NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 2 Geoscientific Preliminary Assessment

Lineament Interpretation

TOWNSHIP OF HORNEPAYNE AND AREA, ONTARIO

APM-REP-01332-0206

APRIL 2017

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Phase 2 Geoscientific Preliminary Assessment

Lineament Interpretation, Township of Hornepayne and Area, Ontario

Report Prepared for

Nuclear Waste Management Organization

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

.

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SRK Consulting (Canada) Inc.
SRK Project Number: 3CN020.004
NWMO Report Number: APM-REP-01332-0206
September 28, 2016
Reissued April 25, 2017

Phase 2 Geoscientific Preliminary Assessment, Lineament Interpretation, Township of Hornepayne, Ontario

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SRK Project Number: 3CN020.004
NWMO Report Number: APM-REP-01332-0206

September 28, 2016
Reissued April 25, 2017

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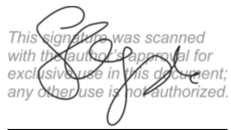

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Executive Summary

This technical report documents the results of an updated surficial and geophysical lineament interpretation study conducted as part of the Phase 2 Geoscientific Preliminary Assessment to further assess the suitability of the Hornepayne area to safely host a deep geological repository. This study followed the successful completion of a Phase 1 Geoscientific Desktop Preliminary Assessment (Geofirma, 2013).

The purpose of the Phase 2 lineament interpretation was to provide an updated interpretation of the geological and structural characteristics of the bedrock units within the area identified in the Phase 1 desktop assessment as warranting further studies, using high-resolution geophysical surveys and geological mapping. The assessment area considered for the lineament study includes the area covered by the newly acquired Phase 2 airborne surveys (SGL, 2017) and is divided into two blocks (Blocks A and B). The interpretation of lineaments was conducted using the new high-resolution airborne magnetic and digital elevation data (DEM), as well as high-resolution digital aerial imagery.

The lineament interpretation followed a systematic workflow involving three steps. The first step included an independent lineament interpretation by two separate interpreters for each data set and assignment of a certainty level (low, medium, or high) of the interpreted lineaments. The second step involved the integration of the interpreted lineaments for each individual data set and a determination of reproducibility. The third and final step involved the integration of the lineament interpretations for the surficial data sets (DEM and digital aerial imagery), followed by the integration of the combined surficial data set with the aeromagnetic data set, with determination of coincidence in each integration step. Over the course of these three steps, a comprehensive list of attributes for each lineament was compiled. The four key lineament attributes and characteristics used in the assessment include certainty, length, density, and orientation.

Geophysical lineaments were interpreted using the newly acquired high-resolution aeromagnetic data (SGL, 2017), which provided a significant improvement to the overall resolution and quality of aeromagnetic data compared with the available data interpreted during the Phase 1 preliminary assessment. Lineaments interpreted using aeromagnetic data are typically less affected by the presence of overburden than surficial data sets, and more likely to reflect potential structures at depth that may or may not have surficial expressions. The geophysical lineament interpretation identified 678 lineaments, including 126 brittle, 280 dyke, and 272 unclassified lineaments through the two blocks of the Hornepayne Phase 2 assessment area. The reproducibility assessment identified coincidence for 66% and a lack of coincidence for 34% of all geophysical lineaments, with 49% assigned the highest level of certainty (three), while 26% were assigned a moderate certainty value of two, and 25% were assigned a low certainty value of one. Brittle lineaments occur dominantly in southeast to south-southeast-trending orientations, and also in northeast- and east-northeast-trending orientations. The density of the brittle and dyke lineaments is variable throughout the two blocks. Areas of higher brittle and dyke density correspond to clusters of tight-spaced brittle and dyke lineaments, and the intersection of these lineament clusters. Dyke lineaments occur throughout the two blocks in a dominant southeast orientation corresponding to the Matachewan dyke swarm, and a subordinate northeast to north-northeast orientation corresponding to the Marathon, Biscotasing, and Abitibi dyke swarms.

Surficial lineaments were interpreted using the high-resolution digital elevation data (DEM) from the airborne surveys, and high-resolution digital aerial imagery with a ground resolution cell of 0.4 metres. Surficial lineaments were interpreted as linear traces along topographic features such as valleys, escarpments, and drainage patterns such as rivers, streams, and linear lakeshore lines. These linear traces may represent the expression of bedrock fractures on the land surface. However, it is uncertain what proportion of surficial lineaments represent actual geological structures and if so, whether the structures extend to significant depth. The observed distribution and density of surficial lineaments is highly influenced by the presence of overburden cover and water bodies, which can mask the surface expressions of potential fractures. The combination of interpreted DEM and digital aerial lineaments yielded 703 integrated surficial lineaments throughout the two blocks of the Hornepayne Phase 2 assessment area. The reproducibility assessment identified coincidence for 21% of the surficial lineaments and a lack of coincidence for 79% of all surficial lineaments, with 8% assigned the highest level of certainty (three), while 42% were assigned a moderate

certainty value of two, and 50% were assigned a low certainty value of one. Surficial lineaments display a dominant broad northeast trend and a subordinate broad southeast trend. The dominant glacial flow direction was also from northeast to southwest, therefore care must be taken when evaluating northeast-trending lineament to ensure they are related to bedrock features. Surficial lineament density is variable throughout the two blocks, with high density areas typically occurring as isolated clusters and along northwest and northeast trends. Zones of elevated density result from multiple closely spaced subparallel southeast- and northeast-trending surficial lineaments, and the intersections of these lineament clusters. Certain low density areas within the surficial data are the result of overburden, including the eastern part of Block B.

