Ag ppm	Co ppm	Easting	Northing	Elevation	Azimuth	Dip	Vertical Thickness
MEX-0290	2209	2273	64	0.86	0.26	0.167	0.554	0.239	2.8	107	2956900.0	805264.6	-579.8	251.7	-70.8	60.4
MEX-0290	2303	2343	40	0.36	0.12	0.048	0.205	0.081	0.9	76	2956870.5	805255.3	-668.6	253.3	-70.9	37.8
MEX-0291M	3698	3828	130	0.97	0.31	0.141	0.753	0.336	3.6	117	2963146.0	805768.6	-2203.1	304.3	-89.0	130.0
MEX-0291M-W1	3698	3818	120	0.93	0.29	0.141	0.722	0.316	3.2	116	2963147.3	805769.4	-2203.1	357.6	-88.8	120.0
MEX-0291M-W2	3698	3828	130	0.92	0.30	0.151	0.699	0.277	3.4	108	2963151.8	805770.3	-2203.0	49.7	-88.1	129.9
MEX-0291M-W3	3706	3821	115	1.01	0.30	0.135	0.765	0.318	3.6	115	2963144.3	805767.3	-2211.0	279.6	-88.8	115.0
MEX-0291M-W4	3713	3823	110	0.97	0.39	0.199	0.743	0.337	3.5	139	2963150.8	805772.6	-2218.0	17.0	-88.2	110.0
MEX-0292	3783	3963	180	0.61	0.18	0.083	0.373	0.161	1.8	99	2965185.8	806352.5	-2249.0	31.4	-85.1	179.3
MEX-0294	2853	3023	170	0.59	0.17	0.115	0.394	0.189	2.5	86	2958877.5	804681.3	-1320.9	338.9	-80.4	167.7
MEX-0295	3502.5	3713	210.5	0.60	0.16	0.113	0.420	0.180	2.1	82	2964686.3	806540.6	-1993.6	78.7	-87.9	210.4
MEX-0296	2183.5	2313	129.5	0.67	0.21	0.084	0.352	0.151	2.3	98	2957880.5	805856.2	-669.9	61.0	-80.9	127.9
MEX-0297	3943	4023	80	0.44	0.11	0.075	0.357	0.156	1.6	75	2965641.5	806780.8	-2288.7	56.0	-77.2	78.0
MEX-0298	3166.5	3323	156.5	0.70	0.21	0.119	0.462	0.235	2.8	98	2958205.3	803833.7	-1489.2	284.5	-76.2	152.1
MEX-0299	1141.5	1428.5	287	0.76	0.21	0.086	0.311	0.135	2.7	102	2954407.3	805036.4	325.6	274.8	-88.2	286.8
MEX-0300	633	673	40	0.36	0.11	0.050	0.164	0.076	1.0	73	2952536.5	803511.0	835.2	2.1	-78.4	39.2
MEX-0301	3648	3788	140	0.51	0.15	0.068	0.319	0.142	1.7	92	2965080.5	806645.6	-2093.2	75.7	-82.2	138.7
MEX-0301	3853	3878	25	0.56	0.10	0.061	0.267	0.127	0.9	47	2965107.5	806651.9	-2296.3	77.6	-82.1	24.8
MEX-0303-W1	2481	2627	146	0.55	0.22	0.054	0.247	0.107	2.4	94	2954936.3	803244.6	-1006.0	316.5	-81.9	144.5
MEX-0304	962	1268	306	0.68	0.20	0.073	0.275	0.110	2.2	103	2954337.8	805238.3	534.2	335.0	-76.0	296.8
MEX-0305	3773	4018	245	0.72	0.22	0.107	0.478	0.199	2.2	100	2965122.3	806900.3	-2143.3	11.5	-82.3	243.1
MEX-0306	733	958	225	0.57	0.17	0.134	0.278	0.113	2.1	91	2952865.5	804071.8	726.2	88.1	-79.3	221.3
MEX-0307	1499	1744	245	0.79	0.23	0.100	0.344	0.146	2.6	105	2954709.3	804718.1	-13.4	135.1	-82.8	243.3
MEX-0308	3252	3417	165	0.49	0.15	0.087	0.379	0.168	1.8	82	2962643.8	806979.6	-1468.2	310.4	-65.1	149.9
MEX-0309	3048.5	3203	154.5	0.68	0.19	0.082	0.403	0.153	2.2	92	2958618.3	803668.8	-1493.2	268.3	-80.1	152.3
MEX-0310	623	823	200	0.79	0.23	0.090	0.380	0.164	2.7	110	2952795.3	804209.5	841.5	21.1	-76.1	194.2
MEX-0310	873	898	25	0.38	0.09	0.050	0.200	0.079	4.3	45	2952815.3	804265.7	598.7	18.9	-76.4	24.3
MEX-0311	3323	3358	35	0.59	0.16	0.162	0.901	0.401	2.4	81	2964395.3	807162.4	-1726.4	354.6	-76.6	34.0
MEX-0312	2732	2813	81	0.59	0.21	0.084	0.378	0.172	2.0	80	2955124.0	803001.0	-1274.1	219.5	-89.7	81.0
MEX-0313	849	859	10	0.48	0.18	0.068	0.401	0.227	1.9	118	2952091.3	803269.2	660.1	318.6	-70.5	9.4
MEX-0314	486	772	286	0.53	0.15	0.056	0.239	0.097	2.1	88	2952664.5	804364.1	1065.2	347.9	-51.9	225.7

Hole	From	To	Thickness	Cu %	Ni %	Au ppm	Pd ppm	Pt ppm	Ag ppm	Co ppm	Easting	Northing	Elevation	Azimuth	Dip	Vertical Thickness
MEX-0315	793	988	195	0.64	0.21	0.079	0.329	0.158	2.4	126	2952973.8	803936.1	687.4	25.3	-72.2	185.8
MEX-0315	1108	1198	90	0.40	0.11	0.044	0.199	0.093	1.3	32	2953014.8	804023.1	387.4	25.9	-72.0	85.6
MEX-0316	1124	1164	40	0.34	0.14	0.040	0.172	0.060	1.1	105	2952274.0	803044.9	333.6	222.6	-88.4	40.0
MEX-0317	2488	2553	65	0.67	0.22	0.080	0.365	0.166	1.9	84	2954457.5	803029.3	-932.5	276.5	-73.9	62.5
MEX-0318	767	925	158	0.60	0.20	0.061	0.277	0.125	2.1	110	2953038.5	803700.6	697.9	84.4	-75.8	153.5
MEX-0320	3142	3302	160	0.76	0.19	0.167	0.725	0.307	3.0	91	2963212.3	807098.3	-1454.2	332.7	-71.1	151.6
MEX-0320	3272	3302	30	0.54	0.13	0.090	0.325	0.177	2.3	76	2963193.3	807135.4	-1577.3	332.9	-71.4	28.4
MEX-0321	3199	3233	34	0.59	0.16	0.078	0.365	0.160	1.6	87	2963979.5	806987.3	-1584.7	328.3	-78.3	33.3
MEX-0321	3378	3403	25	0.37	0.09	0.062	0.293	0.150	1.5	48	2963960.8	807017.8	-1760.0	328.6	-78.5	24.5
MEX-0321	3513	3558	45	0.45	0.05	0.041	0.117	0.036	1.1	18	2963947.0	807041.0	-1892.3	330.6	-78.5	44.1
MEX-0322	658	858	200	0.67	0.22	0.088	0.335	0.139	2.7	112	2952836.8	803692.8	781.2	319.3	-88.9	199.9
MEX-0322	888	908	20	0.32	0.10	0.036	0.146	0.057	4.1	63	2952833.0	803696.6	551.3	318.2	-88.5	20.0
MEX-0324	648	983	335	0.58	0.18	0.053	0.223	0.097	2.3	98	2954149.5	805546.1	840.9	19.0	-76.6	326.3
MEX-0325	698	843	145	0.70	0.22	0.078	0.327	0.143	2.4	108	2952639.0	803991.4	839.6	331.7	-59.6	125.3
MEX-0326	661.5	892	230.5	0.70	0.20	0.074	0.262	0.120	2.4	107	2953930.8	805383.1	833.9	266.2	-74.9	222.5
MEX-0327	1329	1548	219	0.89	0.27	0.107	0.342	0.149	3.1	117	2954358.5	804721.3	164.6	248.4	-79.6	215.3
MEX-0328	859	1091	232	0.78	0.21	0.086	0.343	0.116	3.1	109	2953849.0	804978.3	628.3	237.1	-77.2	226.6
MEX-0329	1095	1259	164	0.84	0.26	0.084	0.344	0.156	3.3	122	2954777.8	805610.3	424.1	14.0	-72.3	156.3
MEX-0330	2321	2418	97	0.69	0.25	0.113	0.371	0.148	1.9	121	2954376.5	803322.3	-711.5	296.5	-68.7	90.3
MEX-0331	1612	1883	271	0.67	0.22	0.112	0.272	0.117	2.3	107	2954814.0	804545.3	-88.5	146.4	-77.9	265.6
MEX-0331	2038	2068	30	0.55	0.13	0.083	0.341	0.165	2.1	70	2954855.5	804473.0	-506.2	152.8	-79.3	29.5
MEX-0331	2238	2253	15	0.66	0.08	0.017	0.111	0.073	1.2	53	2954872.0	804439.6	-702.7	153.4	-79.1	14.7
MEX-0332	1203	1418	215	0.80	0.22	0.090	0.304	0.142	3.1	112	2954664.3	805269.8	260.9	223.4	-87.9	214.8
MEX-0333	2716	2793	77	0.66	0.18	0.066	0.305	0.132	2.1	85	2959576.0	805854.9	-1197.6	33.3	-82.4	76.3
MEX-0333	2818	2853	35	0.59	0.12	0.043	0.287	0.093	2.1	72	2959583.5	805866.3	-1298.7	34.6	-82.3	34.7
MEX-0334	2792	2878	86	0.61	0.24	0.061	0.347	0.132	1.7	83	2955423.3	803349.8	-1311.1	49.7	-85.1	85.7
MEX-0334	2893	2928	35	0.39	0.12	0.051	0.201	0.087	1.7	24	2955430.0	803355.4	-1411.7	49.5	-85.0	34.9
MEX-0335	504	767	263	0.71	0.20	0.068	0.232	0.104	2.4	104	2954016.0	805801.9	1072.6	273.5	-50.8	204.7
MEX-0336	2993	3048	55	0.29	0.06	0.041	0.155	0.086	1.4	36	2961545.0	806483.3	-1435.6	104.3	-80.5	54.2
MEX-0337	1843	2062	219	0.63	0.20	0.075	0.318	0.137	2.0	107	2961603.3	809449.5	-217.8	331.3	-70.2	206.3

Hole	From	To	Thickness	Cu %	Ni %	Au ppm	Pd ppm	Pt ppm	Ag ppm	Co ppm	Easting	Northing	Elevation	Azimuth	Dip	Vertical Thickness
MEX-0337	2087	2142	55	0.40	0.09	0.041	0.162	0.077	2.4	32	2961565.3	809522.1	-447.6	333.3	-70.4	51.8
MEX-0338	603	858	255	0.68	0.19	0.067	0.269	0.125	2.2	103	2954342.0	805783.6	858.6	219.1	-89.7	255.0
MEX-0339	2047	2158	111	0.58	0.19	0.068	0.226	0.111	2.1	112	2955538.3	804653.4	-481.3	225.6	-76.3	107.9
MEX-0340	1088.5	1288	199.5	0.70	0.23	0.064	0.255	0.115	2.3	122	2955376.0	805973.1	431.2	329.0	-73.2	191.2
MEX-0340	1323	1348	25	0.54	0.16	0.044	0.172	0.086	4.4	93	2955342.3	806030.7	206.4	330.3	-73.7	24.0
MEX-0341	2893	2968	75	0.84	0.26	0.156	0.612	0.221	3.0	122	2964221.3	808658.5	-1281.0	338.4	-78.4	73.5
MEX-0341	3023	3058	35	0.39	0.14	0.039	0.191	0.070	1.5	61	2964212.3	808682.3	-1408.5	340.0	-78.9	34.4
MEX-0342	808	883	75	0.58	0.16	0.048	0.160	0.069	2.3	107	2956103.5	806916.3	672.3	348.0	-77.1	73.1
MEX-0342	923	993	70	0.43	0.15	0.039	0.158	0.060	1.5	97	2956098.3	806941.1	560.2	347.8	-77.3	68.3
MEX-0343	1998	2163	165	0.65	0.24	0.073	0.260	0.113	2.7	129	2954618.0	803723.8	-500.6	352.3	-78.7	161.8
MEX-0344	2017	2177	160	0.68	0.21	0.068	0.314	0.136	2.3	93	2962029.8	809298.6	-475.5	18.1	-81.6	158.3
MEX-0344	2227	2267	40	0.47	0.09	0.055	0.186	0.081	2.1	27	2962039.0	809327.1	-683.3	19.2	-82.0	39.6
MEX-0345	1323	1573	250	0.69	0.20	0.064	0.271	0.108	2.7	103	2955568.8	805703.6	143.0	297.9	-89.6	250.0
MEX-0346	522.7	949	426.3	0.53	0.17	0.048	0.178	0.071	1.7	113	2955633.8	806951.4	1049.3	246.4	-54.1	350.4
MEX-0347	1574	1799	225	0.76	0.24	0.080	0.296	0.123	2.7	114	2955721.3	805419.2	-60.9	339.0	-79.8	221.4
MEX-0348	2683	2748	65	0.80	0.24	0.106	0.577	0.200	2.5	100	2963076.5	808597.0	-1125.9	291.3	-80.4	64.1
MEX-0349	793	823	30	0.36	0.10	0.030	0.107	0.049	1.3	76	2955934.3	807274.0	693.8	3.8	-77.0	29.3
MEX-0350	2214.5	2359	144.5	0.68	0.27	0.094	0.298	0.121	2.1	123	2954755.5	803513.5	-748.2	51.7	-85.5	144.0
MEX-0351	2571	2733	162	0.59	0.24	0.081	0.424	0.176	2.1	84	2960226.3	806377.9	-1045.3	4.7	-82.7	160.7
MEX-0352	1748	1943	195	0.65	0.26	0.063	0.306	0.135	2.2	113	2955855.0	805130.6	-266.3	119.5	-87.9	194.8
MEX-0353	2973	3153	180	0.57	0.17	0.119	0.641	0.274	2.9	97	2964668.3	808414.1	-1422.7	21.5	-81.9	178.2
MEX-0353	3213	3243	30	0.36	0.07	0.051	0.246	0.113	1.1	22	2964680.0	808445.6	-1660.3	21.5	-81.9	29.7
MEX-0354	2658	2838	180	0.68	0.19	0.102	0.450	0.207	2.3	72	2961177.5	806883.3	-1114.3	32.6	-82.3	178.4
MEX-0355	2106	2213	107	0.44	0.13	0.035	0.150	0.062	1.4	98	2962284.8	809063.1	-575.0	69.5	-80.7	105.6
MEX-0355	2278	2436.5	158.5	0.91	0.30	0.093	0.496	0.186	3.1	113	2962311.0	809072.6	-744.7	70.6	-80.7	156.5
MEX-0356	1162	1360	198	0.72	0.23	0.072	0.256	0.100	2.5	114	2955847.5	806205.6	342.9	333.6	-75.9	192.0
MEX-0357	1384	1528	144	0.81	0.29	0.085	0.433	0.187	2.9	117	2953410.3	803393.1	62.5	159.5	-80.6	142.1
MEX-0357	1618	1703	85	0.62	0.23	0.071	0.420	0.178	2.4	88	2953423.5	803357.4	-168.4	158.9	-80.6	83.9
MEX-0358	2633	2748	115	0.66	0.21	0.098	0.477	0.170	2.8	86	2962740.3	808740.1	-971.3	293.4	-72.1	109.4
MEX-0359	1282.5	1512.8	230.3	0.78	0.24	0.075	0.312	0.135	3.2	107	2955972.8	806030.1	187.3	5.2	-86.3	229.8

Hole	From	To	Thickness	Cu %	Ni %	Au ppm	Pd ppm	Pt ppm	Ag ppm	Co ppm	Easting	Northing	Elevation	Azimuth	Dip	Vertical Thickness
MEX-0360	2364	2518	154	0.66	0.25	0.065	0.298	0.130	2.3	116	2955195.0	803755.6	-813.8	51.7	-76.9	150.0
MEX-0361	744	968	224	0.66	0.20	0.065	0.265	0.114	2.5	108	2953415.8	804545.1	737.2	336.2	-72.1	213.4
MEX-0362	2647.3	2828	180.7	0.59	0.21	0.085	0.414	0.170	2.1	103	2960715.5	806843.3	-979.1	36.4	-72.2	172.2
MEX-0363	1733	1778	45	0.70	0.25	0.078	0.386	0.164	2.7	137	2960285.8	808248.6	-18.4	271.9	-62.0	39.7
MEX-0363-W1	1720	1975	255	0.60	0.20	0.071	0.282	0.131	2.1	129	2960291.8	808248.4	-6.9	271.9	-62.0	225.2
MEX-0364	592	713	121	0.69	0.20	0.154	0.292	0.126	2.4	93	2956403.5	807499.3	929.4	331.3	-59.2	104.0
MEX-0364	743	773	30	0.56	0.13	0.064	0.182	0.086	2.0	83	2956367.0	807567.1	799.5	331.9	-59.3	25.8
MEX-0365	1238	1463	225	0.73	0.21	0.071	0.310	0.127	2.6	103	2954936.8	805447.0	279.7	335.6	-73.0	215.1
MEX-0366	2260	2362.5	102.5	0.73	0.28	0.084	0.415	0.195	3.1	115	2954393.0	803278.8	-728.6	328.0	-72.0	97.4
MEX-0367	2564.8	2712	147.2	0.76	0.23	0.106	0.496	0.208	3.0	102	2960192.5	806767.1	-879.4	25.7	-73.9	141.5
MEX-0367	2737	2767	30	0.49	0.15	0.071	0.254	0.134	1.7	61	2960211.3	806810.4	-1045.0	22.7	-74.2	28.9
MEX-0368	689	724	35	0.48	0.18	0.060	0.205	0.087	1.7	108	2956555.3	807228.9	750.3	205.2	-89.7	35.0
MEX-0368	779	824	45	0.41	0.14	0.035	0.122	0.053	1.9	114	2956555.0	807228.2	660.3	204.0	-89.5	45.0
MEX-0368	859	978	119	0.56	0.17	0.053	0.200	0.081	2.3	96	2956554.8	807227.5	580.3	204.2	-89.4	119.0
MEX-0369	2598	2643	45	0.64	0.16	0.092	0.335	0.132	2.6	100	2963611.3	808777.0	-1072.7	14.7	-83.5	44.7
MEX-0369	2663	2798	135	0.61	0.18	0.088	0.379	0.194	2.5	87	2963613.0	808784.2	-1137.3	14.0	-83.5	134.1
MEX-0370	2735	2888	153	0.57	0.28	0.076	0.309	0.120	1.6	107	2955500.8	803514.4	-1148.4	85.2	-75.0	147.9
MEX-0371	1554	1749	195	1.18	0.25	0.094	0.499	0.158	4.4	116	2955134.0	805071.9	-90.2	186.6	-89.0	195.0
MEX-0372	1073.25	1233	159.75	0.67	0.21	0.066	0.258	0.106	2.1	110	2956327.3	806598.8	427.0	343.4	-73.5	153.5
MEX-0373	2287	2402	115	0.83	0.25	0.096	0.413	0.194	3.2	103	2953750.8	802929.8	-593.1	285.3	-61.1	100.7
MEX-0374	1768	2008	240	0.80	0.27	0.075	0.333	0.135	3.1	113	2955336.8	804850.4	-264.5	146.6	-80.0	236.6
MEX-0375	2682.5	2818	135.5	0.60	0.18	0.120	0.415	0.212	2.1	82	2960592.8	806315.6	-1142.8	60.3	-82.8	134.5
MEX-0375	2838	2913	75	0.39	0.10	0.035	0.131	0.064	1.0	52	2960609.5	806324.8	-1297.1	61.8	-82.9	74.4
MEX-0376	2718	2868	150	0.68	0.20	0.088	0.396	0.148	2.4	95	2963909.3	809170.6	-1097.0	25.0	-73.0	143.4
MEX-0377	1204	1443	239	0.74	0.22	0.093	0.296	0.144	2.4	113	2956453.0	806384.2	247.6	353.5	-85.6	238.3
MEX-0378	1064.5	1233	168.5	0.64	0.19	0.068	0.266	0.117	2.4	100	2953596.3	804258.4	454.1	322.1	-70.6	159.0
MEX-0379	1728	1828	100	0.41	0.17	0.044	0.246	0.106	1.3	105	2954412.8	804074.7	-227.1	150.5	-80.2	98.5
MEX-0379	1883	1918	35	0.36	0.10	0.045	0.168	0.078	2.4	72	2954425.0	804051.4	-379.9	151.0	-80.4	34.5
MEX-0379	2058	2153	95	0.61	0.15	0.060	0.212	0.101	2.5	72	2954438.5	804026.1	-552.5	152.5	-80.7	93.8
MEX-0380	2453	2549	96	0.59	0.20	0.066	0.288	0.122	2.0	88	2953955.3	802604.7	-867.8	266.9	-69.4	89.9

Hole	From	To	Thickness	Cu %	Ni %	Au ppm	Pd ppm	Pt ppm	Ag ppm	Co ppm	Easting	Northing	Elevation	Azimuth	Dip	Vertical Thickness
MEX-0381	2228	2418	190	0.70	0.22	0.070	0.286	0.157	2.2	94	2959675.8	806744.1	-575.0	2.6	-71.7	180.3
MEX-0382	2097	2281	184	0.61	0.20	0.099	0.308	0.151	2.4	112	2960231.3	807806.0	-340.8	242.6	-59.4	158.0
MEX-0383	1135.5	1319	183.5	0.70	0.22	0.076	0.334	0.134	2.2	97	2953756.8	803976.9	320.8	283.7	-85.9	182.8
MEX-0383	1424	1484	60	0.42	0.16	0.052	0.211	0.092	0.6	67	2953731.5	803982.4	33.5	282.7	-84.4	59.7
MEX-0384	713	992	279	0.54	0.17	0.064	0.201	0.090	1.9	109	2955891.3	806797.4	795.3	289.8	-71.8	266.8
MEX-0385	1308	1598	290	0.56	0.18	0.058	0.234	0.102	1.9	90	2954205.5	804353.3	159.0	314.0	-89.2	290.0
MEX-0385	1778	1813	35	0.44	0.10	0.039	0.192	0.080	2.0	30	2954200.0	804359.4	-310.9	327.4	-88.9	35.0
MEX-0386	957.5	1193	235.5	0.67	0.21	0.076	0.318	0.139	2.3	107	2953327.5	803968.9	549.3	358.2	-69.1	220.8
MEX-0387	948	1198	250	0.64	0.19	0.064	0.269	0.115	2.5	111	2956451.8	806830.6	572.5	74.0	-69.1	234.5
MEX-0387	1233	1258	25	0.40	0.12	0.040	0.152	0.056	1.5	82	2956546.5	806857.1	305.0	75.1	-70.3	23.5
MEX-0388	2588.5	2707.5	119	0.65	0.26	0.071	0.447	0.214	3.0	119	2953958.5	802326.2	-959.7	257.7	-56.9	100.0
MEX-0389	1626.5	1788	161.5	0.62	0.26	0.084	0.303	0.138	2.0	119	2953905.0	803746.7	-148.1	179.3	-83.7	160.7
MEX-0390	1284	1538	254	0.74	0.22	0.067	0.272	0.117	2.1	102	2955731.3	805953.8	207.1	268.1	-81.2	251.2
MEX-0391	2479.5	2633	153.5	0.84	0.26	0.114	0.512	0.243	3.2	109	2959674.0	806287.7	-949.6	344.0	-82.6	152.1
MEX-0392	530	857	327	0.50	0.15	0.054	0.203	0.078	3.2	102	2956079.3	807351.4	1040.5	34.7	-54.3	266.4
MEX-0392	937	962	25	0.34	0.10	0.029	0.105	0.054	2.0	75	2956219.0	807541.5	708.9	38.0	-54.7	20.4
MEX-0393	1003	1088	85	0.61	0.25	0.094	0.313	0.141	2.2	142	2953496.0	803745.3	452.7	51.6	-76.7	82.8
MEX-0394	1836.5	1918	81.5	0.44	0.17	0.058	0.231	0.122	2.4	112	2954686.8	804187.2	-296.0	113.3	-75.1	78.9
MEX-0394	1943	1978	35	0.40	0.11	0.031	0.141	0.062	1.5	103	2954710.5	804176.3	-399.2	115.6	-76.3	34.0
MEX-0394	2083	2108	25	0.43	0.16	0.036	0.142	0.057	1.6	93	2954739.8	804162.2	-535.4	116.8	-77.1	24.4
MEX-0395	1099.5	1343	243.5	0.62	0.20	0.064	0.221	0.099	1.9	98	2955614.3	806228.7	465.3	310.0	-68.1	227.1
MEX-0399	1945.5	2133	187.5	0.76	0.27	0.067	0.331	0.155	2.5	118	2954096.0	803480.6	-415.9	338.2	-68.1	174.0
MEX-0401	1938	2108	170	0.71	0.26	0.085	0.414	0.161	2.6	103	2960988.8	808280.1	-416.1	286.4	-87.5	169.8
MEX-0401	2138	2193	55	0.52	0.31	0.060	0.282	0.131	2.0	108	2960979.0	808283.8	-615.9	292.6	-86.8	54.9
MEX-0402	772.25	1063	290.75	0.67	0.20	0.100	0.260	0.123	2.3	103	2954689.0	806199.4	870.4	44.4	-49.3	219.5
MEX-0403	1123	1329.5	206.5	0.69	0.19	0.070	0.236	0.095	2.4	102	2956040.8	806512.4	511.0	11.2	-58.6	177.0
MEX-0405	1178.75	1358.5	179.75	0.75	0.23	0.086	0.341	0.145	2.8	109	2953827.8	804371.7	323.5	11.2	-75.0	173.8
MEX-0409	2045	2182	137	0.83	0.28	0.151	0.447	0.219	2.7	116	2953873.3	803333.3	-496.2	298.9	-73.0	131.0
MEX-0410	1057	1243.5	186.5	0.82	0.25	0.080	0.342	0.143	3.1	119	2953687.3	804693.6	601.8	306.2	-55.8	154.7

10.5.2 Birch Lake

After the database was closed for resource estimation, additional drilling was completed at Birch Lake. A total of 30 holes (83,005.5 ft) were drilled. The locations of those holes is shown in Figure 10-5 and summarized in Table 10-7. Table 10-8 summarizes the significant intercepts in that drilling.

The drilling was primarily for infill purposes and largely confirmed the model presented herein but will allow significant improvements to future models because of the additional information about the mineralization that was generated.

Figure 10-5: Locations of Recent Drill Holes (green – holes in resource estimate; red – holes completed after the database was closed; grid squares are 1000' square, north is to the top of the map)

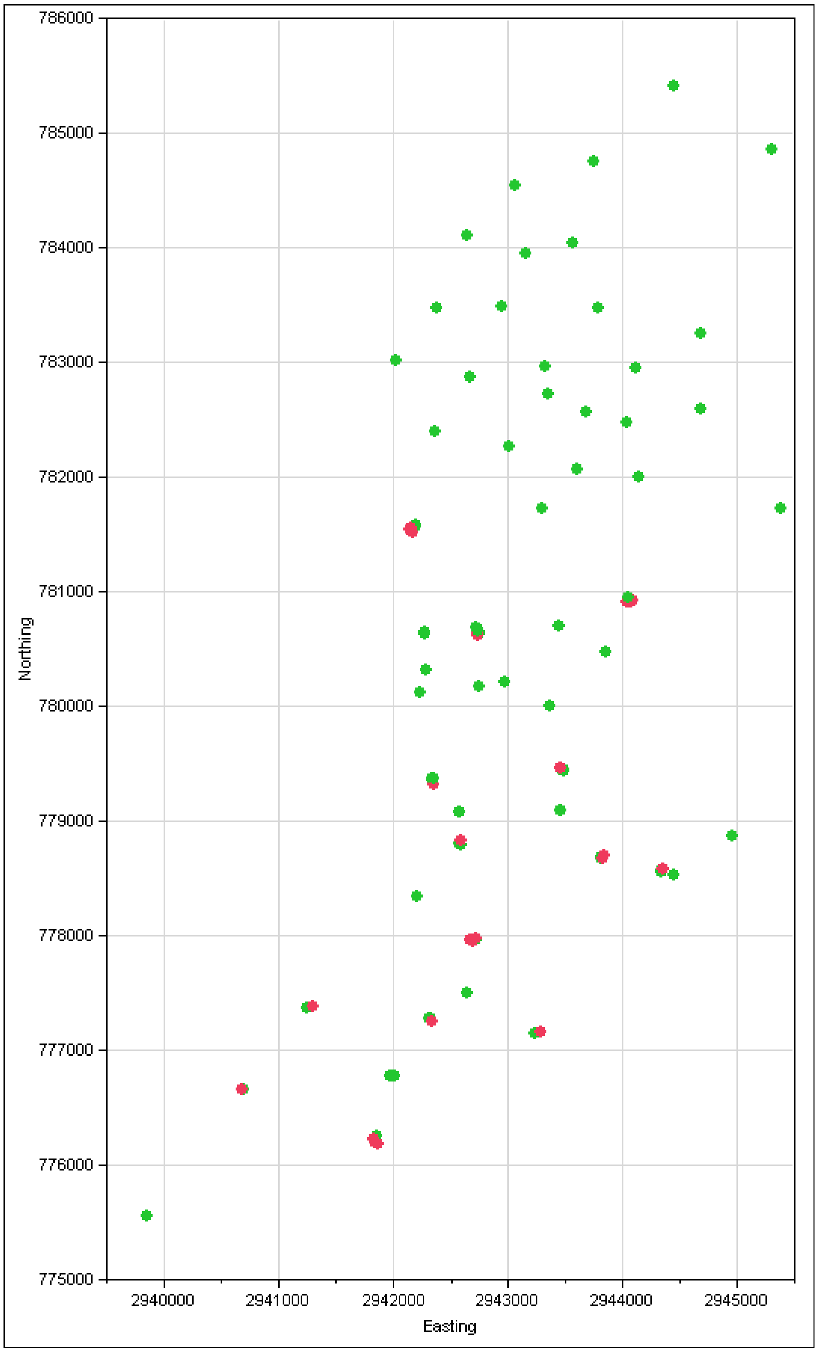


Table 10-7: Locations of Recent Birch Lake Drill Holes (elevation and depths are in feet, azimuths and dips are in degrees)

HOLEID	Easting	Northing	Elevation	Depth	Azimuth	Dip
BL11-01	2942697.3	777949.5	1464.1	2588	256	-78
BL11-02	2943835.9	778702.6	1467.3	2888	192	-79
BL11-03	2942714.2	777975.6	1469.0	2828	8	-80
BL11-04	2943818.7	778679.3	1467.0	2928	275	-76
BL11-05	2944353.9	778578.9	1466.8	3128	16	-80
BL11-06	2942659.0	777958.8	1469.6	3098	97	-79
BL11-07	2941838.8	776226.6	1478.4	2197	185	-81
BL11-07-W1	2941838.8	776226.6	1478.4	3097	185	-81
BL11-08	2941310.5	777384.6	1450.9	2508	218	-76
BL12-01	2944082.6	780915.9	1436.5	3077	194	-73
BL12-02	2942580.2	778827.9	1457.6	2877	56	-79
BL12-03	2940682.6	776659.1	1442.2	2911	173	-77
BL12-04	2944054.9	780916.3	1431.3	2977	166	-71
BL12-05	2942165.8	781514.2	1442.6	2267	266	-74
BL12-06	2941849.4	776200.9	1479.0	457.5	123	-74
BL12-07	2941874.4	776191.9	1481.6	3508	275	-78
BL12-08	2942156.8	781553.1	1436.9	2678	194	-78
BL12-09	2944047.6	780913.7	1435.8	2988	156	-80
BL12-10	2942143.5	781531.5	1442.3	2637	125	-82
BL12-11	2944050.3	780897.7	1431.9	2777	88	-79
BL12-12	2943459.0	779463.8	1463.3	3773	260	81
BL12-13	2942156.1	781525.3	1443.2	2137	340	-55
BL12-14	2942734.8	780629.7	1473.1	2651	272	-65
BL12-15	2944075.1	780896.5	1436.4	2950	31	-75
BL12-16	2942729.6	780632.4	1472.8	2757	242	-62
BL12-17	2944042.1	780898.1	1436.6	2806	340	-70
BL12-18	2943282.5	777159.4	1499.9	3035	349	-79
BL12-19	2942147.7	781527.4	1442.8	3257	355	-76
BL12-20	2942334.7	777246.7	1496.1	2598	238	-82
BL12-21	2942347.8	779314.4	1444.0	2627	278	-78

Table 10-8: Significant Intercepts in Recent Drill Holes (depths and thickness are in feet; azimuth and dips are in degrees)

Hole	From	To	Depth	Cu %	Ni %	Au ppm	Pd ppm	Pt ppm	Ag ppm	Co ppm	Easting	Northing	Elevation	Azimuth	Dip	Vertical Thickness
BL11-01	2248.0	2333.0	85.0	0.38	0.17	0.209	1.457	0.836	1.3	132	2942266.0	777854.2	-740.0	255.9	-79.6	83.7
BL11-02	2388.0	2428.0	40.0	0.29	0.10	0.034	0.153	0.082	1.1	73	2943764.0	778220.3	-870.3	186.6	-77.8	39.1
BL11-02	2503.0	2583.0	80.0	0.40	0.12	0.046	0.169	0.074	1.3	111	2943761.3	778196.1	-982.7	186.2	-77.7	78.2
BL11-02	2603.0	2623.0	20.0	0.38	0.09	0.026	0.071	0.035	1.4	61	2943758.8	778175.3	-1080.5	186.5	-77.8	19.6
BL11-03	2343.0	2628.0	285.0	0.57	0.17	0.092	0.415	0.178	2.1	107	2942777.3	778259.5	-855.5	26.2	-83.6	283.2
BL11-04	2536.5	2593.0	56.5	0.59	0.21	0.103	0.539	0.259	2.0	109	2943244.0	778753.8	-1002.4	279.9	-77.3	55.1
BL11-04	2648.0	2713.0	65.0	0.34	0.11	0.056	0.260	0.124	1.3	77	2943220.0	778758.0	-1111.2	280.5	-77.3	63.4
BL11-05	2720.5	2788.0	67.5	0.71	0.22	0.192	1.115	0.510	2.5	94	2944474.3	778971.6	-1222.2	11.5	-83.2	67.1
BL11-05	2788.0	2918.0	130.0	0.27	0.05	0.101	0.291	0.130	1.6	39	2944475.5	778979.3	-1289.3	7.2	-83.5	129.2
BL11-06	2358.0	2523.0	165.0	0.46	0.12	0.056	0.215	0.145	1.6	100	2943046.8	777867.2	-854.3	108.5	-80.2	162.7
BL11-06	2563.0	2603.0	40.0	0.28	0.09	0.049	0.167	0.076	1.3	76	2943079.0	777855.1	-1056.4	112.3	-80.5	39.4
BL11-07-W1	2303.5	2467.0	163.5	0.75	0.19	0.264	1.072	0.568	2.8	131	2941759.8	775883.7	-797.6	210.5	-82.5	162.2
BL11-08	1581.0	1622.0	41.0	0.36	0.13	0.045	0.169	0.093	1.3	106	2941036.0	777107.6	-81.1	229.9	-75.7	39.7
BL11-08	1718.5	1782.0	63.5	0.38	0.14	0.049	0.199	0.113	1.1	117	2941009.8	777086.4	-214.4	232.5	-75.9	61.6
BL11-08	1962.0	2027.0	65.0	0.30	0.34	0.015	0.054	0.023	0.5	206	2940962.8	777053.0	-451.0	236.7	-76.6	63.2
BL12-01	2672.0	2817.0	145.0	0.52	0.12	0.105	0.559	0.250	1.6	78	2943684.8	780227.3	-1112.0	218.8	-73.6	139.2
BL12-01	2842.0	2922.0	80.0	0.61	0.20	0.086	0.424	0.172	1.6	134	2943655.3	780189.9	-1275.2	217.8	-73.8	76.8
BL12-01	2942.0	2967.0	25.0	0.47	0.08	0.070	0.247	0.123	2.2	25	2943638.5	780167.8	-1371.2	216.6	-73.9	24.0
BL12-02	2468.5	2602.0	133.5	0.59	0.15	0.172	0.643	0.277	2.4	88	2942955.5	778992.8	-976.0	74.0	-80.3	131.7
BL12-02	2637.0	2657.0	20.0	0.53	0.11	0.091	0.430	0.161	2.1	71	2942981.8	779001.3	-1142.3	71.3	-80.6	19.7
BL12-03	2397.0	2452.0	55.0	0.34	0.13	0.053	0.259	0.126	1.2	86	2940654.5	776058.8	-877.0	198.2	-75.9	53.4
BL12-04	2527.7	2632.0	104.3	0.62	0.16	0.099	0.395	0.174	2.0	113	2944249.8	780191.4	-980.9	164.3	-76.6	101.6
BL12-04	2787.0	2807.0	20.0	0.79	1.59	0.010	0.113	0.026	2.1	852	2944267.5	780136.4	-1233.7	162.3	-77.2	19.5
BL12-05	1839.5	1987.0	147.5	0.38	0.13	0.050	0.177	0.085	1.2	101	2941650.8	781550.1	-322.4	281.2	-76.6	143.9
BL12-05	2027.0	2047.0	20.0	0.32	0.10	0.030	0.122	0.059	1.1	75	2941610.8	781559.4	-505.3	284.0	-77.7	19.5
BL12-08	2120.5	2142.0	21.5	0.33	0.16	0.032	0.126	0.053	0.6	124	2942063.5	781157.8	-644.0	197.0	-81.0	21.2
BL12-08	2202.0	2292.0	90.0	0.57	0.18	0.065	0.219	0.102	1.7	99	2942059.5	781145.9	-724.6	199.5	-81.3	88.9
BL12-08	2317.0	2372.0	55.0	0.37	0.06	0.045	0.151	0.064	1.5	36	2942053.5	781129.4	-838.2	201.2	-81.2	54.4
BL12-09	2475.7	2647.0	171.3	0.70	0.22	0.119	0.533	0.256	2.5	124	2944217.0	780549.9	-1006.7	142.4	-83.4	170.2
BL12-10	2146.0	2297.0	151.0	0.46	0.16	0.095	0.384	0.213	1.7	93	2942478.5	781376.3	-671.5	110.8	-81.5	149.4

Hole	From	To	Depth	Cu %	Ni %	Au ppm	Pd ppm	Pt ppm	Ag ppm	Co ppm	Easting	Northing	Elevation	Azimuth	Dip	Vertical Thickness
BL12-10	2357.0	2382.0	25.0	0.52	0.47	0.026	0.187	0.071	0.6	231	2942507.3	781365.7	-880.3	109.8	-81.5	24.7
BL12-10	2417.0	2442.0	25.0	0.48	0.14	0.053	0.209	0.094	1.7	58	2942515.5	781362.6	-939.6	109.9	-81.4	24.7
BL12-11	2341.1	2377.0	35.9	0.48	0.23	0.092	0.567	0.290	1.5	121	2944495.0	780849.4	-865.7	104.3	-79.6	35.3
BL12-11	2407.0	2497.0	90.0	0.44	0.13	0.065	0.314	0.160	1.4	98	2944506.3	780846.6	-930.6	103.9	-79.9	88.6
BL12-12	2601.0	2731.0	130.0	0.62	0.19	0.087	0.347	0.142	2.1	91	2943798.0	779474.6	-1114.1	112.1	-86.3	129.8
BL12-13	1605.5	1912.0	306.5	0.41	0.14	0.047	0.156	0.066	1.6	95	2941860.3	782400.4	130.4	339.7	-57.4	262.0
BL12-14	2212.0	2302.0	90.0	0.38	0.16	0.043	0.183	0.103	0.8	117	2941872.8	780710.0	-561.3	279.1	-69.9	84.5
BL12-14	2352.0	2432.0	80.0	0.45	0.22	0.024	0.132	0.059	0.8	134	2941825.3	780716.6	-692.8	277.5	-70.0	75.2
BL12-15	2416.0	2536.0	120.0	0.45	0.14	0.067	0.286	0.130	1.1	95	2944350.5	781293.4	-927.9	33.9	-82.1	118.8
BL12-15	2591.0	2616.0	25.0	0.67	0.60	0.015	0.116	0.034	0.9	302	2944366.0	781312.3	-1101.1	42.0	-82.0	24.8
BL12-15	2801.0	2856.0	55.0	0.40	0.05	0.055	0.184	0.084	2.0	17	2944386.3	781333.5	-1309.1	45.2	-81.9	54.4
BL12-16	2342.0	2662.0	320.0	0.42	0.20	0.039	0.134	0.066	0.8	115	2941753.8	780219.1	-614.8	250.3	-65.3	291.7
BL12-17	2426.0	2527.0	101.0	0.45	0.15	0.114	0.523	0.231	1.8	104	2943796.0	781508.9	-896.5	327.8	-77.3	98.6
BL12-18	2327.0	2407.0	80.0	0.46	0.14	0.111	0.468	0.254	1.6	89	2943124.8	777425.5	-806.3	335.0	-84.0	79.6
BL12-18	2452.0	2497.0	45.0	0.30	0.09	0.042	0.191	0.086	0.8	105	2943119.8	777437.8	-930.6	338.0	-83.8	44.7
BL12-18	2582.0	2607.0	25.0	0.47	0.11	0.040	0.108	0.053	1.7	73	2943113.8	777450.7	-1059.9	334.3	-83.7	24.8
BL12-19	1704.5	1892.0	187.5	0.65	0.23	0.055	0.230	0.095	2.1	119	2942136.3	781932.5	-212.6	354.8	-77.1	182.8
BL12-19	1912.0	1977.0	65.0	0.28	0.10	0.025	0.094	0.042	1.2	45	2942131.3	781978.4	-414.9	353.9	-77.1	63.4
BL12-20	2223.0	2308.0	85.0	0.44	0.15	0.072	0.374	0.184	1.0	100	2942087.8	777048.4	-704.0	233.9	-82.8	84.4
BL12-21	2203.3	2317.0	113.8	0.56	0.20	0.055	0.207	0.097	1.9	132	2941961.8	779442.6	-720.8	296.8	-79.9	112.0

10.6 Core Logging

10.6.1 Maturi

Legacy logs from INCO, Duval, and others include a description of the lithology and mineralization. No specific logging procedures were discovered for these projects, but the companies were major mining companies at the time of the drilling that generally followed industry best practices for that period.

TMM core for the 2006-2010 programs was placed in 10 ft. capacity (5 ft. by 2 ft. rows) waxed cardboard core boxes at the drill and moved to Duluth's Ely logging and sampling facility by Duluth geologists. The core was logged for lithology, texture, structure, alteration, ore mineralogy, and mineralization. Geotechnical logging includes recovery, rock quality designation, and fracture density. Core was digitally photographed. Samples were marked at the time the core was logged.

10.6.2 Birch Lake

Geological logging recorded major and minor lithology descriptions and RQD and recovery percentages. Sample intervals were marked by geologists at the time of logging. Owing to the number of drilling campaigns on the property since the 1970s, core logging has been done by various geologists. Older core has been re-logged to standardized geologic descriptions.

10.6.3 Spruce Road

Over the course of 20 years of drilling (1954-1973), nine INCO geologists logged core. Two geologists accounted for 90% of the holes, suggesting reasonably consistent logging. The logs include a description of the lithology and mineralization. The logs are consistent with best practices for the time period. The logs have been re-interpreted in order to standardize nomenclature for the current resource estimate.

10.7 Core Recovery

Core recovery is about 100% at Maturi and 99.8% at Birch Lake. Recovery data were not recorded at Spruce Road.

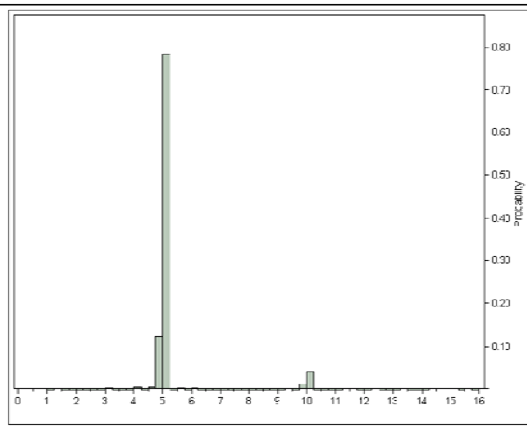
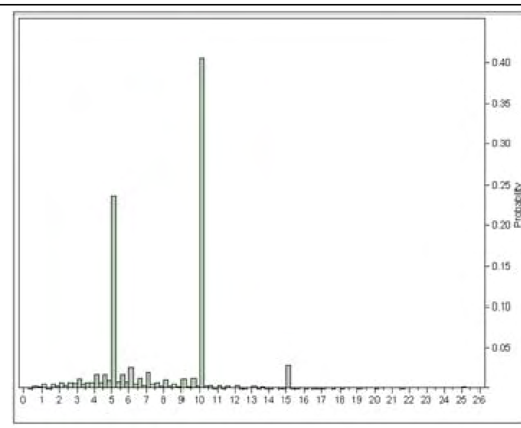
10.8 Core Sampling

10.8.1 Maturi

TMM samples were routinely taken (76%) at 5 ft. (1.52 m) lengths but some are as long as 10 ft. (3.05 m) (Figure 10-6A). Samples are marked by geologists logging the core and split with a diamond saw. One-half is bagged for transport to the sample preparation laboratory; the other half is returned to the box and archived.

Legacy samples range from 0.3 ft (.09 m) to 25 ft (7.62 m) (Figure 10-6B). Core was split with a manual core splitter and one-half sent to the sample preparation laboratory and one-half was returned to the box and archived.

Figure 10-6: Summary of Maturi Sample Lengths (in feet)

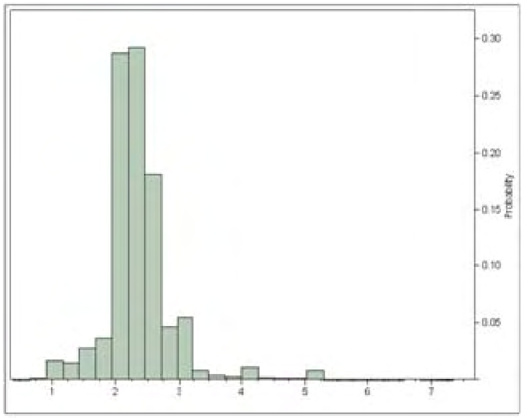
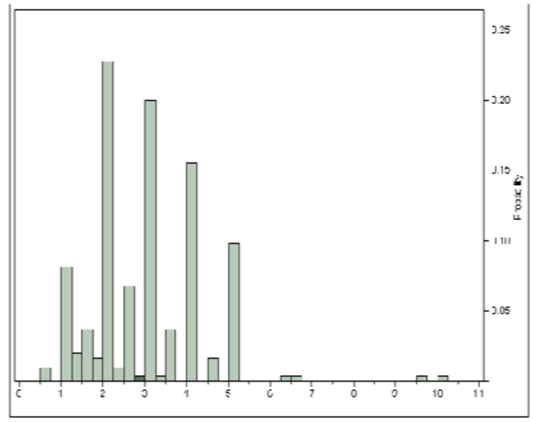
A – TMM Data	B – Legacy Data
	

10.8.2 Birch Lake

TMM samples were routinely 2 - 3 ft. (0.61 – 0.91 m) lengths but are as short as 0.5 ft (0.15 m) as long as 22 ft. (6.71 m) (Figure 10-7A). Samples are marked by geologists logging the core and split with a diamond saw. One-half is bagged for transport to the sample preparation laboratory; the other half is returned to the box and archived.

Legacy samples range from 0.5 ft (0.15 m) to 10 ft (7.62 m) (Figure 10-7B). Core was split with a manual core splitter and one-half sent to the sample preparation laboratory and one-half was returned to the box and archived.

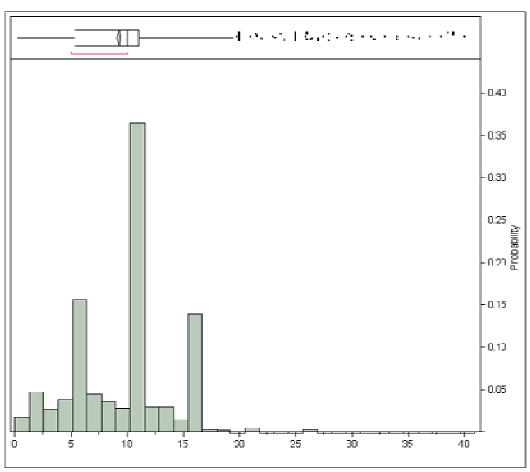
Figure 10-7: Summary of Birch Lake Sample Lengths (in feet)

A – TMM Data (one sample (22 ft) omitted)	B – Legacy Data
	

10.8.3 Spruce Road

All of the data at Spruce Road with the exception of the Wallbridge holes WM-001 and WM-002 are considered to be legacy data. Sample lengths of 5, 10, and 15 ft are the most common sample lengths (Figure 10-8). The minimum sample length is 0.20 ft (0.06 m) and the maximum sample length is 180 ft (54.8 m). Samples longer than 20 ft (6.1 m) (105 total) were excluded from resource estimation. Core was split with a manual core splitter and one-half sent to the sample preparation laboratory and one-half was returned to the box and archived.

Figure 10-8: Summary of Spruce Road Sample Lengths (in feet)



10.9 Comment on Drilling

10.9.1 Maturi

Collar Surveying

Legacy collar surveying is not documented, but is believed to have been done with theodolites and chains which were the standard tools at the time. Re-surveys of legacy collars have uncovered some minor discrepancies, but those are not believed to be significant. Legacy collar surveys are believed to be sufficiently accurate to be used for resource estimation.

Current collar surveying at Maturi utilizes industry-standard instrumentation and procedures and is adequate to support resource estimation.

Downhole Surveying

Legacy down-hole surveying was done primarily with acid-tubes. That method does not generally provide adequate control on the trajectory of drill holes, but in this case, drill hole azimuths are expected to vary very little because of the homogeneity of the rock. Those surveys are thus believed to be adequate for estimation of Inferred Mineral Resources.

Modern drilling should confirm the trajectories of the legacy holes.

Current practice is to use gyroscopic tools that are unaffected by magnetic minerals in the rocks. These tools are widely used in the industry and provide orientation data that are adequate to support resource estimation.

Drill Results

Drill results indicate the presence of mineralization with economically interesting grades over significant widths.

Core Logging

Core logging is adequate to support resource estimation.

Core Sampling

Core sampling conforms to industry standard practices and is adequate to support resource estimation.

10.9.2 Birch Lake

Collar Surveying

Current collar surveying at Maturi utilizes industry-standard instrumentation and procedures and is adequate to support resource estimation.

Legacy collar surveying is not documented, but is believed to have been done with theodolites and chains which were the standard tools at the time. Re-surveys of legacy collars have uncovered some minor discrepancies, but those are not believed to be significant. Legacy collar surveys for the few legacy holes at Birch Lake are believed to be sufficiently accurate to be used for resource estimation.

Downhole Surveying

Legacy downhole surveys were largely acid-tube surveys that provide only inclination information. The locations of the ends of legacy holes is thus somewhat uncertain.

Modern holes have been downhole surveyed with gyroscopic and magnetic instruments that are widely used within the industry. AMEC noted some problems with surveys and was required to make assumptions about which surveys were correct. This uncertainty on reliability of the downhole surveys limits the mineral resource classification to Inferred Mineral Resources.

AMEC recommends that the problem holes be resurveyed if they can be re-entered. This would provide information about the location of the last wedge hole drilled and the locations of other wedges could be more accurately inferred.

Drill Results

Drill results indicate the presence of mineralization with economically interesting grades over significant widths.

Core Logging

Core logging is adequate to support resource estimation.

Core Sampling

Core sampling conforms to industry standard practices is adequate to support resource estimation.

10.9.3 Spruce Road

Collar Surveying

Collar surveying is believed to have been performed with theodolites and chains, which was industry standard practice at the time the holes were drilled, but that has not been confirmed.

Downhole Surveying

Legacy down-hole surveying was done primarily with acid-tubes. That method does not generally provide adequate control on the trajectory of drill holes, but in this case, drill hole azimuths vary very little because of the homogeneity of the rock. Those surveys are thus believed to be adequate for estimation of Inferred Mineral Resources.

Modern drilling should confirm the trajectories of the legacy holes.

Drill Results

Drill results indicate the presence of mineralization with economically interesting grades over significant widths.

Core Logging

Core logging is adequate to support resource estimation. It is adequate to support resource estimation at an Inferred Mineral Resource level, but the knowledge of the rock hosting the mineralization has progressed significantly since the original logging and many of the codes and descriptions are no longer appropriate.

A program of twin hole drilling is recommended to validate the location and tenor of the mineralization at Spruce Road and to allow more direct comparison of current lithological nomenclature with the legacy nomenclature.

Core Sampling

Core sampling conforms to industry standard practices at the time the core was drilled and is believed to be adequate to support resource estimation.

11.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Sample Preparation

11.1.1 Maturi

The Maturi area contains significant legacy data from ACNC. AMEC believes that ACNC followed standard industry practices for sample preparation, but the sample preparation procedures are not documented. At the time that this exploration was being performed, ACNC's parent company, INCO, was an industry leading Cu-Ni miner in Canada and had significant internal expertise in Cu and Ni sample preparation and assaying.

For the Duluth and subsequent TMM drilling campaigns of 2006-2012, core samples were crushed, split, and pulverized in ALS Chemex's preparation facility in Thunder Bay, Ontario. The standard procedure employed by ALS Chemex is to weigh and dry the sample followed by crushing of entire sample to better than 70% passing 2 mm. The sample was then split to 250 g and pulverized to better than 85% passing 75 µm. Barren material is used to clean the mill between sample batches to prevent cross contamination.

11.1.2 Birch Lake

Prior to 2006, sample preparation at both ALS Chemex and Bondar Clegg consisted of crushing and splitting, with a split of the crushed material ring pulverized to -150 mesh (-106 µm).

For the 2006-2008 drilling campaigns, core samples were prepared by ALS Chemex in Thunder Bay, Ontario. Crushing was done to 70% passing 6 mm and LM5 ring and puck pulverizing to 75% passing 75µm (-200 mesh).

For the 2010 drilling campaign, core samples have been prepared by ALS Chemex in Thunder Bay, Ontario. The samples were crushed to 70% passing 2 mm (CRU-31), riffle split (SPL-21) and pulverized to 85% passing 75 µm (PUL-31).

11.1.3 Spruce Road

AMEC believes that ACNC followed standard industry practices for sample preparation, but the sample preparation procedures are not documented. At the time that this exploration was being performed, ACNC's parent company, INCO, was an industry leading Cu-Ni miner in Canada and had significant internal expertise in Cu and Ni sample preparation and assaying.

11.2 Assaying

11.2.1 Maturi

Assay data from Maturi is a mix of modern data with legacy data generated by ACNC. Detailed information about analytical methods employed by ACNC is not available, but prior to 1965, INCO's Process Technology Laboratory in Sudbury determined copper and nickel colorimetrically (Routledge and Cox, 2007). By 1966 copper and nickel atomic absorption spectrometry was adopted. The cost of analysis for precious metals was significant prior to 1970 and assaying for those analytes was generally done on core composites (Routledge and Cox, 2007). Precious metals analysis was done by fire assaying followed by wet chemical extraction of the individual precious metals.

ALS Chemex performed most of the recent analyses at Maturi and is certified to standards of ISO 9001:2008 and has received accreditation to ISO/IEC 17025:2005 from the Standards Council of Canada (SCC) for the following methods:

- Fire Assay Au by Atomic Absorption (AA),
- Fire Assay Au and Ag by Gravimetric finish,
- Fire Assay Au, Pt, and Pd by Inductively Coupled Plasma (ICP),
- Aqua Regia Ag, Cu, Pb, Zn and Mo by AA,
- Four Acid Ag, Cu, Pb, Zn, Ni and Co by AA,
- Aqua Regia Multi-element by ICP and MS,
- Four Acid Multi-element by ICP and MS,
- Peroxide Fusion Multi-element by ICP.

Analysis of copper, nickel, cobalt, silver, sulfur and 30 other elements was done by the ALS Chemex ME-ICP61 procedure which calls for digestion a 0.5 g pulp by HF-HNO_3-$HClO_4$, HCl leach with an ICP-AES finish. Table 11-1 summarizes the lower and upper detection limits for the elements analyzed by procedure ME-ICP61.

Precious metal analysis calls for a one assay ton (±30 g) aliquot of pulp that was fire assayed using a lead collector with an ICP-AES finish (procedure PGM-ICP23). Table 11-2 summarizes the lower and upper detection limits for the elements analyzed by procedure PGM-ICP23.

Table 11-1: Lower and Upper Detection Limits for 2006-2011 Analyses at Maturi (ALS procedure ME-ICP61, values in ppm unless otherwise indicated)

Analyte	Range	Analyte	Range	Analyte	Range	Analyte	Range
Ag	0.5-100	Cr	1-10,000	Na	0.01%-10%	Ti	0.01%-10%
Al	0.01%-50%	Cu	1-10,000	Ni	1-10,000	Tl	10-10,000
As	5-10,000	Fe	0.01%-50%	P	10-10,000	U	10-10,000
Ba	10-10,000	Ga	10-10,000	Pb	2-10,000	V	1-10,000
Be	0.5-1,000	K	0.01%-10%	S	0.01%-10%	W	10-10,000
Bi	2-10,000	La	10-10,000	Sb	5-10,000	Zn	2-10,000
Ca	0.01%-50%	Mg	0.01%-50%	Sc	1-10,000		
Cd	0.5-1,000	Mn	5-100,000	Sr	1-10,000		
Co	1-10,000	Mo	1-10,000	Th	20-10,000		

Table 11-2: Lower and Upper Detection Limits for 2006-2011 Analyses at Maturi (ALS procedure PGM-ICP23; values in ppm)

Analyte	Range
Pt	0.005-10
Pd	0.001-10
Au	0.001-10

When Cu and Ni exceeded 10,000 ppm (1%) in a sample, the sample was re-assayed using a four acid digestion finished by atomic absorption spectrometry (AA; method AA62). Detection limits are given in Table 11-3.

Table 11-3: Lower and Upper Detection Limits for 2006-2011 Analyses at Maturi (ALS procedure AA62; values in ppm)

Analyte	Range
Cu	0.001-40
Ni	0.001-30

11.2.2 Birch Lake

Sample assaying has been performed at the Ottawa, Ontario; Vancouver, British Columbia; and Sparks, Nevada laboratories of Bondar Clegg & Company (now ALS Chemex), Acme Analytical Laboratories Ltd. of Vancouver and ALS Chemex Labs Inc. in Vancouver. These companies are ISO 9000/9002 accredited mineral laboratories. ALS Chemex, who has performed most of the recent analyses, is certified to standards within ISO 9001:2008 and has received accreditation to ISO/IEC 17025:2005 from the Standards Council of Canada (SCC) for the methods detailed in Section 11.2.2.

Multi-element analyses were performed for core samples in 1999 and onward. Prior to this, only selected elements (Cu, Ni, Pt, Pd, Au, Ag, Cr, ±Co, and ±V) were analyzed.

A 32 element ICP-AES (inductively coupled plasma-atomic emission spectroscopy) geochemical package was used at ALS Chemex for 1998 and 1999 samples. Pt, Pd, and Au were analyzed by lead collector fire assay finished by ICP fluorescence spectroscopy (FAICP-AFS).

Bondar Clegg analyzed 35 elements by HCL:HNO_3 acid digestion and ICP including sulfur for 2000-2001 samples. Elevated copper was also analyzed by atomic absorption spectroscopy (AA). For some 1989 holes, only Au, Pt, Pd, Cu, Ni, and Cr were analyzed; the precious metals by the FA-DCP (direct coupled plasma emission method), Cu and Ni by hot acid extraction-AA; and Cr by X-ray fluorescence (XRF). Table 11-4 summarizes lower detection limits for pre-2006 analyses at Birch Lake.

Table 11-4: Lower Detection Limits for Pre-2006 Analyses at Birch Lake

Element	Detection Limit
Cu	1 ppm
Cu	0.01%
Ni	1 ppm
Pt	5 and 15 ppb
Pd	1 and 2 ppb
Au	1 and 2 ppb
Ag	0.2 and 0.5 ppm
Co	1 ppm

For the 2006-2012 drilling campaigns, core samples were analyzed by ALS Chemex in Vancouver, British Columbia. ICP41 package was used for Cu, Ni, and Co and ICP24 for Pt, Pd, and Au. Table 11-5 summarizes detection limits for method ICP41 and Table 11-6 summarizes detection limits for method ICP24.

Table 11-5: Lower and Upper Detection Limits for ALS Method ICP41 (ppm unless otherwise indicated)

Analyte	Range	Analyte	Range	Analyte	Range	Analyte	Range
Ag	0.2-100	Co	1-10,000	Mn	5-50,000	Sr	1-10,000
Al	0.01%-25%	Cr	1-10,000	Mo	1-10,000	Th	20-10,000
As	2-10,000	Cu	1-10,000	Na	0.01%-10%	Ti	0.01%-10%
B	10-10,000	Fe	0.01%-50%	Ni	1-10,000	Tl	10-10,000
Ba	10-10,000	Ga	10-10,000	P	10-10,000	U	10-10,000
Be	0.5-1,000	Hg	1-10,000	Pb	2-10,000	V	1-10,000
Bi	2-10,000	K	0.01%-10%	S	0.01%-10%	W	10-10,000
Ca	0.01%-25%	La	10-10,000	Sb	2-10,000	Zn	2-10,000
Cd	0.5-1,000	Mg	0.01%-25%	Sc	1-10,000		

Table 11-6: Lower and Upper Detection Limits for ALS Method ICP24

Analyte	Range (ppm)
Pt	0.005-10
Pd	0.001-10
Au	0.001-10

Samples exceeding the 10,000 ppm limit for Cu or Ni were analyzed using the OG46 procedure. Upper and lower detection limits are summarized in Table 11-7.

Table 11-7: Lower and Upper Detection Limits for ALS Method OG46

Analyte	Range	Analyte	Range	Analyte	Range	Analyte	Range
Ag	1-1,500	Co	0.001-20	Mn	0.01-50	Pb	0.001-20
As	0.01-60	Cu	0.001-40	Mo	0.001-10	S	0.01-10
Cd	0.0005-10	Fe	0.01-100	Ni	0.001-10	Zn	0.001-30

For the 2010 drilling campaign, core samples were prepared by ALS Chemex in Thunder Bay, Ontario, with assays at ALS Chemex in Vancouver, British Columbia. ALS Chemex protocols for 2010 included ALS procedure ICP41 for Cu, Ni, and 33 other elements (Table 11-5) and ICP24 for Pd, Pt, and Au (Table 11-6). Overlimit base metals were reanalyzed by OG46 (Table 11-7). Overlimit Pt, Pd, and Au were reanalyzed by ICP27 (Table 11-8).

Table 11-8: Precious Metals Analytical Ranges

Analyte	Range (ppm)
Pt	0.03-100
Pd	0.03-100
Au	0.03-100

Acme Analytical Laboratories (Vancouver) Ltd. protocols for the outside laboratory checks on pulps were:

- Fire assay fusion with lead collector for Au, Pt, and Pd finished by ICP-ES (procedures G606 (30 g sample) or G610 (50 g charge))
- Aqua Regia digestion ICP-ES analysis for Cu, Ni, Co (procedure 7AR).

11.2.3 Spruce Road

With the exception of two Wallbridge holes, data from Spruce Road are all legacy data generated by ACNC. Detailed information about analytical methods is not available. Prior to 1965, INCO's Process Technology Laboratory in Sudbury determined copper and nickel colorimetrically (Routledge and Cox, 2007). By 1966 copper and nickel atomic absorption spectrometry was adopted. The cost of analysis for precious metals and sulfur was significant prior to 1970 and assaying for those analytes was generally done on core composites (Routledge and Cox, 2007).

Samples from the 11500 series and most of the 13600 and 32700 series were analyzed for copper and nickel only. Gold, silver, platinum and palladium were determined by fire assay or spectrographically.

Analyses of Cu, Ni, Co, Pt, Pd, and Au for core samples from Wallbridge's drill hole WM-001 in 1999 and WM-002 in 2001 were performed by Lakefield as part of Wallbridges' metallurgical testing. The procedures are not documented, but Lakefield generally employs pyrosulphate fusion for digestion and X-ray fluorescence (XRF) for Ni, Cu, Co and Fe analysis. Au, Pt and Pd are analyzed by fire assay (lead collector) with ICP finish. Lakefield is an independent, commercial mineral laboratory and has ISO/IEC Guide 25 accreditation (Routledge and Cox, 2007).

11.3 Density Measurements

11.3.1 Maturi

Density data for the Maturi deposit was determined by TMM. Volume was determined by immersing the sample in a graduated cylinder and measuring the volume change. Mass was determined by balance in air. The volume is calculated from the diameter and length. This is a standard technique for determination of density. Table 11-9 summarizes density by mineral type.

Table 11-9: Summary Density Data for Maturi

Mineral Type	Density (g/cm^3)
Mineralized	3.02
Waste	2.89
Footwall	2.73

11.3.2 Birch Lake

The density database for this report consists of 2,762 water immersion density determinations on drill core with an average density of 2.97. Table 11-10 summarizes the data. The method is a standard method.

Table 11-10: Summary Density Data for Birch Lake

Mineral Type	Density (g/cm^3)
Mineralized	3.04
Waste	2.94
Footwall	2.80

11.3.3 Spruce Road

No density data are available for the Spruce Road deposit. A bulk density of 3.02 g/cm^3 was used for volume conversion to resource tonnage for the resource estimate. This bulk density is the same as the estimated average density for the Maturi (3.02 g/cm^3) deposit where density was determined by TMM. Waste bulk density at Spruce Road was assumed to be 3.00 g/cm^3.

11.4 Sample Security

11.4.1 Maturi

Sample security for the legacy samples generated by ACNC is not documented. Most ACNC core was lost in a strike fire in Canada. Remaining core is stored at the DNR core library in Hibbing along with other legacy core.

Sample security for current samples consists of collecting core at the drill twice a day and storing it in a lockable core logging facility prior to sampling. Sampled core is stored in sturdy plastic bags in a locked room until it is shipped to the sample preparation laboratory by contract carrier.

11.4.2 Birch Lake

Samples were shipped to analytical laboratories in Nevada was by courier services including UPS and FEDEX. Pre-2006 samples sent to Bondar Clegg and ALS Chemex in Canada were driven to the U.S. border for direct pick-up by laboratory personnel. The 2006-2010 core samples were placed on pallets in Franconia's secure facility at Babbitt and trucked via commercial freight to ALS Chemex sample preparation facility in Thunder Bay, Ontario.

11.4.3 Spruce Road

Sample security for the legacy samples generated by ACNC is not documented. Most ACNC core was lost in a strike fire in Canada. Remaining core is stored at the DNR core library in Hibbing along with other legacy core.

11.5 Quality Assurance-Quality Control (QA/QC)

11.5.1 2011 Maturi Quality Check Programs

TMM completed five assay evaluation programs in 2011, designed to test for potential issues with sample preparation and assaying. These included:

- Determining whether dust losses during sample preparation could be biasing metal grades,
- Testing whether more aggressive grinding during sample preparation could lead to higher grades of platinum group elements (PGEs),
- Determining whether cuttings lost during core sawing are biasing metal grades,
- Determining the proportion of unrecoverable nickel sequestered in silicate minerals using ammonium citrate peroxide leach assays, and
- Testing whether higher grades for PGEs can be expected using nickel sulfide fusion assays.

A discussion of each program is provided below.

Dust Loss

To measure dust loss during drill core sample preparation at the ALS Chemex sample preparation facility in Thunder Bay, Ontario, a batch of 46 mineralized Maturi samples from drill hole MEX-0247 were weighed before and after crushing to >70% passing 2mm.

Dust losses due to crushing ranged between 0.01 and 0.09 kilograms or 0.2 to 2.6% of the sample mass, with an average loss of 0.04 kilograms or 0.9% of the sample. In AMEC's experience, this amount of loss to sample preparation is consistent with expected losses; dust loss at the ALS Chemex sample preparation facility in Thunder Bay is not excessive. Dust losses are sufficiently low that a bias exceeding five percent is unlikely. Hence no further investigation of dust loss is warranted and the crushing method requires no improvement.

Successive Grinding

To determine whether the grinding protocol was adequate to attain total levels of platinum, palladium, and gold from the fire assay process; TMM selected 30 coarse reject samples for test work on finer grinding. TMM had ALS Chemex prepare three splits for each coarse reject sample, one using the normal TMM protocol of 85%

passing 75 microns, another using a finer grind of 95% passing 75 microns, and another using a further finer grind of 90% passing 53 microns.

The results of the test work showed that platinum and palladium values decreased slightly and gold values increased slightly with finer grinding, but not at statistically significant levels. Patterns were consistent by rock type. In AMEC's opinion, the current grind protocol is sufficient.

Core Saw Cuttings Loss

To test whether the core splitting process is selectively removing base metal-bearing minerals from the core and thus producing a systematic low bias, TMM compared the assays from half-core from an entire mineralized interval from one drill hole to the assays from the core saw sludge resulting from the sampling of the mineralized interval.

A total of 240 ft were processed, including 175 ft of mineralized, 35 ft of barren hanging wall rock, and 30 ft of barren footwall rock. The core saw cuttings filled four, 5-gallon buckets. Grade biases between the core and the cuttings were shown to be less than 5% are not considered significant, and therefore no significant bias was observed due to the cutting of the core. AMEC recommends no changes be made to the core cutting method in present use.

Silicate Nickel

To determine the proportion of unrecoverable nickel sequestered in silicate minerals in Maturi mineralized rocks, TMM assayed selected pulps for nickel using the ammonium citrate peroxide leach (ACPL) method, The ammonium citrate peroxide leach (ACPL) selective assay method for nickel does not dissolve nickel in silicate minerals, and assuming there are no nickel oxides present, it provides an estimate of the nickel present in sulfide minerals, and hence amenable to recovery by the sulfide flotation process.

A set of 96 pulps were submitted to Acme Laboratories (ACME) in Vancouver, B.C. for determination of ACPL nickel (Acme procedure code G810). A set of 10 blind CRMs were included in the submission and returned acceptable results.

Results of the ACPL assays show that recoverable nickel ranges between 68 and 81% and vary by rock type (Table 11-11). AMEC finds the amount of nickel sequestered in silicates to be sufficiently high and variable between BMZ subunits that it should be taken into consideration when evaluating metallurgical test results and possibly in establishing domains. Ni in silicates appears to be proportional to the total olivine content in the rocks.

Table 11-11: Summary of Ammonium Citrate Peroxide Leach Assays by Domain and BMZ Unit

Domain Code	Unit Code	N	Mean Total Ni ppm	Mean ACPL Ni ppm	Recoverable Ni pct
PEG	PEG	24	1589.6	1126.7	71
BMZ		72	1686.1	1237.8	73
	U3	23	1741.4	1180.4	68
	BH	24	1824.2	1318.3	72
	BAN	25	1502.8	1213.2	81

Nickel Sulfide Collector Fire Assays

In AMEC's experience, nickel sulfide fusion (NiS fire assay) typically gives results five to ten percent higher on average for platinum and palladium compared to traditional lead collector fire assay. Because the NiS fire assay is costly, projects typically do not use it in a production setting.

To test whether higher grades for platinum and palladium can be expected using nickel sulfide fusion assays, TMM selected 100 Maturi pulps from those intervals returning combined platinum and palladium assay values greater than 0.15 ppm and sent them to SGS in Lakefield, Ontario for NiS fire assay, with an ICP-MS finish. A set of 10 blind CRMs were included within the sample submission to monitor assay quality.

An evaluation of the CRMs inserted with the samples show that the platinum and palladium assays are mostly biased low compared to the recommended values, with an average bias of 12% low for platinum and 16% low for palladium.

When evaluating the results by BMZ unit, the NiS assays show significantly more platinum for BH and PEG, and significantly more palladium for BH. Allowing for the probable low bias in the SGS results shown by the inserted CRMs, these results indicate that more platinum and palladium may be recovered from the BH unit than indicated in the resource estimate, and more platinum may be recovered from the PEG unit than indicated in the resource estimate.

11.5.2 Assay QA/QC

Birch Lake

The drilling campaigns at Birch Lake can be logically divided into three major phases: pre-Franconia (Duval and Lehmann), early Franconia (1989 to 2005), and recent Franconia (2006 to 2010). A discussion of the QA/QC programs of each phase is provided below.

Legacy (pre-Franconia) Drilling

Legacy campaigns at Birch Lake are not known to have included assay QA/QC programs and no QA/QC data are available to TMM for any of these drill holes. Legacy drill holes consist of six Duval drill holes and one Lehman Exploration drill hole and account for 3.0% of the drill holes and 3.4% of the drill footage at Birch Lake.

Early Franconia Drilling (1989 to 2005)

Control samples (standards, blanks, and duplicates) were not inserted into the project sample batches for any of the early Franconia drilling campaigns. However, in 2001, Franconia carried out a check assay program on drill holes completed from 1989 to 2000 to confirm mineralized intercepts. Original mineralized assay intervals were selected and composited into lengths ranging from 9 to 14 feet to approximate minimum mining widths. Composite samples were compiled from rejects retrieved at the Minnesota Department of Natural Resources (DNR) core facility in Hibbing, Minnesota or from pulps from the Franconia core storage facility in Babbitt, Minnesota. Insufficient checks were performed for campaigns 1990, 1995, 2001, and 2005 to make conclusions regarding the assay accuracy of the original results.

A total of 692 individual samples were combined into 102 composite samples for check assay. Samples were assayed at Bondar Clegg in Vancouver, Canada for Cu and Ni by aqua regia acid digestion and ICP finish and Pt, Pd, Rh, Ir, Os, Ru, and Au primarily by neutron activation and less frequently by fire assay and AA finish. Splits of the composites were also sent to Genalysis (Maddington, Western Australia), where Cu and Ni were determined by three-acid digestion and AA finish and Pt, Pd, Rh, Ir, Os, Ru, and Au were assayed by NiS fire assay and ICP-MS finish There is no evidence that external quality control samples were inserted in the check assay batches.

In addition, 33 individual samples from drill hole BL00-7 were sent to Genalysis to directly compare with the original Bondar Clegg individual assays.

Composite check assays for copper and nickel, when all campaigns are plotted together, agree reasonably well with the original assays, and no significant bias is evident. Certain campaigns show a bias for either copper or nickel, but the number of check assays for all campaigns except for 2000 is too few to draw any conclusions. The individual check assays show a potentially significant constant low bias in copper and a very significant low bias in nickel.

Composite check assays for platinum and palladium show significant scatter and possible significant low bias in the original platinum assays above 1,000 ppb. Certain campaigns show a bias for either platinum or palladium, but the number of check assays for all campaigns except for 2000 is too few to draw any conclusions. The individual assays support the conclusions from the composite assays, where platinum assays are biased about 16% low, and palladium assays are biased low, but not significantly so.

Composite check assays for gold show some evidence of high bias in the original results for values below 400 ppb, and some evidence of low bias above 400 ppb. The individual gold check assays show that gold is biased high, but marginally so.

Recent Franconia Drilling (2006 to 2010)

Beginning in 2006, Franconia instructed their primary laboratory, ALS Chemex, to generate a second pulp of every 10th sample and periodically send these samples to ACME Laboratories in Vancouver, Canada for check assays. ACME is an independent ISO 9001:2000 registered assay laboratory.

Copper check assays agree with the 2006 to 2010 Birch Lake original assays from ALS Chemex, with between-lab biases acceptably small, between 1 and 6%. Nickel check assays are consistently high, between 4 and 13%, relative to the original ALS nickel assays. The lack of inserted reference materials in the check assay submissions makes it impossible to determine the sources of the observed relative biases.

Platinum and palladium check assays agree with the original assays for years 2006, 2007, and 2010. Platinum and palladium check assays for the 2008 drilling campaign are significantly higher than the original assays, between 15 and 18%, on average. Gold check assays agree with the original assays for years 2007, 2008, and 2010, but are significantly higher for year 2006, 30% on average. It should be noted that there is a high degree of scatter, or imprecision, in some of the platinum, palladium, and gold check assays.

In 2007, Franconia initiated the insertion of blank samples consisting of cement core-shaped intervals in every batch of 20 samples submitted to ALS Chemex. Several very high concentrations are observed in the blank assays for all elements likely indicating sample switches, where the blank and an adjacent sample were switched. Ignoring the likely sample switches, there appears to be carryover of about 50 to 200 ppm copper, 30 to 60 ppm nickel, and 0.005 to 0.010 ppm palladium in the sample preparation process. Platinum and gold consistently report at or below five times the lower detection limit for the assay. These levels of copper, nickel, and palladium are relatively small and carryover contamination at these levels is not likely to significantly bias grades in the resource estimate.

Comments on Birch Lake QA/QC Program

AMEC believes that resource blocks influenced by Birch Lake legacy drill holes should be classified as Inferred Resources. AMEC also believes that the Franconia Birch Lake assay data can be used as is but that resource blocks influenced by these data be given a maximum classification of Inferred Resources.

AMEC recommends that TMM redo the check assay program for Birch Lake in order to determine the accuracy of the assay results for the resource estimate. All check submissions should include a complete suite of blind certified reference materials.

Maturi

Legacy Drilling

Legacy drilling campaigns at Maturi likely did not employ a modern QA/QC protocol and no data are known to exist for the legacy drilling campaigns.

Duluth/TMM Drilling

Duluth and TMM have consistently applied an assay QA/QC protocol consisting of the following control samples inserted into batches of mineralized samples:

- Two CRMs randomly placed
- Two blanks placed typically after strong visual mineralization
- Two ¼ core duplicates selected from average visual mineralization.

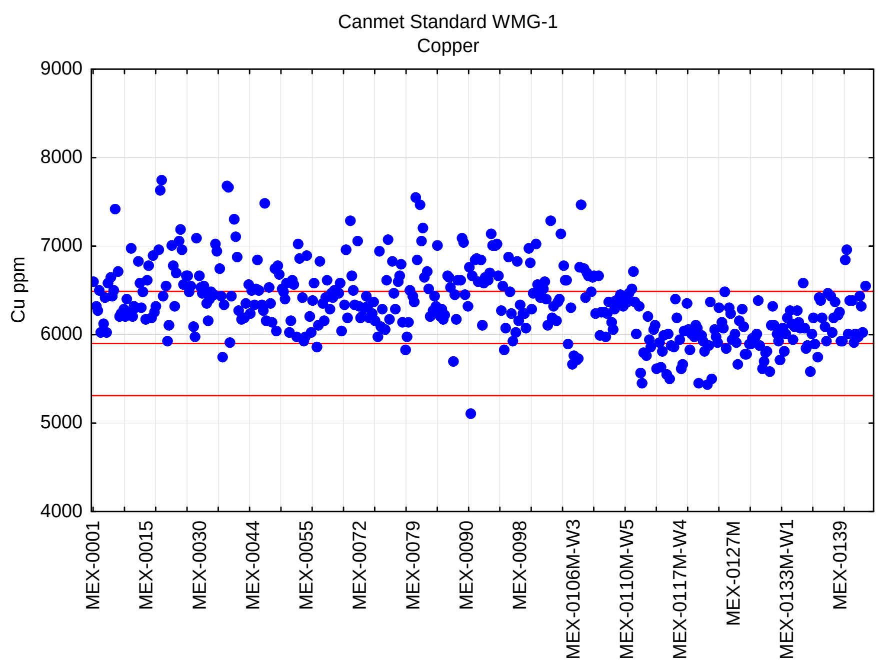
A drill hole submittal typically consists of the BMZ plus 30 ft of hanging wall and 30 ft of footwall, ranges in total length between 150 and 650 ft, and includes 30 to 130 samples. Control sample insertion rates therefore range between 20% (6/30) to 5% (6/130).

A number of CRMs have been used through the project history, including CANMET standard WMG-1 (2006 through March 2008), CANMET standard WPR-1 (March 2008 through May 2011), and more recently AMIS standards 73 and 93, and OREAS standard 13b.

The project's initial monitoring of assay accuracy used a single CANMET standard: WMG-1. This CRM has certified values for 15 elements including gold, platinum, and palladium. The recommended values for copper and nickel are not certified values; they are "provisional" values. Results for an element are classified as provisional if the laboratories participating in the round robin do not agree adequately.

AMEC documented variation in copper results over time from TMM's external CRM WMG-1 assayed by ALS Chemex (Figure 11-1). The middle horizontal red line represents the recommended value for the CRM, and the upper and lower red lines represent acceptable limits of 10% above and below the recommended value.

Figure 11-1: WMG-1 Results for Copper



The copper assays from CRM WMG-1 indicate that the original copper assays for drill holes MEX-0001 to MEX-0112 are biased high 10% relative to the best value and 8% high relative to the average SRM results for drill holes MEX-0113 to MEX-0149. An additional check assay program conducted by Antofagasta Minerals and duplicate assays conducted by TMM, suggest that the bias is real, with the high bias ranging between 4 and 6%.

Based on the evidence, AMEC recommends that copper assays for drill holes MEX-0001 to MEX-0112 be reduced by 6%, the value consistent with the preponderance of evidence.

When the supply of CRM WMG-1 was extinguished, TMM acquired CRM WPR-1 material from CANMET to control assay accuracy. TMM then had SGS package the material into 100 g envelopes, and this CRM was used from March 2008 through early 2011. This CRM has certified values for 11 elements including gold, copper, platinum, and palladium. No significant biases are shown for any of the elements over the period that the WPR-1 was used. Results for platinum and palladium are generally tightly clustered within the acceptable limits. Results for the CRM samples indicate the accuracy of gold for these batches to be good, but the spread of the results indicates poor precision at these low concentration levels.

In early 2011 TMM began using CRM AMIS-0093 to control assay accuracy. This CRM is provided by African Mineral Standards (AMIS) in South Africa, and has certified values for copper, nickel, platinum, and palladium and a more uncertain 'provisional' value for gold. In mid-2011, TMM purchased additional CRMs for use in the assay test programs that are currently being used in TMM routine submittals, AMIS CRM AMIS-0073 and the Ore Research CRM OREAS 13b.

Copper and nickel results for AMIS-0093 indicate that assay accuracy for these elements in the batches tested is acceptable. Platinum and palladium results show no significant bias. Gold results are biased low on average and the high degree of scatter in the results indicates poor precision at these very low grade levels.

An insufficient number of results for AMIS-0073 and OREAS 13b have been received to date to provide meaningful analysis.

Blank samples have been inserted into TMM/Duluth batches consistently throughout the project history. In AMEC's opinion, there is no significant carryover contamination in the sample preparation process at ALS Chemex for copper, nickel, platinum, palladium, and gold.

TMM has consistently employed a program of ¼ duplicates, consisting of two intervals selected in visual mineralization. Results for copper and nickel, show acceptable precision with 90% of the duplicate pairs yielding absolute relative difference (ARD) values of less than 30%. Platinum, palladium, and gold show poor precision, yielding ARD values of 62, 41, and 79% respectively at the 90% population level.

Comments on Maturi QA/QC Program

AMEC recommends that resource blocks influenced by Maturi legacy drill holes be classified as Inferred Resources.

CRM, check assay, and duplicate results indicate that the original copper assays for drill holes MEX-0001 to MEX-0112 are biased high between 4 and 10%.

AMEC recommends that copper assays for drill holes MEX-0001 to MEX-0112 be reduced by 6%, an amount revision consistent with three independent estimates of the bias.

Maturi assay accuracy is acceptable for nickel, platinum, palladium, and gold.

In AMEC's opinion, there is no significant carryover contamination in the sample preparation process at ALS Chemex for copper, nickel, platinum, palladium, and gold.

Duplicate results for copper and nickel show acceptable precision. Platinum, palladium, and gold show poor precision. AMEC recommends that TMM conduct a heterogeneity study to determine whether the sample preparation scheme can practically bring the platinum, palladium, and gold assays into acceptable precision levels.

Maturi Legacy Drilling Campaigns

Legacy drilling campaigns at Maturi likely did not employ a modern QA/QC protocol and no QA/QC data are known to exist for the legacy drilling campaigns. However, one legacy ACNC drill hole was twinned by Lehmann Exploration in 1989, and TMM drilled a series of twin drill holes at Maturi in 2011 to validate the legacy assays.

Spruce Road

No QA/QC data are available for Spruce Road assays.

11.6 Comment

Sample Preparation

Legacy sample preparation by ACNC is not documented, but it is the Qualified Person's opinion that it is reasonable to consider sample preparation procedures as adequate, largely because ACNC's parent company INCO was an industry leader in Cu-Ni mining.

Sample preparation for recent exploration programs by Franconia, Duluth, and TMM has been performed using standard procedures and is believed to be adequate. A test of those procedures is underway to confirm that the procedure is adequate.

Sample Analysis

Analytical procedures used for legacy ACNC samples is not documented, but is believed to be adequate.

Analytical procedures employed by Franconia, Duluth, and TMM are industry-standard procedures and are adequate to support resource estimation.

Density Analysis

Density determinations at Maturi and Birch Lake were performed using standard procedures and are adequate to support resource estimation.

No density determinations have been performed at Spruce Road.

Sample Security

Sample security for legacy samples is not documented. Sample security for modern samples is considered to be adequate.

QA/QC

QA/QC for legacy samples is not documented.

QA/QC for current samples is considered to be adequate to support resource estimation. Some problems were noted by AMEC and have been remedied by TMM. Minor adjustments to the TMM procedures have been implemented.

12.0 DATA VERIFICATION

12.1 Database Compilation and Validation

12.1.1 Introduction

In order to validate the data for Maturi and Birch Lake, AMEC performed an audit of the databases for those two properties (Wakefield, 2011). AMEC's audit consisted of checking the database records against the original documentation for the data that are material to the resource estimation process. This includes the drill collar location information, the down-hole surveys, the core lithological logging data, and the assays.

AMEC also performed a number of database integrity checks which included:

- Checking that all drill holes have collar, assay, survey, and lithology records
- Checking ranges of collar location coordinates
- Checking ranges of assay fields
- Checking ranges of down-hole survey readings
- Check for unusually small or large intervals that have assays
- Check for gaps in sampling/assaying.

12.1.2 Maturi Database Audit

AMEC selected approximately 10% of the TMM, Duluth and legacy drill holes for the purposes of the database audit (Wakefield, 2011). Audit drill holes were selected to be representative spatially (equally spaced throughout the Maturi deposit), and temporally (equally spaced throughout the drilling campaign period).

Results of the Maturi audit are:

- Collar Locations
  - Collar Locations for the MEX series holes drilled by Duluth and TMM are considered adequately accurate. No errors were noted in the database. AMEC located a number of collars in the field with a hand-held GPS unit and found that the coordinates agreed well with those in the database.
  - Legacy collars were surveyed using a variety of coordinate systems. Several legacy collars were located by TMM staff and resurveyed.
- Downhole Surveys

  - Downhole surveys for MEX drill holes were completed using two methods: FlexIT Gyro® and FlexIT Multismart®. AMEC checked the depth, azimuth, and inclination (dip) values for a total of 5,101 downhole surveys against the original paper survey files found in the drill hole folders in the TMM offices in Ely. No errors were found.
  - Downhole surveys for legacy drill holes consist of acid-tube tests that provide only dip information. AMEC checked the depth and inclination values for a total of 97 acid-tube surveys from nine drill holes that had been surveyed down hole. One error was found out of the 194 values checked, for an error rate of 0.5%.
- Lithology Logs
  - Lithology logs from the TMM and Duluth drill campaign have been logged in a consistent manner. AMEC checked the From, To, and RockType values for a total of 706 logged intervals from 16 drill holes. A total of 9 errors were found out of the 2,118 values checked for an error rate of 0.4%.
  - Legacy lithology data in the database is a product of the original drill logs or re-logs conducted by the NRRI. AMEC did not audit original lithology logs, and will instead rely upon the Unit code picks by TMM staff.
- Assays
  - MEX drill core has been consistently submitted to ALS Chemex for assay, and assay methodology has also remained consistent through the years. ALS Chemex provided AMEC with digital copies of original assay certificates for the 16 audit drill holes through secure login to their website. AMEC checked the From, To, Cu, Ni, Pt, Pd, and Au for 1,190 assay intervals from the 16 audit drill holes and found no errors.
  - Assay data for the Maturi legacy drill holes typically consist of hand-written or typed Cu and Ni values entered into the margins of the lithology log for the drill hole. In most cases, the assay method, laboratory, and even units are not known for certain. AMEC checked From, To, Cu, and Ni values for 744 assay intervals from 13 legacy audit drill holes. AMEC also checked From, To, Au, Pt, Pd, Cu, Ni, and S values from 88 assay intervals from four legacy drill holes from the NRRI re-sampling/re-assaying program. AMEC found a total of five errors.

12.1.3 Birch Lake Database Audit

AMEC selected approximately 6% of the Franconia drill holes and 71% of the legacy drill holes for the purposes of the database audit. Collar locations, downhole surveys, lithology logs and assays were checked against the original documentation for all these drill holes. The audit drill holes were selected to be representative spatially (equally spaced throughout the Birch Lake deposit), and temporally (equally spaced throughout the drilling campaign period).

Results of the Birch Lake audit are:

- Collar Locations
  - Collar locations for BL drill holes were surveyed by Livgard Surveying, Inc. of Superior. AMEC checked easting, northing, and elevation values for the 14 audit drill holes and found one discrepancy in the elevation values that is likely due to truncation of the original value. AMEC located a number of collars in the field with a hand-held GPS unit and found that the coordinates agreed well with those in the database.
  - Legacy drill collars at Birch Lake were surveyed by Livgard Surveying, Inc. of Superior, Wisconsin where they could be located in the field. AMEC checked easting, northing, and elevation values for the five legacy audit drill holes and found one small discrepancy in the elevation values of the three drill holes.
- Downhole Surveys
  - Downhole surveys for BL holes were completed using two separate methods: FlexIT Gyro® and FlexIT Multismart®. AMEC checked the depth, azimuth, and inclination (dip) values for a total of 772 downhole surveys against the original paper survey files. Significant issues were found with six of the 14 audit drill holes. AMEC also found significant issues with some pilot and wedge hole surveys. As a result, AMEC picked holes that were the most consistent with the geology and used those surveys. AMEC recommends that all BL holes that can be re-entered be resurveyed. The current data are adequate to support only Inferred Mineral Resources. Indicated Mineral Resources can only be declared after the discrepancies with downhole surveys are resolved.
  - Downhole surveys for legacy drill holes generally consist of acid-tube tests whose results are typed into the margin or at the end of the lithology log. AMEC checked the depth, azimuth, and inclination (dip) values for downhole surveys from the two legacy audit drill holes that have downhole surveys against the surveys recorded on the original drill logs and found them to accurately represent the original records.
- Lithology Logs
  - AMEC checked the From, To, and RockType values for a total of 428 logged intervals from 14 Franconia (BL) drill holes. A total of 6 errors were found out of the 1,284 values checked for an error rate of 0.5%.

  - The lithology codes for the seven material legacy drill holes at Birch Lake were not audited.