The integration of the geophysical and surficial lineament data sets resulted in the final integrated lineament data set. This data set identified 1274 lineaments, including 674 brittle, 282 dyke, and 318 unclassified lineaments through the two blocks of the Hornepayne Phase 2 assessment area. The reproducibility assessment between geophysical and surficial features revealed that 36% of the interpreted geophysical lineaments were also interpreted in at least one of the two surficial data sets. In general, reproducibility values for the final integrated data reveal a low coincidence between surficial and magnetic lineaments. For all subareas, only 7% of the final integrated lineaments were identified in all three data sets, and 20% of the final integrated lineaments were identified in two of the three data sets. Lineaments that were reproduced in all three data sets (RA_2=3), and lineaments with the highest certainty value (3) typically represent the longest lineaments (i.e., greater than 5 km). As with the geophysical lineaments, southeast-trending brittle and dyke lineaments are common. In addition, there is an abundance of northeast-trending final integrated lineaments, which is due to the dominance of this trend in the integrated surficial data set. As with the geophysical and surficial data sets, the density of the final integrated brittle and dyke lineaments is variable throughout the assessment area. Areas of higher brittle and dyke density again correspond to clusters of closely spaced lineaments, and the intersection of these lineament clusters. Brittle lineaments of all orientations are observed to offset and truncate, and be offset and truncated by all other brittle and dyke lineament orientations. The complexity and inconsistency of the structural relationships observed between all brittle lineaments suggest a protracted deformation history that likely includes multiple generations of brittle reactivation.

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1 Introduction

This technical report documents the results of an updated geophysical and surficial lineament interpretation study conducted as part of the Phase 2 Geoscientific Preliminary Assessment, to further assess the suitability of the Hornepayne area to safely host a deep geological repository. This study followed the successful completion of a Phase 1 Geoscientific Desktop Preliminary Assessment (Geofirma, 2013). The desktop assessment identified several potentially suitable areas warranting further studies, such as high-resolution geophysical surveys and geological mapping.

The purpose of the Phase 2 lineament interpretation was to provide an updated interpretation of the geological and structural characteristics of the bedrock units within the potentially suitable areas identified in the Phase 1 desktop assessment. The assessment area considered for the lineament study includes the areas covered by the newly acquired Phase 2 airborne geophysical surveys (SGL, 2017).

The interpretation of geophysical lineaments was conducted using newly acquired high-resolution airborne magnetic data (SGL, 2017). The interpretation of surficial lineaments was conducted using newly acquired topographic data (SGL, 2017) and high-resolution digital aerial imagery of the area (Forest Resource Inventory digital aerial imagery: OMNR, 2009).

1.1 Scope of Work and Work Program

The scope of work for this study includes the completion of a structural lineament interpretation of remote sensing data for the Hornepayne area in northeastern Ontario (Figure 1). The lineament study involved the interpretation of remotely-sensed data sets, including surficial (digital elevation and digital aerial imagery) and geophysical (magnetic) data sets (SGL, 2017) for the Hornepayne area. The investigation interpreted lineament locations and orientations in terms of their potential impact as bedrock structural features (e.g., individual fractures/faults or fracture/fault zones) and evaluated their relative timing relationships within the context of the local and regional geological setting. For the purpose of this report, a lineament was defined as “a linear or curvi-linear geophysical, topographic or surficial feature.” The approach undertaken in this lineament investigation is based on the following:

- Lineaments were interpreted using newly acquired high-resolution aeromagnetic and digital elevation data (SGL, 2017), and purchased high-resolution digital aerial imagery (Forest Resource Inventory digital aerial imagery; OMNR, 2009);
- Lineament interpretations for each data set were made by two specialist interpreters using a standardized workflow;
- Lineaments were interpreted as having unclassified, brittle, or dyke character by each interpreter;
- Lineaments were analyzed based on an evaluation of the quality and limitations of the available data sets;
- Lineaments were evaluated using: age relationships; reproducibility tests, particularly the coincidence of lineaments identified by different interpreters; coincidence of lineaments identified from different data sets; and comparison to literature and mapped geology;
- Classification was applied to indicate the significance of lineaments based on certainty, length and reproducibility.

These elements help to address the issues of uncertainty, subjectivity and reproducibility normally associated with lineament investigations. Their incorporation into the methodology increases the confidence in the resulting lineament interpretation.

1.2 Assessment Area

The Hornepayne Phase 2 assessment area used for the lineament assessment and interpretation includes two separate subareas (Block A and B), totalling approximately 937 square km (km^2) in area (Figure 1), and was provided by NWMO as a shape file. Block A is a rectangular shape and comprises 600 km^2. Block B is an irregularly shaped polygon and comprises 337 km^2. The approximate coordinates defining the boundaries of the Phase 2 lineament assessment areas (Blocks A and B) are listed in Table 1 (UTM NAD83, Zone 16N).