- Assays
  - The four drill holes assayed at Bondar Clegg were audited against paper copies of the assay certificates. ALS Chemex provided AMEC with digital copies of original assay certificates for the remaining 10 audit drill holes through secure login to their website. AMEC checked the From, To, Cu, Ni, Pt, Pd, and Au for 412 assay intervals from the four audit drill holes assayed by Bondar Clegg and found nine errors, for an error rate of 0.3%. AMEC then checked the From, To, Cu, Ni, Pt, Pd, and Au for 1,065 assay intervals from the 10 audit drill holes assayed by ALS Chemex and found no errors.
  - AMEC checked the From, To, Cu, Ni, Pt, Pd, and Au for assay intervals from four legacy audit drill holes. Database values matched all original assays, but AMEC found that the Pt, Pd, and Au original assays for two drill holes are not in the database.

12.1.4 Spruce Road Data Checks

The Spruce Road database consists of legacy data with the exception of two holes. The legacy data are from ACNC who explored the area. The assay and lithology data have not been verified by twin holes or other methods. None of the core from that exploration remains. Comparison of a limited number of assay data for ACNC exploration during that time period at Maturi suggests that there are no significant biases at Spruce Road. AMEC believes that the data are adequate to support Inferred Mineral Resources, but additional verification by twin holes is required to support higher confidence classification.

12.2 Comment

AMEC believes that the Birch Lake and Spruce Road databases are adequate to support estimation of Inferred Mineral Resources only. The Maturi database is adequate to support estimation of mineral resources without restriction.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Introduction

A small number of samples have been tested at each of the deposits. The primary objective was to establish general amenability to flotation recovery of base and precious metals and to produce concentrate for testing of final metal recovery by hydrometallurgical (pressure leaching) means and other methods.

13.1.1 Test Samples

Samples for metallurgical testing at Maturi were composite drill core samples from various parts of the deposit. The composite sample is marginally higher grade than the average of the overall deposit, but represents what is likely to be the first several years of production but does not account for local metallurgical variability.

Samples for metallurgical testing at Birch Lake were also composite drill core. This sample is considered to be representative of the overall deposit, but may not account for local metallurgical variability.

Spruce Road metallurgical testing was based on a bulk sample taken from a small open pit on the deposit. That sample is not likely representative of the overall deposit, but represented the first few years of production based on the plans at the time.

13.1.2 Metallurgical Domains

A number of mineralogical domains have been identified at Maturi. Those domains are based on mineralogy, grade, and metal ratios. The QPs believe that the metallurgical response may vary from domain to domain. Mineralization within those domains should be tested to determine if there is indeed significant variability in metallurgical response.

No domains have been identified at Birch Lake or Spruce Road as of the effective date of this report; however, different styles of mineralization have been identified at Birch Lake. Those styles include; disseminated, semi-massive sulfide, and massive sulfide mineralization as well as mineralization associated with Fe/Ti oxides. At the present time, metallurgical response of those material types is unknown. The QPs believe that the metallurgical response may vary by material type and that those material types should be tested.

13.1.3 Deleterious Elements

Preliminary metallurgical testing has not identified any significant deleterious elements reporting to the concentrates. Routine assays include typical deleterious elements such as As, Bi, and Sb. Those elements are present in small quantities in all of the deposits. Additional testwork is required to determine if they will pose significant problems or not.

13.2 Flotation

Various flotation testwork campaigns have been conducted on Maturi, Birch Lake, and Spruce Road mineralization or core samples.

13.2.1 Maturi

Bench scale flotation test work on a composite sample of drill core from the Maturi Deposit was undertaken at SGS Lakefield for Duluth (Cox et al, 2009). The composite graded 0.75% Cu, 0.24% Ni, 0.19 g/t Pt, 0.43 g/t Pd and 0.12 g/t Au. The key findings of the SGS Lakefield test work are summarized below (Cox et al, 2009):

- Ni recovery to concentrate is limited by the amount of silicate-hosted Ni, which appears to be about 25% of total nickel in the sample
- The production of various concentrates was investigated, including a low grade bulk concentrate (6.3% Cu, 4.5% Ni) and a reasonably high grade Cu concentrate (28% Cu, 1.0% Ni). Flotation recoveries were 95% for copper in the copper concentrate and the bulk concentrate and 61% for nickel in the bulk concentrate. Flotation recoveries of precious metals were as follows: Pd (87%); Pt (86%), and Au (73%). Overall recoveries, including pressure leaching, were about: Cu (95%); Ni (60%); Pd (85%); Pt (84%); Au (61%).

13.2.2 Birch Lake

Bench scale flotation testwork on a composite sample of drill core from the Birch Lake deposit was undertaken at SGS Lakefield Research (Lakefield) in 2005. Additional flotation testwork was initiated in late 2006 and crushing and milling work index and grindability testing was done in late 2008.

Flotation recoveries were as follows: Cu (97%); Ni (68%); Pd (91%); Pt (91%); Au (90%). Overall recoveries, including pressure leaching, were about: Cu (93%); Ni (66%); Pd (78%); Pt (82%); Au (40%).

13.2.3 Spruce Road

In 1973 a 10,000 ton bulk sample from surface pits at Spruce Road was processed at INCO's Creighton mill in Sudbury, Ontario. INCO performed extensive testwork that defined and demonstrated a workable flotation process that gave an average recovery of 89% for copper and 63% for nickel for a bulk flotation concentrate grade of 13.4% Cu and 2.8% Ni.

In 2000, Wallbridge submitted 90 core samples metallurgical test work in 2000. A single composite was prepared from the samples and a series of scoping froth flotation tests. Results indicated that a bulk concentrate with a combined Cu+Ni grade of 15% can be produced at recoveries of 90% for copper and 66% for nickel.

13.3 Pressure Leaching

Onsite processing of a bulk concentrate has significant advantages in terms of total value recovery from the deposit. Several technologies have been considered to process the bulk Cu/Ni concentrate produced from Maturi, Birch Lake, and other deposits.

13.4 Platsol™ Technology

Platsol™ utilizes high temperature (230 – 240^{o} C) and elevated chloride in leach solution (10 – 20 g/L). The Platsol™ process (IPGM) results in high copper, nickel, cobalt, and PM recoveries through total oxidation of the concentrate. Base and precious metals are leached from the concentrate and report to the leach solution. PMs are recovered from solution by precipitation; copper is recovered from solution via standard SX/EW methods; nickel and cobalt are recovered to an intermediate, high grade product, which can then undergo further refining to produce refined metal products. By the end of 2011, almost 70 individual bench Platsol™ tests had been completed on several different flotation concentrates, with results indicating that TMM concentrates are amenable to Platsol™ technology extraction and recovery: typical extraction values are 99% for Cu, 99% for Ni, 90% for Pt, 90% for Pd, and 85% for Au.

13.4.1 CESL™ Technology

CESL™ technology medium temperature (150^{o} C) and elevated chloride in leach solution (12 g/L). The CESL™ process (proprietary to Teck Resources) results in high copper, nickel, cobalt, and PM recoveries through selective, partial oxidation of the concentrate. Base metals are leached from the concentrate and report to the leach solution, with copper recovery by standard SX/EW methods and nickel and cobalt reporting to an intermediate, high grade product that undergoes additional refining to produce refined metal products. PMs remain in the leach residue, and are recovered through a combination of gravity concentration and flotation. By the end of 2011, almost 30 individual bench CESL™ tests had been completed on several different flotation concentrates, with results indicating that TMM concentrates are amenable to CESL™ technology extraction and recovery: typical extraction values are 98% for Cu, 97% for Ni, and 70% for Pt, Pd, and Au.

The choice of processing technology for the Twin Metals Project will depend on a combination of metal recovery, capital cost, and operating cost. A study is currently underway to compare revenue, capital and operating costs for both the Platsol™ and CESL™ technology options.

13.5 Comments

Metallurgical testwork is very preliminary at this time, but has demonstrated that copper, nickel, and precious metals can be concentrated using conventional technology. Final recovery of metals is by pressure oxidation and leaching which is a reasonably new technology that has not been widely used, but has been shown to be effective for some deposits.

A number of mineralogical domains and/or material types have been identified at Maturi and Birch Lake. The Qualified Persons believe that those domains/material types may exhibit variability in metallurgical response that should be tested. AMEC recommends that flotation tests be performed to determine the magnitude of the variability in metallurgical response.

14.0 MINERAL RESOURCE ESTIMATES

14.1 Overview

Mineral resources have been estimated for Maturi, Birch Lake and Spruce Road. New estimates are summarized for Maturi and Birch Lake and a previous estimate for Spruce Road has been re-tabulated using more current concepts. Mineral Resources have an effective date of 23 April 2012, and the Qualified Person for the estimates is Dr Harry Parker, RM SME.This section is a summary of AMEC (2012) which provides details of the resource estimates reported here.

14.2 Maturi

14.2.1 Introduction

This report summarizes the 2011 resource model of the Maturi deposit completed in October 2011 and finalized in April 2012. The resource model was completed by Douglas Reid, AMEC Senior Geological Engineer. Todd Wakefield, Principal Geologist, and Ananta Yemmenani, Mining Engineer, completed audits of the Maturi drill hole database.

The Maturi 2011 geological model was constructed using 336 drill holes (990,293 ft) that were drilled between 1960s and 2011. A database review for the 2011 update was completed in July 2011, and additional verification of the data was completed in September 2011.

The 2011 resource model was completed using Vulcan® Software. The estimation was completed using the Vulcan Unfolding (Tetra-Projection) methodology and Ordinary Kriging (OK). Model validation consisted of Box Plots and Swath plots. Nearest neighbor and ID2 models were also constructed for validation purposes.

14.2.2 Maturi Database

TMM project is an active project, with drilling ongoing at the time of the resource estimate. The cut-off date for the database was September 16, 2011, and TMM provided AMEC an Access database "*MasterDB_sept16.mdb*". The database contained drill holes for a number of projects controlled by TMM. AMEC used selected legacy drill holes and selected holes drilled by TMM from MEX-0001 to MEX-0269. There were some MEX holes in this series which had pending assay results.

Many of the TMM holes had multiple wedges drilled from the main or pilot hole. In most cases these wedges were drilled because the main drill hole had to be abandoned. Subsequent wedges were drilled until the BMZ unit (Basal Mineralized Zone) was completely intersected and the hole extended well into the underlying GRB unit (Giants Range Batholith). Due to declustering difficulties and potential grade estimation issues, only one hole from each of the pilot and wedge drill holes was used to build the geological model and subsequent grade estimation. AMEC reviewed the drill hole database and selected the drill hole which completely penetrated the BMZ and extended deepest into the GRB.

A total of 336 holes were used for constructing the geological model and performing the grade estimation, 70 legacy holes and 266 TMM holes. A summary of drill holes used in the model and footage by company is presented in Table 14-1.

Table 14-1: Maturi Drill Campaigns (Drill Holes used in Model)

Year	Company	Type	Number of Holes	Footage Drilled
1960s	INCO	Core	45	51,713
1960s	Hanna	Core	3	7,357
1960s	Duvall	Core	11	32,755
1960s	Bear Creek	Core	7	7,958
1960s	Newmont	Core	4	19,465
2006	TMM	Core	11	34,070
2007	TMM	Core	73	223,756
2008	TMM	Core	67	208,742
2009	TMM	Core	2	6,836
2010	TMM	Core	52	206,052
2011	TMM	Core	61	191,590
Total			**336**	**990,293**

Drilling

Collar Surveys

Collar locations for the MEX drill holes were surveyed by Northern Lights Surveying & Mapping Inc. of Ely, Minnesota at various times throughout the TMM/Duluth drilling campaign. Though coordinates were originally surveyed in metric units using the UTM NAD83 datum, these coordinates were converted to imperial units by Northern Lights using the State Plane datum upon request by TMM and reissued in Excel and PDF format for loading to separate columns in the database that was used for resource estimation.

Legacy drill collars were surveyed in a variety of coordinate systems, and are typically recorded in the header of the lithology log for the drill hole. Several legacy collar locations were located in the field by TMM staff and surveyed in State Plane coordinates by Northern Lights Surveying & Mapping. The remaining legacy collar coordinates were taken from the NRRI database and converted to State Plane coordinates by TMM staff. The accuracy of these collar coordinates is unknown.

AMEC located 16 TMM drill holes, 9 legacy drill holes and the Maturi shaft location during the site visits in July and September using a Garmin eTrex handheld GPS unit as WGS84 coordinates. AMEC converted these coordinated to Minnesota State Plane coordinates using MCON V3.1.1 (Minnesota Department of Transport). The results of AMEC's checks are shown in Table 14-2. In general, AMEC's field checks verified TMM's database coordinates (within stated accuracy of the GPS unit). AMEC did adjust the location of drill hole K-08 to reflect the location determined in the field. AMEC recommends TMM find and survey the collar locations of the legacy drill holes that can be confidently located.

Downhole Surveys

Downhole surveys for MEX drill holes were completed using two separate methods: FlexIT Gyro™ and FlexIT Multismart™. The FlexIT Gyro™ tool is the preferred method for down-hole survey data as the tool is not influenced by magnetic rocks, which do occur at Maturi. Where FlexIT Gyro™ data were available, these data were loaded into the database. Some of the early MEX drill holes were not surveyed with the FlexIT Gyro™ tool, because when TMM staff realized that the FlexIT Multismart™ tool produced erroneous readings in the presence of magnetic rocks, these collar locations were no longer accessible and so could not be resurveyed using the FlexIT Gyro™ tool. Downhole survey readings were collected every 20 ft down-hole for both FlexIT Gyro™ and FlexIT Multismart™ surveys.

AMEC found several holes in the database were missing downhole surveys data for a number of reasons. In most cases AMEC incorporated the downhole survey results of one of the wedges. In one case (MEX-0071), there were no wedges drilled; AMEC applied the average deviation of all holes drilled at a 90° inclination.

AMEC had found an issue with downhole surveys at Birch Lake. Therefore AMEC compared the Multismart™ downhole survey results to the Gyro™ survey results for the inclined MEX holes drilled at Maturi. AMEC found no differences in bearing or dip measurements between the two instruments.

Table 14-2: AMEC Collar Checks

		GPS - WGS 84		MSCON Conversion		Database		Difference	
PT	HoleID	UTM_E	UTM_N	MNSP X	MNSP Y	EMNSP83NFT	NMNSP83NFT	Easting	Northing
68	11533	593706.3	5295380.4	2956753.1	806956.8	2956782.7	806981.3	29.55	24.47
71	DU-02	593150.9	5294182.1	2954935.7	803022.1	2954945.6	803043.3	9.85	21.15
61	DU-03	595835.5	5295715.2	2963738.4	808064.4	2963735.1	808053.5	-3.29	-10.90
60	DU-04	596763.8	5296064.6	2966783.3	809214.8	2966826.2	809229.5	42.87	14.63
74	DU-13	593414.0	5293436.7	2955802.3	800577.3	2955796.2	800519.2	-6.09	-58.12
69	DU-18	593930.5	5295124.2	2957489.9	806116.8	2957506.1	806111.3	16.16	-5.51
54	DU-19	593932.7	5295120.3	2957497.1	806104.1	2957506.1	806111.3	8.96	7.28
75	K-08	593020.6	5293530.9	2954510.8	800884.8	2954657.6	800653.5	146.81	-231.32
55	MATURI-SHAFT	593359.2	5295245.1	2955614.7	806511.3	2955636.5	806544.9	21.84	33.58
62	MEX-0014	595925.2	5296068.4	2964031.6	809223.9	2964017.5	809251.5	-14.02	27.51
65	MEX-0023	594740.6	5296111.0	2960144.2	809358.6	2960178.3	809376.0	34.17	17.40
57	MEX-0027	593965.4	5295334.1	2957603.7	806806.0	2957619.5	806788.8	15.81	-17.21
77	MEX-0036	594401.5	5295410.0	2959034.1	807056.8	2959026.0	807017.1	-8.15	-39.68
53	MEX-0041	593794.0	5294903.9	2957042.9	805393.5	2957056.7	805392.2	13.75	-1.30
58	MEX-0062	597205.3	5295597.4	2968234.2	807683.6	2968240.1	807684.6	5.94	1.02
56	MEX-0075M	594003.4	5295213.8	2957728.7	806411.2	2957745.1	806412.9	16.40	1.76
66	MEX-0119	595391.4	5295687.6	2962281.2	807972.1	2962322.9	807997.1	41.62	24.99
59	MEX-0120	596893.7	5295900.8	2967210.3	808678.0	2967226.1	808669.2	15.73	-8.82
72	MEX-0121	594317.4	5295482.4	2958757.9	807294.1	2958765.4	807320.8	7.57	26.76
76	MEX-0137M	594401.3	5295582.4	2959033.0	807622.6	2959038.4	807611.9	5.36	-10.66
64	MEX-0150	594782.7	5295908.3	2960283.2	808693.6	2960281.4	808724.3	-1.75	30.65
73	MEX-0193	596292.8	5294805.7	2965243.0	805081.9	2965248.2	805075.1	5.15	-6.84
63	MEX-0221	595022.6	5295788.6	2961070.7	808301.9	2961096.6	808284.1	25.92	-17.80
67	MEX-0249	593810.2	5295344.6	2957094.3	806839.8	2957121.4	806836.8	27.03	-2.97
70	MEX-0269	593804.4	5294901.8	2957077.0	805386.7	2957097.3	805398.2	20.30	11.56

Downhole surveys for legacy drill holes generally consist of acid-tube tests (a common survey method before downhole cameras became available) typed into the margin or at the end of the lithology log. Acid-tube tests only provide inclination values, are prone to erroneous values, and lack the precision of modern methods.

Assays

MEX drill core has been consistently submitted to ALS Chemex for assay, and assay methodology has also remained consistent through the years. TMM received assay results for Cu, Ni, Pt, Pd and Au.

Legacy core had been assayed at a number of unknown assay labs for Cu and Ni. In the early 2000s, NRRI resampled select legacy drill core intervals (often quartered AW

27 mm diameter core) and assayed samples at Swastika Laboratories Ltd. in Swastika, Ontario for Cu, Ni, Co, Pt, Pd, and Au.

Assay data was reviewed by AMEC during the database audit and are reported in a separate report (Wakefield, 2011). AMEC found no errors in the assay database.

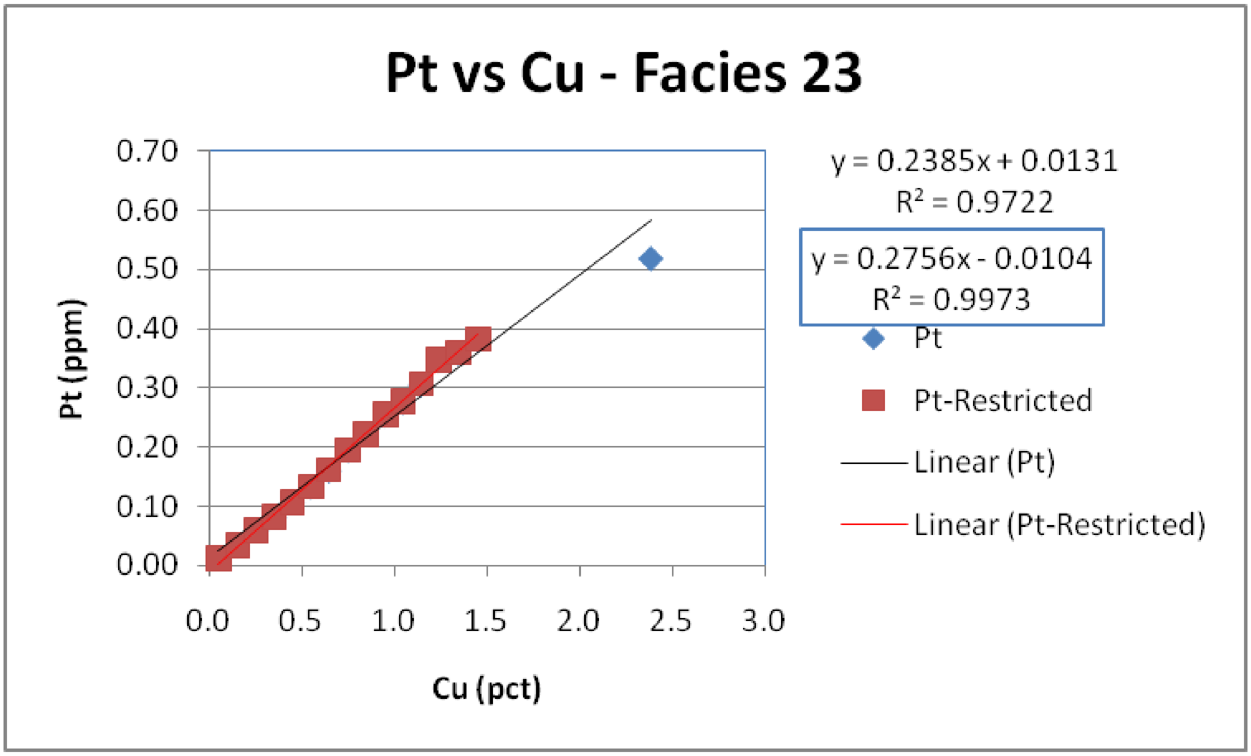
The QA/QC data indicated ALS Chemex results for copper were biased high by 6% for holes MEX-0001 through MEX-0112. To account for this bias TMM and AMEC agreed to reduce the copper grade for these holes by 6%. (Wakefield, 2011)

PGE and Minor Element Regression

Legacy drill holes were only assayed for copper and nickel. NRRI only submitted selected intervals of the legacy drill holes for PGE analysis. To aid in grade estimation in areas populated by the legacy drilling, AMEC developed regression formulas for Pt, Pd, Au, Co, Ag, S, and MgO using either copper or nickel grades, depending on which pairing had the highest correlation.

To help smooth the data, AMEC grouped the data pairs into bins. Regression formulae for individual domains were developed for each metal. An example plot is shown in Figure 14-1. The formulas were applied, and the resulting regressed values were added to the assay database in Vulcan®.

Figure 14-1: Maturi Grade Regression – Domain 23 – Pt versus Cu



Lithology

Lithology from the TMM drill campaign has been logged in a consistent manner. The primary control on mineralization is lithology (RockType code), and alteration and structure are less important. In addition to the hand-written lithology logs, TMM has compiled a set of unit codes for each drill hole at Maturi. These unit codes, which are based on the lithology codes, will be the basis for the lithology model that will be used to control grade estimation. The unit codes are:

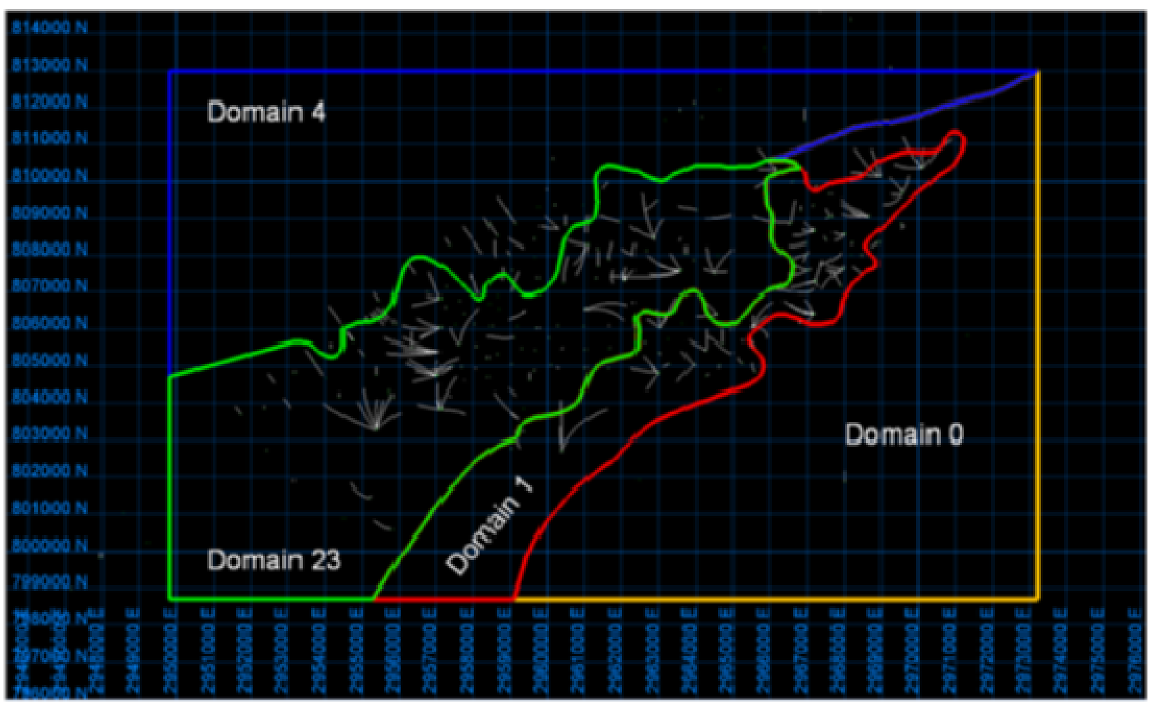
- Hanging Wall: A series of upper sulfide-free troctolite with anorthosite layers and lower sulfide-enriched troctolite, picrite, dunite, anorthosite, oxide cumulates and hornfels.
- PEG: A coarse pegmatitic unit comprising all of the lithologies in the BMZ, but dominated by anorthositic troctolite. PEG occurs at the top of the BMZ in most of the holes drilled at Maturi and is used as a marker horizon for that reason. Thickness of PEG is extremely variable, but averages about 60 ft (20 m) thick with a maximum thickness of 216 ft (65 m).

- BMZ: The Basal Mineralized Zone is a heterogeneous mixture of troctolite, augite troctolite, melatroctolite/picrite, olivine gabbro, anorthositic gabbro, norite, and gabbronorite. The BMZ is as thick as 865 ft (260 m) and averages 215 ft (65 m) thick. Mafic intrusive rocks (troctolite and anorthosite) dominate with minor ultramafic rocks (melatroctolite, picrite).
- GRB: A thick unit comprised of the Giants Range Batholith. The upper contact of the GRB with the BMZ may be mineralized. For this reason grade estimation is conducted in the upper 30 feet of the GRB unit (GRB Skin).

Domains

Within the Maturi Deposit, TMM has defined several broad domains of the Basal Mineralized Zone (BMZ) have been differentiated (Boerst, 2011). Original ideas delineated five different domains; 0, 1, 2, 3 and 4. The model has been further simplified into four domains by merging domains 2 and 3 into a single domain, domain 23 with the receipt of new data. The boundaries of these domains tend to be somewhat irregular, but overall tend to be strike-oriented (SW-NE). Each of the four domains exhibits properties, both lithologically and geochemically, that are distinctive of that domain. Figure 14-2 shows the domains boundaries.

Figure 14-2: Geological Domains



Domain 0

Domain 0 is largely unknown. Only a few drill holes exist for this zone located mainly down-dip, southeast of Domain 1. The few holes for which data is known for this area are typified by extremely low-grade mineralization with a leucocratic, very homogenous BMZ.

Domain 1

Domain 1 is a high-grade, sinuous, more or less strike-oriented zone within the deposit, mainly at significant depths >3,500 ft. Lithologically, the BMZ is very homogenous compared to the rest of the deposit tending to be generally more leucocratic, with a higher and more consistent Ca/Mg ratio. Besides being higher grade, the Cu/Pd ratio is noticeably lower as well. Thicknesses can be extremely erratic but generally much thinner than Domain 4.

Domain 23

Domain 23 is the combination of Domains 2 and 3 which lie between Domains 1 and 4, and possesses some attributes of each. Overall, it tends to be more consistent than Domain 1.

Grades tend to be modest, but with distinct areas of lower and higher grades. The highest grades within this domain tend to be concentrated mainly at the interface with Domain 4 along its north-western flank and axially in the lateral center of the zone from MEX-0056 westward through the Maturi Deposit. Overall, this domain contains more Ni than the other domains increasing towards the west into the Maturi Deposit. Contrarily, the eastern half of this domain contains slightly more PGE's than does the western half.

Domain 4

Among the four defined domains, Domain 4 is the most easily delineated. This zone occurs in the north-central area of the Maturi Deposit and can be traced along strike to the northeast. It is interpreted to have originated from a separate pulse of magma from the remainder of the Maturi Deposits and is similar to the Spruce Road Deposit.

Geology

Geology Model

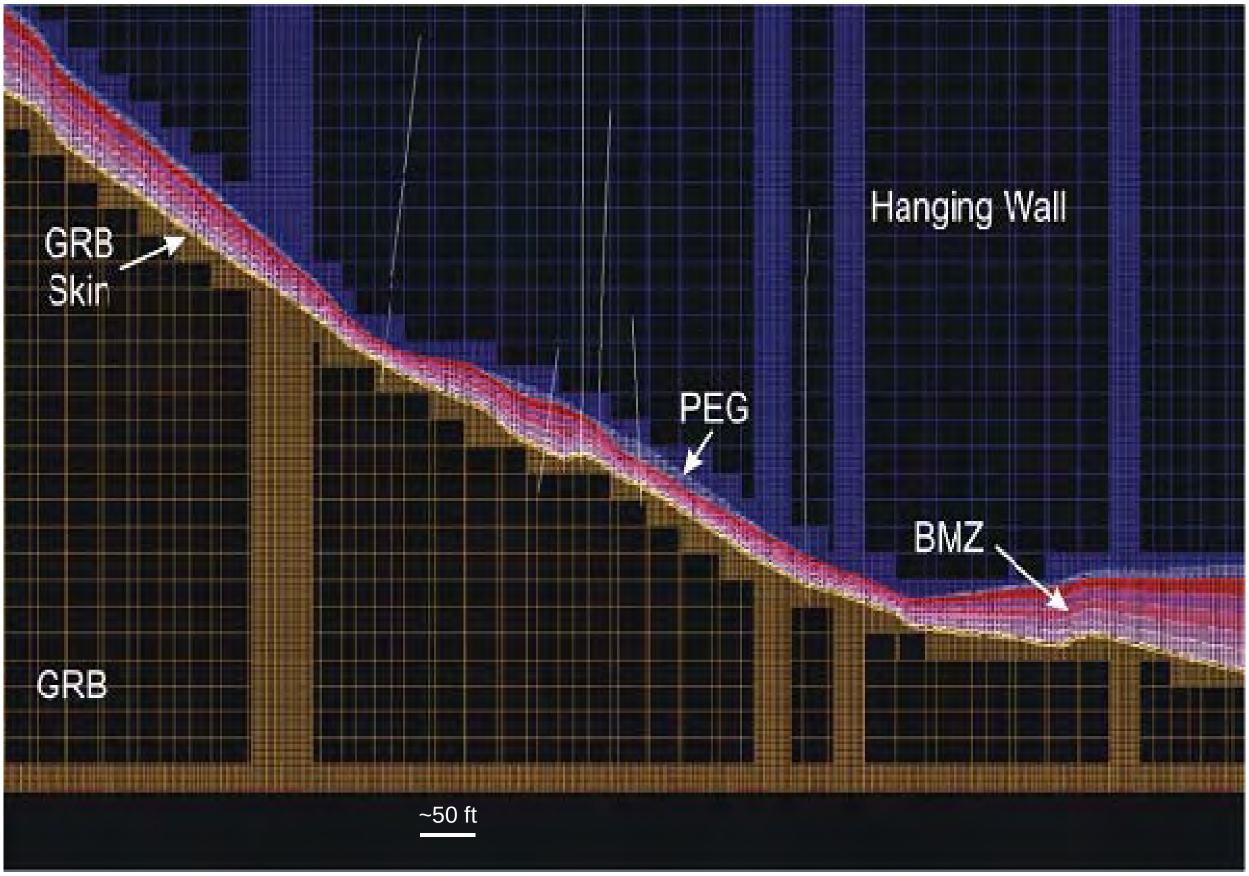
A three-dimensional model of the geological units was constructed using selected TMM drill holes as well as legacy drill holes drilled by various companies in the 1960s. TMM drilled a series of wedge holes to ensure complete penetration through the BMZ unit. These closely spaced wedges posed geological modeling and potential grade estimation complications; thus AMEC selected the one drill hole or wedge that completely intersected the BMZ and extended furthest into the GRB unit.

Using the simplified data set, AMEC constructed gridded surface models with the aid of Vulcan Grid Calc routines. A 50x50 ft cell size was used to create upper surfaces for the PEG, BMZ, and GRB units. Triangulations were constructed, including spot elevations from the drill holes, of the gridded surfaces. The upper surface of the GRB unit was dropped 30 feet vertically to create the lower surface of the GRB Skin. These triangulations were used to control compositing and the construction of the block model.

A typical section showing these modeled units is shown in Figure 14-3. The Unit codes for compositing and blocks are:

HW	100
PEG	200
BMZ	Divided into stratigraphic Layers 301 through 305
GRB Skin	400
GRB	500

Figure 14-3: Typical Modeled Unit Geology



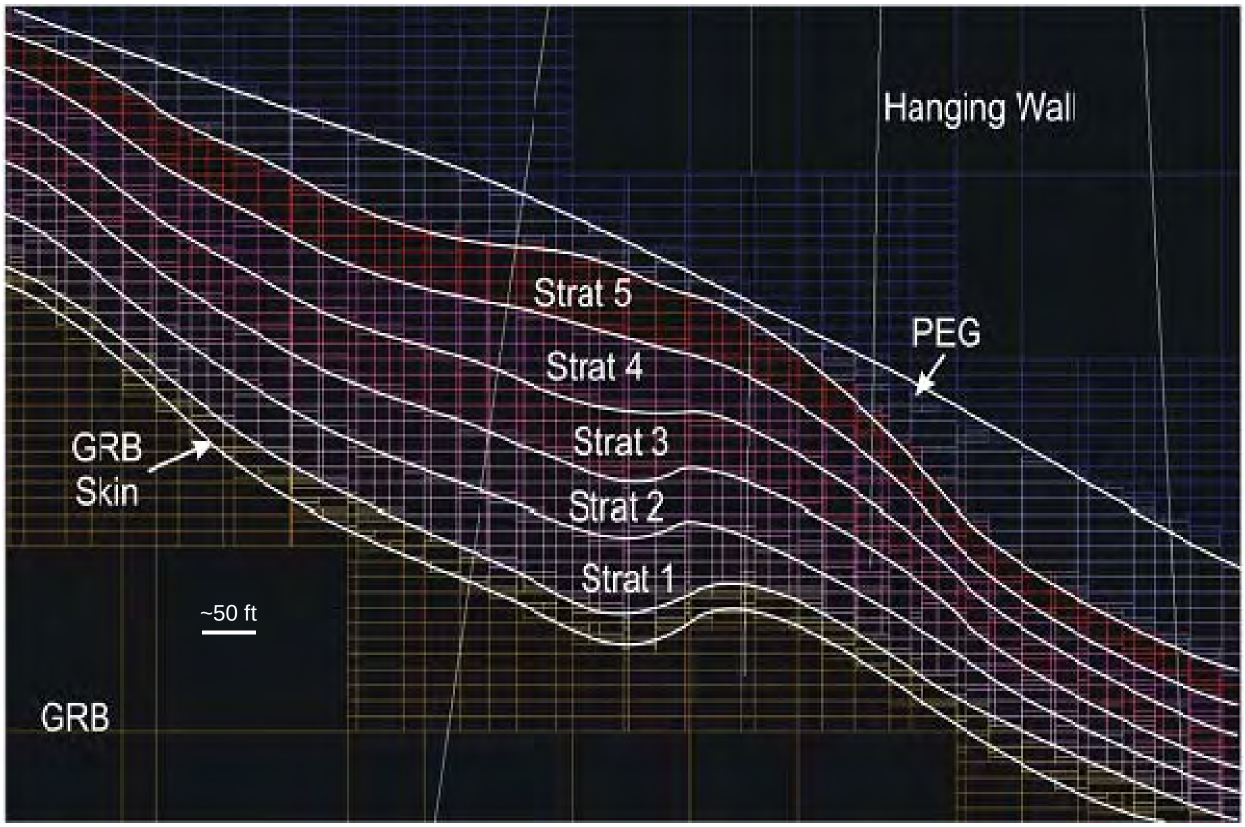
BMZ Stratigraphic Layers

AMEC separated the BMZ into five stratigraphic layers which allows investigation and the decision to treat the upper and lower levels of the BMZ differently. AMEC found a distinct increase in grade for all metals from the base of the BMZ to the top of the BMZ. An example of this is shown in Figure 14-9 and will be discussed in greater detail in the section on EDA. Stratigraphic layer 0 represents the bottom of the BMZ; stratigraphic layer 5 represents the top of the BMZ. Figure 14-4 shows the stratigraphic layers within the BMZ as defined by AMEC.

Composites

AMEC generated 15 foot composites for Cu, Ni, Pt, Pd, Au, Ag, Co, S and MgO. The composites were broken by the geological units: HW, PEG, BMZ, and the GRB. Composites with lengths less than 7.5 feet were merged with adjacent composites within the same geological unit where possible.

Figure 14-4: Typical Modeled Unit Geology showing Stratigraphic Layers and GRB Skin

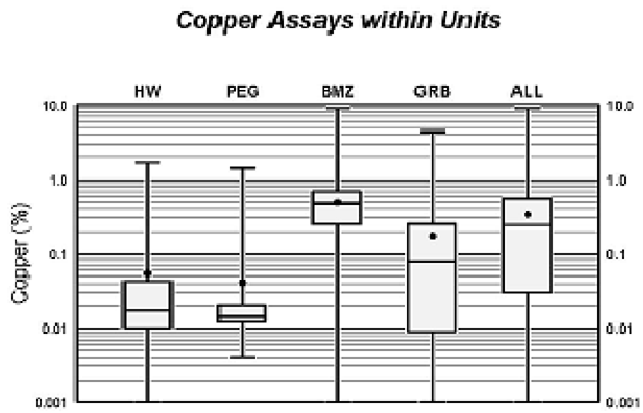


14.2.3 Exploratory Data Analysis

Assays - Box Plots

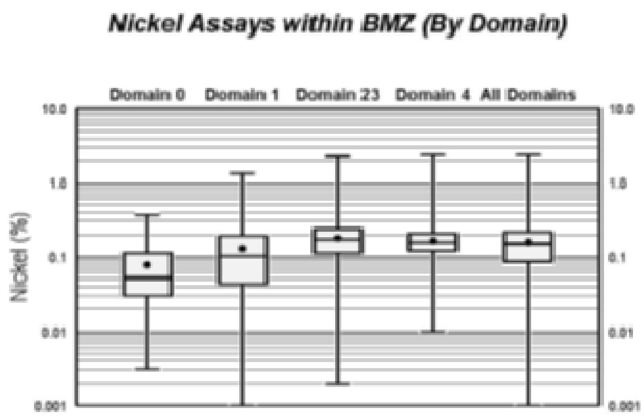
AMEC created boxplots of assay data to examine the behavior of each metal separated by domain and by unit. Assay intervals were tagged with unit geology codes from the drill hole database and domain codes from the geology model. Figure 14-5 shows a boxplot of copper assays by unit geology while, Figure 14-6 shows nickel assays within the BMZ divided by domain.

Figure 14-5: Boxplot Copper Assays by Unit Geology



	HW	PEG	BMZ	GRB	ALL	
Number of data	4336	897	17638	6405	29276	Number of data
Mean	0.054	0.041	0.492	0.175	0.332	Mean
Maximum	1.66	1.395	8.98	4.42	8.98	Maximum
Upper quartile	0.043	0.02	0.694	0.249	0.556	Upper quartile
Median	0.017	0.014	0.474	0.078	0.24	Median
Lower quartile	0.01	0.012	0.244	0.009	0.03	Lower quartile
Minimum	0.001	0.004	0.001	0.001	0.001	Minimum
Variance	0.0104	0.0094	0.108	0.0646	0.1147	Variance
CV	1.877	2.378	0.668	1.455	1.019	CV
Skewness	4.297	5.366	2.481	4.201	2.185	Skewness

Figure 14-6: Boxplot Nickel Assays by Geological Domain (BMZ Only)

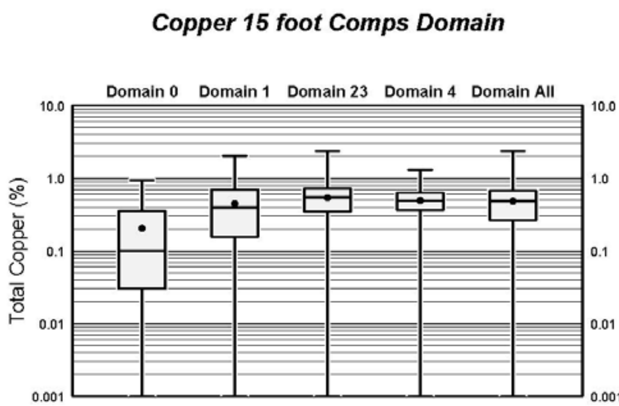


	Domain 0	Domain 1	Domain 23	Domain 4	All Domains	
Number of data	789	4662	8101	3282	16834	Number of data
Mean	0.078	0.13	0.182	0.167	0.16	Mean
Maximum	0.365	1.325	2.27	2.4	2.4	Maximum
Upper quartile	0.113	0.194	0.24	0.208	0.218	Upper quartile
Median	0.052	0.102	0.175	0.16	0.153	Median
Lower quartile	0.03	0.044	0.112	0.12	0.086	Lower quartile
Minimum	0.003	0.001	0.002	0.01	0.001	Minimum
Variance	0.0042	0.0123	0.0103	0.0056	0.0103	Variance
CV	0.828	0.852	0.556	0.447	0.632	CV
Skewness	1.237	2.636	2.219	4.303	2.324	Skewness

Composites - Box Plots

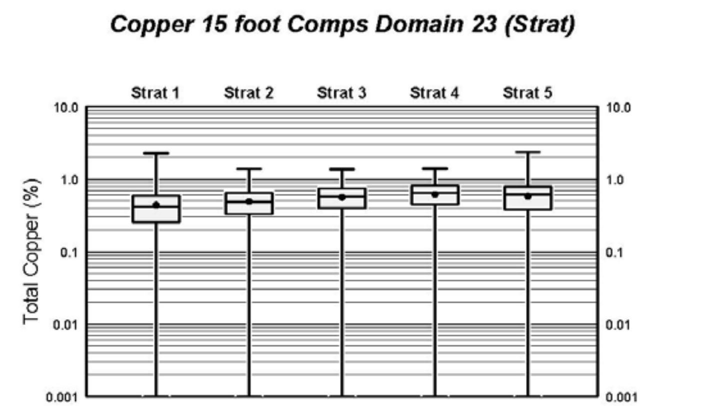
AMEC then applied the same procedure to the 15 foot composites database. These were used to determine possible grouping of domains and stratigraphic layers for each metal. Proposed groupings were then refined using contact plots. Figure 14-7 shows BMZ copper composites separated by domain. An example for copper composites separated by the stratigraphic layers within Domain 23 is shown in Figure 14-8.

Figure 14-7: Boxplot Copper Composites by Geological Domain (BMZ Only)



	Domain 0	Domain 1	Domain 23	Domain 4	Domain All	
Number of data	244	1305	2059	995	4603	Number of data
Mean	0.205	0.447	0.538	0.494	0.484	Mean
Maximum	0.931	2.024	2.327	1.303	2.327	Maximum
Upper quartile	0.353	0.697	0.72	0.63	0.679	Upper quartile
Median	0.1	0.394	0.545	0.493	0.485	Median
Lower quartile	0.03	0.156	0.35	0.366	0.264	Lower quartile
Minimum	0.001	0.001	0.001	0.001	0.001	Minimum
Variance	0.0494	0.1087	0.0751	0.0455	0.0828	Variance
CV	1.084	0.738	0.51	0.432	0.594	CV
Skewness	1.105	0.659	0.397	0.074	0.419	Skewness

Figure 14-8: Boxplot Copper Composites – Stratigraphic Layers in Domain 23



	Strat 1	Strat 2	Strat 3	Strat 4	Strat 5
Number of data	412	412	412	412	411
Mean	0.438	0.49	0.562	0.617	0.582
Maximum	2.269	1.38	1.368	1.401	2.327
Upper quartile	0.591	0.648	0.737	0.81	0.786
Median	0.421	0.485	0.573	0.65	0.611
Lower quartile	0.254	0.333	0.396	0.45	0.383
Minimum	0.001	0.001	0.001	0.001	0.001
Variance	0.0768	0.058	0.0593	0.0775	0.083
CV	0.632	0.491	0.434	0.451	0.495
Skewness	1.63	0.345	-0.058	-0.284	0.269

Contact Profiles

A Contact Profile is a very useful tool to analyze the behavior of metal mineralization as a contact is crossed. It helps determine if the mineralization ends sharply at the contact or is there an area of diffuse mineralization on the other side of the contact. Initially contact profiles were completed using 15 ft composites coded by geologic domain. These profiles were then refined by incorporating stratigraphic position with the BMZ. Stratigraphic layers 1 and 2 were combined to represent the lower stratigraphic layer and layers 3, 4 and 5 were combined to represent the upper stratigraphic layer. Figures 14-9, 14-10 and 14-11 illustrate the nature of the contact between Domain 0 and Domain 1. Figures 14-10 and 14-11 show the contact plot analysis between the same domains refined by incorporating the stratigraphic groups. Figures 14-12, 14-13 and 14-14 show the contact profiles for copper between Domain 1 and Domain 23. Figures 14-13 and 14-14 show the contact plot analysis between the same domains refined by incorporating the stratigraphic groups. Figure 11-13 indicates a hard contact should be applied between domains for the upper level rather than a soft contact as originally indicated when stratigraphy was not considered. A table summarizing the nature of the contacts between the domains is shown in Table 14-3.

Figure 14-9: Contact Plots – Hard Boundary for Copper – Domain 0 and Domain 1

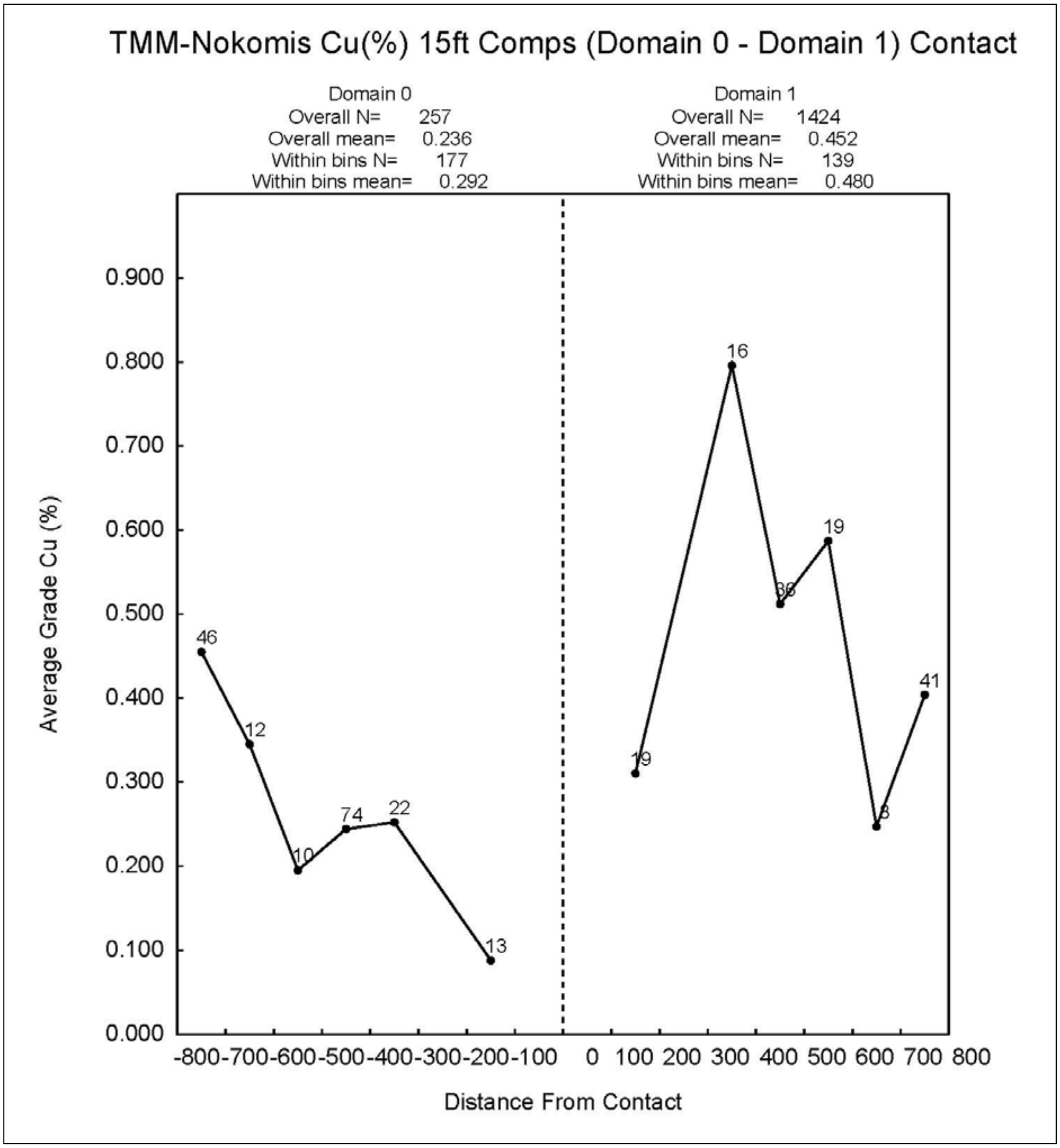


Figure 14-10:Refined Contact Plots – Hard Boundary for Copper – Domain 0 and Domain 1 – Lower Stratigraphic Groups

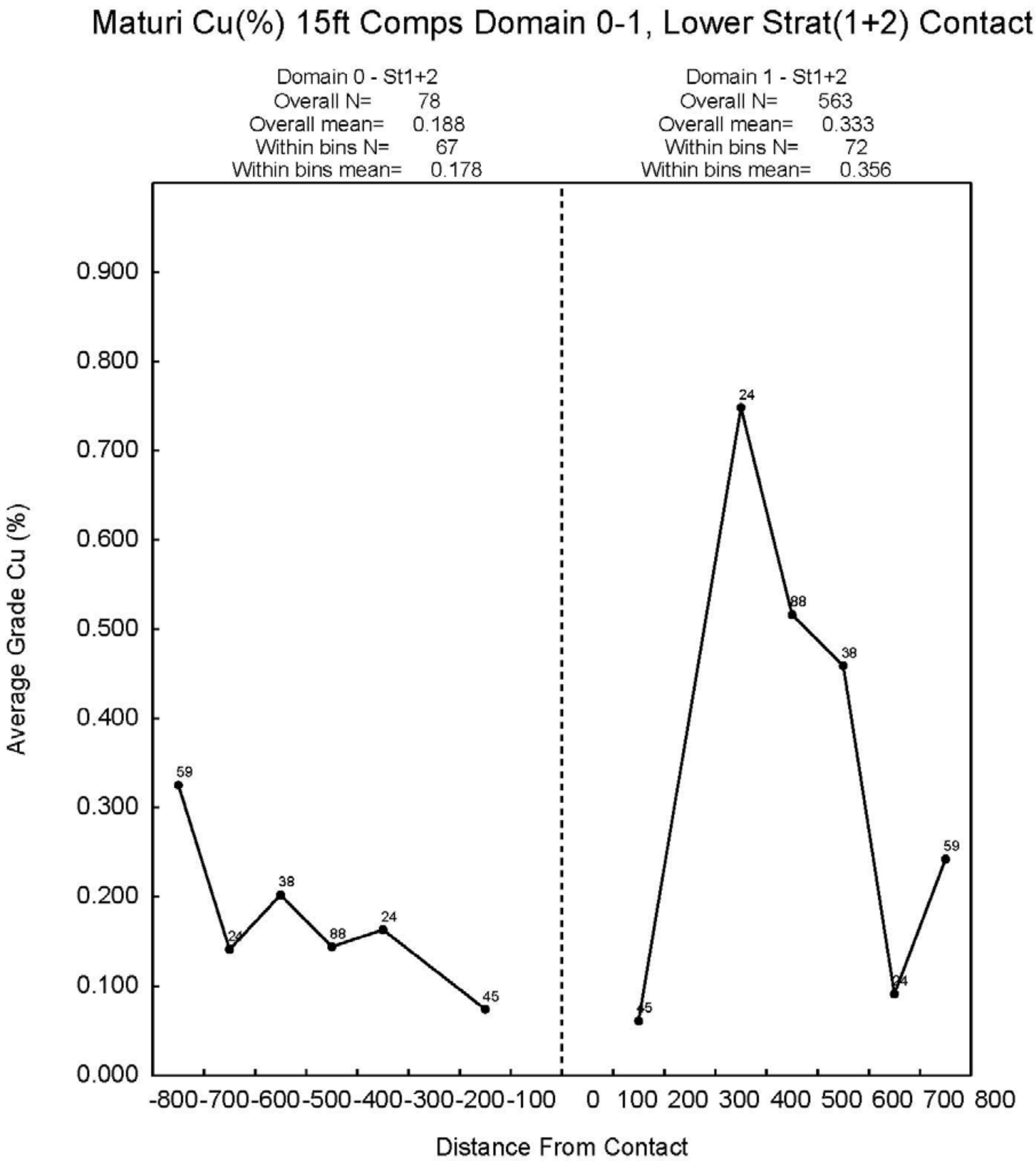


Figure 14-11:Refined Contact Plots – Hard Boundary for Copper – Domain 0 and Domain 1 – Upper Stratigraphic Groups

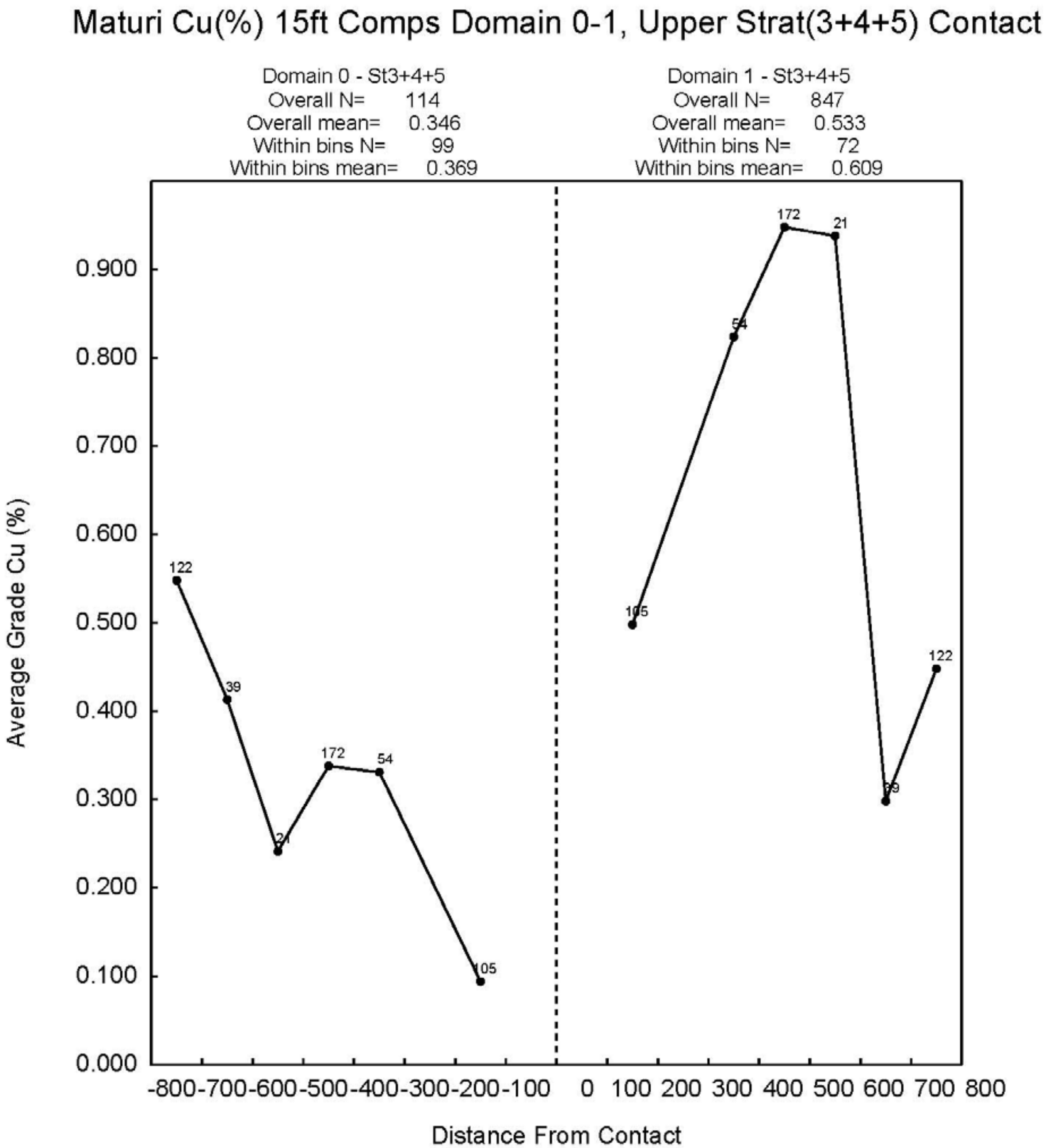


Figure 14-12:Contact Plots – Soft Boundary for Copper – Domain 1 and Domain 23

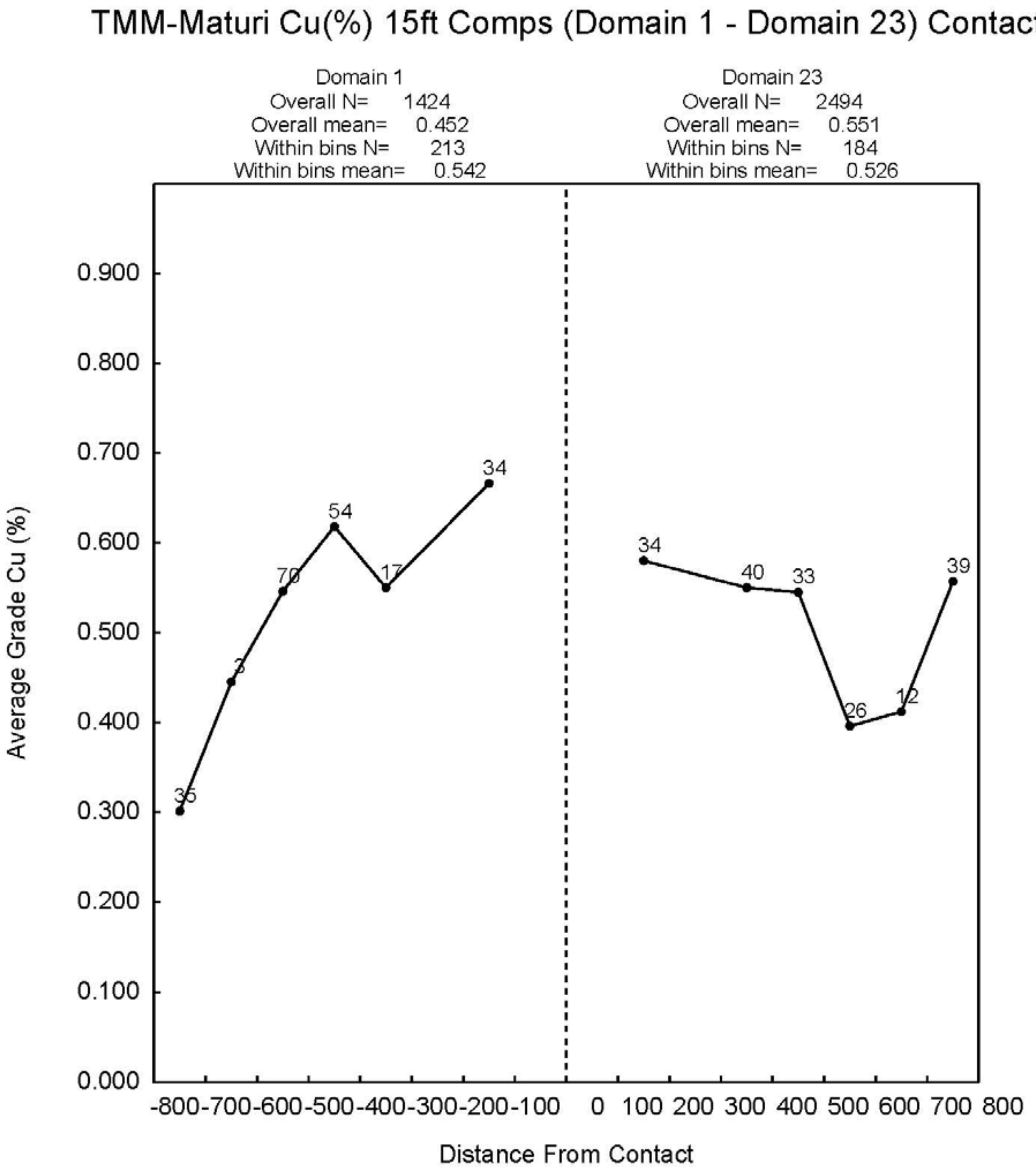


Figure 14-13: Refined Contact Plots – Soft Boundary for Copper – Domain 1 and Domain 23 – Lower Stratigraphic Groups

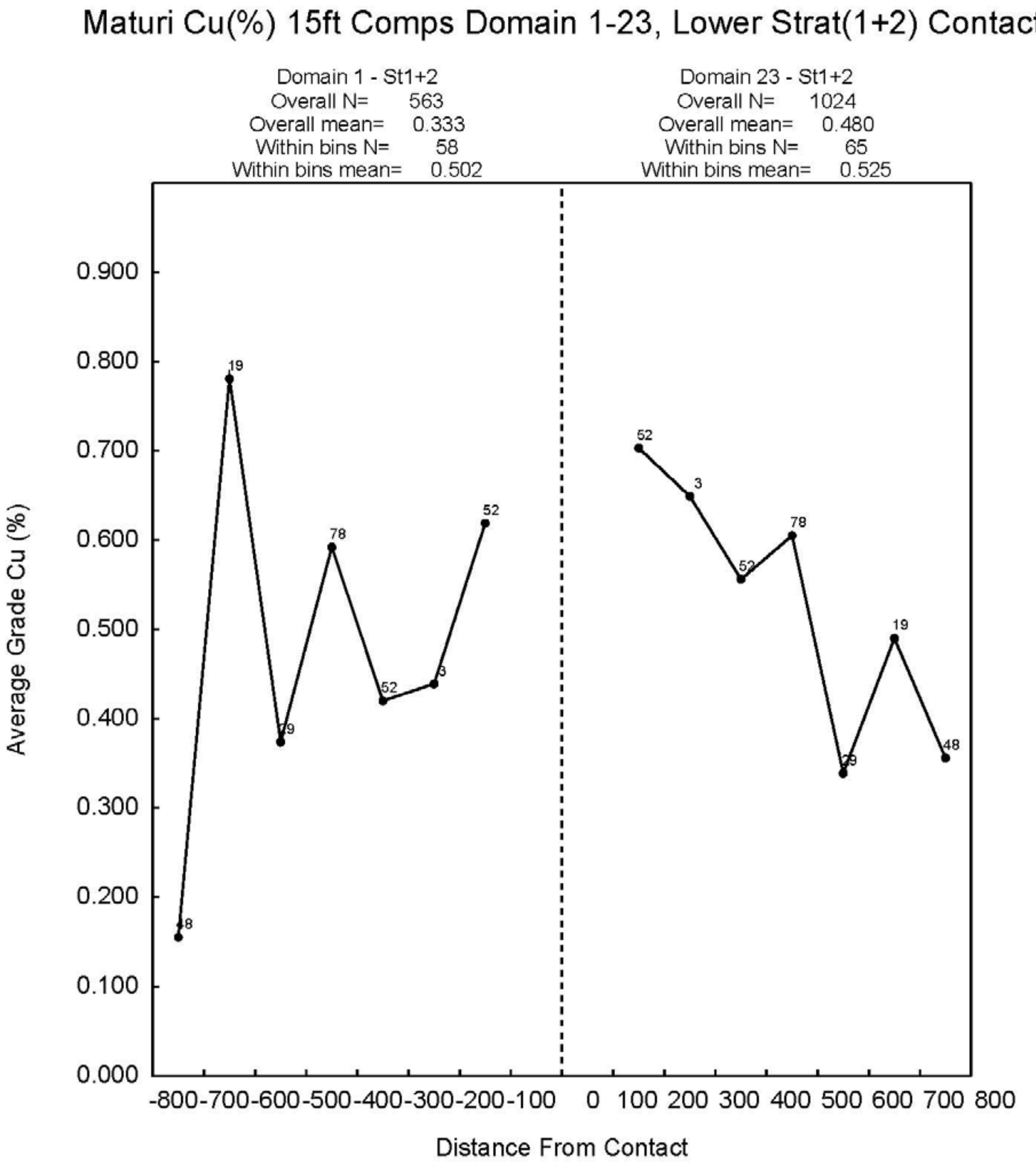


Figure 14-14: Refined Contact Plots – Hard Boundary for Copper – Domain 1 and Domain 23 – Upper Stratigraphic Groups

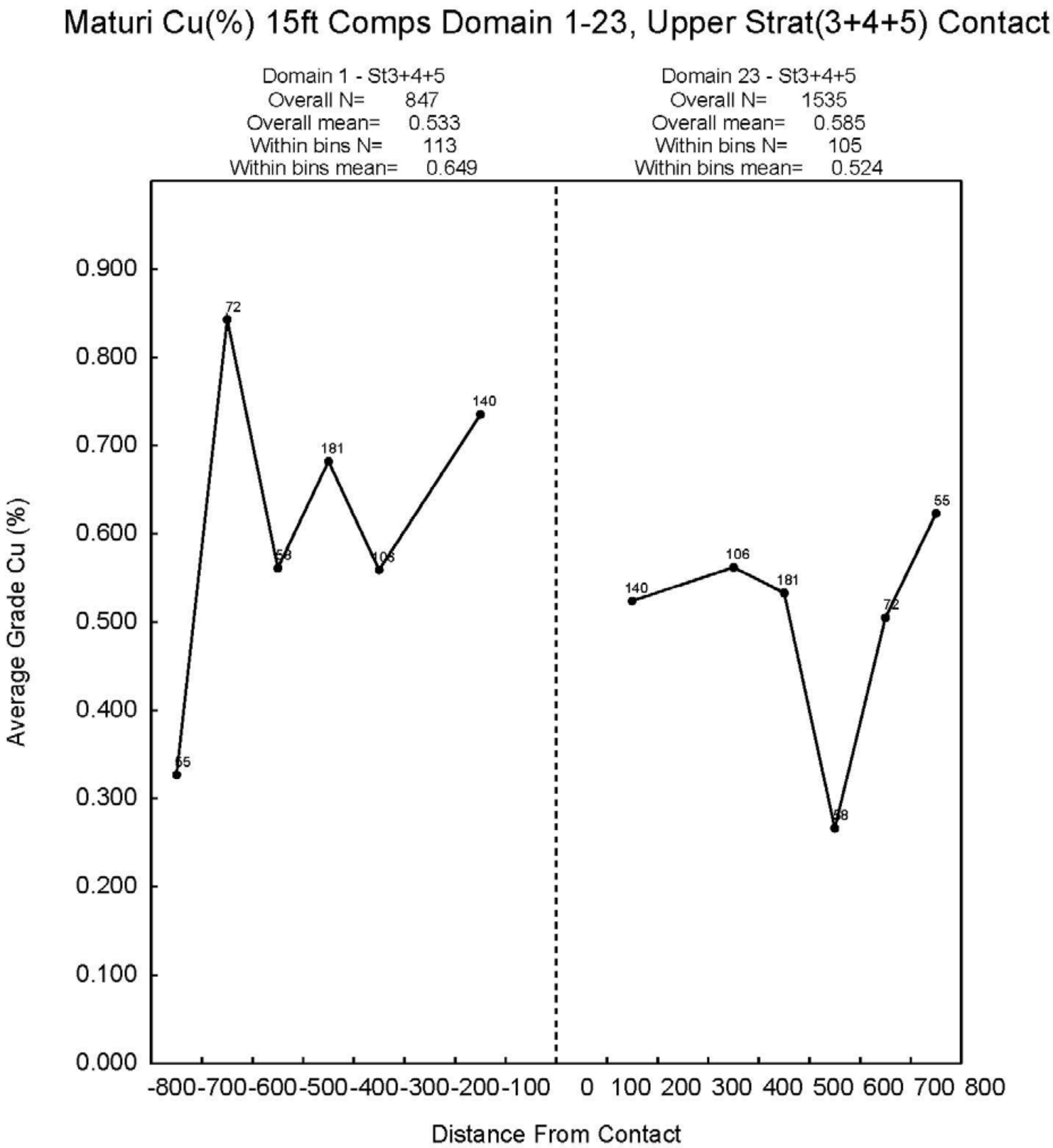


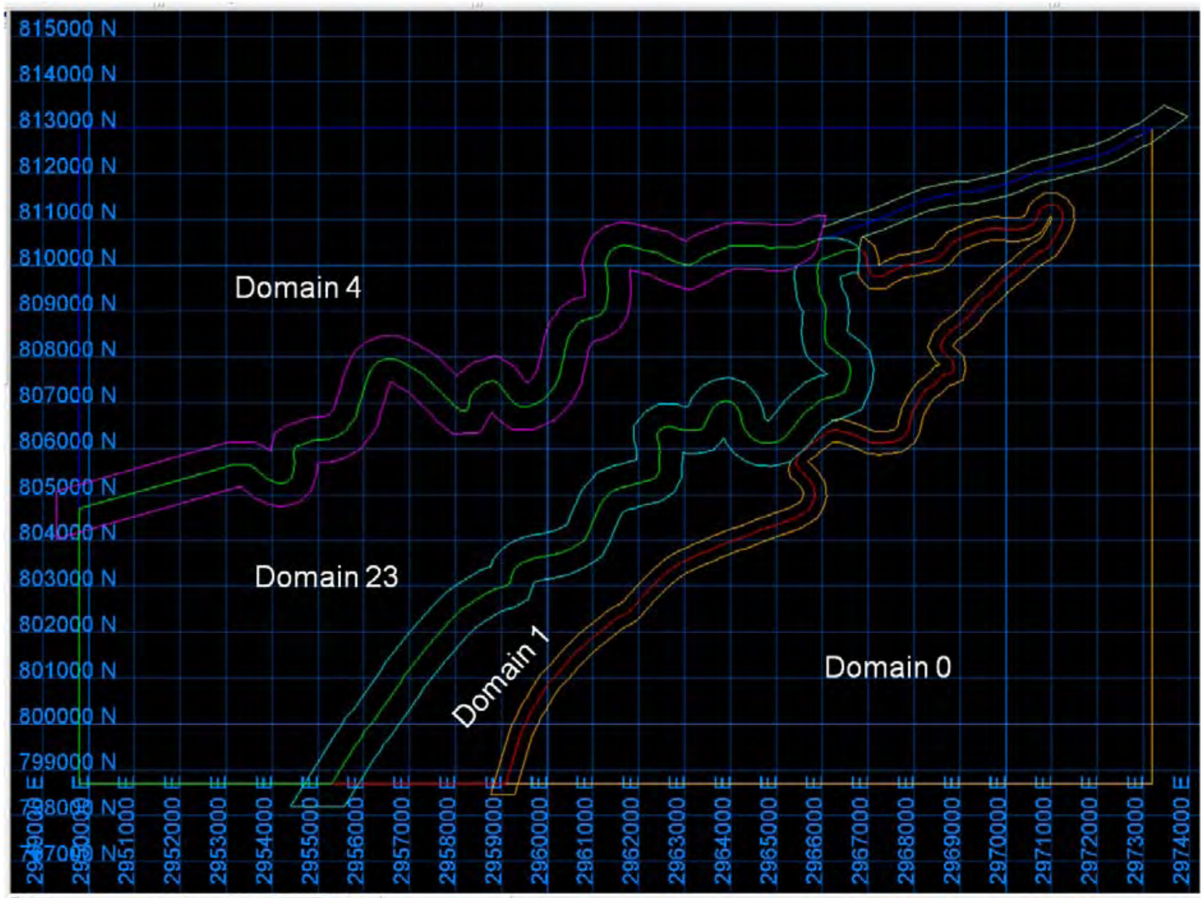
Table 14-3: Stratigraphic and Domain Groupings

	BMZ UNIT					
Domain	**Strat Interval**	**Copper**	**Nickel**	**Platinum**	**Palladium**	**Gold**
0	All	Hard	Hard	Hard	Hard	Hard
1	Lower (1+2)	1+23	1+23	1+23	1+23	1+23
	Upper (3+4+5)	Hard	Hard	Hard	Hard	Hard
23	Lower (1+2)	1+23+4	1+23+4	1+23+4	1+23+4	1+23+4
	Upper (3+4+5)	Hard	Hard	Hard	Hard	Hard
4	Lower (1+2)	23+4	23+4	23+4	23+4	23+4
	Upper (3+4+5)	Hard	Hard	23+4	Hard	Hard

	GRB UNIT				
Domain	**Copper**	**Nickel**	**Platinum**	**Palladium**	**Gold**
0	Hard	Hard	Hard	Hard	Hard
1	Hard	Hard	Hard	Hard	Hard
23	Hard	Hard	23+4	23+4	23+4
4	Hard	Hard	23+4	23+4	23+4

Upon final review of the model, a decision was made to relax the composite selection restriction along contacts immediately adjacent to the domain boundaries. A 500 foot buffer was applied to each side of the contacts between Domains 1 and 23 and Domains 23 and 4. A 250 foot buffer was applied to each side of the contacts between Domains 0 and 1 and Domains 0 and 4. Within these “fuzzy” contacts, composites from either domain were selected for use in grade estimation; essentially a soft contact was defined within these zones. These are shown in Figure 14-15.

Figure 14-15:"Fuzzy Contacts" along Domain Boundaries



Density

SG data were collected by TMM using core samples by immersing a piece of core into a graduated cylinder and recording the volume of water displaced. A total of 11,692 measurements have been recorded. Figures 14-16 through 14-19, show histograms of SG for each unit. AMEC then subdivided the BMZ and GRB units by domain. SG for the BMZ was further refined by the stratigraphic layer. The SG values for the main geological units unit are shown in Table 14-4; the SG values for stratigraphic layers within the BMZ are shown in Table 14-5. AMEC used the mean SG value calculated for each of these groups to derive a tonnage factor used in the block model.

Figure 14-16:Histogram of SG Values – HW

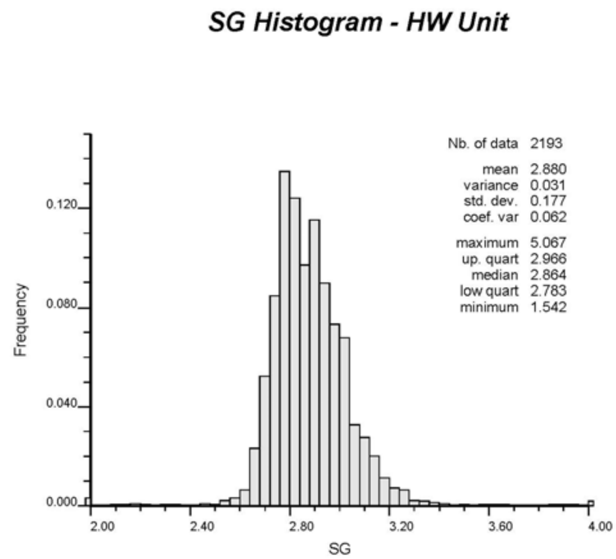


Figure 14-17:Histogram of SG Values – PEG

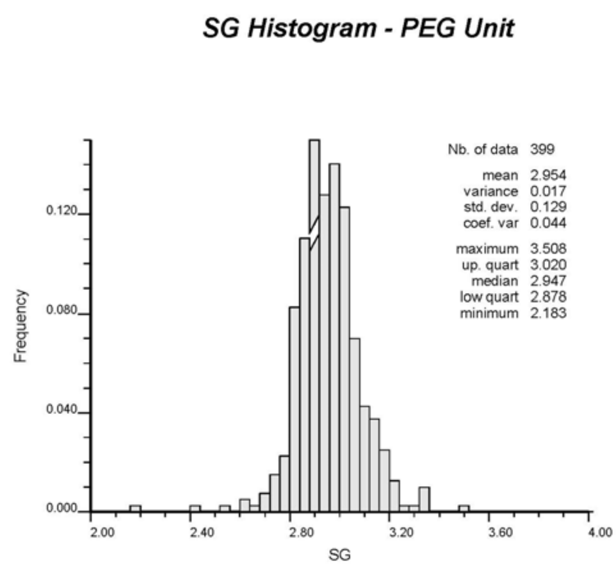


Figure 14-18:Histogram of SG Values – BMZ

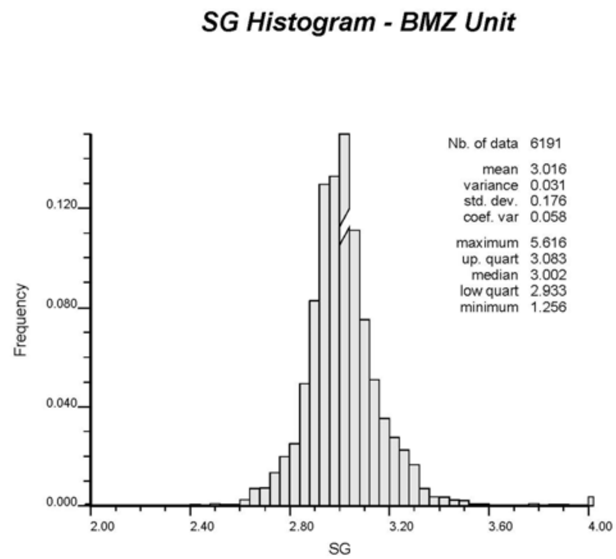


Figure 14-19:Histogram of SG Values – GRB

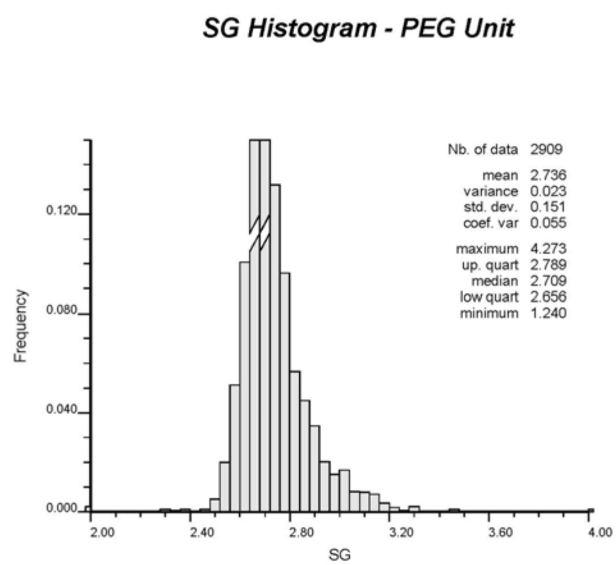


Table 14-4: SG Value – By Unit

Overall		
Unit	**SG**	**Count**
HW	2.88	2193
PEG	2.95	399
BMZ	3.02	6191
GRB	2.74	2909

Table 14-5: SG Values – Stratigraphic Layers within the BMZ

DOMAIN 0 - BMZ		
Strat	**SG**	**Count**
5	3.01	45
4	3.01	44
3	2.97	45
2	2.99	43
1	3.00	42
DOMAIN 1 - BMZ		
Strat	**SG**	**Count**
5	3.00	403
4	2.99	387
3	3.01	385
2	3.03	384
1	2.99	392
DOMAIN 23 - BMZ		
Strat	**SG**	**Count**
5	3.01	611
4	3.01	586
3	3.03	572
2	3.03	577
1	3.01	586
DOMAIN 4 - BMZ		
Strat	**SG**	**Count**
5	2.96	224
4	3.05	215
3	3.07	219
2	3.05	217
1	3.05	214

Block Model

The block model was constructed in Vulcan using sub blocking to ensure accurate coding of blocks within the BMZ and GRB skin units. Outside of these units the blocks were defined to be 200 ft x 200 ft x 180 feet (in x, y and z directions). Internal to these units the blocks were allowed to be as small as 25 feet x 25 feet x 5 feet, but as large as 50 feet x 50 feet x 15 feet.

The geological model was generated using the Unit Geology intervals supplied by TMM. A topographic surface was generated using regional 10 foot contour intervals supplied by TMM. The upper surface for each of the PEG, BMZ and GRB units was generated using X, Y and Z of drill hole intercepts using Vulcan Grid Calc modeling functions. A grid cell size of 50 ft x 50 ft was used over the model area. A stratigraphic model of the BMZ unit was developed by dividing the calculated BMZ thickness into 5 equal units. The GRB upper surface was then dropped 30 feet to provide a base to the GRB skin. Grade estimation was carried out within the BMZ unit and the GRB skin. A typical cross section showing the geological model is shown in Figures 14-3 and 14-4.

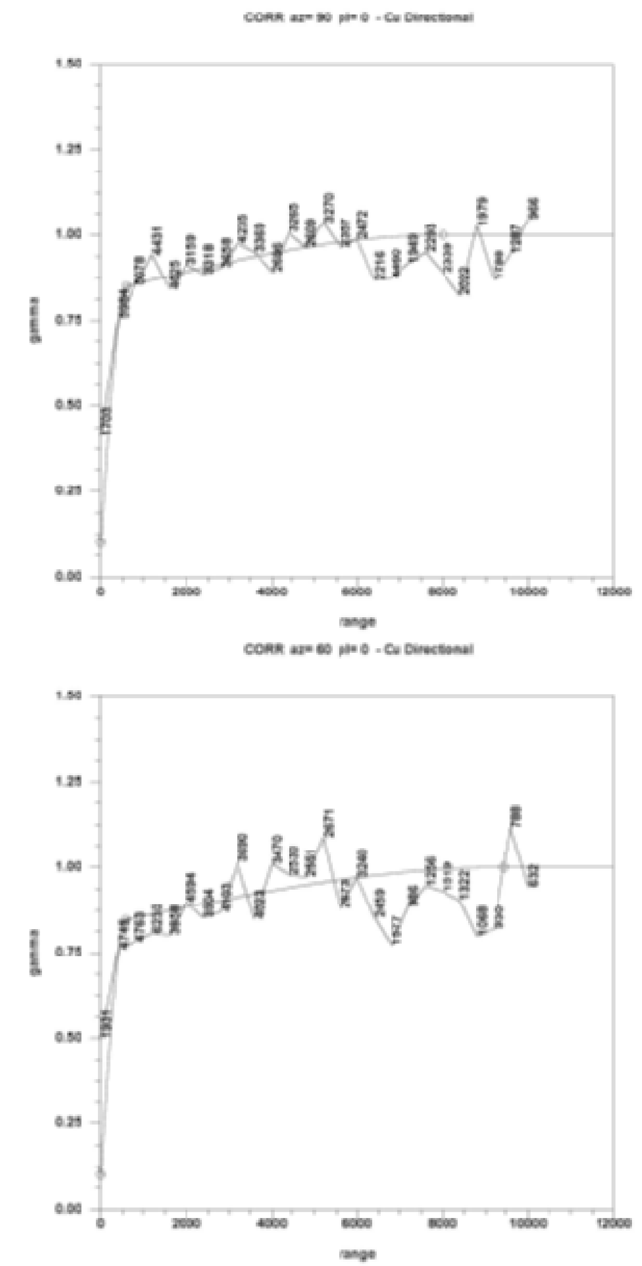
14.2.4 Variography

Variography using the correlogram model was carried out on copper, nickel, platinum, palladium and gold within the BMZ and GRB skin units. Due to the limited amount of GRB skin data available, AMEC applied the BMZ model to the GRB skin estimation. Because the model was developed as a Vulcan™ Tetra model, AMEC was required to use the Vulcan variogram tools to develop the variogram models. One variogram for each metal was modeled within the BMZ unit. Initially downhole variograms were modeled to determine the nugget effect, and this was applied to the final directional variogram model. Table 14-6 summarizes the variogram models and example variogram plots for copper are shown in Figure 14-20.

Table 14-6: Variography Parameters

Metal	Nugget	C1	Azm	Range - Structure 1			C2	Azm	Range - Structure 2		
				Major	Semi	Minor			Major	Semi	Minor
Copper	0.10	0.731	86	579	525	525	0.169	62	9460	5670	5670
Nickel	0.11	0.647	3	510	483	483	0.243	166	9250	9240	9240
Platinum	0.10	0.291	51	9570	4430	4430	0.609	280	600	500	500
Palladium	0.20	0.308	56	8710	4270	4270	0.492	284	606	490	490
Gold	0.50	0.349	98	385	12.9	12.9	0.151	232	9130	3710	3710

Figure 14-20:Copper Variogram Model (Major Directions)



14.2.5 Estimation

The grade estimation for the 2011 resource model update used the Vulcan Tetra-Projection unfolding methodology and Ordinary Kriging (OK). The grade estimations were completed for copper, nickel, palladium, platinum, gold, silver cobalt, sulfur, and magnesium oxide. The estimations were completed for each element independently. The BMZ and GRB skin were each estimated independently. Grade estimates were not completed for the HW, PEG and GRB unit (below the GRB skin).

Each element was estimated independently in 56 passes with expanding searches for each pass within the BMZ. Passes 1 through 28 for copper are shown in Table 14-7. An additional 28 passes are repeated to estimate blocks along the "Fuzzy Contacts" discussed above. Domain 0 was estimated with four passes. Each of the other domains was estimated with 8 passes.

The GRB is estimated utilizing 32 passes within the GRB skin. The significant number of passes was required to accommodate the various combinations of stratigraphic layers, domains and grade restrictions. At the completion of grade estimation, a Vulcan script was run to fill any remaining un-estimated blocks with the average grade for the particular domain and stratigraphic level. Similar tables outlining the search strategy for all metals for both BMZ and GRB are contained in AMEC (2012).

Table 14-7: Search Strategy for Copper OK Interpolation (BMZ)

Pass	Domain	Strat	Search			Composites			Grade Restriction			
			X	Y	Z	Min	Max	Max per Hole	Cu (%)	X	Y	Z
1	0	Lower +Upper	500	500	0.2	5	12	3	0.69	500	500	0.1
2	0	Lower +Upper	1000	1000	0.15	5	12	3	0.69	500	500	0.1
3	0	Lower +Upper	2500	2500	0.1	5	12	3	0.69	500	500	0.1
4	0	Lower +Upper	3500	3500	0.1	5	12	3	0.69	500	500	0.1
5	1	Lower	500	500	0.2	5	12	3	0.84	500	500	0.1
6	1	Lower	1000	1000	0.15	5	12	3	0.84	500	500	0.1
7	1	Lower	2500	2500	0.1	5	12	3	0.84	500	500	0.1
8	1	Lower	3500	3500	0.1	5	12	3	0.84	500	500	0.1
9	1	Upper	500	500	0.2	5	12	3	1.09	500	500	0.1
10	1	Upper	1000	1000	0.15	5	12	3	1.09	500	500	0.1
11	1	Upper	2500	2500	0.1	5	12	3	1.09	500	500	0.1
12	1	Upper	3500	3500	0.1	5	12	3	1.09	500	500	0.1
13	23	Lower	500	500	0.2	5	12	3	0.89	500	500	0.1
14	23	Lower	1000	1000	0.15	5	12	3	0.89	500	500	0.1
15	23	Lower	2500	2500	0.1	5	12	3	0.89	500	500	0.1
16	23	Lower	3500	3500	0.1	5	12	3	0.89	500	500	0.1
17	23	Upper	500	500	0.2	5	12	3	0.99	500	500	0.1
18	23	Upper	1000	1000	0.15	5	12	3	0.99	500	500	0.1
19	23	Upper	2500	2500	0.1	5	12	3	0.99	500	500	0.1
20	23	Upper	3500	3500	0.1	5	12	3	0.99	500	500	0.1
21	4	Lower	500	500	0.2	5	12	3	0.73	500	500	0.1
22	4	Lower	1000	1000	0.15	5	12	3	0.73	500	500	0.1
23	4	Lower	2500	2500	0.1	5	12	3	0.73	500	500	0.1
24	4	Lower	3500	3500	0.1	5	12	3	0.73	500	500	0.1
25	4	Upper	500	500	0.2	5	12	3	0.89	500	500	0.1
26	4	Upper	1000	1000	0.15	5	12	3	0.89	500	500	0.1
27	4	Upper	2500	2500	0.1	5	12	3	0.89	500	500	0.1
28	4	Upper	3500	3500	0.1	5	12	3	0.89	500	500	0.1

Note: The Vulcan Tetra™ model normalizes the vertical extent to 1. For example, a 0.2 in the z direction indicates a 20% search radius in the vertical direction. The search and sample selection was the same for each element.

14.2.6 Metal at Risk

An outlier restriction protocol was implemented on uncapped 15 ft composites to address metal-at-risk, i.e., limit the influence of high-grade samples. The outlier restriction for each metal was based restricting grades above the 95th percentile to a distance of 500 ft. This restriction was refined by determining the 95th percentile for each metal within each domain and by stratigraphic grouping (Lower and Upper). The same restriction was applied in both the BMZ and the GRB Skin units. Samples grading greater than the outlier grade threshold are not used where their distances to the block are greater than the distance threshold. Grade thresholds are summarized in Table 14-8.

Table 14-8: Grade Restriction Thresholds

Metal	Domain	Strat Group	95th Percentile
Cu	0	Lower	0.51
Cu	0	Upper	0.69
Cu	1	Lower	0.84
Cu	1	Upper	1.09
Cu	23	Lower	0.89
Cu	23	Upper	0.99
Cu	4	Lower	0.73
Cu	4	Upper	0.89
Ni	0	Lower	0.16
Ni	0	Upper	0.21
Ni	1	Lower	0.22
Ni	1	Upper	0.31
Ni	23	Lower	0.30
Ni	23	Upper	0.33
Ni	4	Lower	0.24
Ni	4	Upper	0.29
Pt	0	Lower	0.13
Pt	0	Upper	0.24
Pt	1	Lower	0.32
Pt	1	Upper	0.55
Pt	23	Lower	0.30
Pt	23	Upper	0.30
Pt	4	Lower	0.13
Pt	4	Upper	0.16
Pd	0	Lower	0.28
Pd	0	Upper	0.59
Pd	1	Lower	0.79
Pd	1	Upper	1.18
Pd	23	Lower	0.63
Pd	23	Upper	0.68
Pd	4	Lower	0.30
Pd	4	Upper	0.40
Au	0	Lower	0.06
Au	0	Upper	0.14
Au	1	Lower	0.17
Au	1	Upper	0.25
Au	23	Lower	0.15
Au	23	Upper	0.17
Au	4	Lower	0.08
Au	4	Upper	0.10

Metal removed from the BMZ Unit is summarized in Table 14-9. The Metal removed was determined by comparing grades between the unrestricted kriged model and the final kriged model where the outlier restriction was applied. Metal removed for copper and nickel are 1.2% and 1.4% respectively. Metal removed for platinum, palladium and gold is 3.8%, 3.5% and 4.9% respectively.

AMEC considers the level of metal removed from the resource to be reasonable for the Indicated and Inferred Resource Classifications.