Table 1: Bounding Coordinates of the Phase 2 Lineament Assessment Areas in the Hornepayne Area, Ontario

X UTM	Y UTM	Block
641522.86	5450500	A
665062.14	5450500	A
665062.14	5425000	A
641522.86	5425000	A
662733.8	5473683	B
681148.84	5473683	B
681148.84	5459077.9	B
654055.45	5459077.9	B
654055.45	5466909.6	B
662733.8	5466909.6	B

* (UTM NAD83 Zone 16N)

1.3 Qualifications of SRK and SRK Team

The SRK Group comprises more than 1,400 professionals, offering expertise in a wide range of resource engineering disciplines. The independence of the SRK Group is ensured by the fact that it holds no equity in any project it investigates and that its ownership rests solely with its staff. These facts permit SRK to provide its clients with conflict-free and objective recommendations on crucial issues. SRK has a proven track record in undertaking independent assessments of mineral resources and mineral reserves, project evaluations and audits, technical reports and independent feasibility evaluations to bankable standards on behalf of exploration and mining companies, and financial institutions worldwide. Through its work with a large number of major international mining companies, the SRK Group has established a reputation for providing valuable consultancy services to the global mining industry.

The lineament interpretation and the compilation of this report were completed by Ms. Anna Fonseca, PGeo and Mr. Simon Craggs. Dr. James P. Siddorn, PGeo served as a technical advisor and reviewed lineament interpretations and drafts of this report prior to their delivery to the NWMO as per SRK internal quality management procedures.

Following is a brief description of the qualifications and roles of the project team members.

Ms. Anna Fonseca, MSc, PGeo is a Principal Consultant – Geology and has more than 20 years of international experience in geological mapping at various scales. She has conducted structural lineament interpretations of remote sensing data sets for the Rice Lake Greenstone Belt of the

Superior Province and of the Yaramoko project area in Burkina Faso. She recently completed Phase 2 structural lineament interpretations for the Ignace study area for the NWMO and acted as Project Manager for the Creighton (SRK, 2015a), Ignace (SRK, 2015b), and Schreiber (SRK, 2015c). Phase 2 lineament interpretation projects. In this study, Ms. Fonseca was the lead interpreter and the report author.

Mr. Simon Craggs, MSc is a Senior Consultant – Structural Geology and specializes in regional mapping, detailed analysis of fracture/fluid flow mechanics and the structural controls on epithermal ore deposit formation. Mr. Craggs has conducted several structural interpretations for vein-type precious metal deposits in poly-deformed terranes across Canada. He recently completed Phase 2 structural lineament interpretations for the Creighton (SRK, 2015a) and Schreiber (SRK, 2015c) study areas for the NWMO.

Dr. James Siddorn, PGeo is a Practice Leader (Structural Geology) and specialist in applied structural interpretation of remotely sensed data combined with the structural analysis of ore deposits. Dr. Siddorn has conducted numerous detailed interpretations of magnetic and electromagnetic data sets for gold and diamond exploration, and rock mechanics/hydrogeological engineering studies. Previously, he completed a structural lineament interpretation of the Ignace area for the NWMO. He also oversaw the Phase 2 structural lineament interpretations for the Creighton (SRK, 2015a), Ignace (SRK, 2015b), and Schreiber (SRK, 2015c)areas. In this study, Dr. Siddorn was the senior reviewer.

Mr. Jason Adam is an Associate Consultant (GIS) who has a broad experience in GIS (geographical information systems). Mr. Adam provided GIS support for the study, mainly in the preparation of figures, under the direction of Ms. Fonseca.

2 Summary of Geology

The detailed geology of the Hornepayne area was described in the Phase 1 Geoscientific Desktop Preliminary Assessment (Geofirma, 2013). The following subsections provide a brief description of the geologic setting, bedrock geology, structural history and mapped structures, metamorphism and Quaternary geology of the Hornepayne area. The focus of the following section a the bedrock units and important structural features in the areas identified during Phase 1 as being potentially suitable to host a deep geological repository.

2.1 Geological Setting

The Hornepayne area is located within the Archean Superior Province of northern Ontario. The Superior Province is a stable craton created from a collage of ancient plates and accreted juvenile arc terranes that were progressively amalgamated over a period of more than 2 billion years (e.g., Percival et al., 2006). The Superior Province covers an area of approximately 1,500,000 km^2 and is divided into subprovinces, including the Wawa and Quetico subprovinces. The Hornepayne Block A is located entirely within the Wawa Subprovince, whereas Block B is located entirely within the Quetico Subprovince (Figure 2).

The Wawa Subprovince is comprised of multiple units of volcanic and associated metasedimentary rocks (greenstone belts) separated by extensive granitic plutons and batholiths. These volcanic and metasedimentary units typically occur in elongate narrow geometries and represent volumetrically a relatively minor percentage of the rocks. The surrounding granitic bodies are composed primarily of tonalite to granodiorite, and represent the vast majority of the rock present throughout the area.