Table 14-9: Metal Removed by Outlier Restriction

Indicated			
Metal	**OK Unrestricted**	**OK Restricted**	**Metal Removed**
			(OKunres vs Okres)
Copper (%)	0.552	0.548	0.7%
Nickel (%)	0.173	0.172	0.6%
Platinum (ppm)	0.153	0.15	2.0%
Palladium (ppm)	0.348	0.342	1.7%
Gold (ppm)	0.081	0.078	3.7%
Inferred			
Metal	**OK Unrestricted**	**OK Restricted**	**Metal Removed**
			(OKunres vs Okres)
Copper (%)	0.540	0.530	1.9%
Nickel (%)	0.182	0.178	2.2%
Platinum (ppm)	0.126	0.118	6.3%
Palladium (ppm)	0.348	0.329	5.5%
Gold (ppm)	0.080	0.075	6.3%
Indicated+Inferred			
Metal	**OK Unrestricted**	**OK Restricted**	**Metal Removed**
			(OKunres vs Okres)
Copper (%)	0.546	0.540	1.2%
Nickel (%)	0.177	0.175	1.4%
Platinum (ppm)	0.140	0.135	3.8%
Palladium (ppm)	0.348	0.336	3.5%
Gold (ppm)	0.081	0.077	4.9%

14.2.7 Model Validation

Model Validation consisted of visual inspection of cross-sections and plan-sections comparing estimated grades to the 15 foot composites. Box plots and swath plots were used to compare grade estimates to NN grades, ID2 grades and 15 foot composite grades.

Nearest-Neighbor Model

A Nearest-Neighbor (NN) model was completed for model validation. The NN model utilized the same search criteria as the OK estimate and was used for comparison of summary statistics in box plots and swath plots. Model validation was completed using blocks estimated in Pass 1 or Pass 2.

Inverse Distance Model

An Inverse distance mode was also completed to assist with the model validation. The ID2 model was completed in multiple passes, similar to the kriged model. Model validation was completed using blocks estimated in Pass 1 or Pass 2.

Visual Inspection

Visual inspection on sections and plans comparing estimated block grades to the 15 foot composites was completed for all elements. Figure 14-21 shows the section location. Figures 14-22 and 14-23, show block grades for copper. The apparent continuity of grade (correspondence of block grades to closest hole) may become less evident with more drilling.

AMEC noted good correlation between composite data and block grades. In general AMEC observed good grade and thickness continuity between drill holes, however in some areas, additional drilling is required to reduce the distance between existing drill holes. This additional drilling is required to increase the confidence in the resource model and to reduce the reliance on legacy drill holes.

Figure 14-21:Section Location

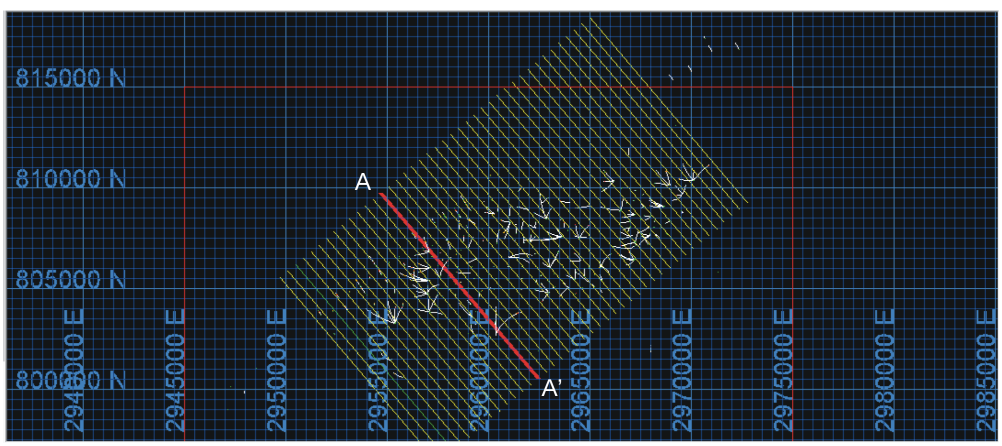
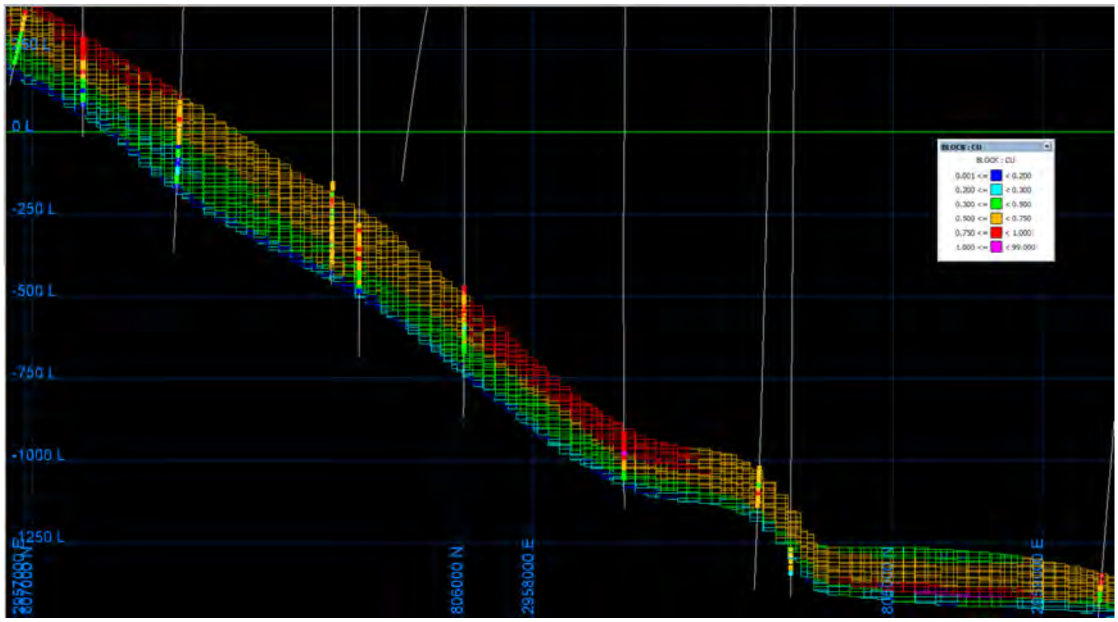
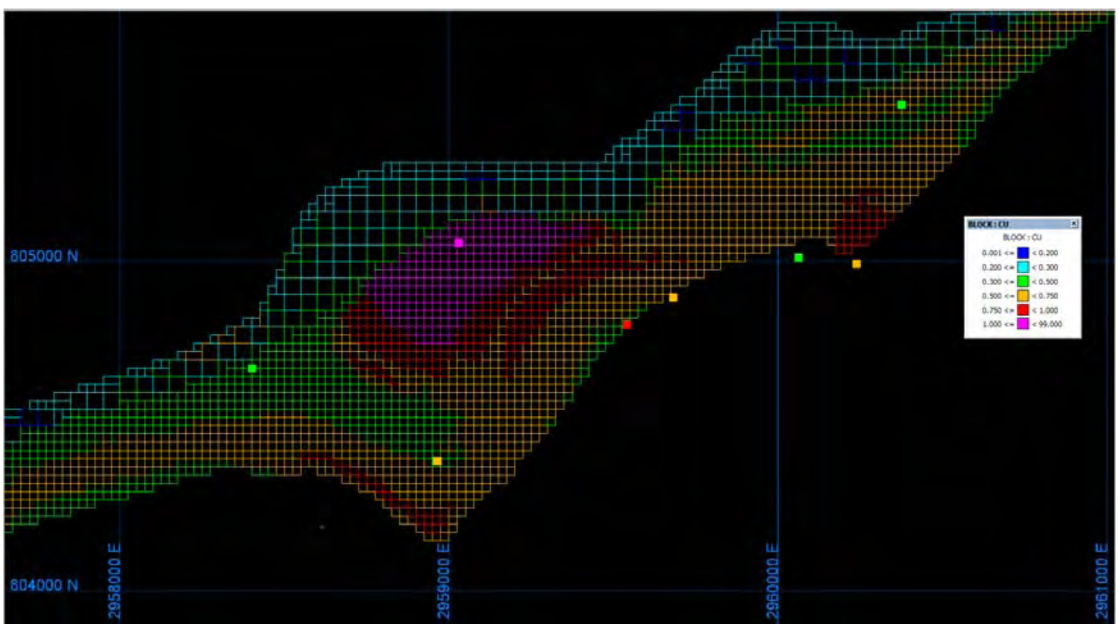


Figure 14-22: Copper Grades for Blocks and Composites – Section A-A' (looking northeast) – Detail View



Note: Composites are projected 250 ft each side of the section

Figure 14-23: Copper Grades for Blocks and Composites – Elevation – 1400 ft

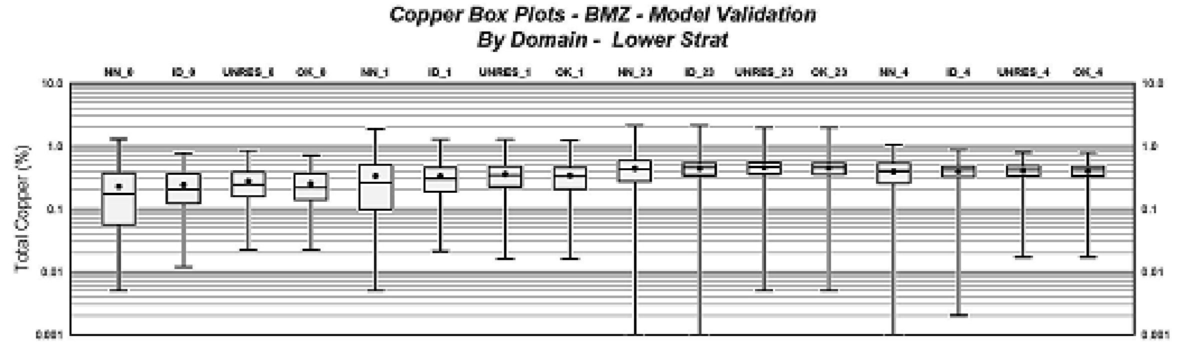


Note: Composites are projected 25 ft each side of the plan

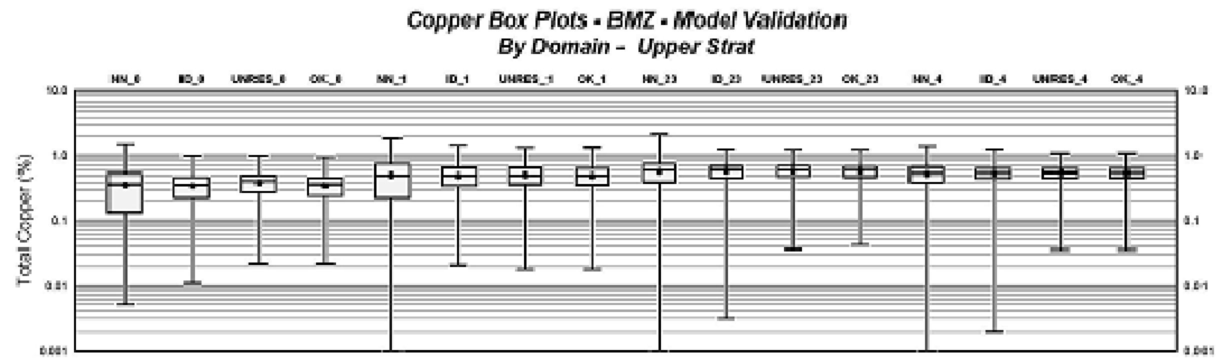
Box Plots

Box plots were completed for each element comparing the nearest neighbor, inverse distance, unrestricted kriged and kriged estimates by domain and by stratigraphic group for each metal. Figure 14-23 displays a box plot for copper grades for the BMZ.

Figure 14-24: Box Plots of Copper Grades for BMZ



	NN_0	ID_0	UNRES_0	OK_0	NN_1	ID_1	UNRES_1	OK_1	NN_23	ID_23	UNRES_23	OK_23	NN_4	ID_4	UNRES_4	OK_4	
No. of data	96273	96273	96273	96273	328688	328688	328688	328688	682246	682246	682246	682246	380928	380928	380928	380928	No. of data
Mean	0.227	0.241	0.274	0.251	0.334	0.331	0.354	0.338	0.438	0.440	0.452	0.443	0.392	0.395	0.405	0.401	Mean
Maximum	1.290	0.767	0.850	0.710	1.803	1.268	1.271	1.232	2.133	2.131	1.989	1.962	1.071	0.861	0.796	0.781	Maximum
Quartile	0.388	0.358	0.386	0.362	0.500	0.456	0.475	0.454	0.586	0.536	0.545	0.532	0.536	0.476	0.483	0.476	Quartile
Median	0.172	0.201	0.242	0.215	0.259	0.303	0.344	0.327	0.420	0.451	0.461	0.453	0.400	0.410	0.414	0.411	Median
Quartile	0.056	0.123	0.159	0.140	0.098	0.190	0.224	0.208	0.273	0.340	0.356	0.354	0.257	0.319	0.335	0.332	Quartile
Minimum	0.005	0.012	0.022	0.023	0.005	0.021	0.016	0.016	0.001	0.001	0.005	0.005	0.001	0.002	0.017	0.017	Minimum
Variance	0.040	0.021	0.021	0.019	0.080	0.034	0.032	0.030	0.066	0.026	0.025	0.022	0.038	0.014	0.013	0.012	Variance
CV	0.880	0.607	0.534	0.551	0.845	0.558	0.505	0.510	0.584	0.366	0.347	0.337	0.494	0.302	0.277	0.274	CV
Skewness	1.113	0.614	0.388	0.490	1.006	0.601	0.377	0.425	1.110	0.348	0.261	0.208	-0.045	-0.318	-0.285	-0.301	Skewness



	NN_0	ID_0	UNRES_0	OK_0	NN_1	ID_1	UNRES_1	OK_1	NN_23	ID_23	UNRES_23	OK_23	NN_4	ID_4	UNRES_4	OK_4	
No. of data	139329	139329	139329	139329	493035	493035	493021	493025	1016440	1016440	1016437	1016440	450325	450325	450325	450325	No. of data
Mean	0.362	0.351	0.392	0.354	0.502	0.481	0.507	0.491	0.572	0.572	0.581	0.575	0.526	0.532	0.543	0.537	Mean
Maximum	1.508	0.961	0.961	0.830	1.865	1.437	1.308	1.320	2.187	1.256	1.214	1.211	1.401	1.234	1.077	1.077	Maximum
Quartile	0.533	0.475	0.506	0.461	0.729	0.686	0.646	0.626	0.738	0.678	0.692	0.673	0.683	0.621	0.629	0.624	Quartile
Median	0.373	0.360	0.411	0.372	0.498	0.493	0.510	0.485	0.580	0.589	0.592	0.585	0.528	0.535	0.543	0.537	Median
Quartile	0.132	0.230	0.282	0.248	0.230	0.350	0.372	0.361	0.389	0.465	0.484	0.481	0.394	0.452	0.466	0.460	Quartile
Minimum	0.005	0.011	0.022	0.022	0.001	0.021	0.018	0.018	0.001	0.003	0.036	0.041	0.001	0.002	0.036	0.035	Minimum
Variance	0.062	0.024	0.023	0.020	0.098	0.041	0.039	0.037	0.068	0.026	0.023	0.022	0.050	0.019	0.017	0.017	Variance
CV	0.687	0.444	0.386	0.396	0.625	0.411	0.391	0.383	0.456	0.282	0.264	0.258	0.424	0.257	0.242	0.242	CV
Skewness	0.435	-0.073	-0.241	-0.167	0.389	0.024	-0.095	0.000	-0.033	-0.222	-0.229	-0.201	-0.066	-0.327	-0.228	-0.239	Skewness

Swath Plots

Swath plots were constructed for a combination of domain and stratigraphic group within the BMZ. The swath plots compare the OK grade estimates to the NN grades and the grades of the 15 ft composites in swaths across the model. Swath intervals were 500 ft in the easterly and northerly directions and 100 ft in the vertical direction. Swaths generally show good agreement with the exception of areas where data become sparse. The swath plots for the copper by domain-stratigraphic group are shown in Figures 14-25 through 14-28.

Figure 14-25:Copper Swath Plots – BMZ – Domain 0

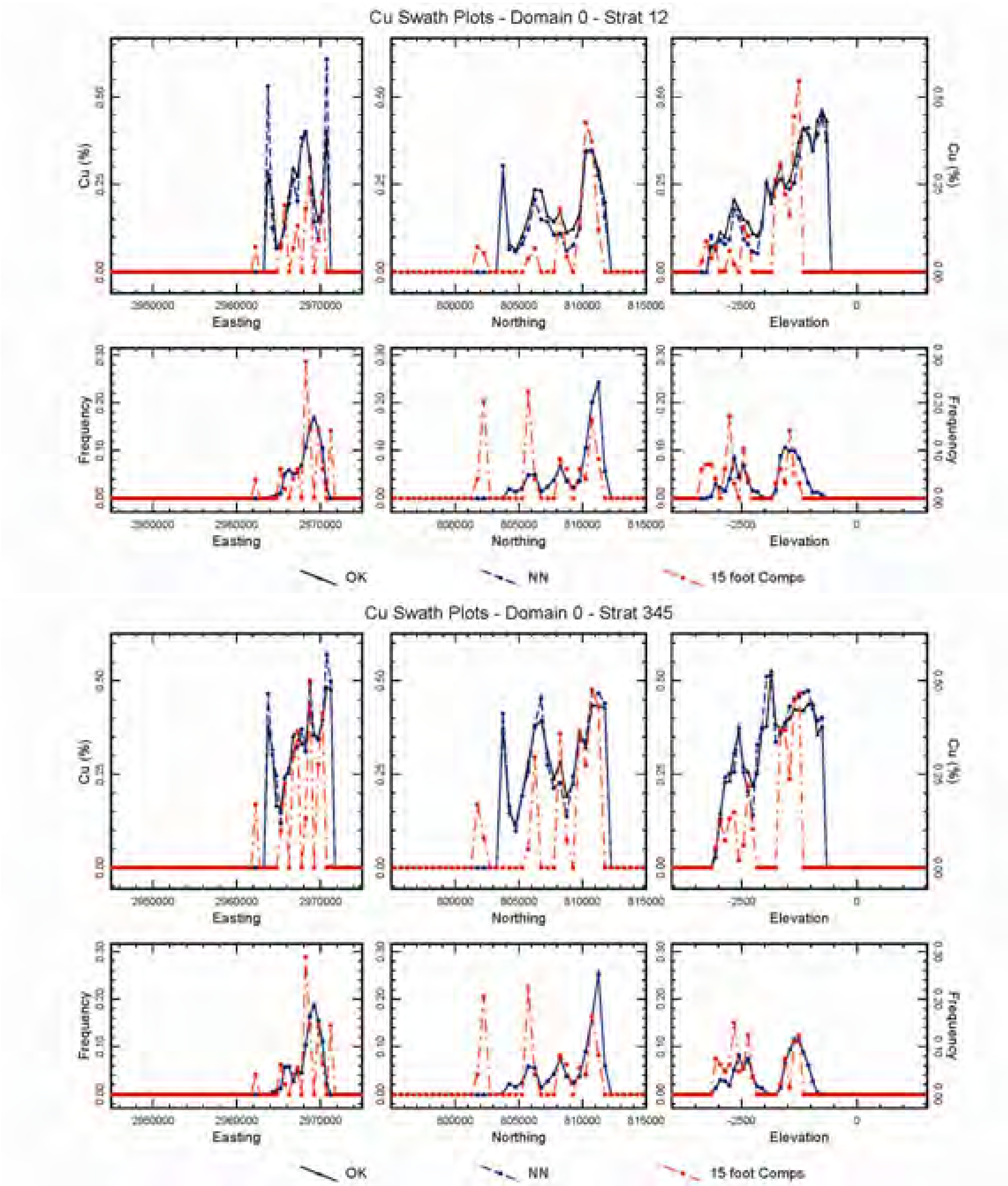


Figure 14-26:Copper Swath Plots – BMZ – Domain 1

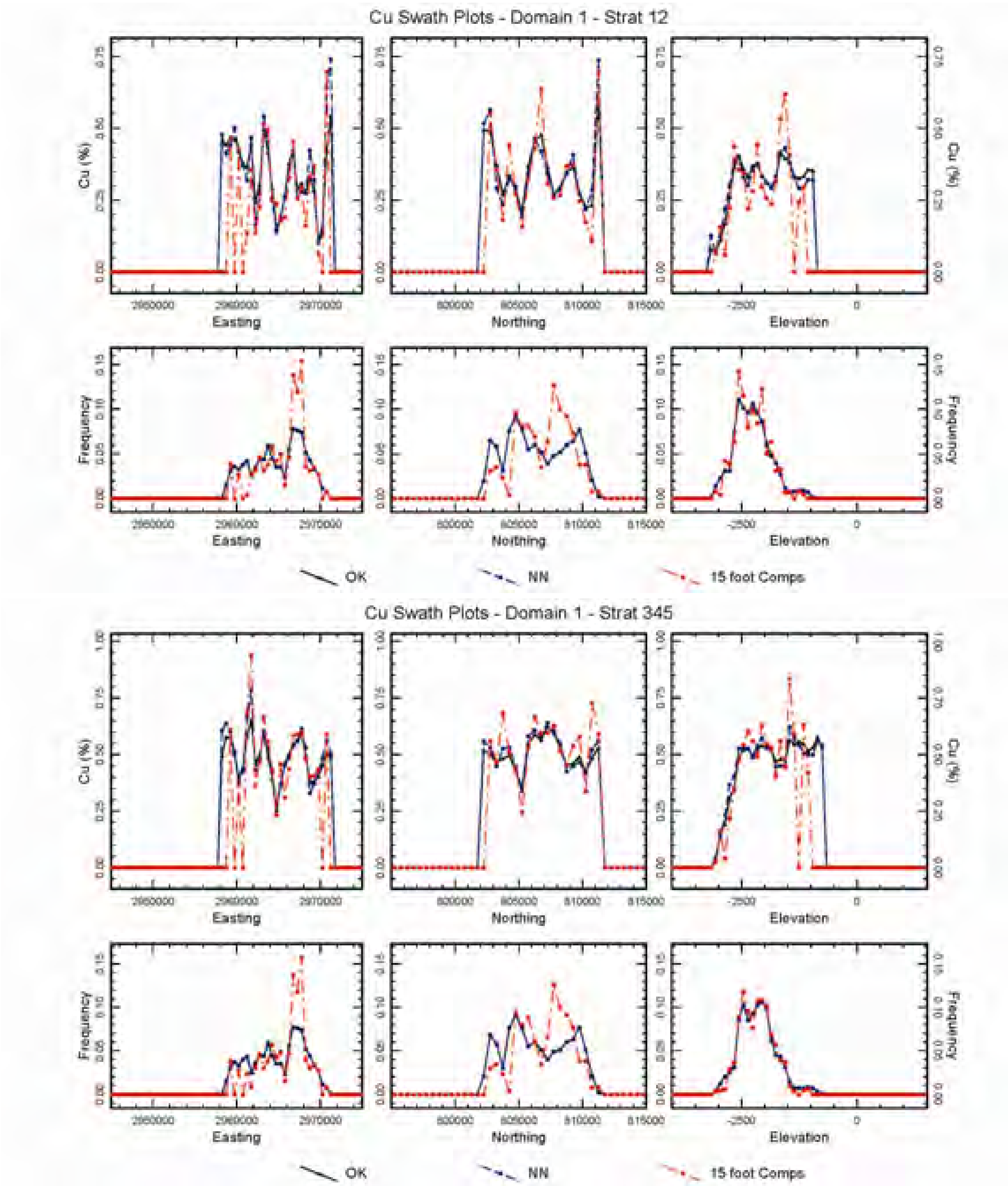


Figure 14-27:Copper Swath Plots – BMZ – Domain 23

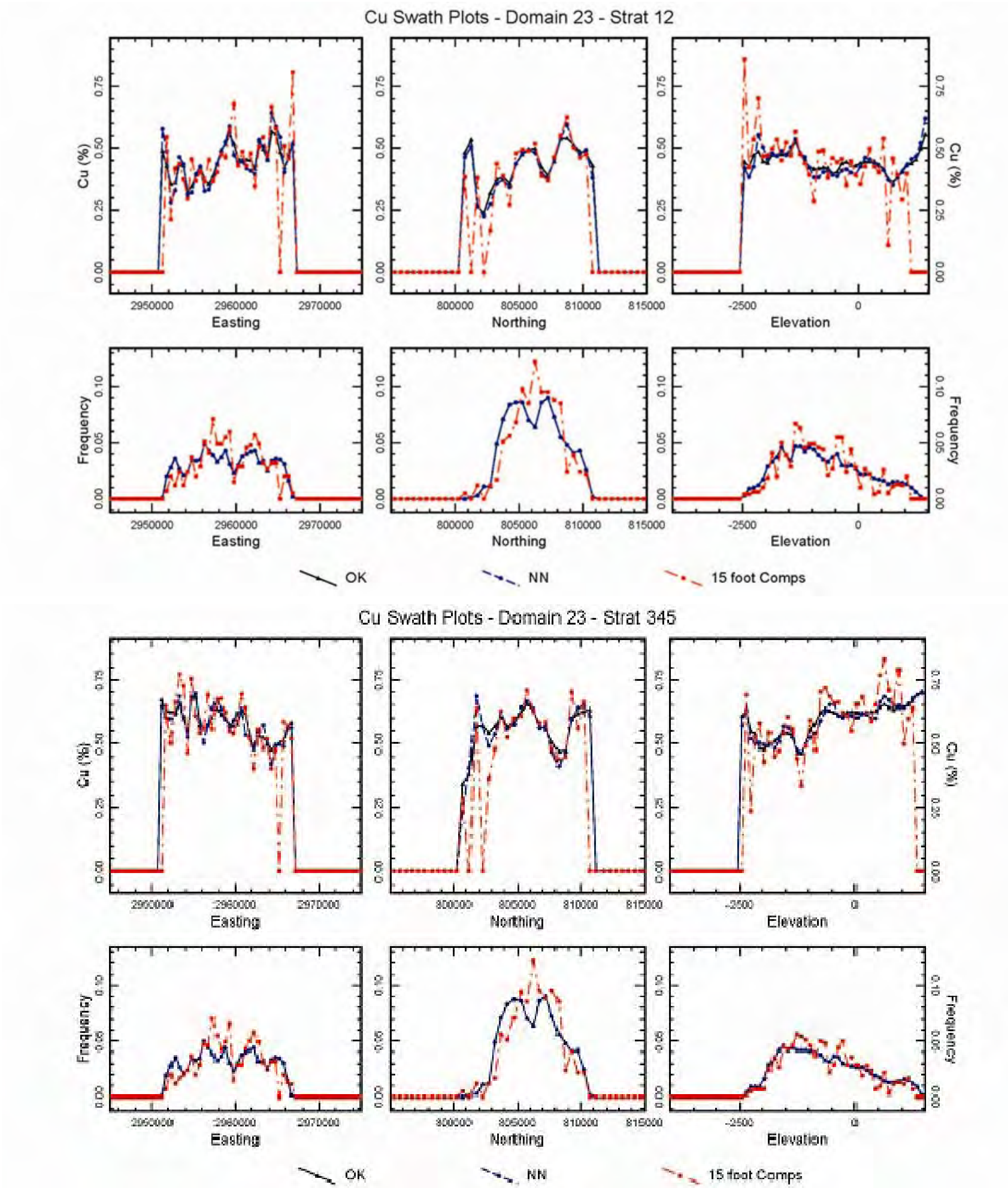
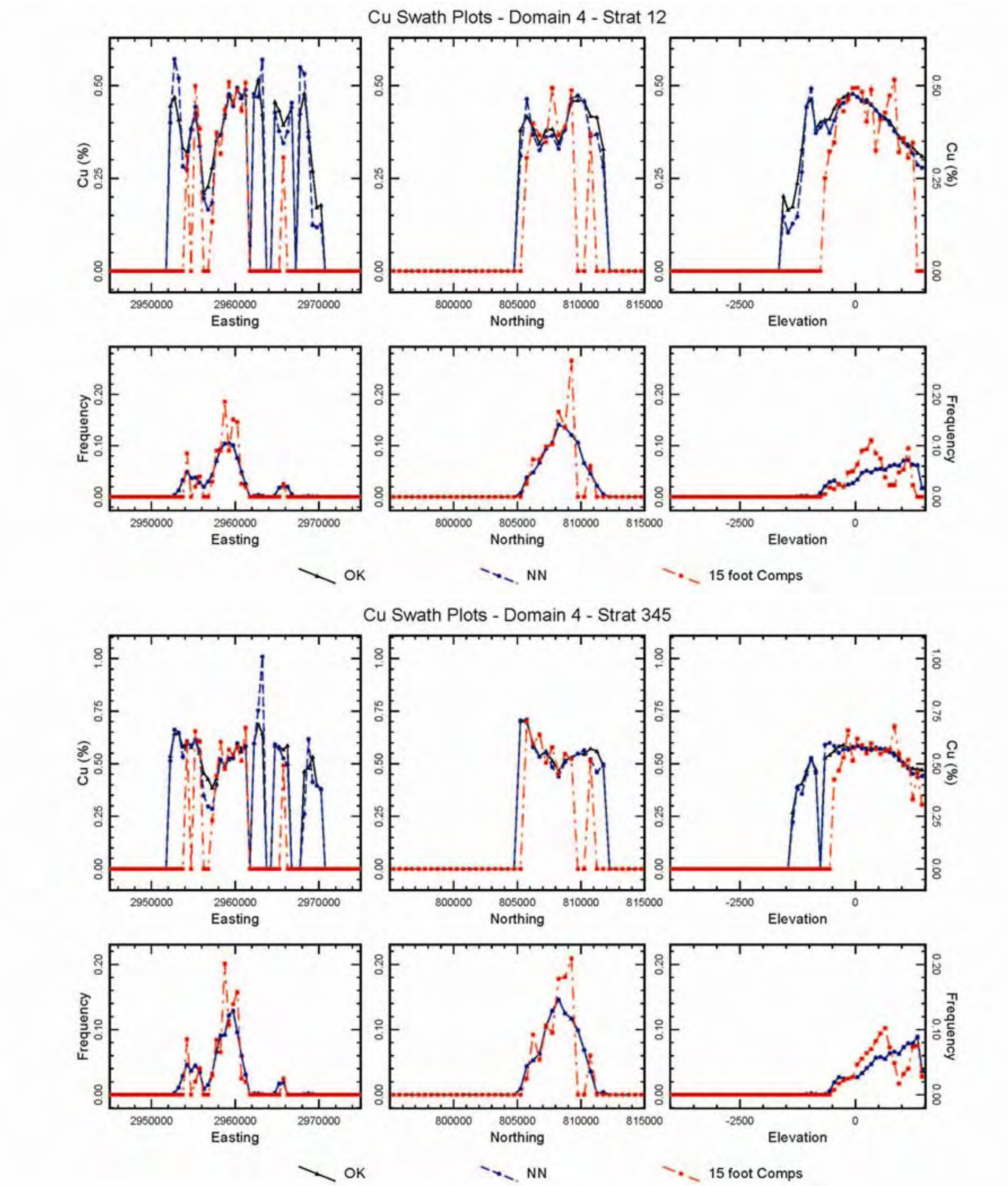


Figure 14-28: Copper Swath Plots – BMZ – Domain 4



14.3 NSR Calculation

A Net Smelter Return (NSR) was calculated for each block using a Vulcan script. Criteria for the NSR Calculation are summarized in Table 14-10. The metal prices used in the NSR calculation were mutually agreed upon by TMM, Antofagasta and AMEC on December 7, 2011. .

Table 14-10:NSR Parameters

Metal	Price (US$)	Recovery Concentrate	Recovery Platsol	Recovery Global	Payable	Refining Charge
Copper	$3.00/lb	94.80%	98.00%	92.90%	97.5%	
Nickel	$9.38/lb	72.80%	97.00%	70.62%	100.0%	
Gold	$1050/troy oz	68.40%	88.00%	60.19%	90.0%	$5.00
Palladium	$805/troy oz	85.20%	90.00%	76.68%	95.0%	$25.00
Platinum	$1840/troy oz	87.70%	90.00%	78.93%	95.0%	$25.00

14.4 Prospects for Economic Extraction

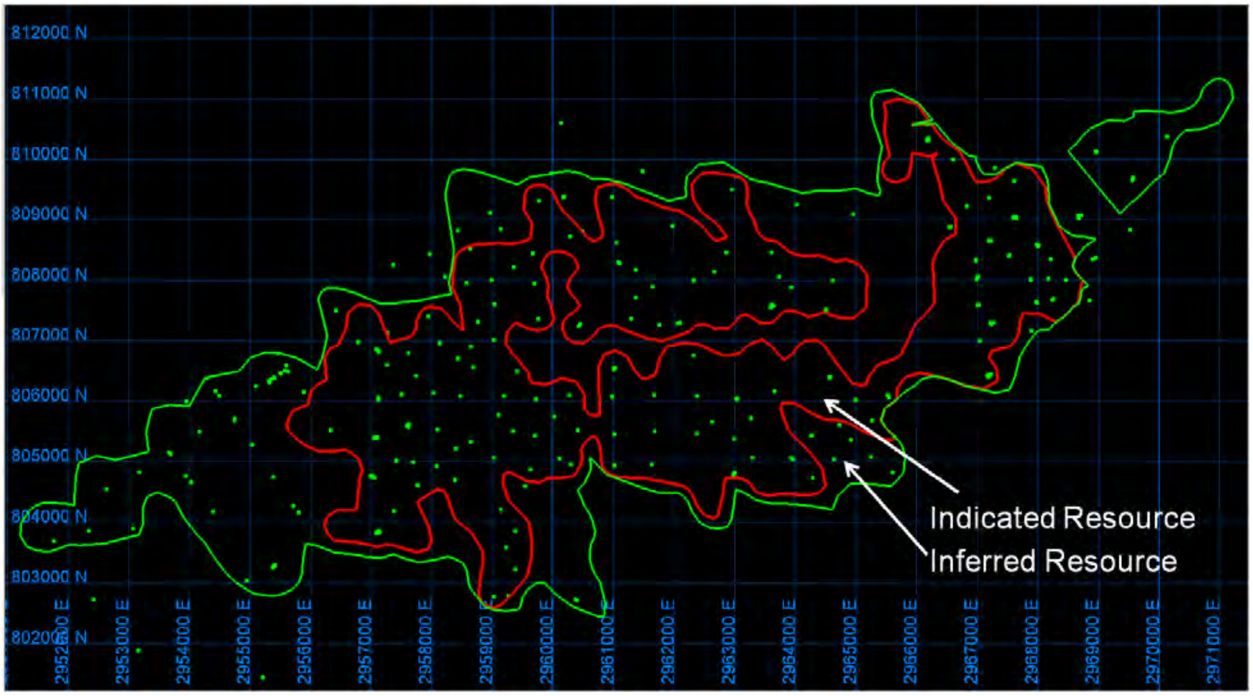
SRK (2011) evaluated a number of mining scenarios. A few of those scenarios were found to be economically attractive and were recommended for additional study. In particular, the 80ktpd option with Platsol™ processing was the most attractive. This work shows that the project has reasonable prospects for economic extraction and was the basis for the NSR parameters in Section 14.3. AMEC used the SRK (2011) study as the basis for NSR and cut-off grade calculations.

AMEC believes, based on the SRK (2011) work that all three deposits described in this Report have reasonable prospects for economic extraction and that similar cut-off parameters apply to all three deposits. AMEC cautions that economic viability can only be demonstrated through prefeasibility or feasibility studies.

14.4.1 Resource Classification

The Maturi mineral resource is designated a combination of Indicated and Inferred Mineral Resources. The Indicated Mineral Resource boundary generally extends 250 feet from well drilled areas showing continuity in NSR values and geological geometry. Areas defined by only legacy drilling are not included within the Indicated Mineral Resource outline. The Inferred Mineral Resource boundary typically extends 500 feet from well drilled areas showing continuity in NSR values and geological geometry. Overall, the drill hole spacing averages 500 feet (excluding wedges). Areas within Domain 0 were not classified as a resource; this Domain was defined as an Exploration Target. The classification outlines are shown in Figure 14-29. Drill hole collars used in the resource estimation are shown for reference.

Figure 14-29:Maturi Resource Classification



14.4.2 NSR Calculation

A Net Smelter Return (NSR) was calculated for each block using a Vulcan script. Criteria for the NSR Calculation are summarized in Table 14-11. The metal prices used in the NSR calculation were mutually agreed upon by TMM, Antofagasta and AMEC on December 7, 2011.

Table 14-11:NSR Parameters

Metal	Price (US$)	Recovery Concentrate	Recovery Platsol	Recovery Global	Payable	Refining Charge
Copper	$3.00/lb	94.80%	98.00%	92.90%	97.5%	
Nickel	$9.38/lb	72.80%	97.00%	70.62%	100.0%	
Gold	$1050/troy oz	68.40%	88.00%	60.19%	90.0%	$5.00
Palladium	$805/troy oz	85.20%	90.00%	76.68%	95.0%	$25.00
Platinum	$1840/troy oz	87.70%	90.00%	78.93%	95.0%	$25.00

14.4.3 Resource Tabulation

The base case for the Maturi Indicated and Inferred Mineral Resources uses a 0.3% copper cut-off grade. Table 14-12 shows the sensitivity of the base case Indicated Mineral Resource for the BMZ and GRB Skin Units to copper cut-off grade. Table 14-13 shows the sensitivity of the Inferred Mineral Resource for the BMZ and GRB Skin

Units by copper cut-off. The base case for 0.30% copper is gray-shaded. The Indicated and Inferred Mineral Resources are stated in Million Short Tons (Mt).

Table 14-12: Maturi Indicated Mineral Resource by Copper Cut-Off Grade

Cut-off Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	836	0.51	0.16	0.139	0.317	0.073	0.004	0.009	0.002
0.3	***726***	***0.55***	***0.17***	***0.150***	***0.342***	***0.078***	***0.004***	***0.010***	***0.002***
0.4	607	0.59	0.18	0.162	0.367	0.083	0.005	0.011	0.002
0.5	430	0.64	0.20	0.180	0.408	0.091	0.005	0.012	0.003
0.6	248	0.71	0.22	0.205	0.464	0.101	0.006	0.014	0.003

Table 14-13: Maturi Inferred Mineral Resource by Copper Cut-Off Grade

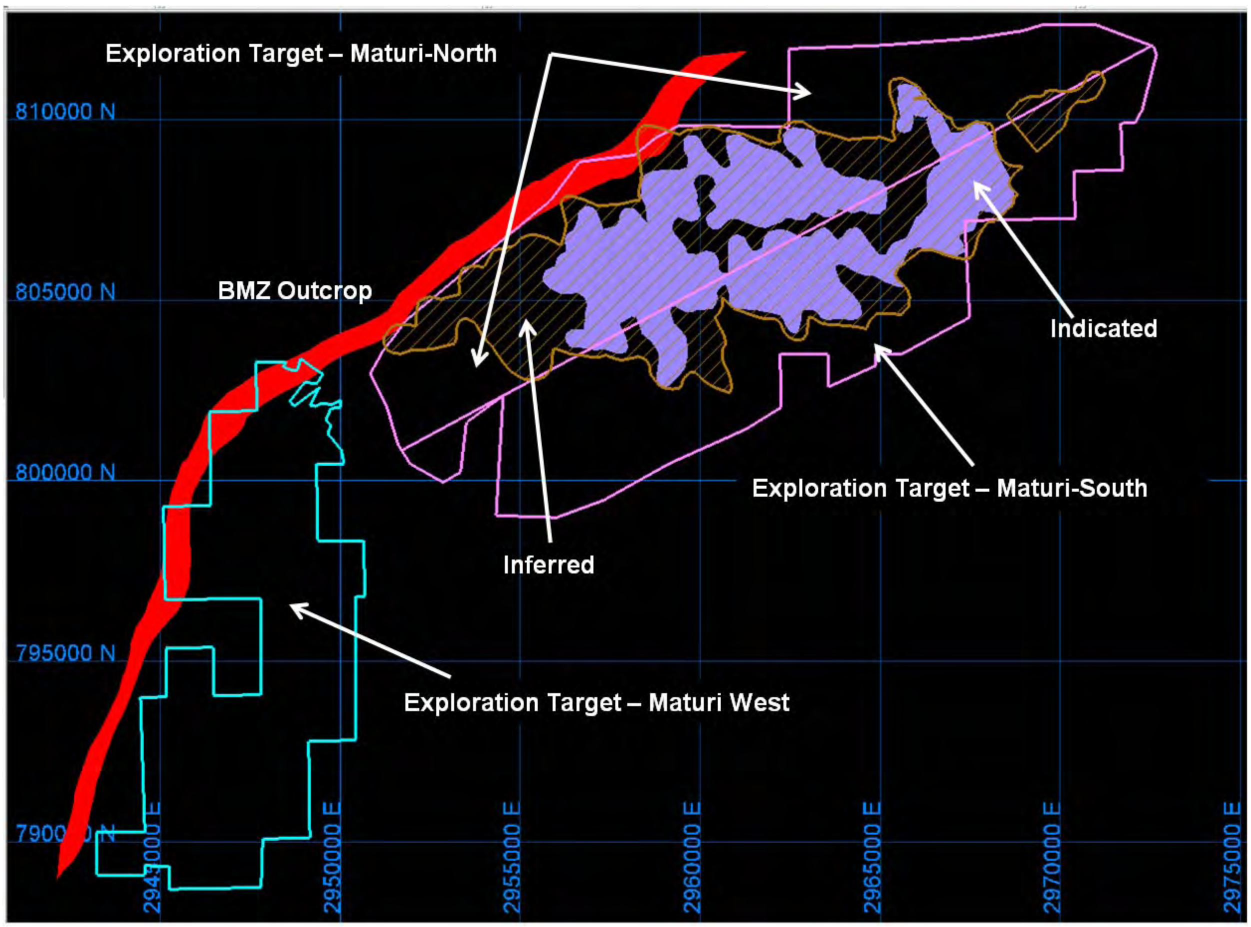
Cut-off Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	748	0.49	0.17	0.110	0.306	0.070	0.003	0.009	0.002
0.3	**651**	***0.53***	***0.18***	***0.118***	***0.328***	***0.075***	***0.003***	***0.010***	***0.002***
0.4	531	0.57	0.19	0.124	0.350	0.079	0.004	0.010	0.002
0.5	354	0.63	0.21	0.132	0.389	0.088	0.004	0.011	0.003
0.6	190	0.70	0.24	0.135	0.434	0.098	0.004	0.013	0.003

14.4.4 Exploration Targets

Canadian disclosure standards under NI 43-101 allow the estimated quantities of an exploration target to be disclosed as a range of tonnes and grade. AMEC cautions that the potential tons and grade of the exploration target are conceptual in nature, and that there has been insufficient exploration to define the exploration targets as a Mineral Resource. It is uncertain if additional exploration will result in the target(s) being delineated as a Mineral Resource.

The area inside the Maturi model perimeter surrounding the Indicated and Inferred Mineral Resources was divided into two exploration targets, Maturi North and Maturi South. An additional exploration target, Maturi West, lies outside and to the west of the current model area. The location of the exploration targets is shown in Figure 14-30. The exploration target tons have been constrained within the mineral property boundary. The tonnage and grades of the Maturi North exploration target could range from 450 to 690 Mt grading 0.44 to 0.52 %Cu, 0.16 to 0.18 %Ni, 0.002 to 0.003 oz/ton (0.08 to 0.12 ppm) Pt, 0.006 to 0.009 oz/t (0.21 to 0.29 ppm) Pd and 0.001 to 0.002 oz/t (0.05 to 0.07 ppm) Au. The tonnage and grades of the Maturi South exploration target could range from 350 to 740 Mt (million short tons) grading 0.42 to 0.55 %Cu, 0.13 to 0.17 %Ni, 0.006 to 0.008 oz/ton (0.21 to 0.28 ppm) Pt, 0.015 to 0.016 oz/t (0.51 to 0.55 ppm) Pd and 0.002 to 0.004 oz/t (0.09 to 0.13 ppm) Au. The tonnage and grades of the Maturi West exploration target could range from 600 to 980 Mt (million short tons) grading 0.41 to 0.52 %Cu, 0.15 to 0.18 %Ni, 0.003 to 0.004 oz/ton 0.10 to 0.13 ppm) Pt, 0.008 to 0.009 oz/t (0.26 to 0.32 ppm) Pd and 0.002 to 0.002 oz/t (0.06 to 0.08 ppm) Au. The range of PM values stated for Maturi West, are based on regression formulas defined for Domain 23.

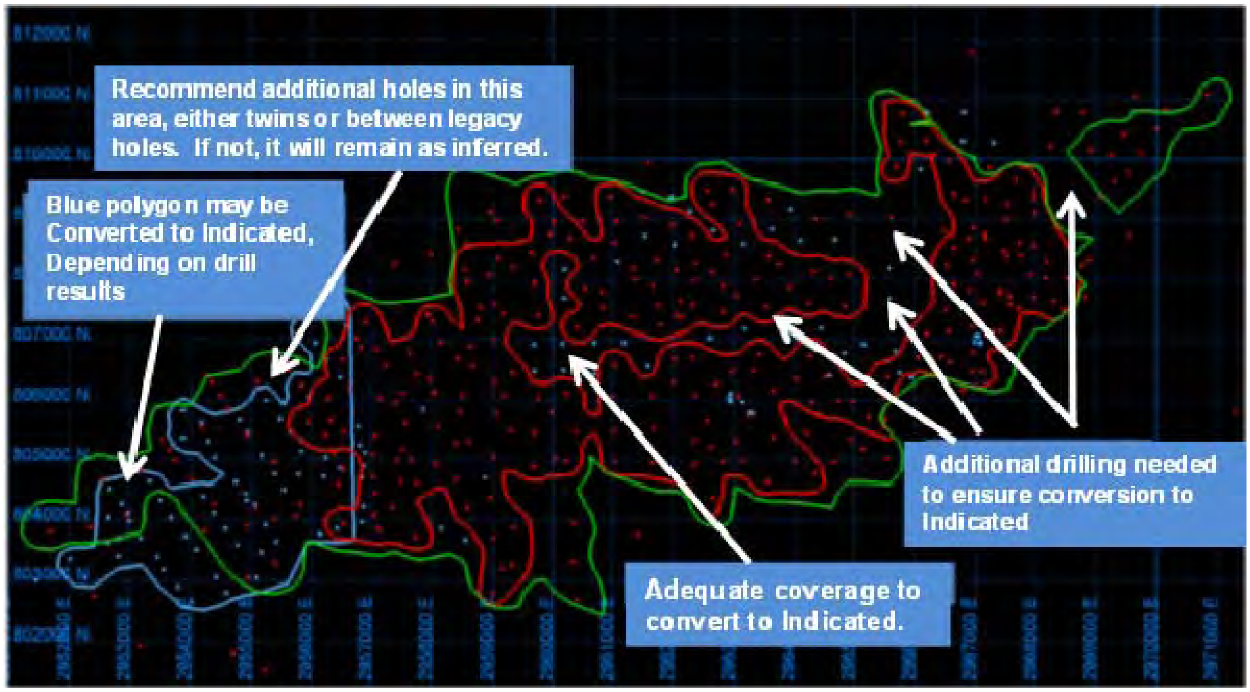
Figure 14-30: Maturi Exploration Targets



14.4.5 Maturi Conclusions and Recommendations

The Maturi deposit contains a significant Mineral Resource currently classified as Inferred. It is possible the classification of this resource could be upgraded with additional drilling. TMM has a current drill program in place. Several holes have been added to their database, and several additional drill holes are planned. AMEC has reviewed TMM's proposed drill program and recommended additional drill holes in areas to reduce the current drill hole spacing. The proposed drill program and AMEC's recommendations are shown in Figure 14-31.