The Quetico Subprovince is an expansive geological domain comprised predominantly of metasedimentary rocks (Zaleski et al., 1995). Numerous granitic intrusions, and rare mafic to ultramafic intrusions are also located throughout the Quetico Subprovince (Williams, 1989; Sutcliffe, 1991).

Four generations of Paleoproterozoic diabase dyke swarms, ranging in age from ca. 2.473 to 2.101 Ga intrude all bedrock units in the Hornepayne area (Hamilton et al., 2002; Buchan and Ernst, 2004; Halls et al., 2006).

2.2 Bedrock Geology

The main bedrock geology units present within the two Hornepayne interpretation blocks include the Black-Pic batholith (Block A) of the Wawa Subprovince and the metasedimentary rocks of the Quetico Subprovince (Block B). Additionally, a sliver of the Strickland pluton occurs in the southeastern portion of Block A, and the southern boundary of a granite-granodiorite intrusion is located along the northern boundary of Block B (Figure 2). All bedrock units in the Hornepayne area are transected by three generations of diabase dykes. The bedrock in the Hornepayne area has experienced several generations of ductile and brittle deformation, and the individual rock units have been subjected to varying amounts of metamorphism ranging from amphibolite to granulite facies metamorphism (Williams and Breaks, 1996).

A detailed description of these bedrock units, and structural and metamorphic events, can be found in the Phase 1 Geoscientific Desktop Preliminary Assessment (Geofirma, 2013), and are summarized in the following subsections. A description of the bedrock geology units surrounding, but not included within the individual Phase 2 Hornepayne interpretation areas, can also be found in the aforementioned reference, and are not repeated here.

2.2.1 Metasedimentary Rocks of the Quetico Subprovince

Metasedimentary rocks of the Quetico Subprovince occur in the northern portion of the Hornepayne assessment area and underlie the entire Block B, with the exception of the northernmost boundary, which is located along the contact of a granite-granodiorite intrusion (Figure 2).

Metasedimentary rocks of the Quetico Subprovince include wackes, pelites, and arenites, as well as varying amounts of ironstone, conglomerate, and siltstone (Williams and Breaks, 1996; Zaleski et al., 1999). Rocks within the Quetico Subprovince have experienced varying degrees of metamorphism ranging from amphibolite to granulite facies, and deformation, and commonly exhibit gneissic and migmatitic textures (Percival, 1989; Williams and Breaks, 1996; Zaleski et al., 1999). Extensive deformation can be observed in the form of numerous small-scale folds, shear zones, and boudinaged units (Williams and Breaks, 1996). Evidence of extensive metamorphism includes significant volumes of leucosome, resulting from partial melting and segregation during high-grade metamorphism (Williams and Breaks, 1996).

The Quetico Subprovince has been interpreted to be an accretionary prism of an Archean volcanic island-arc system, which developed where the Wawa and Wabigoon belts formed converging arcs (Percival and Williams, 1989). The timing of the Quetico-Wawa belt accretion has been constrained between ca. 2.689 Ga and 2.684 Ga (Percival, 1989), and the metasedimentary rocks have been dated at 2.700 to 2.688 Ga (Percival, 1989; Zaleski et al., 1999).

2.2.2 Intrusive Rocks of the Quetico Subprovince

The southern boundary of a mapped granite-granodiorite intrusion straddles the northern boundary of the Hornepayne Block B (Figure 2). Similar intrusions have been mapped in the region, and described as quartzo-feldspathic gneisses (Coates, 1970) and biotite leucogranite (Percival, 1989). In general, granitic rocks in the Quetico Subprovince are typically medium- to coarse-grained and massive (Percival, 1989).

2.2.3 Intrusive Rocks of the Wawa Subprovince

Black-Pic Batholith

The Black-Pic batholith is a regionally-extensive intrusion located within the Wawa Subprovince, encompassing an area of approximately 3,000 km^2. With the exception of several relatively small granitic intrusions (e.g., Strickland pluton), the bedrock underlying Block A is entirely contained within this batholith (Figure 2).

The Black-Pic batholith comprises a multi-phase suite of hornblende-biotite monzodiorite, foliated tonalite, and pegmatitic granite, with subordinate foliated diorite, granodiorite, granite and crosscutting aplitic to pegmatitic dykes (Williams and Breaks, 1989; Zaleski and Peterson, 1993). Local lithological variations occur throughout the batholith, including upper levels of the tonalite, which are frequently cut by granitic sheets of pegmatite and aplite, and are generally more massive (Williams and Breaks, 1989). Also present throughout the batholith are zones of migmatized sedimentary rocks and massive granodiorite to granite. The contact between these rocks and the tonalitic rocks is gradational and associated with extensive sheeting of the tonalitic unit (Williams and Breaks, 1989; Williams et al., 1991).

The Black-Pic batholith is interpreted to be a domal structure with shallow dipping foliation radiating outward from its centre (Williams et al., 1991). Structurally deeper levels of the tonalite suite contain a strong sub-horizontal foliation and a weak north-trending mineral elongation lineation (Williams and Breaks, 1989).

The age of emplacement of the Black-Pic batholith has been constrained by U-Pb (zircon) dating of the oldest recognized phase of the tonalite at ca. 2.720 Ga (Jackson et al., 1998). A younger monzodioritic phase has also been dated at ca. 2.689 Ga (Zaleski et al., 1999).

Strickland Pluton

Part of the Strickland pluton occurs in the southeast portion of the Hornepayne area bordering the Black-Pic batholith. The pluton occupies an area of approximately 600 km^2 and has maximum dimensions in the area of 34 km north-south and 55 km east-west (Figure 2). Stott (1999) described the Strickland pluton as a relatively homogeneous, quartz-porphyritic granodiorite. Although near the outer margin of the pluton, adjacent to greenstone belt rocks, granodiorite to tonalite and diorite are present. In the area west of the Kabinakagami greenstone belt, Siragusa (1977) noted that massive quartz monzonite (i.e., monzogranite in modern terminology) intrudes the granodioritic and trondhjemitic rocks in the form of medium-grained to pegmatitic dykes and small sills and irregular bodies.

Some degree of post-emplacement deformation and metamorphism of the Strickland pluton is indicated by the observed presence of fine- to medium-grained titanite and the widespread presence of hematite-filled fractures and weak alteration of silicate minerals (Stott, 1999). Stott (1999) noted that the pluton is petrographically similar to the ca. 2.697 Ga Dotted Lake batholith, located southwest of the Hornepayne area, and suggested that these plutons are members of an intrusive suite commonly found along the margins of greenstone belts in this part of the Wawa Subprovince.

2.2.4 Mafic Dykes

Four diabase dyke swarms crosscut the Hornepayne area (Figure 2), including:

- Northwest-trending Matachewan dykes (ca. 2.473 Ga; Buchan and Ernst, 2004). This dyke swarm is one of the largest in the Canadian Shield. Individual dykes are generally up to 10 metres wide, and have vertical to subvertical dips. Matachewan dykes are mainly quartz-diabase dominated by plagioclase, augite, and quartz (Osmani, 1991).
- North-northeast-trending-trending Marathon dykes (ca. 2.121 Ga; Buchan et al., 1996; Hamilton et al., 2002). These dykes form a fan-shaped distribution pattern around the northern, eastern, and western flanks of Lake Superior. The dykes vary in orientation from northwest to northeast, and occur as steep to subvertical sheets, typically a few metres to tens of metres thick, but occasionally up to 75 metres thick (Hamilton et al., 2002). The Marathon dykes are quartz-diabase dominated by equigranular to subophitic clinopyroxene and plagioclase (Osmani, 1991).
- Northeast-trending Biscotasing dykes (ca. 2.167 Ga; Hamilton et al., 2002). Locally, Marathon dykes also trend northeast and cannot be separated with confidence from the Biscotasing Suite dykes.
- Northeast-trending Abitibi dykes (ca. 1.14 Ga; Ernst and Buchan, 1993). These dykes occur locally in the Hornepayne area crosscutting older dykes.

The four dyke swarms in the Hornepayne area are generally distinguishable by their unique strike directions, crosscutting relationships and, to a lesser extent, by the amplitude of the associated, magnetic anomalies.

2.3 Structural History

Information on the structural history of the Hornepayne area is based predominantly on structural investigations of the Hornepayne and Dayohessarah greenstone belts (Polat, 1998; Peterson and Zaleski, 1999) and the Hemlo gold deposit and surrounding region (Muir, 2003). Additional studies by Lin (2001), Percival et al. (2006), and Williams and Breaks (1996) have also contributed to the structural understanding of the area. The aforementioned studies were performed at various scales and from various perspectives. Consequently, the following summary of the structural history of the Hornepayne area should be considered as a best-fit model that incorporates relevant findings from all studies. The structural history of the Hornepayne area is described below and summarized in Table 2.

The Hornepayne area straddles a structurally complex boundary between the metasedimentary-migmatitic Quetico Subprovince and the volcano-plutonic Wawa Subprovince within the Archean Superior Province. The structural history of the Hornepayne and nearby Schreiber-Hemlo greenstone belts is generally well characterized and includes multiple phases of deformation (Polat et al., 1998; Peterson and Zaleski, 1999; Lin, 2001; and Muir, 2003). Polat et al. (1998) interpreted the Schreiber-Hemlo and surrounding greenstone belts to represent collages of oceanic plateaus, oceanic arcs, and subduction-accretion complexes amalgamated through subsequent episodes of compressional and transpressional collision.

On the basis of overprinting relationships between different structures, Polat et al. (1998) suggested that the Schreiber-Hemlo greenstone belt underwent at least two main episodes of deformation that also affected rocks of the Wawa Subprovince, including the Hornepayne area These deformation events can be correlated with observations from Peterson and Zaleski (1999) and Muir (2003), who reported at least five and six generations of structural elements, respectively. Two of these generations of structures account for most of the ductile strain, and although others can be distinguished on the basis of crosscutting relationships, they are likely the products of progressive deformation events. Integration of the structural histories detailed in Williams and Breaks (1996), Polat et al. (1998), Peterson and Zaleski (1999), Lin (2001), and Muir (2003) suggests that six deformation events occurred within the Hornepayne area. The first four deformation events (D_1-D_4) are associated with ductile and brittle-ductile deformation. D_5 and D_6 were associated with a combination of brittle deformation and fault propagation through all rock units in the Hornepayne area. The main characteristics of each deformation event are summarized in Table 2.