Figure 14-31:Maturi Proposed Drill Program and Recommendations



14.5 Birch Lake Resources

Lake Deposit resource model update was completed with 79 drill holes (191,341 ft) that were drilled between 1970 and 2010. A database review was completed in July 2011 (Wakefield, 2011) and QA/QC data was reviewed in the fall of 2011 (Wakefield, 2012). AMEC completed field checks of drill hole collars and reviewed the deviation surveys in September 2011, and these checks are summarized in this report.

The 2011 resource model was completed using Vulcan Software. The estimation was completed using the Vulcan Unfolding (Tetra-Projection) methodology and Ordinary Kriging (OK). Model validation consisted of Box Plots and Swath plots.

14.5.1 Database

AMEC was provided with the TMM master database on 31 August 2011. The database included all drilling for the TMM properties (Maturi Deposit, Birch Lake Deposit and Spruce Road Deposit). The TMM database includes the following tables:

- Assay
- Birch_Lake_Major_Lithology
- Birch_Lake_Major_Mineralogy
- Birch_Lake_Minor_Lithology
- Birch_Lake_Minor_Mineralogy
- Collar
- Mineralogy
- Nokomis_Maturi_Unit_Geology
- NIRR_PGE_ETC
- RQD
- Specific Gravity
- Survey
- TMM_Lithologic
- Unique_Litho_Codes.

The Birch Lake Deposit collar, survey, and assay data were included in the collar, survey, and assay tables respectively. The Birch Lake lithology and mineralogy data are contained in the Birch_Lake tables. Unit picks for the stratigraphic units to be modeled were provided in a separate file (*blgeol.xls*). The collar, survey, assay, Birch Lake Major Lithology, Birch Lake Major Mineralogy, Birch Lake Minor Lithology, Birch Lake Minor Mineralogy and *blgeol* files were exported to csv for import into Vulcan

14.5.2 Birch Lake Database Audit

AMEC completed a database audit of the TMM database in June, 2011 (Wakefield, 2011a). Wakefield (2012) summarized the review of the QA/QC of the Birch Lake data.

AMEC completed field checks of collar locations of Birch drill holes in September 2011. AMEC also reviewed downhole survey data and completed an inspection of drill core and geological logging.

The 2011 Birch Lake model update included 79 DDH drill holes (191,341 ft) that were completed in drill campaigns between 1971 to 2010 (Table 14-16). Core diameter ranges from NQ to PQ.

The Birch Lake database includes many wedge drill holes that were completed primarily to obtain mineralized material for metallurgical sampling (Table 14-17).

Due to issues regarding the deviation surveys, the wedge drill holes were not used for the Birch Lake resource model.

Table 14-14: Birch Deposit Drill Campaigns

Year	Company	Drill Type	No Drill Holes	Total Meters
Duval	Duval	Core	5	13.525
KCC	Kennecott	Core	1	2,402
1989	BBJV	Core	2	5,275
1990	Lehman	Core	2	5,117
1995	BBJV	Core	2	4,520
1999	BBJV	Core	2	5,368
2000	Franconia	Core	11	24,329
2001	Franconia	Core	7	16,944
2005	Franconia	Core	4	10,973
2006	Franconia	Core	6	14,705
2007	Franconia	Core	17	41,853
2008	Franconia	Core	9	17,093
2010	Franconia	Core	11	29,238
Total			79	191,341

Table 14-15: Birch Lake Deposit Wedge Holes

Year	Company	No Wedges From Pilot	Total Wedge Meters
D5	Duval	1	125.0
DU-15	Duval	1	165.0
DU9	Duval	1	187.0
BL90-3	Lehmann	1	246.0
BL95-1	BBJV	1	539.0
BL98-1	BBJV	1	130.4
BL99-1	BBJV	1	165.0
BL00-01	Franconia	2	214.0
BL00-02	Franconia	2	683.0
BL00-03	Franconia	1	66.1
BL00-04	Franconia	2	970.3
BL00-05	Franconia	2	1034.7
BL00-06	Franconia	3	733.0
BL00-07	Franconia	3	734.0
BL00-08	Franconia	3	603.2
BL00-09B	Franconia	1	243.0
BL00-10	Franconia	1	227.0
BL00-11	Franconia	2	236.5
BL01-1	Franconia	3	247.5
BL01-2	Franconia	3	730.7
BL01-3	Franconia	3	314.2

Year	Company	No Wedges From Pilot	Total Wedge Meters
BL01-4	Franconia	3	1837.0
BL01-5	Franconia	3	636.3
BL01-6	Franconia	2	596.0
BL01-7	Franconia	2	872.0
BL05-1	Franconia	1	514.7
BL05-3	Franconia	2	769.0
BL05-4	Franconia	1	199.0
BL06-1	Franconia	4	1989.7
BL06-2	Franconia	4	1865.5
BL06-3	Franconia	4	1331.9
BL06-4	Franconia	4	1013.1
BL06-5	Franconia	4	970.3
BL06-6	Franconia	4	2197.1
BL07-1	Franconia	4	1270.6
BL07-2	Franconia	4	1629.5
BL07-3	Franconia	4	1407.1
BL07-4	Franconia	2	1974.5
BL07-5	Franconia	4	1063.9
BL07-6	Franconia	4	1002.4
BL07-8	Franconia	4	1644.4
BL07-9	Franconia	4	1161.5
BL07-10	Franconia	1	621.3
BL07-11	Franconia	18	8662.3
BL07-12	Franconia	1	315.6
BL07-13	Franconia	4	2014.2
BL07-14	Franconia	10	5225.8
BL07-15	Franconia	4	1632.1
BL07-16	Franconia	4	1212.0
BL07-18	Franconia	4	1137.7
BL08-1	Franconia	4	1964.3
BL08-2	Franconia	1	419.9
Total		155	59138.8

Collar Field Checks

AMEC located 24 Birch Lake drill collars in the field. Each drill collar drilled from land has been marked with a steel stand-pipe welded to the casing that extends 4 to 6 ft above the ground surface (Figure 14-34). The stand-pipes are sealed with a steel cap welded to the stand-pipe, and each drill hole is labeled with drill hole ID using an aluminum tag.

The drill holes that were completed from the surface of Birch Lake using a barge are not recoverable. Drill holes that were drilled from the barge were cemented, and the casing was cut 6 to 18 inches below the bottom of the lake.

Figure 14-32: Collar Location and Hole ID Tag for Birch Drill Hole BL06-04

14.5.3 Coordinate Field Checks

AMEC captured the longitude and latitude coordinates for the 24 drill holes using a GARMIN hand held GPS. The longitude and latitude were converted to MN State Plane coordinates using Corpson Software Ver 5.11.08 (US Corp of Engineers). Table 14-18 summarizes the results of the AMEC field checks of collar locations. Generally, the collars are ±10 ft of the coordinates in the TMM database and are considered to be within the accuracy of the hand-held GPS unit.

Table 14-16: Comparison of Birch Lake Collar Field Checks

Corpscon Input Reformat to degrees, minutes, seconds							Corpscon Output MN State Plane Coordinates		TMM Database MN State Plane Coordinates		Relative Difference (ft)	
HoleID	Latitude			Longitude			North	East	North	East	North	East
BL00-2	47°	43'	27.30"	91°	48'	33.48"	2942308.34	777268.71	2942308.32	777283.87	0.02	-15.16
BL00-3	47°	43'	25.62"	91°	48'	19.20"	2943287.29	777114.84	2943228.86	777145.03	58.44	-30.19
BL00-9A	47°	43'	28.26"	91°	48'	48.96"	2941248.58	777348.32	2941257.20	777373.98	-8.61	-25.66
BL00-9B	47°	43'	28.26"	91°	48'	48.96"	2941248.58	777348.32	2941257.57	777377.45	-8.98	-29.13
BL01-6	47°	43'	44.70"	91°	48'	29.40"	2942557.76	779036.05	2942572.78	779082.06	-15.01	-46.01
BL05-1	47°	43'	42.36"	91°	48'	28.98"	2942590.43	778799.48	2942588.10	778799.34	2.33	0.14
BL05-3	47°	43'	0.90"	91°	48'	26.70"	2942714.86	780680.26	2942720.97	780683.15	-6.11	-2.89
BL06-1	47°	43'	22.44"	91°	48'	38.16"	2941996.65	776771.03	2941999.52	776773.26	-2.87	-2.23
BL06-2	47°	43'	42.42"	91°	48'	29.22"	2942573.93	778805.29	2942566.22	778809.44	7.71	-4.15
BL06-4	47°	43'	29.40"	91°	48'	28.56"	2942641.09	777487.06	2942637.12	777499.73	3.97	-12.67
BL06-5	47°	43'	22.50"	91°	48'	38.58"	2941967.84	776776.63	2941980.44	776779.12	-12.60	-2.49
BL06-6	47°	43'	27.36"	91°	48'	32.94"	2942345.15	777275.40	2942326.61	777277.98	18.54	-2.58
BL07-5	47°	43'	48.06"	91°	48'	32.64"	2942330.63	779372.73	2942337.32	779377.20	-6.69	-4.47
BL06-3	47°	43'	9.90"	91°	48'	34.08"	2942195.27	781583.57	2942195.40	781575.36	-0.13	8.21
BL07-7	47°	43'	48.06"	91°	48'	32.64"	2942330.63	779372.73	2942334.13	779372.89	-3.50	-0.15
BL07-11	47°	43'	9.72"	91°	48'	34.26"	2942183.27	781565.13	2942186.51	781557.98	-3.23	7.14
BL07-9	47°	43'	47.94"	91°	48'	32.64"	2942330.83	779360.58	2942333.79	779356.00	-2.96	4.58
BL07-14	47°	43'	0.66"	91°	48'	25.98"	2942764.47	780656.77	2942724.45	780653.05	40.03	3.72
BL07-15	47°	43'	0.48"	91°	48'	26.16"	2942752.48	780638.33	2942748.09	780641.11	4.39	-2.78
BL07-16	47°	43'	0.78"	91°	48'	26.64"	2942719.16	780668.17	2942724.67	780667.20	-5.50	0.98
BL10-2	47°	43'	9.42"	91°	48'	34.62"	2942159.18	781534.33	2942163.40	781536.71	-4.22	-2.38
BL10-3	47°	43'	9.42"	91°	48'	34.62"	2942159.18	781534.33	2942165.16	781533.79	-5.98	0.53
BL10-9	47°	43'	39.84"	91°	48'	3.48"	2944337.63	778573.41	2944336.42	778572.22	1.21	1.19
BL10-10	47°	43'	39.84"	91°	48'	3.48"	2944337.63	778573.41	2944337.67	778561.13	-0.04	12.28

Down-Hole Surveys

The Birch Lake drilling includes numerous wedges completed from the initial pilot drill hole. The primary purpose of the wedges was to obtain sample material for metallurgical testing.

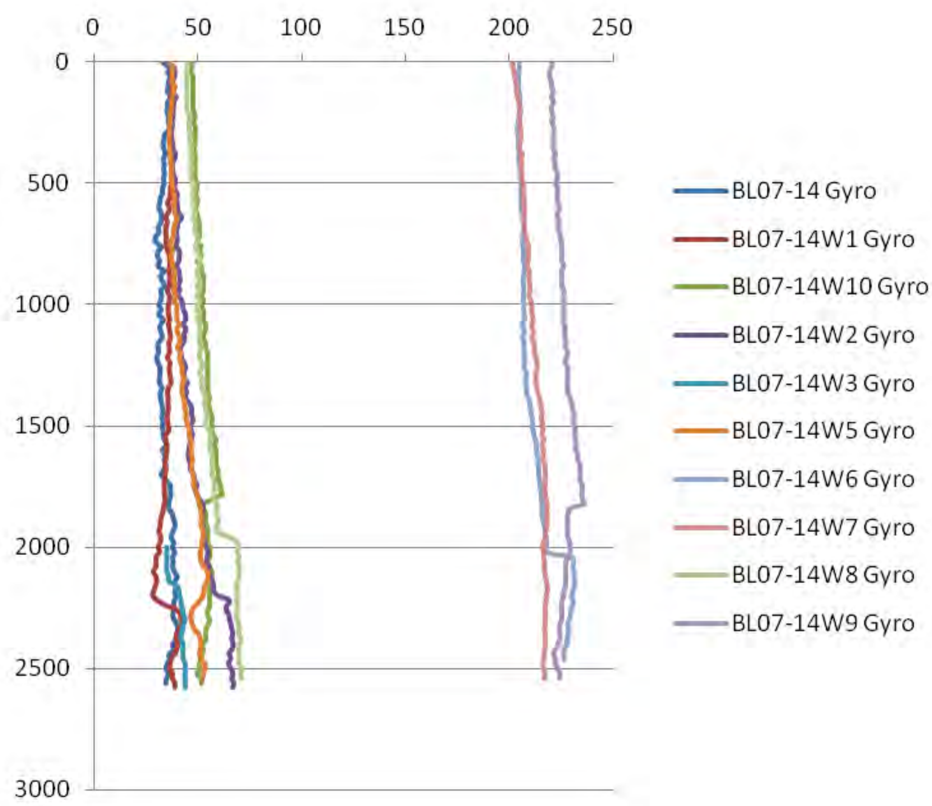
Generally, each wedge was surveyed from collar to the total depth of the wedge. The survey methods were either a Flexit Gyro™, a gyroscopic survey instrument or a Flexit MultiSmart™ tool, a magnetic tool. The reliability of the Flexit MultiSmart™ is questionable in areas containing significant quantities of magnetite magnetite such as in the Birch Lake area.

AMEC reviewed the down-hole survey data in the Birch Lake drill data and observed inconsistencies. Surveys were completed on many wedge holes from collar to total depth. This provided the opportunity to compare the numerous surveys that were completed on each pilot drill holes.

AMEC observed significant differences between surveys of the same pilot hole. Figure 14-33 displays azimuth data versus depth for BL07-14 including the pilot hole (BL07-

14) and 10 wedge holes (BL07-14W1 to BL07-14W10). The pilot drill hole and each wedge was surveyed with a gyro from the total depth to the collar, resulting in the pilot hole above the wedge points being surveyed 11 times. In Figure 14-33, there are 4 azimuths noted from the 11 surveys (approximately 40°, 50°, 200° and 220°). The significant differences between the different surveys indicate issues with the quality of the deviation surveys. Additional investigation is required. AMEC recommends that the available drill holes be resurveyed and then compare the new data with the data in the drill hole database.

Figure 14-33:Plots of Down-Hole Azimuth Data from Eleven Gyroscopic Surveys from Birch Lake Drill Holle BL07-14



Assays

Assay data were reviewed by AMEC during the database audit. Results of that review are reported in Wakefield (2011). AMEC found no errors in the assay database.

Un-sampled Intervals

Early campaigns in the Birch Lake area did not sample the full extent of the Basal Mineralized Zone (BMZ). The un-sampled intervals within the BMZ create issues during the grade estimation. Table 14-17 lists Birch Lake drill holes that AMEC observed to have un-sampled drill intersections in the BMZ. The unsampled intervals range in length from 1 ft to 198 ft. AMEC recommends that intervals exceeding 5 ft in length should be sampled. For the purpose of the resource model, the detection limit value for each element was used to populate the un-sampled interval fields. The detection limit for the elements is summarized in Table 14-18.

Table 14-17:Birch Lake Drill Holes with Un-Sampled BMZ Intervals

Hole	UNIT
BL95-1	BMZ
BL95-1W	BMZ
BL99-1	BMZ
BL99-2	BMZ
BL00-1	BMZ
BL00-10	BMZ
BL00-10W1	BMZ
BL00-2	BMZ
BL00-2W1	BMZ
BL00-2W2	BMZ
BL00-3	BMZ
BL00-4	BMZ
BL00-4W3	BMZ
BL00-4W4	BMZ
BL00-5	BMZ
BL00-6	BMZ
BL00-6W1	BMZ
BL00-6W2	BMZ
BL00-6W3	BMZ
BL00-7	BMZ
BL00-7W1	BMZ
BL00-7W2	BMZ
BL00-7W3	BMZ
BL00-8	BMZ
BL00-8W1	BMZ
BL00-8W2	BMZ
BL00-8W3	BMZ
BL00-9A	BMZ
BL00-9B	BMZ
BL00-9B-W1	BMZ
BL01-1	BMZ
BL01-1W1	BMZ
BL01-1W2	BMZ
BL01-2	BMZ

Hole	UNIT
BL01-3	BMZ
BL01-4	BMZ
BL01-5W2	BMZ
BL05-1	BMZ
BL05-3	BMZ
BL05-4W1	BMZ
BL06-5	BMZ
BL06-5W2	BMZ
BL06-5W3	BMZ
BL07-10	BMZ
BL07-2W3	BMZ

Table 14-18: Values used for Birch Lake Un-Sampled Intervals

Hole	UNIT
Copper	0.001
Nickel	0.001
Platinum	0.005
Palladium	0.001
Gold	0.001
Silver	0.100
Cobalt	0.250
Magnesium	0.005
Sulfur	0.005

Regressions for Missing Data (Assays)

The TMM database includes assay intervals that have not been analyzed for the suite of elements estimated in the resource model (Cu, Ni, Pd, Pt, Au, Ag, Co, S). Missing data in the BMZ potentially creates grade smearing issues and may cause an over estimation of high-grade mineralization. Conversely, using detection limit values for these intervals may adversely affect the grade estimation.

Generally, samples were analyzed for copper and nickel. Analysis for platinum, palladium, gold, silver, cobalt, magnesium and sulfur were completed for some drill campaigns and are missing in other campaigns. AMEC developed regression formulas in Excel™ based on copper and nickel. The copper regressions were chosen to estimate missing analysis for Au, Pt, Pd, Ag, Co, Mg, and sulfur. Regression plots for Au, Pt, Pd, Ag, Co, Mg, and sulfur are presented in Figure 14-34. A Vulcan fcl script (*set_assay_regressions.fcl*) was used to apply the regression formulas to the Vulcan Isis drill hole database. Regression values that resulted in negative values were given the detection value for the element (Table 14-18).

AMEC recommends TMM review the database for sample intervals with incomplete data. These intervals should be submitted for analysis if sample material is available.

Lithology

AMEC checked drill core against geology logs for 8 drill holes. AMEC checked the major lithology intervals noted on the geology logs as well as the Unit intervals that were used to construct the geological model. Table 14-19 summarizes the drill core that was reviewed.

The geological logging was summarized using software owned by a geologist that has departed. This creates issues for continuity of geologic logs. AMEC recommends that standardized software should be adopted. AMEC considers the geological logging of the Birch Lake Deposit drill holes to be adequate and notes a significant improvement in the geological logs in recent drill campaigns. AMEC recommends drill holes from earlier campaigns be relogged to maintain consistency. AMEC recommends a reference collection of rock types be established and made available to geologists tasked with the geological logging. AMEC recommends a geologist mark the saw cuts on the core for sampling.

AMEC recommends that whole rock analysis be completed for each sample interval in the BMZ for two drill holes. Elemental ratios can be plotted and the amount of silicate nickel can be established.

AMEC noted intervals of high concentrations of magnetite. High-magnetite intervals should be noted so that magnetite zones can be modeled as they may present milling issues. AMEC recommends magnetic susceptibility be measured on the core.

AMEC observed no lithology issues during the audit of the TMM database.

Figure 14-34:Regressions Based on Copper Grades

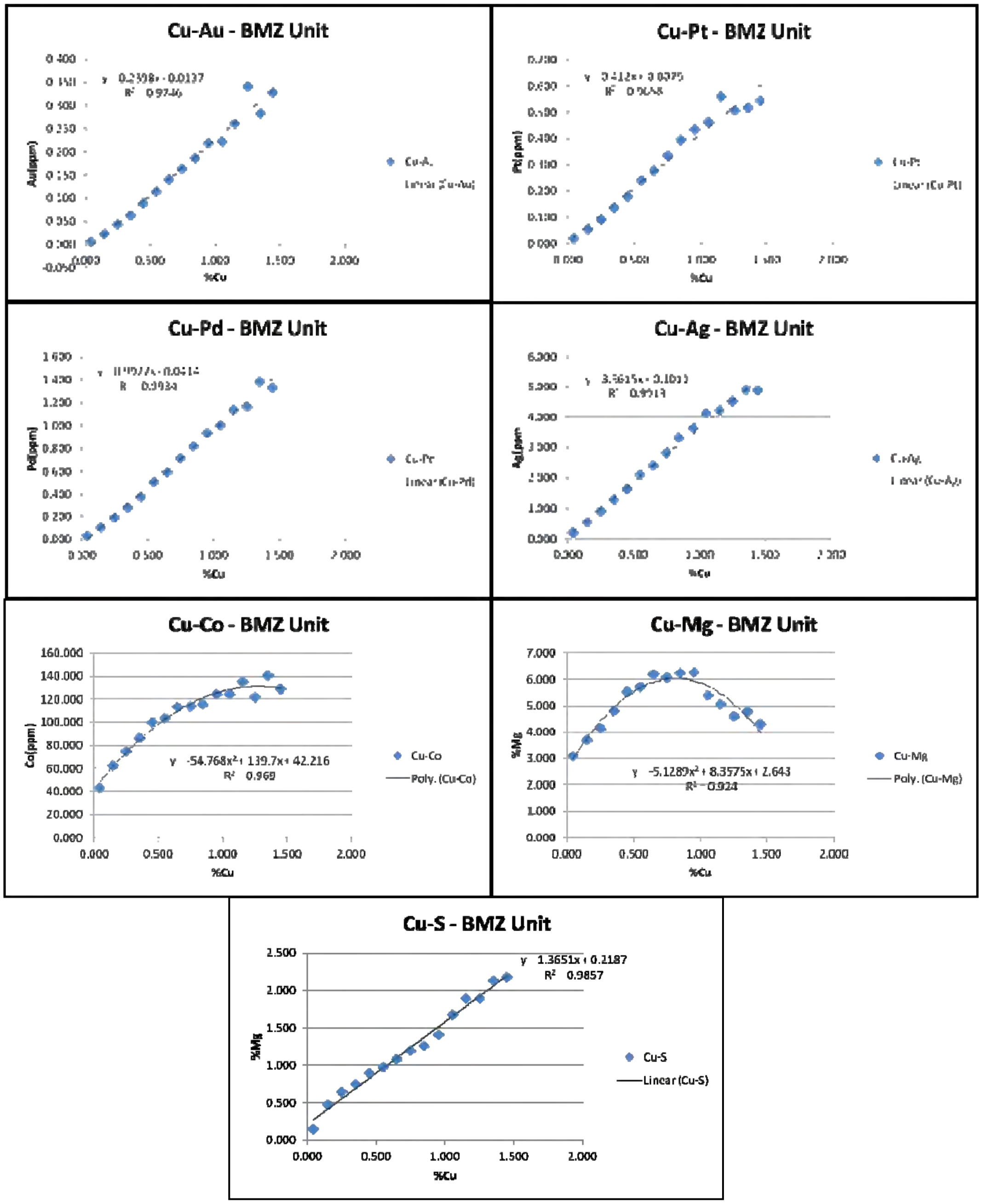


Table 14-19: Drill Hole Compared for Geological Logs and Drill Core

Hole	UNIT
BL07-03	Babbitt
BL07-08	Babbitt
BL07-13	Babbitt
BL101-05	Babbitt
BL01-7	Hibbing
BL90-1	Hibbing
BL00-7	Hibbing
BL05-3	Hibbing

Birch Lake Deposit Unit Codes

In addition to the data provided in the Master DB, TMM provided AMEC with unit picks for the PEG, BMZ and GRB in a separate Excel™ file (BL Geological Units.xls). This file included HoleID, From and To drill depths, Unit Code (PEG, BMZ, and GRB) and a comment field. AMEC added a HW (Hanging Wall) Unit to the data that extends from 0 ft to the top of the first Unit pick. The Unit code data was imported into Vulcan. Table 14-20 summarizes the Unit Coding for drill hole data, composites codes and the resource model block codes.

Table 14-20: Lithology Codes for Assays, Composites, Block Model

Rock Type	Assays	Composites	Model
Hanging Wall	HW	100	100
Pegmatite	PEG	200	200
Basal Mineralized Zone	BMZ	300	300
Granites Range Batholith	GRB	400	400

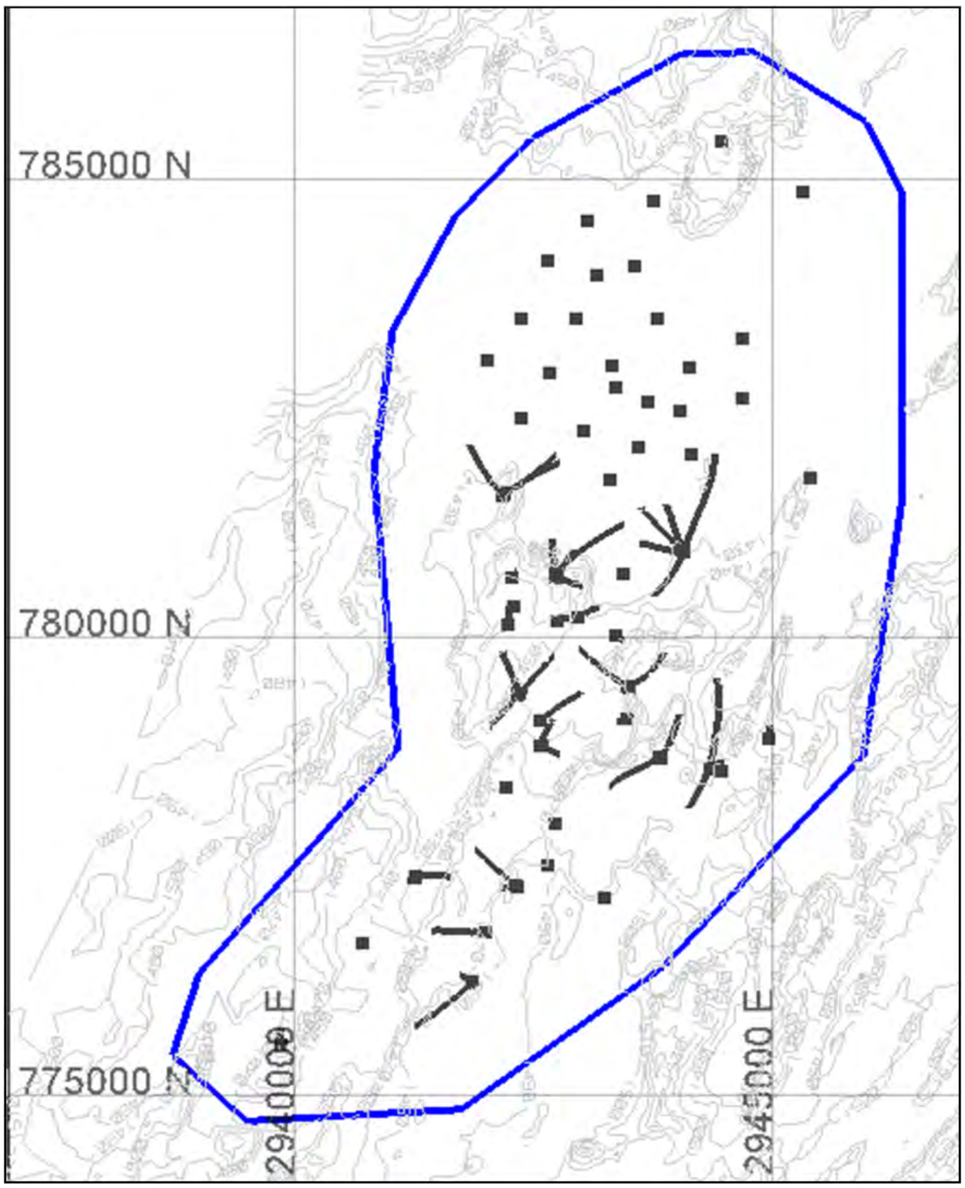
AMEC noted that the Unit intervals picks are subjective. AMEC observed that PEG interval picks do not readily correlate between the wedge drill holes. In some instances the beginning of the PEG unit is picked at the start of the wedge when it is actually in the pilot hole. AMEC also noted that PEG unit is present in some wedge holes but is absent from adjacent wedge holes, suggesting either an inconsistency in the determination of the PEG unit or PEG is not a consistent widespread mappable unit that can be used as a marker bed.

The lower contact of the BMZ with the GRB is more reliable. Minor inconsistencies were noted with the metasedimentary rocks at the top of the Granitic rocks of the GRB.

AMEC recommends TMM geological staff construct cross sections of the Birch Lake units. Correlation issues between wedge holes should be identified, and if a correlation of the PEG is not possible, the core should be re-logged to eliminate the discrepancy.

The Birch Lake Deposit area defined for the 2011 resource model update is presented in (Figure 14-35). The extent of the block model was determined by nominally adding 1,000 ft beyond the drill hole data.

Figure 14-35:Birch Lake Deposit Model Areas



14.5.4 Geology Model

The Birch Lake geological model was defined using the 4 Unit Codes (HW, PEG, BMZ, GRB). All rocks above the PEG (or above the BMZ where the PEG does not exist) were considered HW. All rocks below the bottom of the BMZ were considered GRB.

Gridded surface models (25 X 25) were created for the Top of PEG, Top of BMZ and Top of GRB using Vulcan grid modeling functions. Where the PEG unit did not exist, the Top of PEG and Top of BMZ grid surfaces were coincident. The grid modeling functions can be captured in a Vulcan GridCalc Macro that permits quick updates as new data are acquired and interpretations are modified. The grid surfaces were converted to surface triangulations using spot elevations from the drill holes. These triangulations were used to control compositing and the construction of the block model. Composite and block codes are summarized in Table 14-22.

14.5.5 Composites

The Birch Lake assay data were composited to 15 ft length composites using Vulcan procedures. The triangulated surfaces for the Topography, Top of PEG, Top of BMZ and Top of GRB were used to control the compositing. The stitching option was implemented and composites <7.5 ft in length were added to the previous composite when the previous composite was of the same unit code. The Birch Lake composite database contains 12,605 composites. The BMZ contains 2,716 composites.

Determination of Main Zone Composites

TMM asked that the November 2011 resource model include estimated grades for the entire BMZ unit (Main Zone and Lower Unit). For expediency, the Main Zone within the BMZ was identified using a PACK model methodology. The IND1 field for each 15 ft composite was given the integer code of 1 (IND1=1) if the composite met the criteria defining the Main Zone:

IND1 = 1; when Cu-Pd Ratio < 20,000 (based on ppm) and Cu > 0.30%

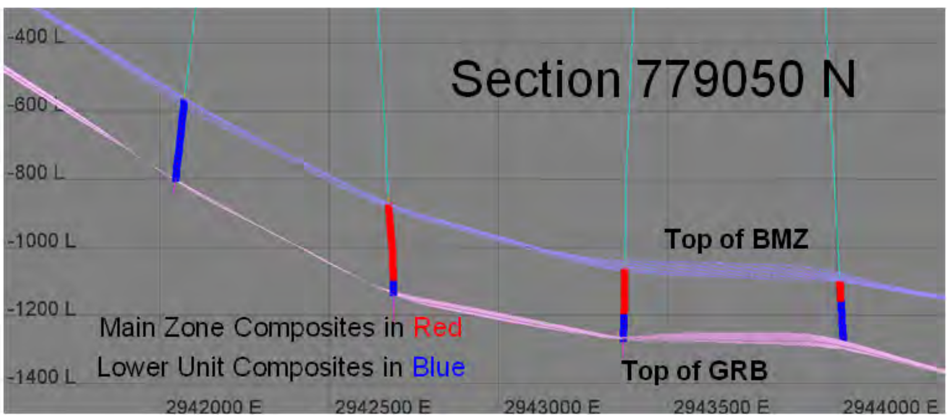
Composites that did not meet these criteria were coded 0 (IND1=0) for the Lower Unit. These criteria were defined early in the program at Birch Lake as a useful tool to determine mineralized versus non-mineralized material. The Cu-Pd ratio was used to initially code the assays as BMZ or other. The minimum Cu grade was imposed to restrict the indicators to significantly mineralized material.

Flipping

The coded composites were inspected on cross-section. In the event that composites outside the main body of mineralization were found, those with IND1 = 1 were flipped to 0. Composites within the area interpreted to be Main mineralized area coded IND1=0 were flipped to IND1=1. This is a manual exercise that relies on some interpretation of the Main and Lower zones. The procedure, with rare exception, is very reproducible because of the consistency of the mineralized and non-mineralized intervals.

Figure 14-36 is a representative cross-section showing the coded Main Zone and Lower Unit Composites within the BMZ.

Figure 14-36:Birch Lake Geological Section 684032 E (looking West) with Drill Holes

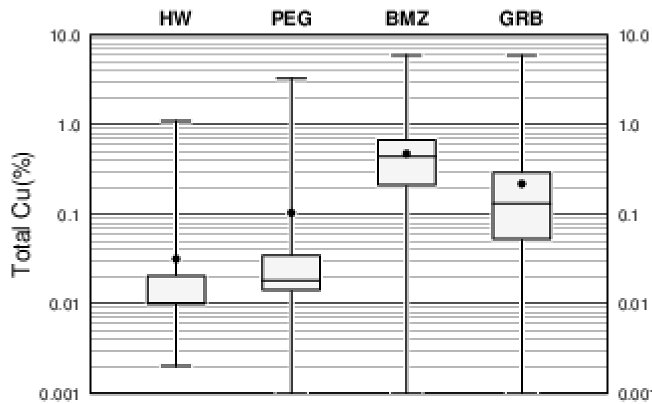


14.5.6 Exploratory Data Analysis

Assays

Exploration data analysis (EDA) for assay data was limited to box plots. Lithology codes were added to each assay interval by creating straight composites of the drill hole database. The straight composites convert the assay intervals in the drill hole database to a sample database. Assay intervals are retained, and a lithology code is added to each assay interval. Boxplots were constructed to compare the numerous rock types identified in the lithology table. Boxplots were also constructed for the Unit codes. Figure 14-37 displays a boxplot for copper assays by unit code.

Figure 14-37:Birch Lake Deposit Copper Assays by Unit



	HW	PEG	BMZ	GRB	
Number of data	438	525	17270	3094	Number of data
Mean	0.0311	0.1039	0.472	0.2182	Mean
Maximum	1.09	3.21	5.93	5.9	Maximum
Upper quartile	0.02	0.034	0.673	0.292	Upper quartile
Median	0.01	0.018	0.441	0.132	Median
Lower quartile	0.01	0.014	0.211	0.053	Lower quartile
Minimum	0.002	0.001	0.001	0.001	Minimum
Variance	0.0089	0.0727	0.1132	0.0815	Variance
CV	3.0375	2.5947	0.7128	1.3081	CV
Skewness	6.8493	5.9113	1.6205	5.6877	Skewness

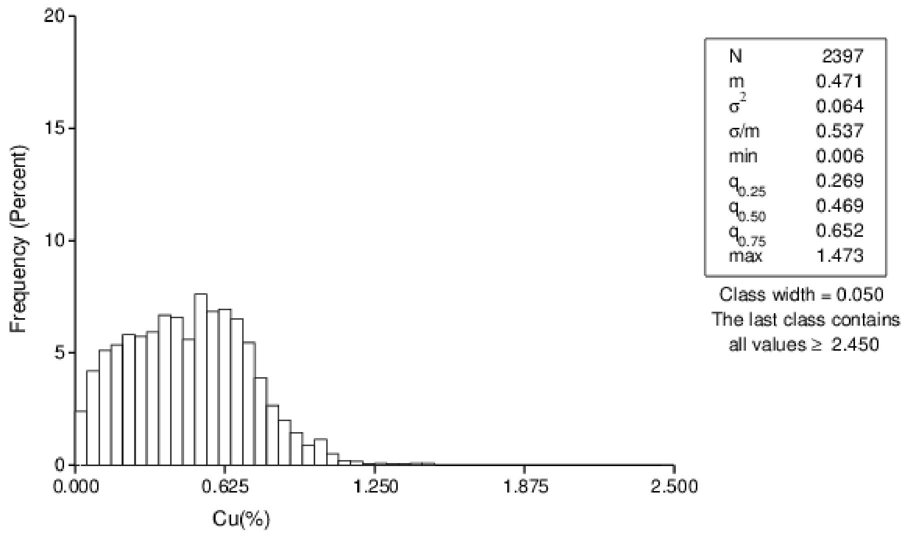
Composites

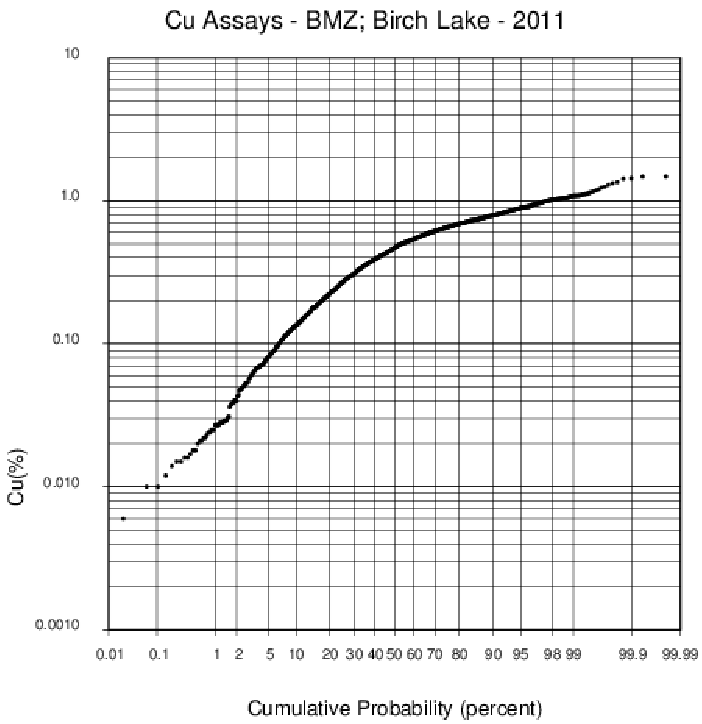
Exploratory data analysis (EDA) of the 15 ft composites consisted of Histograms, Boxplots and contact profiles. The 15 ft composites were coded as Main Zone or Lower Unit.

Histograms and Probability Plots

Histograms and probability plots were completed for copper, nickel, platinum, palladium, gold, silver, cobalt and sulfur. Probability plots for the BMZ generally display a curvilinear profile suggesting multiple populations. The histogram and probability plot for copper in the BMZ is displayed in Figure 14-38 and appears to show two overlapping lognormal populations.

Figure 14-38: Birch Lake Copper Histogram and Probability Plot – 15 ft Composite



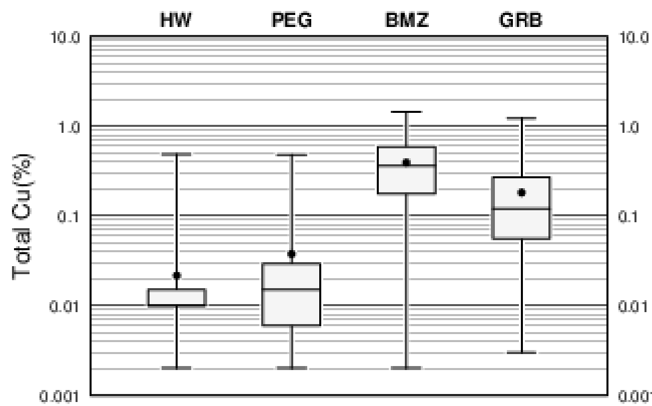


Boxplots

Boxplots were completed for the 15 ft composites by Unit. Those boxplots display the higher-grade mineralization in the BMZ unit. Figure 14-39 displays the boxplot for copper.

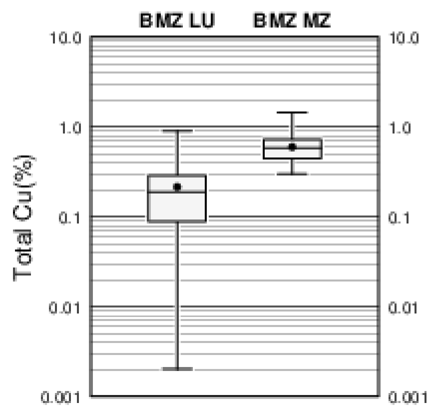
Boxplots were also completed for the Main Zone and the Lower Unit of the BMZ unit. Figure 14-40 displays the copper boxplot of the Main Zone and Lower Unit of the BMZ.

Figure 14-39: Birch Lake Copper Boxplot by Unit Code (15 ft Composites)



	HW	PEG	BMZ	GRB
Number of data	217	61	979	263
Mean	0.0215	0.0374	0.3886	0.1803
Maximum	0.48	0.475	1.437	1.229
Upper quartile	0.015	0.029	0.579	0.2675
Median	0.01	0.015	0.356	0.119
Lower quartile	0.01	0.006	0.1758	0.0553
Minimum	0.002	0.002	0.002	0.003
Variance	0.0028	0.0054	0.0673	0.0304
CV	2.4514	1.9717	0.6674	0.9666
Skewness	6.1635	4.0872	0.5445	1.9122

Figure 14-40: Birch Lake Copper Boxplot by Main Zone and Lower Unit (15 ft Composites)



	BMZ LU	BMZ MZ	
Number of data	536	443	Number of data
Mean	0.2148	0.5972	Mean
Maximum	0.897	1.437	Maximum
Upper quartile	0.2876	0.719	Upper quartile
Median	0.1896	0.579	Median
Lower quartile	0.089	0.442	Lower quartile
Minimum	0.002	0.3	Minimum
Variance	0.0266	0.0363	Variance
CV	0.7595	0.3191	CV
Skewness	1.2581	0.7969	Skewness

Variography

Unfolded variography (Correlogram Models) for the Birch Lake area were completed using the Vulcan Tetra™ unfolding option. The correlogram models were completed for copper, nickel, platinum, palladium, gold, silver, cobalt and sulfur. Variogram models were completed for the Main Zone and the Lower Unit within the BMZ. The nugget effect was determined using a down-hole variogram. The nugget effect was then applied to the directional variogram models. Table 14-21 summarized the variogram.

Table 14-21:Unfolded Variography Parameters for Main Zone and Lower Unit

Metal	Nugget	C1	Azm	Range - Structure 1			C2	Azm	Range - Structure 2		
				Major	Semi	Minor			Major	Semi	Minor
Copper MZ	0.250	0.739	223.0	711	309	309	0.106	57	128	117	117
Copper LU	0.100	0.752	88.0	1130	272	272	0.148	205	4050	1040	1040
Nickel MZ	0.096	0.738	16.0	930	171	171	0.166	303	3000	2930	2930
Nickel LU	0.100	0.304	2.0	4330	4330	4330	0.596	218	554	431	431
Platinum MZ	0.150	0.488	239.0	2770	280	280	0.362	210	2460	209	209
Platinum LU	0.043	0.352	271.0	2630	1740	1740	0.605	309	676	433	433
Palladium MZ	0.171	0.476	239	2770	280	280	0.353	210	2460	260	260
Palladium LU	0.050	0.779	144	620	573	573	0.171	260	3820	2160	2160
Gold MZ	0.150	0.488	239	2770	280	280	0.362	210	2460	209	209
Gold LU	0.120	0.699	265	679	526	526	0.181	86	2760	1390	1390
Silver MZ	0.350	0.013	205	230	5	5	0.636	247	1050	142	142
Silver LU	0.144	0.143	199	5610	445	445	0.713	255	665	218	218
Cobalt MZ	0.190	0.615	232	3140	214	214	0.195	330	2840	140	140
Cobalt LU	0.200	0.201	84	5720	4830	4830	0.599	272	2080	221	221
Sulfur MZ	0.250	0.566	53	513	19	19	0.184	180	3570	144	144
Sulfur LU	0.250	0.299	5	2650	2620	2620	0.450	151	3910	343	343

14.5.7 Block Model

The Birch Lake Resource Model is not rotated. The parent block size is 200 x 200 x 180 (x,y,z); sub-blocks are 25 x 25 x 5 to 50 x 50 x 15 (x,y,z), and the maximum block size In the BMZ is 25 x 25 x 15 (x,y,z). The origin of the Birch Lake Resource Model is at 2,937,000 East, 774,000 North, and -2,000 elevation.

Geological Model

The geological model was coded for the HW, PEG, BMZ and GRB units using the Topography, Top of PEG, top of BMZ, and TOP of GRB surfaces. The geological codes for the model are summarized in Table 14-20.

The BMZ was partitioned into the Main Zone and the Lower Unit using a PACK methodology. The 3DBM was coded with the Main Zone shell (MZONE30 = 1) to identify blocks of the Main Zone and Lower Unit domains of the BMZ.