Table 2: Summary of the Geological and Structural History of the Hornepayne Area (adapted from Geofirma, 2013)

Approximate Time Period (years before present)	Geological Event
2.89 to 2.77 Ga	Progressive growth and early evolution of the Wawa-Abitibi terrane by collision, and ultimately accretion, of distinct geologic terranes
2.770 – 2.673 Ga	- ca. 2.720 Ga: Volcanism and subordinate sedimentation associated with the formation of the Manitouwadge-Hornepayne greenstone belt - ca. <2.693: Deposition of sedimentary rocks in the Hornepayne greenstone belt and the Quetico Subprovince - ca. 2.720-2.678 Ga: Inferred emplacement of granitoid intrusions in the Hornepayne area. Emplacement of the Pukaskwa and Black-Pic gneissic complexes at ca. 2.72 Ga Emplacement of Loken Lake pluton (ca. 2.687 Ga), Nama Creek pluton (2.680 Ga), and Fourbay Lake pluton (ca. 2.678 Ga) Emplacement of Dotted Lake pluton, and possibly of Strickland pluton (ca. 2.697 Ga) - ca. 2.719 to 2.673 Ga: Four generations of brittle-ductile deformation (D_1-D_4) D_1: ca. 2.719 – 2.691 Ga D_2: ca. 2.691 – 2.683 Ga D_3: ca. 2.682 – 2.679 Ga D_4: ca. 2.679 – 2.673 Ga
2.675 to 2.669 Ga	Peak metamorphism of the Hornepayne greenstone belt
< 2.673 Ga	Two phases of brittle deformation (D_5-D_6)
2.666 to 2.650 Ga	Peak metamorphism of the Quetico Subprovince
2.5 to 2.100 Ga	- ca. 2.5 Ga: Supercontinent fragmentation and rifting in Lake Superior area; development of the Southern Province - ca. 2.473 Ga: Emplacement of the Matachewan dyke swarm - ca. 2.167 Ga: Emplacement of Biscotasing dyke swarm - ca. 2.121 Ga: Emplacement of the Marathon dyke swarm
1.9 to 1.7 Ga	Penokean Orogeny in Lake Superior and Lake Huron areas; possible deposition and subsequent erosion in the Hornepayne area
1.150 to 1.090 Ga	Rifting and formation of the Midcontinent Rift structure - ca. 1.1 Ga
540 to 355 Ma	Possible coverage of the area by marine seas and deposition of carbonate and clastic rocks subsequently removed by erosion
145 to 66 Ma	Possible deposition of marine and terrestrial sediments of Cretaceous age, subsequently removed by erosion
2.6 to 0.01 Ma	Periods of glaciation and deposition of glacial sediments

The earliest recognizable deformation phase (D_1) is associated with rarely preserved small-scale isoclinal (F_1) folds, ductile shear zones that truncate stratigraphy, and a general lack of penetrative foliation development. Peterson and Zaleski (1999) reported that an S_1 foliation is only preserved locally in outcrop and in thin section. D_1 deformation is poorly constrained between ca. 2.719 and ca. 2.691 Ga (Muir, 2003).

D_2 structural elements include prevalent open to isoclinal F_2 folds, an axial planar S_2 foliation, and L_2 mineral elongation lineations (Peterson and Zaleski, 1999). Muir (2003) interpreted D_2 to have resulted from progressive north-northeast to northeast directed compression that was coincident with the intrusion of various plutons. The S_2 foliation is the dominant meso- to macro-scale regional fabric evident across the study area. Ductile flow of volcano-sedimentary rocks between more competent batholiths may also have occurred during D_2 deformation. This generation of deformation is constrained to between ca. 2.691 and ca. 2.683 Ga (Muir, 2003).

D_3 deformation was the result of northwest-southeast shortening during regional dextral transpression. D_3 structural elements include macroscale F_3 folds, including the regional scale isoclinal fold developed within the Hornepayne greenstone belt (Figure 2), and local shear fabrics that exhibit a dextral sense of motion and overprint D_2 structures (Peterson and Zaleski, 1999; Muir, 2003). D_3 deformation did not develop an extensive penetrative axial planar and (or) crenulation cleavage. D_3 deformation is constrained to between ca. 2.682 and ca. 2.679 Ga (Muir, 2003).

D_4 structural elements include isolated northeast-plunging F_4 kink folds with a Z-asymmetry, and associated small-scale fractures and faults overprinting D_3 structures. D_3-D_4 interference relationships are best developed in the Hornepayne greenstone belt and in rocks of the Quetico Subprovince (Muir, 2003). D_4 deformation is roughly constrained to between ca. 2.679 and ca. 2.673 Ga (Muir, 2003).

Details of structural features associated with the D_5 and D_6 deformation events are limited in the literature to brittle faults of various scales and orientations (Lin, 2001; Muir, 2003). Within the Hemlo greenstone belt, Muir (2003) suggested that local D_5 and D_6 faults offset the Marathon and Biscotasing dyke swarms (all ca. 2.2 Ga), and as such, suggested that in the Hemlo region D_5 and D_6 faults propagated after ca. 2.2 Ga. However, since there are no absolute age constraints on specific events, the entire D_5-D_6 interval of brittle deformation can only be constrained to a post-2.673 Ga timeframe that may include many periods of re-activation attributable to any of several post-Archean tectonic events.

2.3.1 Mapped Structures and Named Faults

In the Hornepayne area, in both the Quetico and Wawa subprovinces, only three unnamed faults are indicated on public domain geological maps (Figure 2) within Blocks A and B. These faults display two dominant orientations: northeast and northwest and are considered to be associated with D_5-D_6 brittle deformation.

Outside of the Hornepayne lineament interpretation blocks, the east-northeast-trending Shekak River fault, which is mapped immediately east of the Hornepayne Block A, affects granitic rocks of the Black-Pic batholith.

2.3.2 Metamorphism

Studies on metamorphism in Precambrian rocks across the Canadian Shield have been summarized in multiple publications (e.g., Fraser and Heywood, 1978; Kraus and Menard, 1997; Menard and Gordon, 1997; Berman et al., 2000; Easton, 2000a, 2000b; and Berman et al., 2005) and the thermochronological record for large parts of the Canadian Shield is documented in a number of studies (Berman et al., 2005; Bleeker and Hall, 2007; Corrigan et al., 2007; and Pease et al., 2008).

The Superior Province of the Canadian Shield largely preserves low pressure, high temperature Neoarchean (ca. 2.710-2.640 Ga) metamorphic rocks. The relative timing and grade of regional metamorphism in the Superior Province corresponds to the lithological composition of the subprovinces (Easton, 2000a; Percival et al., 2006). Subprovinces comprising volcano-sedimentary assemblages and synvolcanic to syntectonic plutons (i.e., granite-greenstone terranes) are affected by relatively early lower greenschist to amphibolite facies metamorphism. Subprovinces comprising both metasedimentary- and migmatite-dominated lithologies, such as the English River and Quetico, and dominantly plutonic and orthogneissic domains, such as the Winnipeg River, are affected by relatively late middle amphibolite to granulite facies metamorphism (Breaks and Bond, 1993; Corfu et al., 1995). Subgreenschist facies metamorphism in the Superior Province is restricted to limited areas, notably within the central Abitibi greenstone belt (e.g., Jolly, 1978; Powell et al., 1993).

In general, most of the Canadian Shield preserves a complex episodic history of Neoarchean metamorphism overprinted by Paleoproterozoic tectonothermal events culminating at the end of the Grenville orogeny ca. 950 Ma. The distribution of contrasting metamorphic domains in the Canadian Shield is a consequence of relative uplift, block rotation, and erosion resulting from Neoarchean orogenesis, subsequent local Proterozoic orogenic events and broader epeirogeny during later Proterozoic and Phanerozoic eons.

In the Hornepayne area, metasedimentary rocks of the Quetico Subprovince exhibit granulite facies metamorphic conditions close to the boundary between the Wawa and Quetico subprovinces (Williams and Breaks, 1989, 1996; Zaleski and Peterson 1995; Pan et al., 1994).

Geothermobarometric and geochronological calculations by Pan et al. (1994) indicate that low pressure-high temperature, amphibolite facies metamorphism in metasedimentary rocks of the Quetico Subprovince had been in place before ca. 2.666 Ga, in agreement with the period ca. 2.671-2.665 Ga estimated by Percival and Sullivan (1988). This prograde amphibolite facies regional metamorphism would have been initiated ca. 2.675 Ga, increased after ca. 2.666 Ga and reached granulite facies under a thermal peak of 680-700 degrees Celsius (°C) and 4-6 Kbar perhaps ca. 2.658 Ga. Granulite facies metamorphism would have lasted until ca. 2.650 Ga, after which a retrograde event would have occurred at 550-660°C, 3-4 Kbar. After the retrogression, hydrothermal alteration occurred at 200-400°C, 1-2 Kbar.

In Block A, the Black-Pic batholith and other smaller plutons typically display greenschist facies metamorphism (Geofirma, 2013). Locally, higher metamorphic grades up to upper amphibolite facies are recorded in rocks along the margins of plutons. No records exist that suggest that rocks in the Hornepayne area may have been affected by thermotectonic overprints related to post-Archean events.

2.4 Quaternary Geology

The Quaternary geology of the Hornepayne area is described in detail in the remote sensing and terrain evaluation completed as part of the Phase 1 Geoscientific Desktop Preliminary assessment (JDMA, 2013). An overview of the relevant Quaternary features are presented in Figure 3, and summarized below.

The Quaternary sediments in the Hornepayne area comprise glacial and post-glacial materials that overlie the bedrock. All glacial landforms and related materials are associated with the Wisconsinan glaciation, which began approximately 115,000 years ago (Barnett, 1992). Throughout the majority of the Hornepayne area, bedrock outcrops are common and the terrain is dominantly classified, for surficial purposes, as a bedrock-drift complex, i.e., thin drift cover that only locally achieves thicknesses that mask or subdue the bedrock topography (Figure 3). When present, drifts overlying the bedrock are typically limited in thickness and the ground surface reflects the bedrock topography. Beyond bedrock-drift complexes, valleys and lowland areas present, which typically exhibit extensive and thick surficial deposits, frequently have a linear geometry.