Defining the Main Zone

AMEC applied a Probabilistic Assisted Constrained Kriging (PACK) methodology to define the Main Zone using Vulcan's Tetra-Projection™ functions. However, the interpolation was completed using IDW2. Sample selection criteria are summarized in Table 14-22. The probability values were visually inspected in section and plan (Figure 14-41).

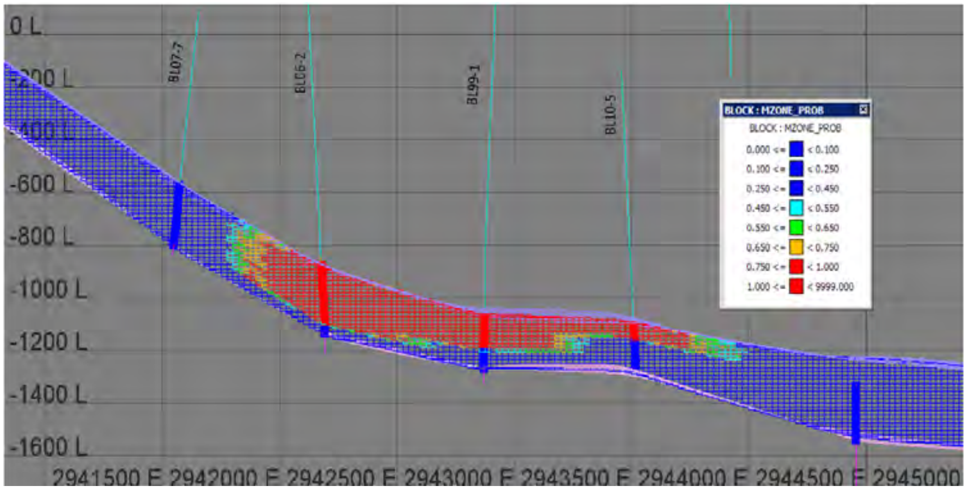
A nearest neighbor (NN) model was completed to validate and calibrate the probability threshold used to define the Main Zone. A probability threshold of 0.47 was chosen to define Main Zone blocks. This threshold was determined by comparing the probability in the block model to grades and geological codes in the composites. Although a probability of 0.5 would be expected to separate the Main and Lower zones, the 0.47 probability better fit the composites to the blocks. Blocks with a probability ≥ 0.47 were identified as Main Zone. Blocks with a probability <0.47 were identified as Lower Unit. A Vulcan™ script file was used to tag the model blocks as Main Zone or Lower Unit. The Main Zone domain was coded to the block model field MZONE30 = 10 for Lower Unit and MZONE30 = 11 for Main Zone.

Table 14-22: Search Strategy for Copper PACK Interpolation

Area	Search (x,y,z)	Samples max-min - max per DH
Copper	1500,1500,0.2	3 – 6 – 2
Gold	1500,1500,0.2	3 – 6 – 2

Note: The Vulcan™ Tetra model normalizes the vertical extent to 1. The 0.2 in the z direction indicates a 20% search radius in the vertical direction.

Figure 14-41: Birch Lake Section 779050 N (looking North) of the BMZ Block Model and the Main Zone



14.5.8 Estimation

Grade estimation for the 2011 resource model update used the Vulcan Tetra-Projection unfolding methodology and Ordinary Kriging (OK). Grade estimations were completed for copper, nickel, palladium, platinum, gold, silver, and cobalt. The Main Zone and Lower Unit were estimated independently with the exception of sulfur. Grade estimates were not completed for the HW, PEG and GRB units. Sulfur was estimated for the BMZ, with no separation for Main Zone and Lower Unit.

Each element was estimated independently in 3 passes with expanding searches for each pass. The search and sample selection is summarized in Table 14-23.

Table 14-23: Birch Lake Search Strategy for Copper PACK Interpolation

Pass	Search (x,y,z)	Samples max-min-max/DH
Pass 1	250, 250,0.2	5 - 12 - 2
Pass 2	1000,1000,0.2	5 - 12 - 2
Pass 3	3500, 3500. 0.2	3 – 8 - 2

Note: The Vulcan Tetra model normalizes the vertical extent to 1. The 0.2 in the z direction indicates a 20% search radius in the vertical direction. The search and sample selection was the same for each element.

14.5.9 Metal at Risk

An outlier restriction protocol was implemented on uncapped 15 ft composites to address metal-at-risk, i.e., limit the influence of high-grade samples. The distance threshold for the outlier restriction was 500 ft in the Main Zone and 250 ft in the Lower Unit. Grade thresholds are summarized in Table 14-24.

Metal removed from the Main Zone is summarized in Table 14-25. Metal removed for copper and nickel are 5.0% and 4.4% respectively. Metal removed for palladium, platinum and gold is 6.6%. 8.4% and 5.6% respectively. Metal removed from cobalt and silver is 2.3% and 11.7% respectively.

Metal removed from the Lower Unit is summarized in Table 14-26. Metal removed for copper and nickel are 2.7% and 5.3% respectively. Metal removed for palladium, platinum, and gold is 0.8%, 1.7%, and 3.1% respectively. Metal removed for cobalt and silver is 17.7% and 6.9% respectively.

AMEC considers the level of metal removed from the resource to be reasonable for the Inferred Resource Classification.

Table 14-24:Birch Lake Outlier Restriction Thresholds

Rock Type	Element	Distance Threshold	Grade Threshold
Main Zone	Cu	500	0.75%
	Ni	500	0.25%
	Pd	500	1.00 ppm
	Pt	500	0.50 ppm
	Au	500	0.25 ppm
	Ag	500	2.00 ppm
	Co	500	125 ppm
	S	500	none
Lower Unit	Cu	250	0.75%
	Ni	250	0.25%
	Pd	250	1.00 ppm
	Pt	250	0.50 ppm
	Au	250	0.25 ppm
	Ag	250	2.00 ppm
	Co	250	125 ppm
	S	250	none

Table 14-25: Birch Lake Metal Removed by Outlier Restriction – Main Zone

Area	Unrestricted Mean	Restricted Mean	Metal Removed
Copper	0.601	0.571	5.0%
Nickel	0.183	0.175	4.4%
Palladium	0.633	0.591	6.6%
Platinum	0.298	0.273	8.4%
Gold	0.143	0.135	5.6%
Silver	2.290	2.022	11.7%
Cobalt	99.79	97.49	2.3%

Table 14-26: Birch Lake Metal Removed by Outlier Restriction – Lower Unit

Area	Unrestricted Mean	Restricted Mean	Metal Removed
Copper	0.223	0.217	2.7%
Nickel	0.075	0.071	5.3%
Palladium	0.123	0.122	0.8%
Platinum	0.059	0.058	1.7%
Gold	0.032	0.031	3.1%
Silver	0.871	0.717	17.7%
Cobalt	60.01	55.84	6.9%

14.5.10 Bulk Density

The Birch Lake database included 2,771 density determinations. Density data were coded with the Unit Code and histograms of the density determinations were constructed. The mean of the density value for each unit was used for the Unit density. The results are summarized in Table 14-27. Histograms of density determinations are shown in Figures 14-42, 14-43, 14-44, and 14-45.

Table 14-27: Birch Lake Density Determinations

Rock Type	No. Determinations	Mean SG
HW	1418	2.92
PEG	28	2.96
BMZ	952	3.06
GRB	373	2.90

Figure 14-42:Histogram of Birch Lake Density Determinations – HW

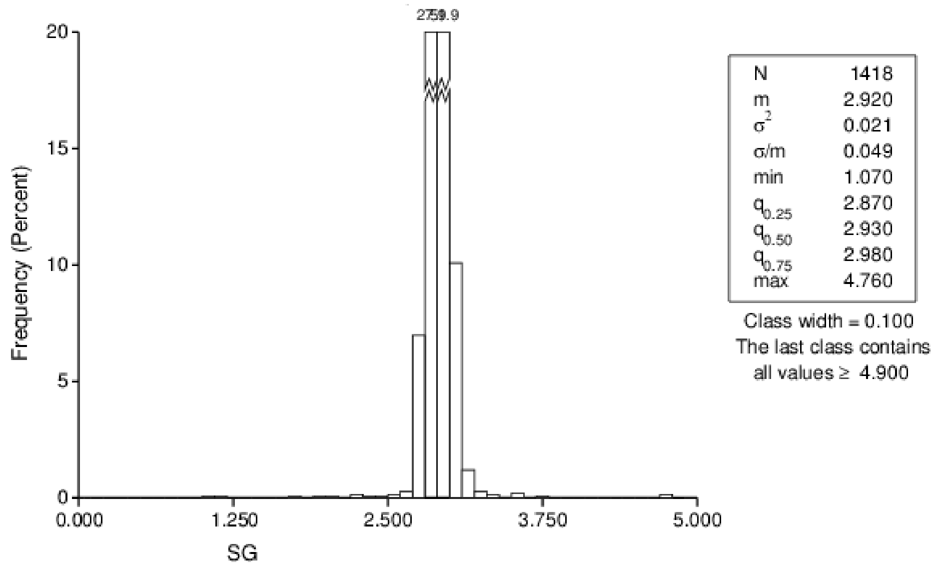


Figure 14-43:Histogram of Birch Density Determinations – PEG Unit

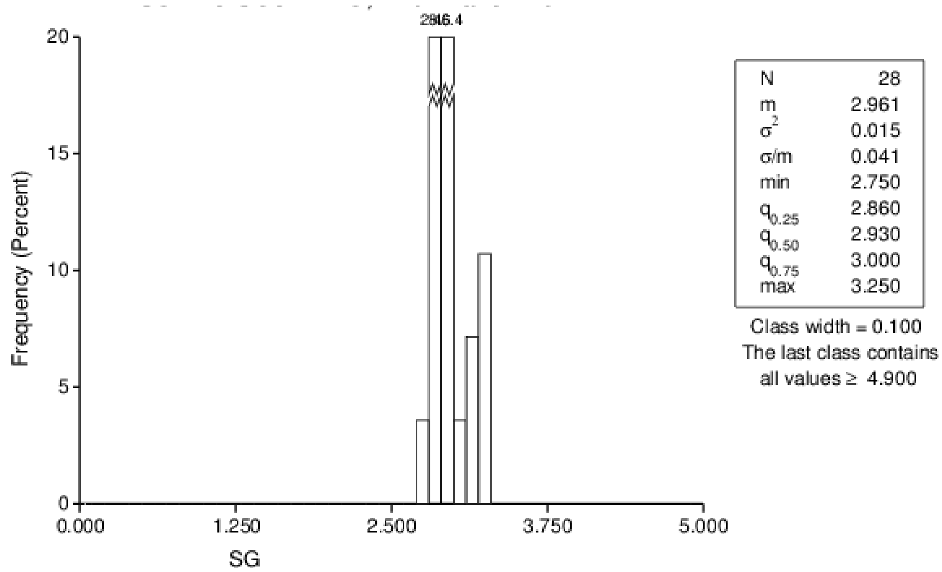


Figure 14-44: Histogram of Birch Lake Density Determinations – BMZ Unit

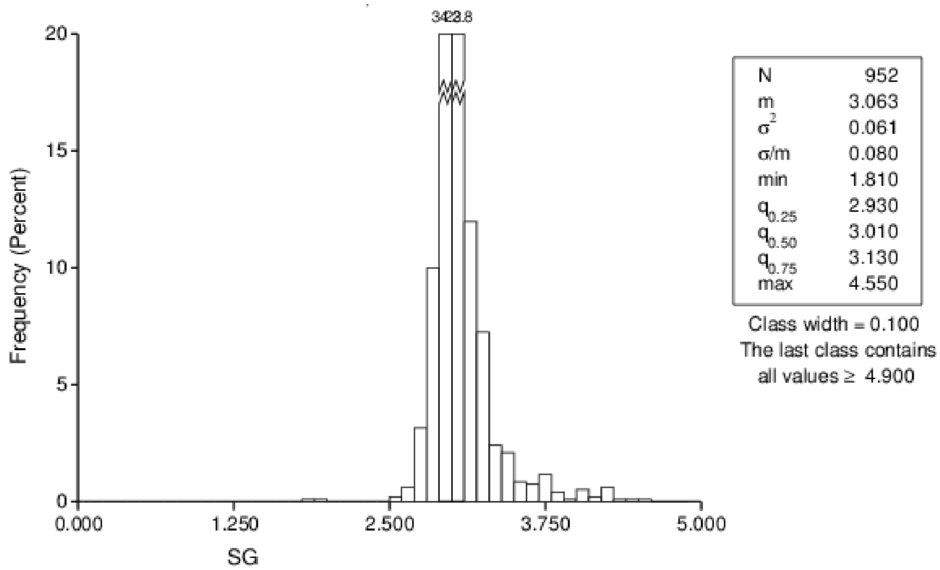
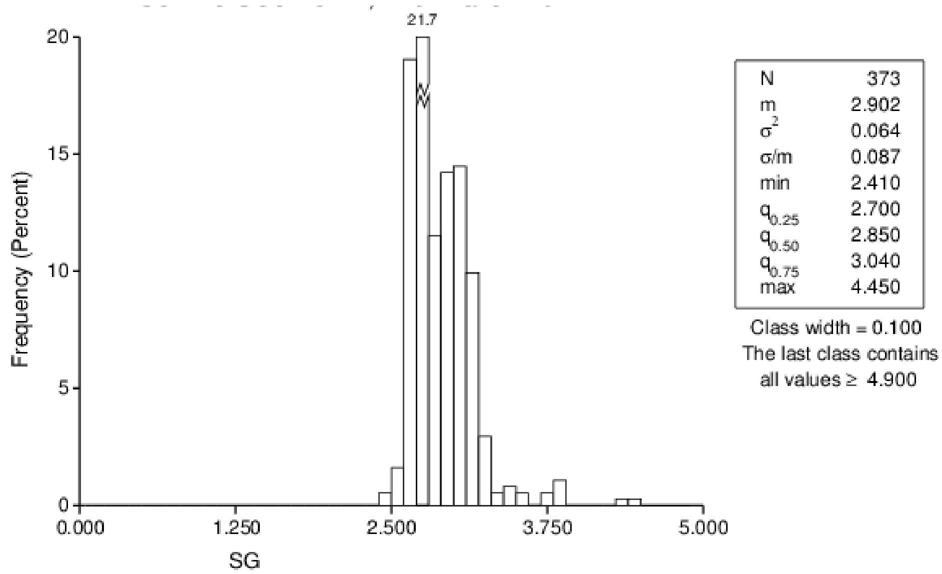


Figure 14-45: Histogram of Birch Lake Density Determinations – GRB Unit



14.5.11 Model Validation

Model Validation consisted of visual Inspection of cross-sections and plan-sections. Box plots and swath plots were used to compare grade estimates to NN grades.

Nearest-Neighbor Model

A Nearest-Neighbor (NN) model was completed for model validation. The NN model utilized the same search criteria as the OK estimate and was used for comparison of summary statistics in box plots and swath plots. Model validation was completed using blocks estimated during pass 1 and 2.

Inverse Distance Model

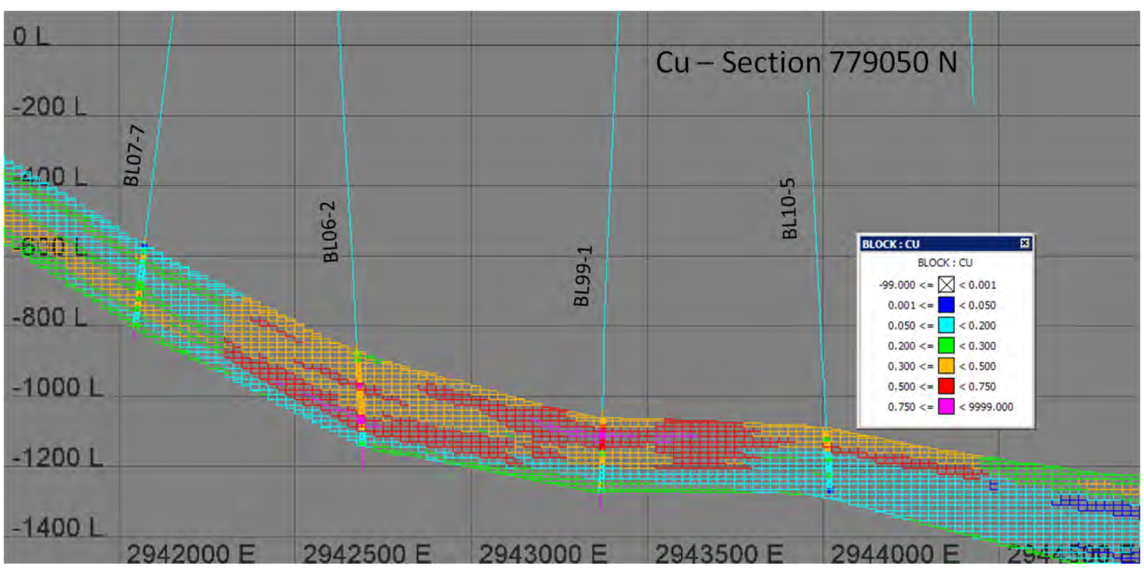
An Inverse distance model was also completed to assist with the model validation. The IDW model was completed in 3 passes and used an expanded search. A NN model using the IDW search criteria was also constructed. The IDW model blocks estimated in passes 1 and 2 were compared to the OK estimate.

Visual Inspection

Inspection of cross sections and plan sections was completed for all elements. Figures 14-46, 14-47, and 14-48 show block grades for copper.

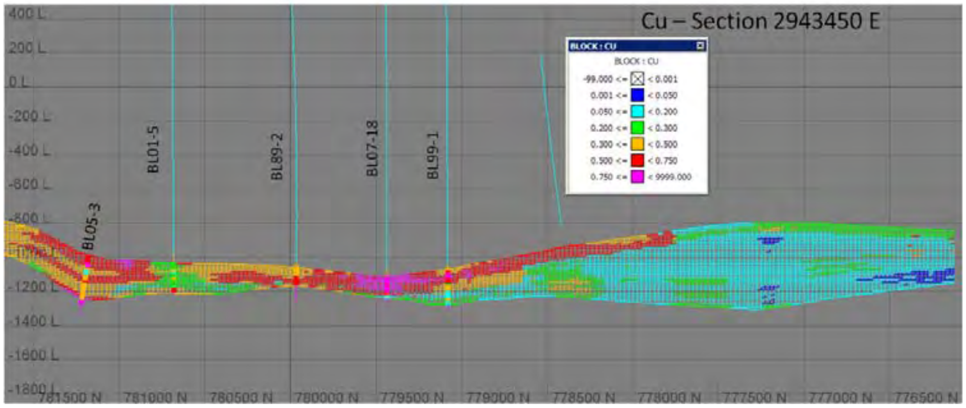
AMEC noted good correlation between composite and block grades. In general, AMEC observed poor grade continuity between drill holes indicating in-fill drilling is required to increase the confidence in the resource model.

Figure 14-46: Copper Grades for Blocks and Composites – Birch Lake Section 779050 N (looking North)



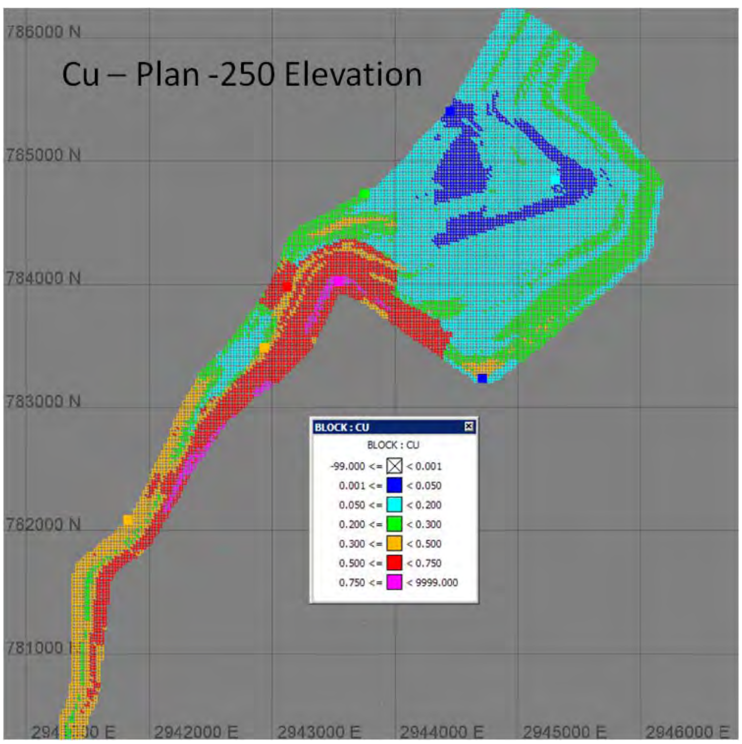
Note: Composites are projected 200 ft.

Figure 14-47: Copper Grades for Blocks and Composites – Birch Lake Section 2943450 E (looking East)



Note: Composites are projected 200 ft.

Figure 14-48: Copper Grades for Blocks and Composites – Birch Lake Elevation 250

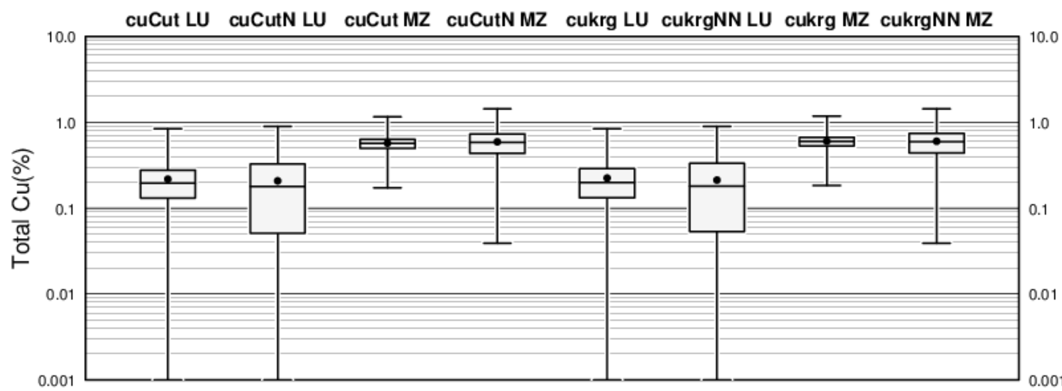


Note: Composites are projected 200 ft.

Boxplots

Boxplots were completed for each element comparing the OK estimate to the NN grades. Figure 14-49 displays a box plot of copper grades for the BMZ. Boxplots include restricted and unrestricted grade estimates for the Main Zone and the Lower Unit. The boxplot also includes the NN model.

Figure 14-49: Box Plot of Copper Grades for Birch Lake BMZ for Main Zone and Lower Unit



	cuCut LU	cuCutN LU	cuCut MZ	cuCutN MZ	cukrg LU	cukrgNN LU	cukrg MZ	cukrgNN MZ	
Number of data	441269	441268	206366	206366	447179	447179	222953	222953	Number of data
Mean	0.2174	0.2074	0.5705	0.5913	0.2236	0.2118	0.6005	0.6003	Mean
Maximum	0.8385	0.897	1.1566	1.437	0.8385	0.897	1.172	1.437	Maximum
Upper quartile	0.2755	0.327	0.6339	0.728	0.2897	0.333	0.6633	0.739	Upper quartile
Median	0.1951	0.178	0.5687	0.583	0.1983	0.18	0.5999	0.593	Median
Lower quartile	0.1306	0.051	0.4971	0.435	0.1322	0.053	0.5282	0.438	Lower quartile
Minimum	0.001	0.001	0.1717	0.039	0.001	0.001	0.1832	0.039	Minimum
Variance	0.0154	0.0348	0.0129	0.0481	0.0166	0.0367	0.0128	0.0491	Variance
CV	0.5706	0.9	0.1992	0.371	0.5756	0.9047	0.1886	0.3692	CV
Skewness	1.0285	0.9295	0.362	0.2592	0.9593	0.9711	0.2026	0.2422	Skewness

Notes: **cuCutLU** = Lower Unit Kriged capped Cu; **cuCutNLU** – Lower Unit Cu capped NN; **cuCutMZ** – Main Zone Kriged capped Cu; **cuCutNMZ** - Main Zone Cu capped NN; **cukrgLU** – Lower Unit Kriged Cu; **cukrgNNLU** – Lower Unit Cu NN; **cukrgMZ** – Main Zone Kriged Cu kriged; **cukrgNNMZ** – Main Zone Cu NN

Swath Plots

Swath plots were constructed for each domain in the BMZ (Main Zone and Lower Unit). The swath plots compare the OK grade estimates to the NN grades and the grades of the 15 ft composites in swaths across the model. Swath intervals were 500 ft in the easterly and northerly directions and 300 ft m in the vertical direction. Swaths generally show good agreement with the exception of areas where data become sparse. The swath plots for the Main Zone copper and palladium are shown in Figures 14-50 and 14-51 respectively.

Figure 14-50: Birch Lake Main Zone Copper Swath Plot

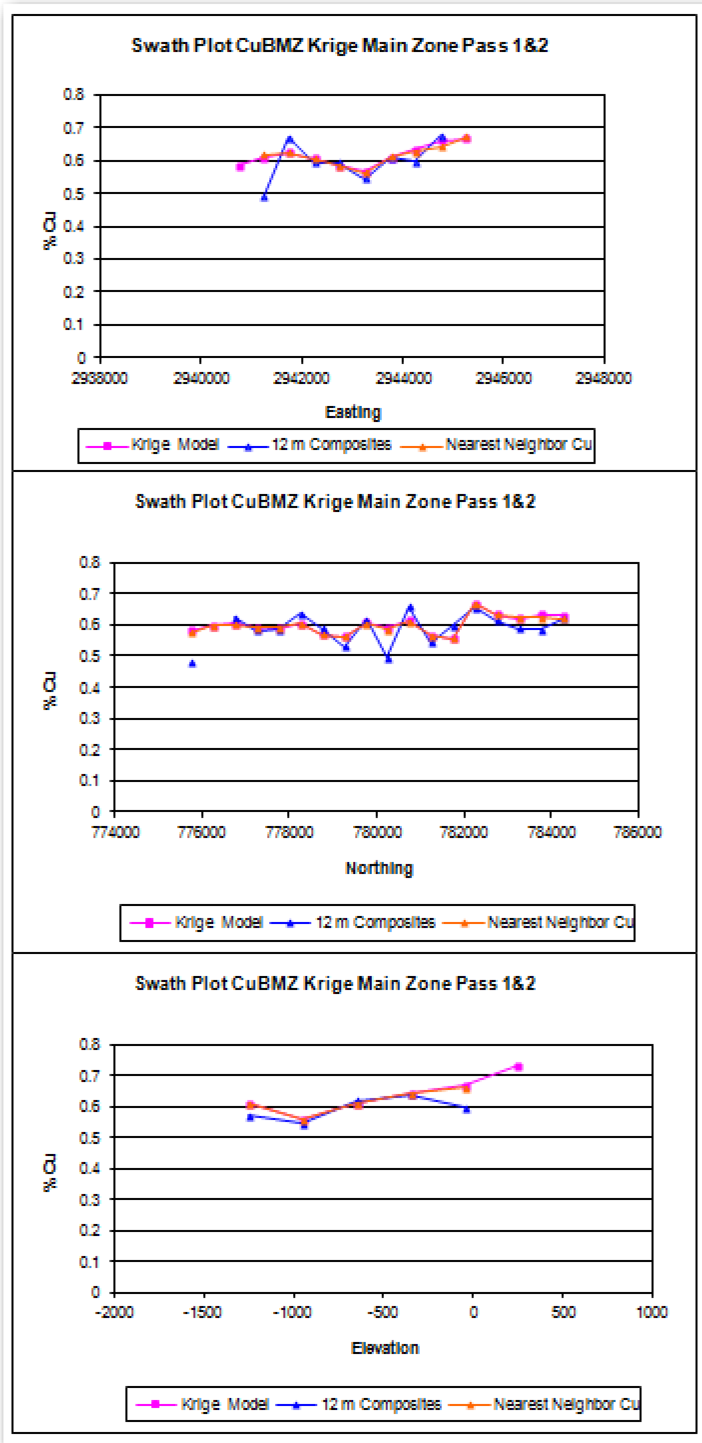
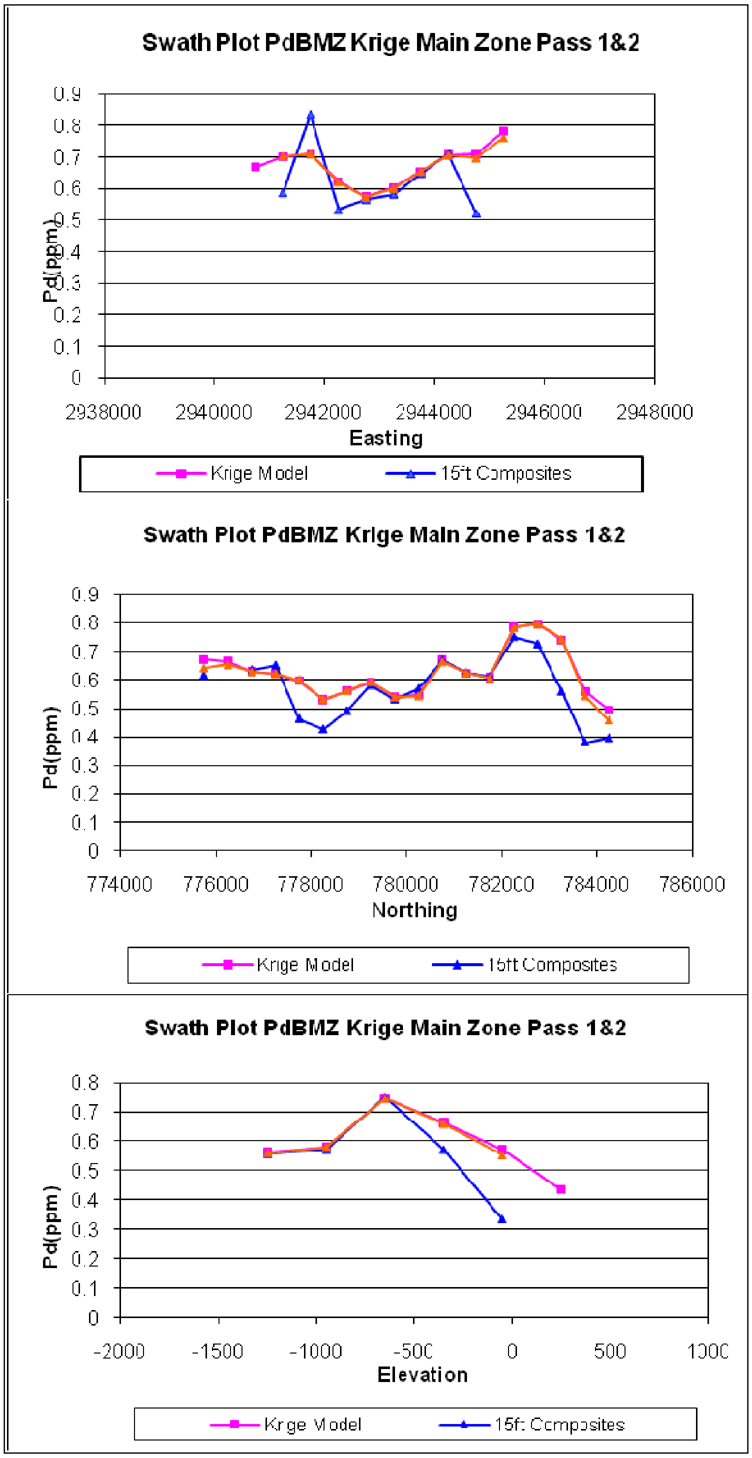


Figure 14-51:Birch Lake Main Zone Palladium Swath Plot



14.5.12 Classification

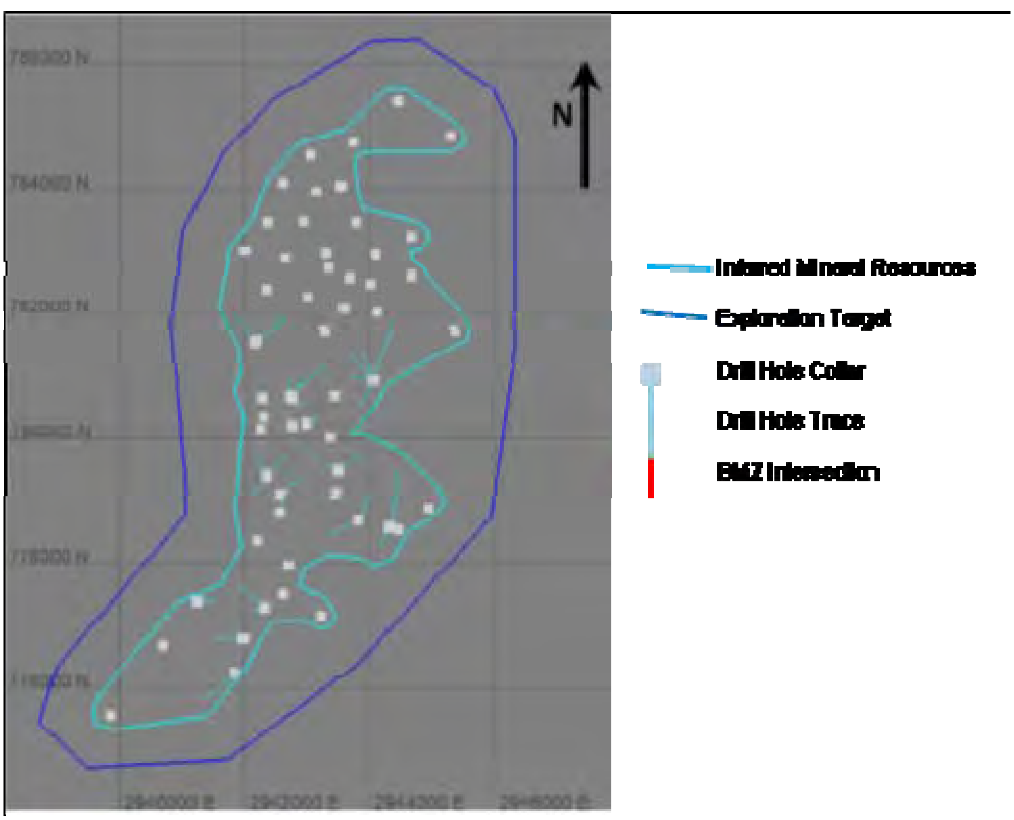
The Birch Lake mineral resource is designated an Inferred Mineral Resource.

Factors contributing to the resource classification are:

- The spacing of the drill hole intersection of the BMZ at Birch ranges from 500 ft to 1000 ft. Because of the wide-spaced drilling, the grade continuity is not confirmed.
- Incomplete QA/QC on the Birch drill hole data.
- Intervals of the BMZ that have not been sampled.
- Issues regarding the down-holes surveys.

The Inferred Mineral Resource is within the current drill envelope and extends 250 ft beyond the drill envelope (Cyan polygon in Figure 14-52). The Portion of the block model outside the Inferred boundary is considered exploration target (area between Cyan and Blue polygons).

Figure 14-52: Birch Lake Resource Classification



NSR Calculation

A Net Smelter Return (NSR) was calculated for each block using a Vulcan script. Criteria for the NSR Calculation are summarized in Table 14-28.

Table 14-28:NSR Parameters (Source TMM)

		Units [1]	Value
Price	Copper	lb	$3.00
	Nickel	lb	$9.38
	Platinum	oz	$805
	Palladium	oz	$1840
	Gold	oz	$1050
Concentrate Recovery	Copper		94.80%
	Nickel		72.80%
	Platinum		87.70%
	Palladium		85.20%
	Gold		68.40%
Recovery Platsol	Copper		98.00%
	Nickel		97.00%
	Platinum		90.00%
	Palladium		90.00%
	Gold		88.00%
Recovery Global	Copper		92.90%
	Nickel		70.62%
	Platinum		78.93%
	Palladium		76.68%
	Gold		60.19%
Payable	Copper		97.5%
	Nickel		100.0%
	Platinum		90.0%
	Palladium		95.0%
	Gold		95.0%
Refining Charge	Copper		-
	Nickel		-
	Platinum		$5
	Palladium		$25
	Gold		$25
Note: Currency is $US dollars			

14.5.13 Resource Tabulation

The Birch Lake Inferred Mineral Resource is tabulated using incremental copper cut-off grades and also by incremental NSR cut-off grades. Table 14-29 tabulates the Inferred Mineral Resource for the Birch Lake Main Zone by incremental copper cut-offs. The base case for 0.30% copper is gray-shaded. Tonnages are in million short tons (Mt).

Table 14-29: Birch Lake Inferred Mineral Resource by Copper Cut-Off (Main Zone + Lower Unit, Base Case Gray-Shaded)

Cut-off Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	346	0.44	0.14	0.18	0.39	0.09	0.005	0.011	0.003
0.3	242	0.52	0.16	0.23	0.49	0.11	0.007	0.014	0.003
0.4	196	0.57	0.17	0.26	0.55	0.13	0.007	0.016	0.003
0.5	141	0.61	0.18	0.28	0.60	0.14	0.008	0.018	0.004
0.6	65	0.68	0.20	0.32	0.68	0.16	0.009	0.020	0.004

14.6 Exploration Target

At Birch Lake blocks with extrapolated grades outside the main mineralized zone are considered to be Exploration Target material. Figure 14-52 shows the location of the Inferred Mineral Resources and Exploration Target material. Exploration Target material is in the range of 100 to 375 Mt and contains 0.34 to 0.51% Cu, 0.11 to 0.16% Ni, 0.003 to 0.006 opt (0.11 to 0.2 ppm) Pt, 0.007 to 0.-12 opt (0.23 to 0.42 ppm) Pd, and 0.002 to 0.003 opt (0.06 to 0.1 ppm) Au.

AMEC cautions that the potential tons and grade of the exploration target are conceptual in nature, and that there has been insufficient exploration to define the exploration targets as a Mineral Resource. It is uncertain if additional exploration will result in the target(s) being delineated as a Mineral Resource.

14.6.1 Conclusions and Recommendations

The Birch Lake area contains significant mineralization that has been defined as an Inferred Mineral Resource.

The Birch Lake resource model is based on a drill spacing of 500 to 1000 ft. Infill drilling will be required to increase the confidence of the classification.

AMEC recommends:

- A drill hole spacing study should be completed to identify potential drill spacing for Measured and Indicated resources.
- Sample un-sampled intervals within the BMZ to complete the database.
- Analyze missing elements for sample intervals missing the full suite of analysis.
- Resurvey open drill holes to investigate down-hole survey issues.

14.7 Spruce Road

14.7.1 Introduction

Scott Wilson Roscoe Postle Associates Inc. (SWRPA) produced a resource estimate for the Spruce Road deposit in 2007 (Routledge and Cox, 2007). That work was done for Franconia Minerals Corporation. NI 43-101 rules require that the property and resources be discussed in the NI 43-101 report currently being prepared by AMEC. TMM asked that an underground-only mining option be considered. That request required that the resource estimate be reviewed and accepted by AMEC and that the resource estimate be recast as an underground-only resource.

The Spruce Road resource estimate is based almost entirely on legacy INCO data that are largely unverified. Wallbridge Mining drilled a single hole (WM_001) in 1999 and that hole is included in the model. The INCO core shed and offices were destroyed by fire and all physical records of the Spruce Road deposit were in those facilities; thus the data used for the resource estimate are largely unverified. Recent drilling at Maturi has largely verified legacy INCO data from the same era; thus AMEC believes that it is reasonable that the data at Spruce Road will be verified when twin holes are drilled there and that those data are appropriate to use for resource estimation at an Inferred Mineral Resource level.

Troctolitic rocks comprise much of the SKI at Spruce Road and carry abundant rafted basement inclusions of sedimentary hornfels and iron formation (Routledge and Cox, 2007). Inclusions are mostly barren, but locally are mineralized. At Spruce Road, in contrast to the Maturi and Birch Lake deposits, there does not appear be to any specific correlation of mineralization to lithology and there is no key unit or hanging wall marker horizon, such as the pegmatite, that overlies the mineralized unit at Maturi. Mineralization is considered to be consistent with the Basal Mineralized Zone (BMZ) and is very similar to the thick Cu-Ni mineralization in the northwestern part of Maturi. Typical features of the rocks are discontinuous layering, variable textures and common inclusions and erratic disseminated copper-nickel mineralization. There is some uncertainty as to the attitude and geometry of the mineralization at progressively higher grades at Spruce Road but, for the purpose of resource estimation, mineralization trends are assumed to parallel intrusive layering and conform to the overall geometry of the SKI.

The BMZ at Spruce Road is very thick, locally as thick as 1,200 ft (365 m) locally, although there will be poorly mineralized zones within the total thickness and the average thickness is on the order of 300 ft (91 m). This is much thicker than the average BMZ at Maturi and Birch Lake.

Mineralization tends to be very uniform where it occurs. Grades are somewhat lower than grades at Maturi and Birch Lake.

14.7.2 SWRPA Model

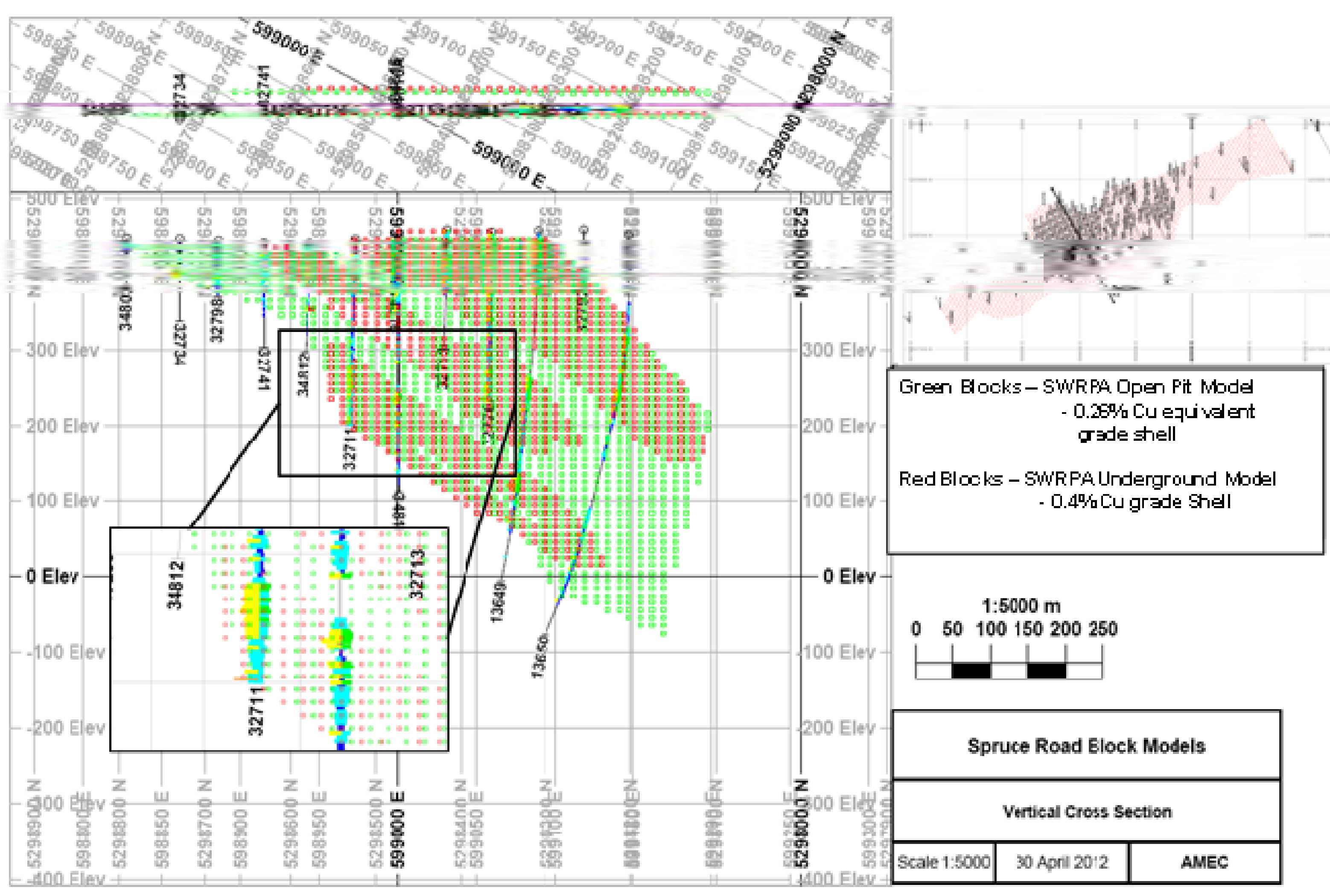
Scott Wilson RPA estimated Mineral Resources at cut-off grades appropriate for underground mining (0.4% Cu) and for open pit mining (0.26% Cu equivalent) in accordance with the requirements of NI 43-101 and the definitions set out by the CIM Definition Standards for Mineral Resources and Mineral Reserves adopted by the CIM Council on December 11, 2005 (CIM definitions). The resource estimate is based on diamond drilling and core sampling data and employs 3D computer block modeling with inverse distance squared (ID2) interpolation for the underground resource and ordinary kriging (OK) for the open pit resource. Block dimensions were 30x15x10 m and rotated 28^{o} to be parallel with regional strike and inclined to be parallel with the base of the BMZ.

Resources on the property have been estimated from the northwest boundary of the Spruce Road property from surface to approximately 1,683.1 ft (513 m) depth. The resource estimate is based entirely on diamond core drilling and core sample assays. The drill hole information was obtained from INCO and consists of results of core drilling from 1954 to 1973. Cobalt results are incomplete and PGE and Au assays are mostly lacking on an individual assay basis for the INCO holes. Consequently resources for these metals are not estimated.

The resources in the Spruce Road deposit extend off the property and have been reported by “clipping” the underground resource block model at the property boundary and by constraining the open pit shell to the property.

SWRPA utilized grade shells for control of estimation at Spruce Road. One grade shell was at 0.26% Cu, the other was at 0.4% Cu. Separate block models were produced for each of the grade shell models. SWRPA called the block model utilizing the 0.26% Cu grade shell the “Open Pit Model” and the block model utilizing the 0.4% Cu grade shell the “Underground Model”. It is not clear from Routledge and Cox (2007) why independent block models were used but the blocks are somewhat offset. Figure 14-55 shows the locations of blocks on a section across the center of the deposit. This clearly shows the offset of the block centers. For this work, AMEC has used the “Open Pit Model” shown in green squares in Figure 14-53.

Figure 14-53: Spruce Road Block Model Cross Section showing Block Centers



14.7.3 AMEC Methodology

Resource Definition

AMEC calculated an NSR value for each block in the “Open Pit Model” using the same equation as was used at Maturi but excluded the terms for PGEs which were not analyzed in the original data and are thus lacking in the SWRPA model and converted the tonnage factors to metric tonnes because the original model was done in metric tonnes. AMEC then used a US$25 value as a cut-off value to partially accommodate the fact that PGEs are likely present but not accounted for. Figure 14-54 through Figure 14-57 are cross sections showing the NSR for blocks across the deposit. Figure 14-58 is a long section showing NSR for blocks.

These sections show remarkable consistency in the US$20-40 NSR range that breaks up rapidly in the higher NSR ranges. This led AMEC to believe that additional work such as stope optimization was not necessary to estimate these resources.

Figure 14-54: Spruce Road Section 1

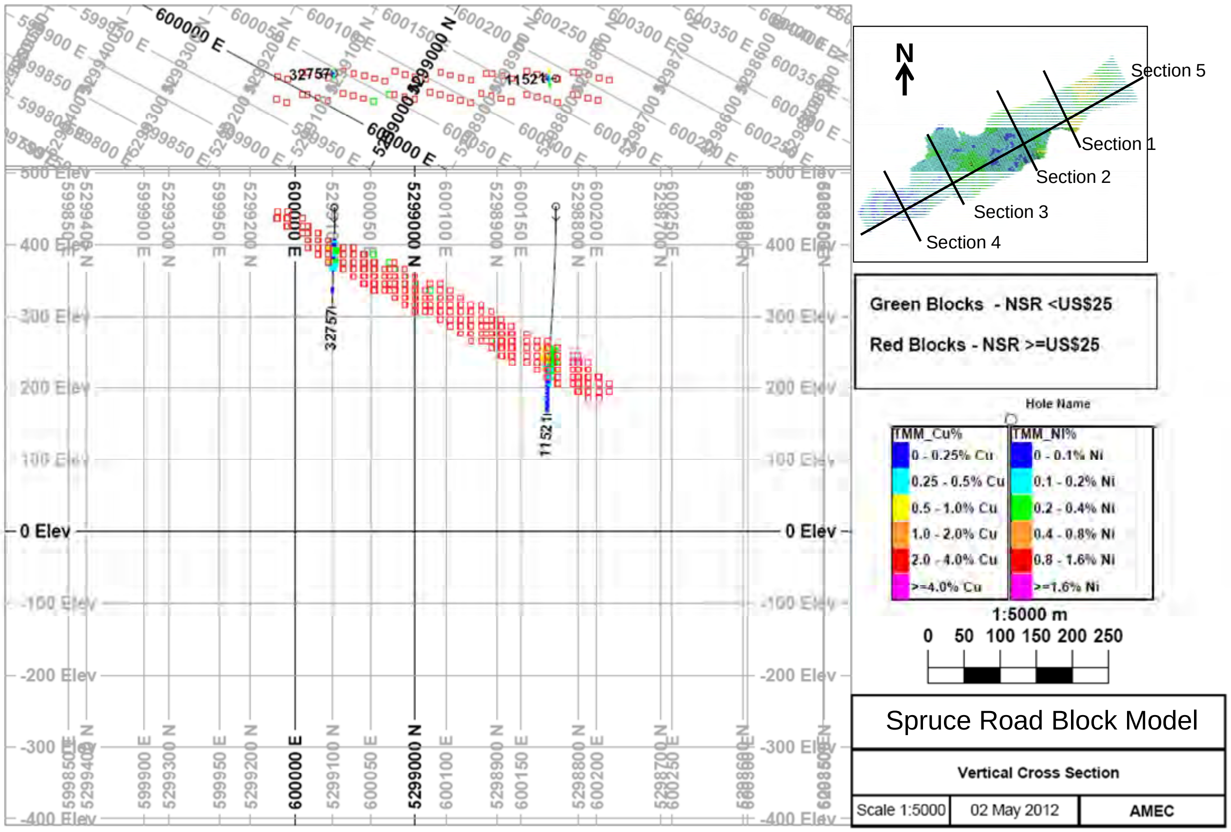


Figure 14-55: Spruce Road Section 2

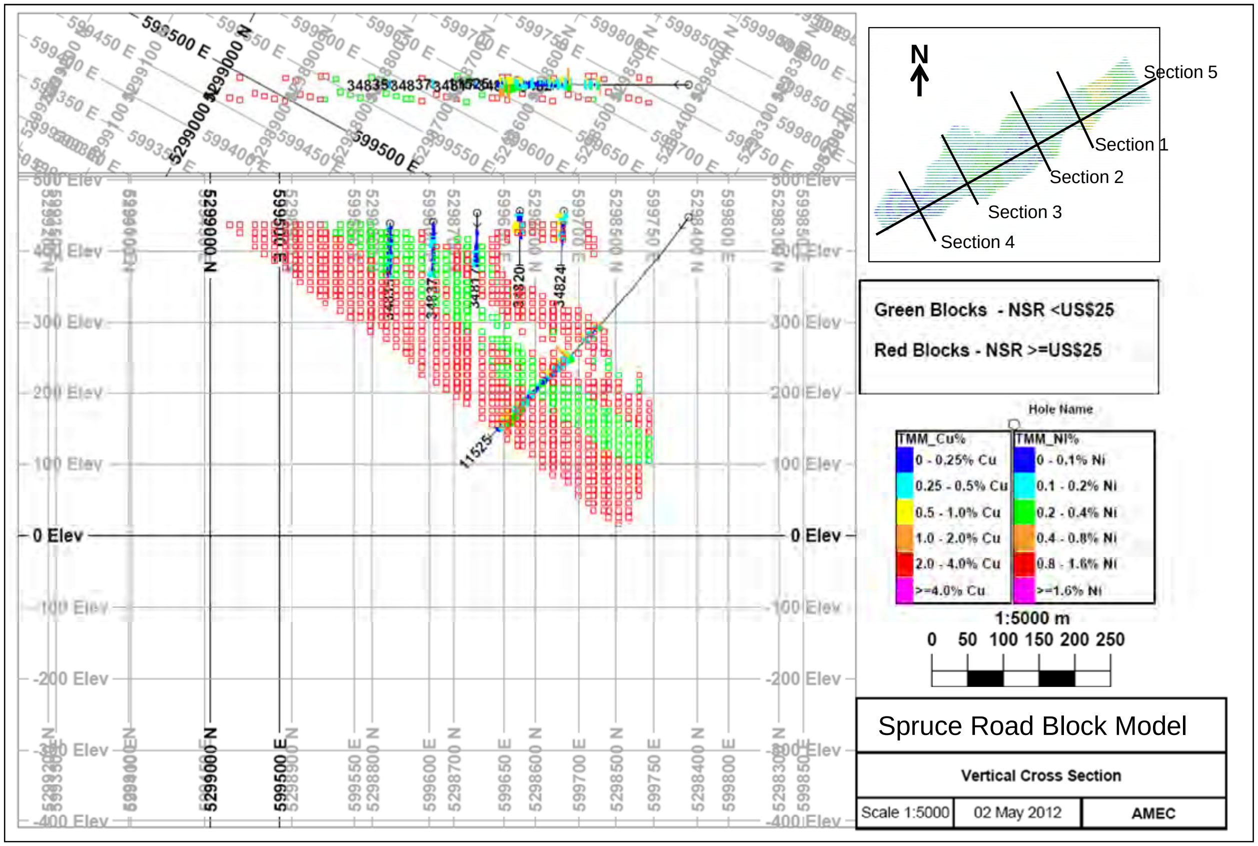


Figure 14-56: Spruce Road Section 3

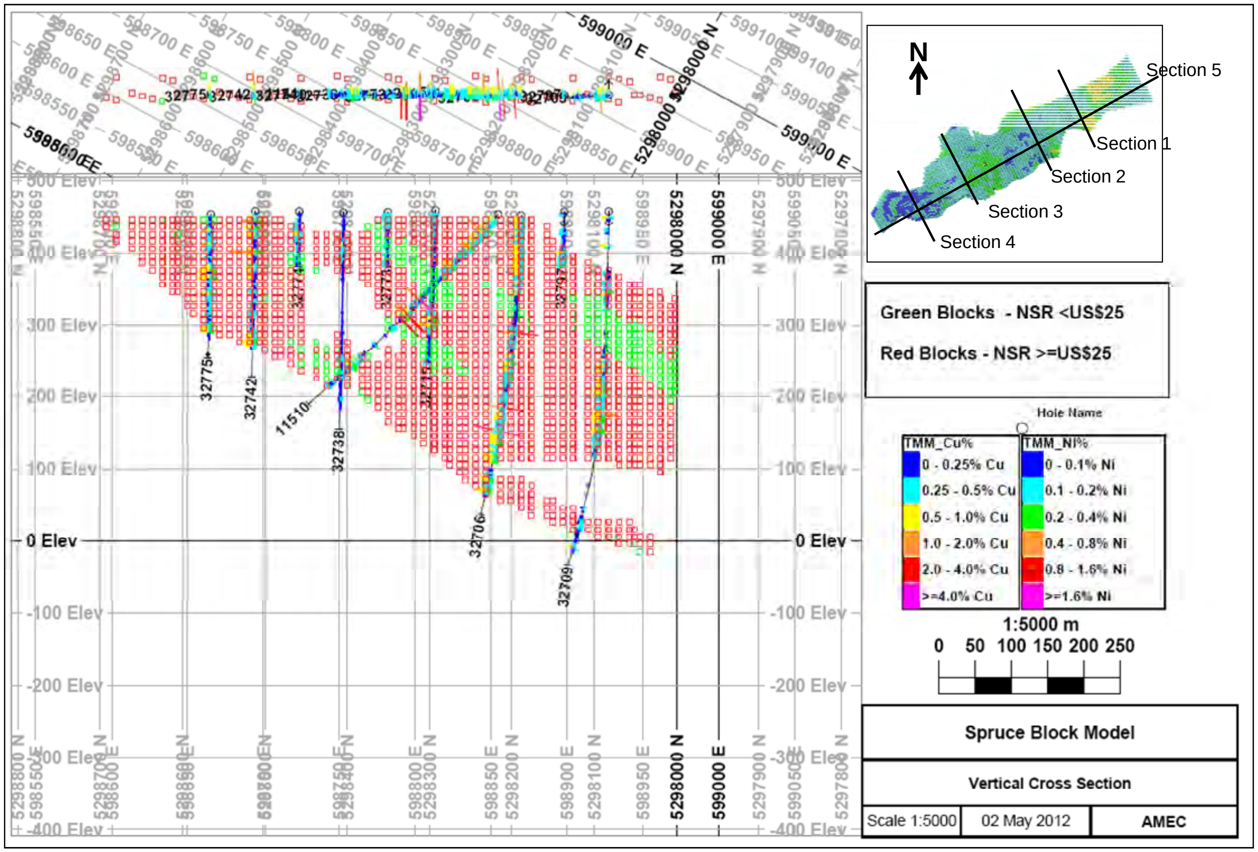


Figure 14-57:Spruce Road Section 4

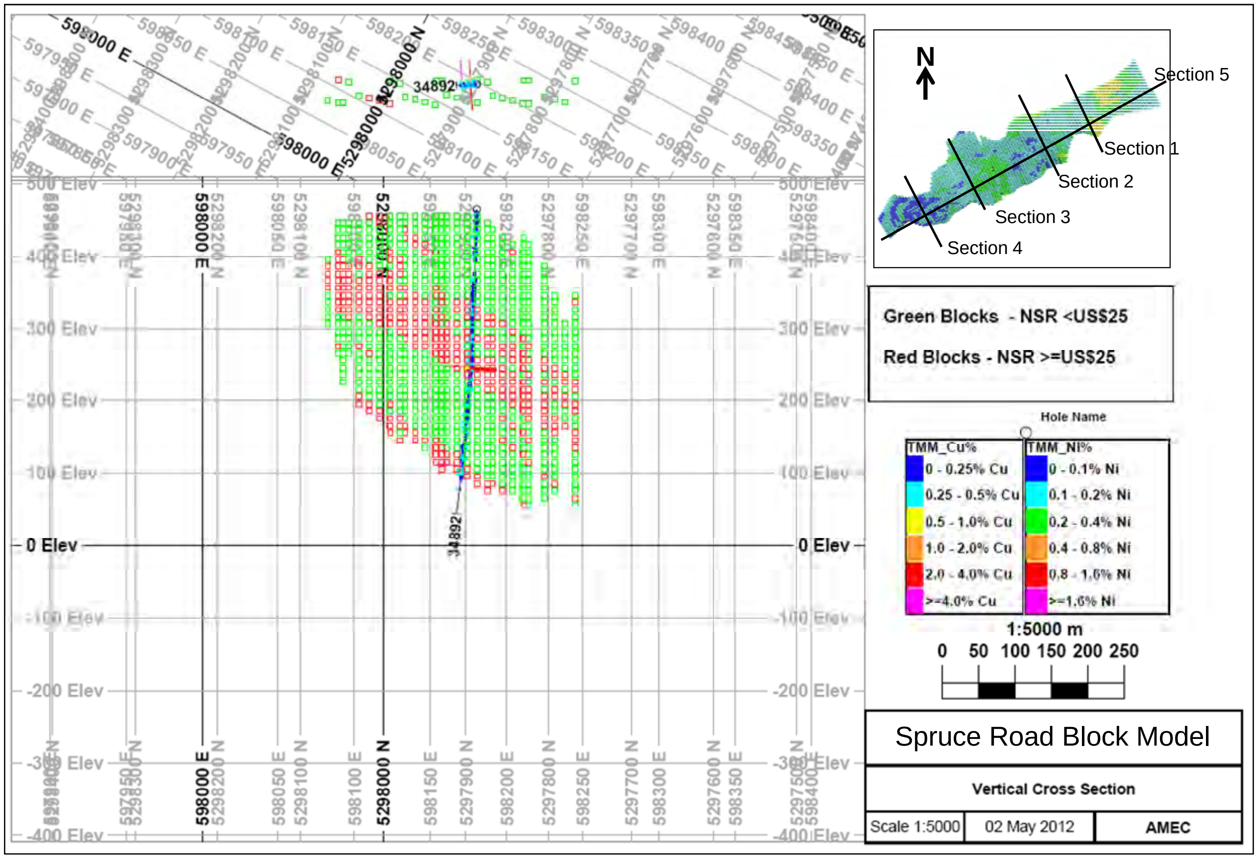
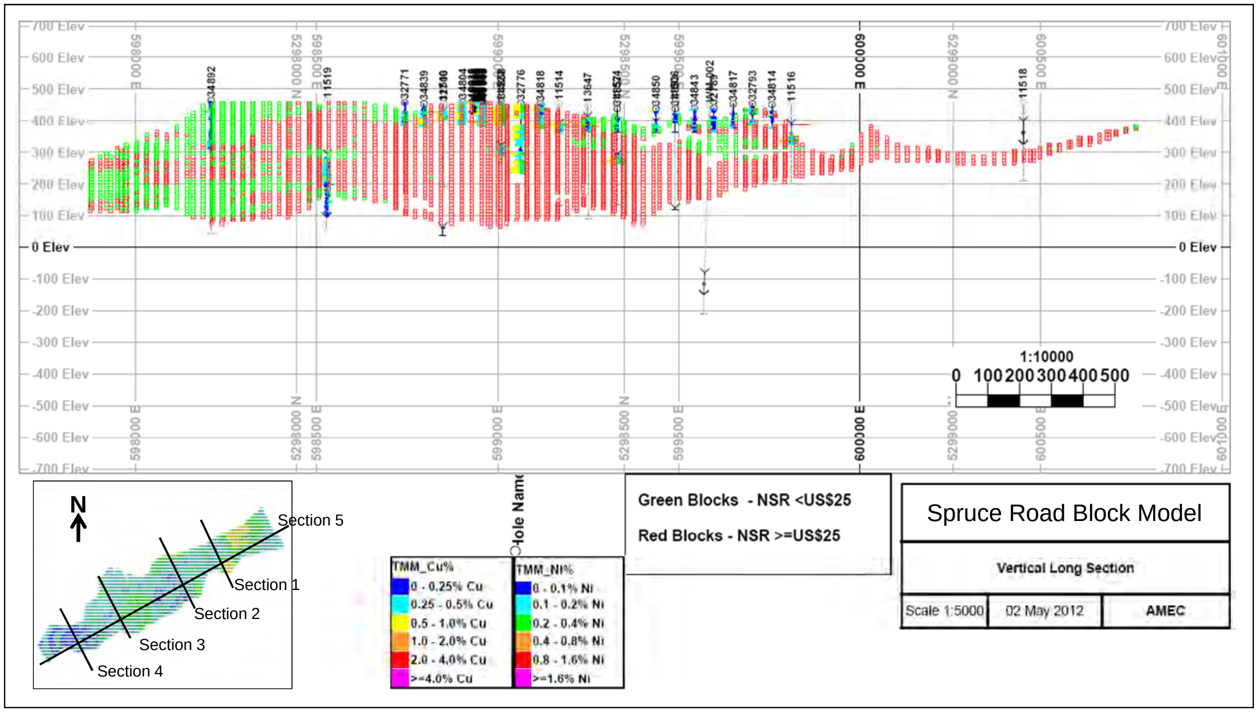


Figure 14-58: Spruce Road Section 5



Checks for Extrapolated Blocks

Spruce Road was estimated within grade shells at 0.26% Cu and 0.4% Cu. This method normally significantly restricts extrapolation of grades the shell is normally carefully matched to data in drill holes and does not extend beyond the limits of data. In order to confirm that few, if any blocks, were extrapolated, AMEC calculated the distance between block centers and the nearest sample from drilling. The nearest neighbor (NN) distances to blocks within the 0.26% Cu are as shown in Figure 14-59. The longest distance is 248.9 m with the mean distance of 62.9 m.

Figure 14-60 and Figure 14-61 show the distance to data for a bench in the 0.26% grade shell model. Figure 14-60 is included to show the location of drill holes (gray dots) and distance to data. Medium and dark blue colors indicate that block centers are <410 ft (125 m) from the nearest drill sample. Yellow and red colors indicate that the block centers are >410 ft (125 m) from drill data. Figure 14-61 is a contour map showing distance to data for a bench in the 0.26% Cu grade shell model. From these data, AMEC concludes, that for the purposes of this report, all of the block data are interpolated.

Figure 14-59:Histogram of Distances to Data for the 0.26% Cu Grade Shell

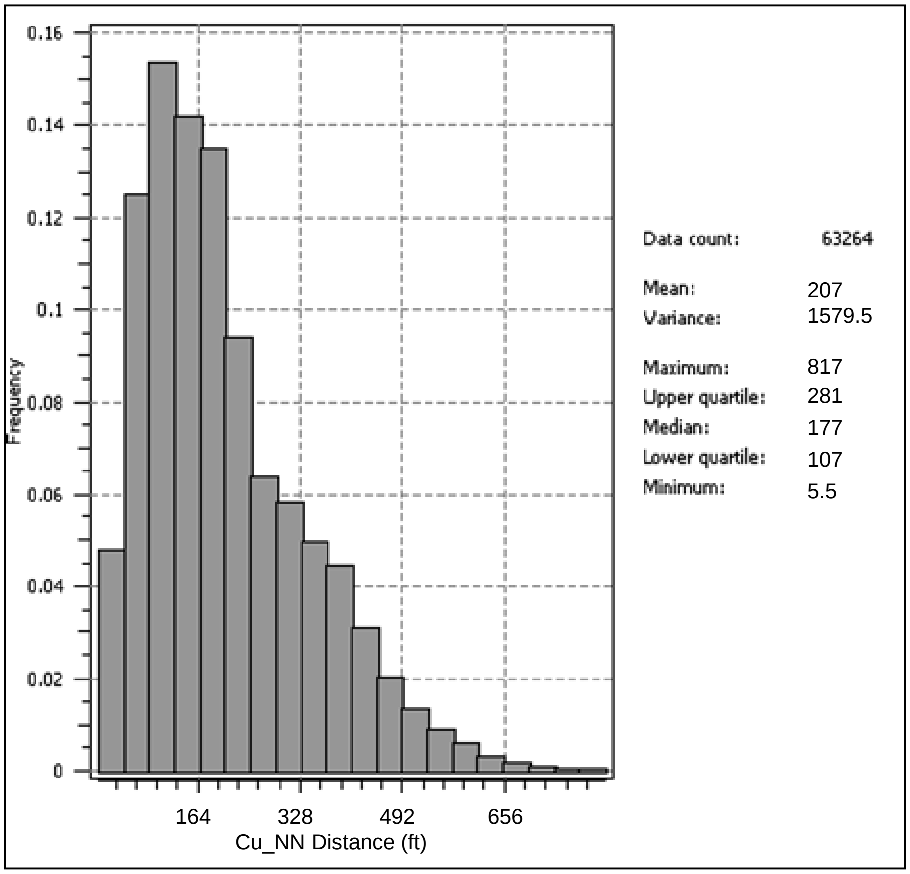


Figure 14-60:0.26% Cu Grade Shell – Bench Map showing Distance from Block Center to Data

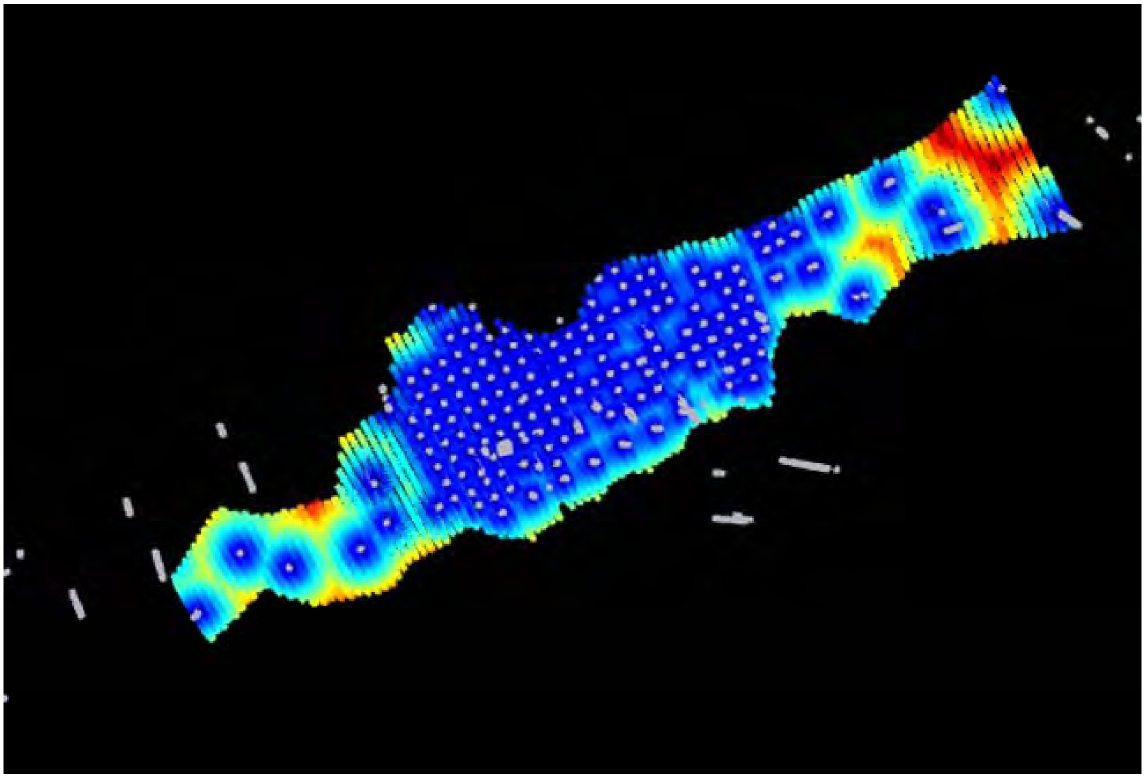
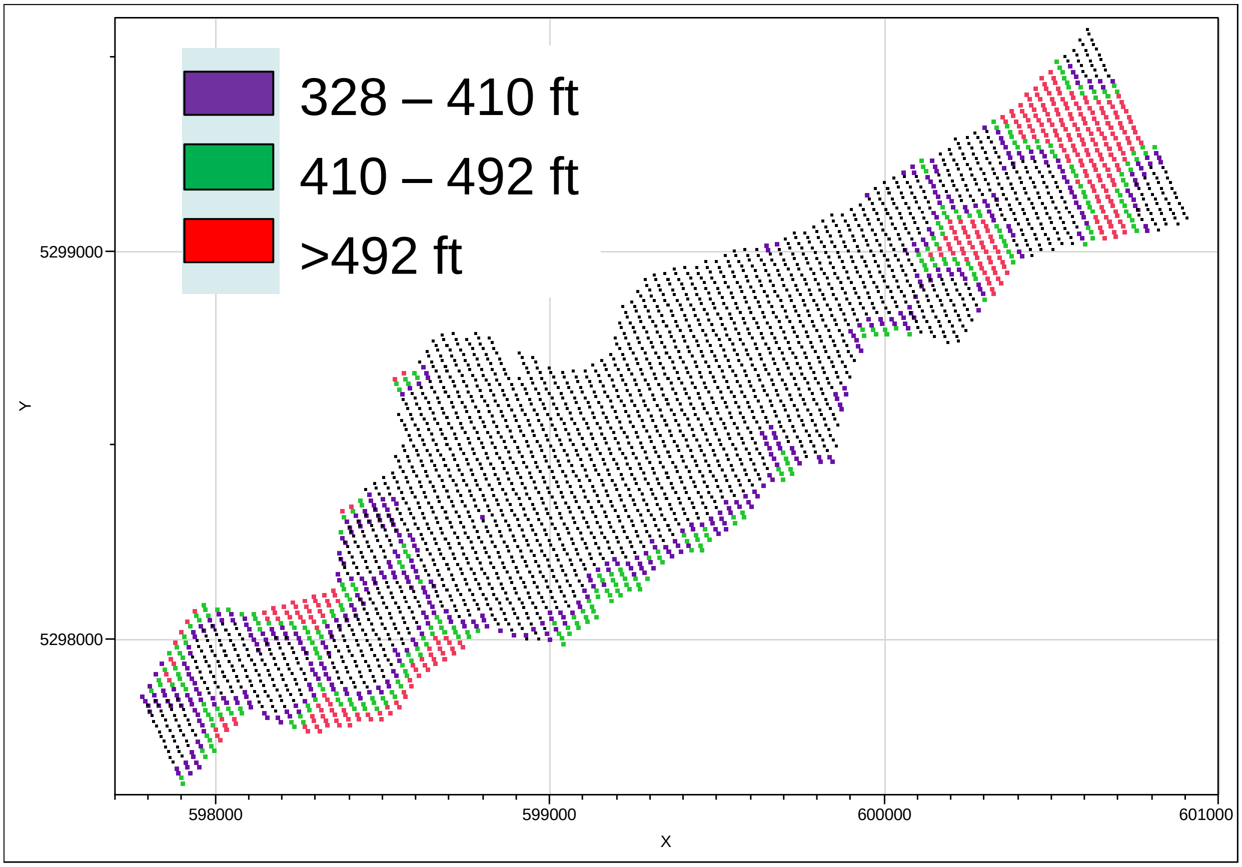


Figure 14-61:0.26% Cu Grade Shell – Bench Map showing Distance from Block Center to Data



In order to confirm that blocks in the 0.4% grade shell are all interpolated, AMEC calculated the distances from block centers to the nearest drill data (Figure 14-62; Figure 14-63). NN Distances for all of the 0.4% Cu grade shell model are <120 m which indicates that that all of the block grades were interpolated.

Figure 14-62:0.4% Cu Grade Shell – Histogram of Distance from Block Center to Data

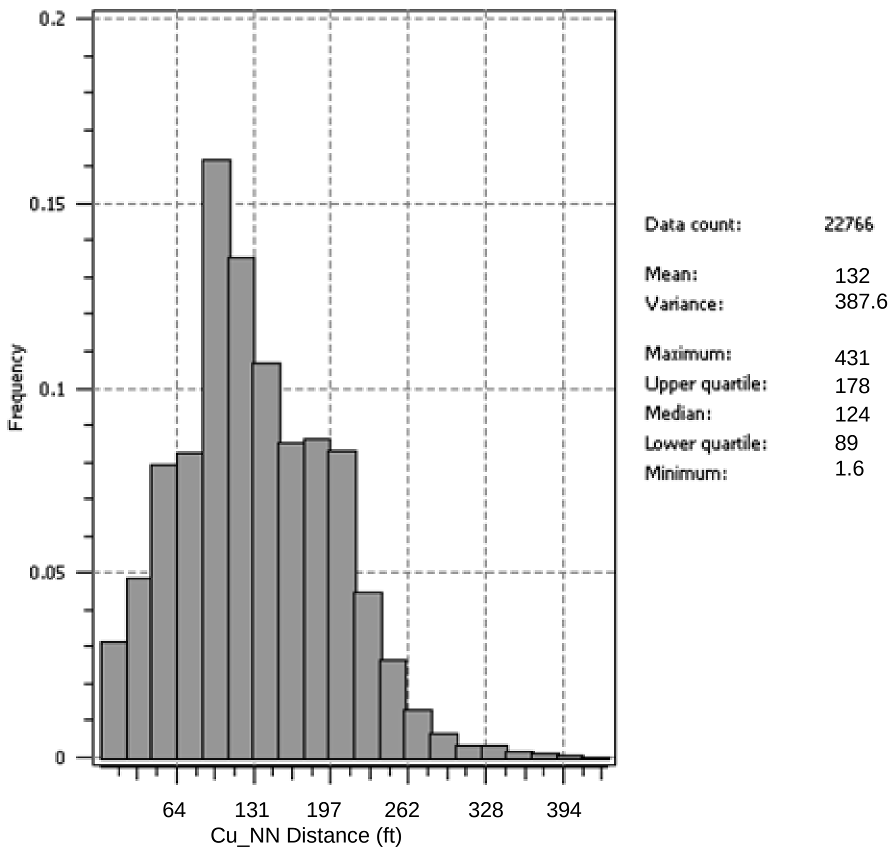
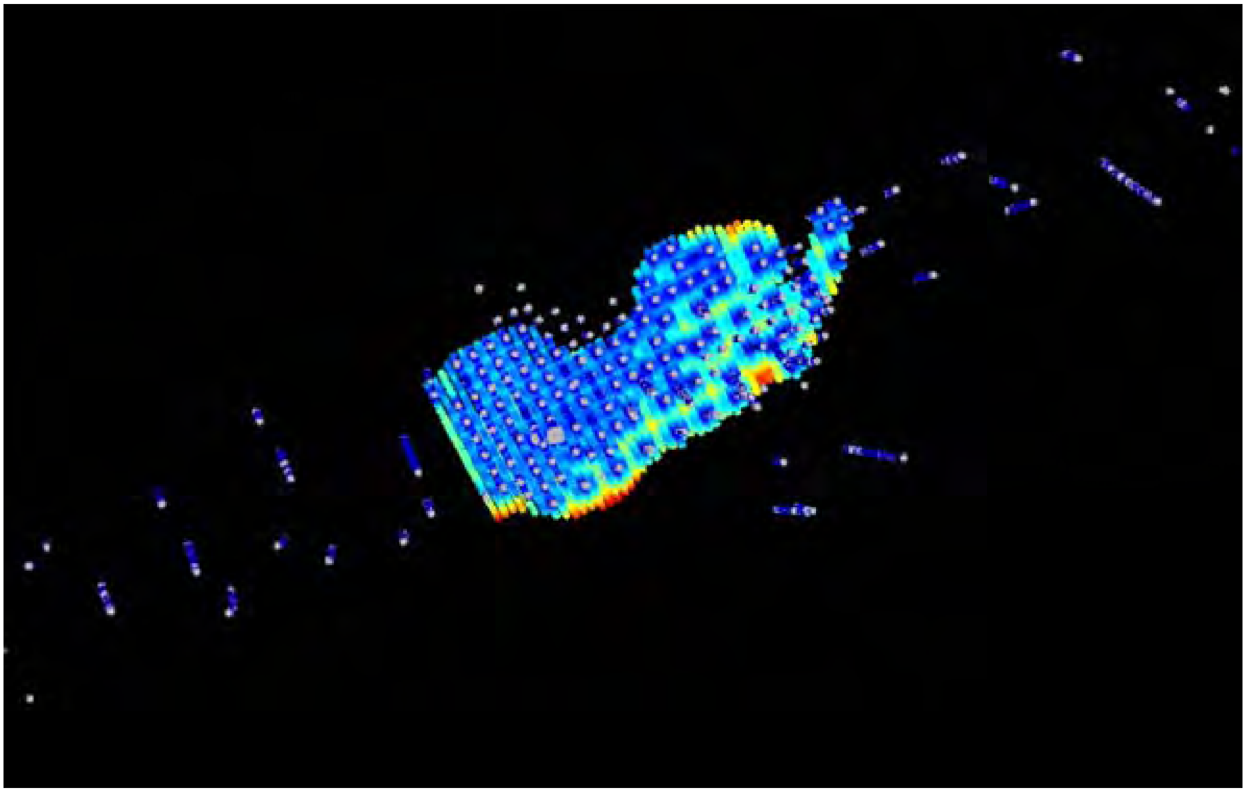


Figure 14-63:Cu Grade Shell – Bench Map showing Distance from Block Center to Data



14.7.4 Spruce Road Mineral Resources

SWRPA classified the resources at Spruce Road as a mix of Indicated and Inferred Mineral Resources. While the drill spacing generally supports the Indicated Mineral Resource classification, the estimate is based largely on unverified legacy data. A single hole was drilled by Wallbridge Mining in 1999 (WM-001). That hole was drilled to obtain material for metallurgical testing and to test the off-hole conductor in BH13648. The hole was assayed for PGEs which suggest similarities to Maturi. TPGEs are on the order of 0.5 g/t. The legacy (INCO) data are not directly verifiable. Core and hard copies of the data were destroyed in a fire that consumed the INCO core storage facility and offices.

AMEC believes that the data will be validated. Current work at Maturi with similar vintage INCO legacy data suggests that no significant problems will be encountered, but the work has not been done at Spruce Road.

Table 14-30 summarizes the mineral resources at Spruce Road. AMEC used a 0.3% Cu cut-off for the tabulation and assumed a 164 ft (50 m) crown pillar. All material above the minimum NSR value was tabulated as an Inferred Mineral Resource. Tonnages are in million short tons (Mt).

AMEC classified the resource as Inferred Mineral Resources recognizing the belief that the underlying data will be validated. It also recognizes the fact that little geotechnical work has been completed on the deposit to allow underground mine planning.

Table 14-30:Spruce Road Inferred Mineral Resources – Cu Cut-Off

Cut-off Cu (%)	Tons (Mt)	Cu (%)	Ni (%)
0.2	674	0.38	0.14
0.3	480	**0.43**	**0.16**
0.4	254	0.5	0.18
0.5	101	0.57	0.21
0.6	24	0.66	0.24

14.7.5 Comment on Spruce Road Resource Estimate

AMEC believes that the SWRPA estimate is adequate for a preliminary resource estimate. Re-tabulation of the results of the estimate was utilized for this report.

AMEC must again caution that this estimate is based on unverified data. AMEC believes that SWRPA verified the data as well as those data can be verified, but the lack of original collar and down-hole surveys, assay certificates, and drill logs is detrimental to the project can only be resolved by drilling twin holes to verify the data.

15.0 MINERAL RESERVE ESTIMATES

Not applicable to this report at this time.

16.0 MINING METHODS

Not applicable to this report at this time.

17.0 RECOVERY METHODS

Not applicable to this report at this time.

18.0 INFRASTRUCTURE

Not applicable to this report at this time.

19.0 MARKET STUDIES AND CONTRACTS

Not applicable to this report at this time.

20.0 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

Not applicable to this report at this time.

21.0 CAPITAL AND OPERATING COSTS

Not applicable to this report at this time.

22.0 ECONOMIC ANALYSIS

Not applicable to this report at this time.

23.0 ADJACENT PROPERTIES

There are no adjacent properties.

24.0 OTHER RELEVANT DATA AND INFORMATION

Not applicable to this report at this time.

25.0 INTERPRETATION AND CONCLUSIONS

25.1 Tenure

TMM's mineral tenure, while secure, is subject to some uncertainty due to proximity to the Boundary Waters Canoe Area Wilderness. Permitting of a project will be subject to political and economic pressures which pose a significant risk to the project.

25.2 Geological Setting

Mineralization at Maturi, Birch Lake, and Spruce Road are hosted by the Duluth Complex which is a composite intrusion, comprising 12 sub-intrusions emplaced over a period of 10 to 12 million years. These bodies include the South Kawishiwi Intrusion, Bald Eagle Intrusion, Partridge River Intrusion, Logan Sills, Greenwood Lake Intrusion, Power Line Gabbro, Silver Bay Gabbro, and the Sonju Lake Intrusion. The basal portion of the South Kawishiwi intrusion (SKI) hosts all three deposits in what is locally known as the basal mineralized zone (BMZ) which is as much as 1,000 ft thick locally. The BMZ is a complex zone comprising numerous small intrusive bodies ranging in composition from anorthosite to melatroctolite.

Mineralization comprises primarily chalcopyrite, cubanite, and talnakhite with numerous base and precious metals bearing minerals in trace quantities.

The geological setting is adequately known to support resource estimation and preliminary mine planning.

25.3 Deposit Types

The Maturi, Birch Lake, and Spruce Road deposits are classified as magmatic nickel-copper-platinum group element (PGE) deposits which are a broad group of deposits containing nickel, copper, and PGEs occurring as sulfide concentrations associated with a variety of mafic and ultramafic magmatic rocks (Eckstrand and Hulbert 2007). Because the partition coefficients of nickel, copper, and PGE as well as iron favor sulfide liquid over silicate liquid, these elements preferentially transfer into the sulfide droplets from the surrounding magma. The sulfide droplets tend to sink toward the base of the magma because of their greater density, and form sulfide concentrations. On further cooling, the sulfide liquid crystallizes to form the ore deposits that contain these metals.

The deposit type is well known and understood.

25.4 Drilling

Drill procedures at Maturi are consistent with industry best practices and are adequate to support resource estimation and mine planning.

At Birch Lake, some downhole surveys are questionable, which leads to uncertainty about the location of the mineralization in those holes. That uncertainty is sufficient to limit resource classification at Birch Lake to Inferred Mineral Resources. Otherwise, drill procedures at Birch Lake are consistent with industry best practices and are adequate to support resource estimation and mine planning.

Drill procedures at Spruce Road are largely unknown. The operator of the exploration effort, INCO, was an established mining house with a very good track record of finding and developing copper-nickel deposits. While the procedures are not verified, AMEC believes that they would meet typical standards today and that they are adequate to support resource estimation. AMEC recommends that 15-20 twin holes be drilled in the area to verify the legacy data.

25.5 Sample Preparation, Analyses, and Security

Sample Preparation

Sample preparation of current samples at both Maturi and Birch Lake has been done using industry-standard procedures and is adequate to support resource estimation.

Sample preparation of legacy samples from Maturi and Birch Lake and at Spruce Road is unknown, but is believed to have been done at INCO's internal laboratory which would have used industry-standard procedures at the time.

Sample Analysis

Sample analysis for the current samples at both Maturi and Birch Lake is done using standard procedures and is adequate to support resource estimation. Sample analysis of legacy samples at Maturi and Birch Lake and at Spruce Road is unknown, but is believed to have been done by acid digestion followed by atomic absorption (AA) spectrometry which is a standard procedure today. These analyses have been largely validated by work at Maturi which has a large number of legacy drill holes and is believed by AMEC to be adequate to support resource estimation.

Density Analysis

Density data at Maturi and Birch Lake have been collected using standard procedures and is adequate to support resource estimation. There are no density data for Spruce Road which is a small risk, but the uniformity of the rocks and the small density range shown by Maturi and Birch Lake tend to mitigate that risk.

Sample Security

Sample security is adequate.

QA/QC

Accuracy and precision for current Maturi and Birch Lake sample results is adequate to support resource estimation. Although a small number of problems were noted during the course of the project, those problems have been largely resolved and will not pose a risk to the project. NiS collector fire assays at Maturi show significantly more platinum palladium than were indicated in the original assays. Allowing for the probable low bias in the SGS results shown by the inserted CRMs, these results indicate that more platinum and palladium may be recovered from Maturi than indicated in the resource estimate.

25.6 Data Verification

Extensive audits and other checks of the database indicate that the error rate is quite small. The Maturi database is adequate to support estimation of Indicated Mineral Resources. AMEC believes that the Birch Lake database is only adequate to support Inferred Mineral Resources largely because of questions regarding downhole surveys. The Spruce Road database is adequate to support estimation of Inferred Mineral Resources because it is comprises largely unverified legacy data. While unverified at Spruce Road, similar vintage data from Maturi have been largely verified, and thus AMEC believes that Spruce Road will be similarly verified when additional exploration is done in the area.

25.7 Metallurgical Testwork

Metallurgical testwork is preliminary at this point but shows that copper, nickel, and precious metals can be concentrated using conventional flotation procedures. In order to recover the maximum amount of metals, a pressure oxidation procedure is required, and that procedure, while a proven technique, may not be optimal for these deposits. There is an unquantifiable risk that these deposits will not react well with pressure oxidation and that the recoveries anticipated by the preliminary testwork will be realized.

25.8 Mineral Resources

Indicated and Inferred Mineral Resources carry an inherent risk that they may not be converted to Mineral Reserves because of economic considerations. AMEC believes that the resources, as stated, have potential for economic recovery but there is no guarantee that any of the resources will convert to reserves. The primary source of this risk is economic. Preliminary estimated capital and operating cost estimates may not be realized. Permitting may require significant time and expenditures which will pose an economic risk to the project.

26.0 RECOMMENDATIONS

Based on the size and grade of the three deposits and the mining potential, AMEC recommends that TMM complete a prefeasibility study in order to evaluate mining and processing options described by SRK (2011). That study would include additional drilling, preliminary mine planning, additional metallurgical testwork, and environmental baseline studies at Maturi and Birch Lake. Spruce Road is excluded from this study because preliminary mining scenarios have concentrated on Maturi and Birch Lake. Spruce Road, while an attractive target, has been given a lower priority by TMM.

Drilling at Maturi should be driven by the need to confirm legacy data that, in some parts of the deposit, restrict classification to Inferred Mineral Resources, infill where data density is too low to allow Indicated Mineral Resources, and in a few areas where significant mineralization along the fringes of the deposit are judged to have potential to significantly increase tonnages. AMEC believes that approximately 170 holes averaging about 2,400 ft (732 m; 408,000 ft (124,400 m) total) would be required to confirm the legacy data, convert most of the Inferred Mineral Resources to Indicated Mineral Resources, and to provide material for metallurgical testing. On average, approximately 70 samples would be collected from each hole for a total of 11,900 samples.

Drilling at Birch Lake should be driven by the need to convert Inferred Mineral Resources to Indicated Mineral Resources. AMEC believes that approximately 30 holes would be adequate for that purpose. Those holes would average about 2,800 ft (853 m) in depth for a total of about 84,000 ft (25,600 m). On average, approximately 80 samples would be collected from each hole for a total of 2,400 samples.

Although the topography is subdued, significant drill support in the form of bulldozers and lifting equipment are required to access sites, remove snow, and to construct drill pads, sumps, site reclamation, etc.

AMEC recommends that a significant metallurgical testwork program be undertaken. This program should be driven by the need to better define the process flowsheet as well as confirming legacy testwork. Additional samples from additional PQ core holes should be collected from various parts of both projects to better understand geometallurgical variability due to geography and material types within the deposit. The flowsheet should be more or less complete at the end of this process.

There is a need for significant geotechnical data to allow mine designs to be completed. At the present time, the only geotechnical data is core recovery and RQD data collected during routine geological logging of core. Oriented core may be required for complete the geotechnical assessment of the deposits as well as specific geotechnical logging of the core. This work should include an assessment of the hydrogeological character of the deposits.

Environmental baseline data collection and community outreach should begin at this time. Environmental baseline data are a necessary part of a prefeasibility study.

When the drilling is completed, it will be necessary to update the resource estimate. That work should be completed as soon as the drilling is completed.

Preliminary mine planning should be completed as soon as the resource estimate is updated and acquisition of geotechnical data are completed. Although the final mine plan will be completed during the feasibility study, the preliminary mine plan should define mining methods, mining sequence, general mine layout, infrastructure requirements and capital and operating costs.

When the preliminary mine plan is completed, the economic potential of the deposits can then be assessed.

26.1 Budget

Table 26-1 summarizes the budget for the proposed work.

Table 26-1: Proposed Budget

Budget Item	Units		Cost/unit	Estimated Cost (US$)
Exploration Drilling	492,000	ft	40	18,680,000
Drill Support				1,250,000
Assays	14,300	ea	55	786,500
Geotechnical Drilling	5,000	ft	70	350,000
Geotechnical Drill Support				25,000
Geotechnical Testwork				1,000,000
Metallurgical Drilling	15,000	ft	70	1,050,000
Metallurgy Drill Support				250,000
Metallurgical Testwork				1,500,000
Environmental Baseline Work				1,500,000
Updated Resource Estimate				365,000
Mine Planning				500,000
Prefeasibility Study				2,500,000
Total				**29,756,500**

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