The main direction of the most recent glacial advance in the Hornepayne area was from the north-northeast (Gartner and McQuay, 1980).

In the Hornepayne area, a common glacial deposit is stony, sandy till (ground moraine) which forms a veneer in rocky upland areas. The till composition is variable and two types are regionally recognizable (Geddes et al. 1985; Geddes and Kristjansson, 1986). A moderately loose, locally derived, very stony variety with a sandy texture dominates in areas of thin till cover in the western part of the area. A calcareous, silty till, rich in “exotic” carbonate lithologies derived from the James Bay Lowland (Geddes and Kristjansson, 1986) occurs in two facies, one of which is stone poor, massive, silty, and quite dense. The other more dominant facies is less compact and slightly sandier, and has a variable stone content. In some areas, the calcareous till is capped by coarser, locally derived till or till-like material. Geddes and Kristjansson (1986) noted that in areas where there is little relief on the land surface, the calcareous till is usually prominent, especially in areas on the leeside of significant topographic features. It is typical of the stony till to have a more hummocky or moranic surface expression.

The most significant Quaternary landforms occurring in Block A of the Hornepayne area are two large northeast-trending esker complexes in the Bayfield Lake and West Larkin Lake-Shekak River areas (Figure 2). These esker complexes consist of sands and gravels and can exceed 15 metres in depth (Gartner and McQuay, 1980). The most significant Quaternary landforms occurring in Block B are moraine in the southeastern part, and glaciolacustrine plains in the northwestern part.

Glaciolacustrine sediments cover the west-central portion and form a narrow northeastern belt that transects Block A, and partly cover the northwest corner of Block B. These sediments comprise stratified to laminated sand, silt, and clay that were deposited during the incursion of glacial lakes (Prest, 1970; Gartner and McQuay, 1980; Kettles and Way Nee, 1998). The thickness of glaciolacustrine deposits is variable, ranging from several tens of metres to a relative thin drape over bedrock (Kettles and Way Nee, 1998).

Minor organic-rich alluvial deposits and eolian deposits are also locally present throughout the Hornepayne area, and have limited extents. Alluvial deposits are organic-rich, consist of sand, silt and clay, and are typically present along water courses. Eolian deposits consist of sand and are present as dunes developed on certain glacial deposits (Gartner and McQuay, 1980; Geddes and Kristjansson, 1986; Kettles and Way Nee, 1998).

3 Methodology

The structural lineament interpretation of the Hornepayne area was based on high-resolution remote sensing data sets, including a high-resolution airborne magnetic survey contracted by the NWMO to Sander Geophysics Limited (SGL, 2017), topographic data collected during the airborne magnetic survey (SGL, 2017), and high-resolution Ontario Ministry of Natural Resources Forest Resources Inventory (FRI) digital aerial imagery procured from Land Information Ontario (OMNR, 2009).

3.1 Source Data Description

All data were assessed for quality, enhanced, and reviewed before use in the lineament interpretation. The geophysical data were used to evaluate deeper bedrock structures, and were instrumental in identifying potential bedrock structures beneath areas of surficial cover. Furthermore, the geophysical data were instrumental in establishing the age relationships among the different lineament sets. Topographic (DEM) and FRI digital aerial imagery data sets were used to identify surficial lineaments expressed in the topography, drainage, and vegetation. For this study, the best resolution data available was used for the lineament interpretation.

3.1.1 High-resolution Aeromagnetic Data

Sander Geophysics Limited (SGL) completed a fixed-wing high-resolution airborne magnetic survey in the Hornepayne area (SGL, 2017; Figure 4).

The airborne survey in the Hornepayne area included a total of 12,694 km of flight lines covering a surface area of over 1,000 km^2. Flight operations were conducted out of the Manitouwadge Municipal Airport, in Manitouwadge, Ontario, using a Cessna 208B Grand Caravan. Data were acquired along traverse lines flown in an east-west direction spaced at 100 metres, and control lines flown north-south spaced at 500 metres.. The survey was flown at a target altitude of 80 metres above ground level, with an average ground speed of 100 knots (approximately 185 km/hour). The survey acquisition parameters are listed below:

- Traverse line spacing of 100 metres
- Traverse line azimuth of 090 - 270°
- Control line spacing of 500 metres
- Control line azimuth of 000 - 180°
- Grid cell size of 25 metres
- Targeted sensor height of 80 metres
- Acquisition date of Jul 26 to Oct 7, 2015

Acquired data was processed by SGL (SGL, 2017) and provided to SRK as GRD files. The following products of the high resolution airborne magnetic survey were available for this structural lineament interpretation:

- Reduction to the pole of the total magnetic intensity
- First vertical derivative of the reduction to the pole of the total magnetic intensity
- Second vertical derivative of the reduction to the pole of the total magnetic intensity
- Tilt derivative of the reduction to the pole of the total magnetic intensity

The reduced to pole total magnetic intensity, first and second vertical derivatives, and tilt derivative grids were converted to ERS images, shaded by intensity, and the data ranges and colour were enhanced in ERMapper to highlight potential structures. Ultimately, a series of compressed raster images was created in ERMapper for use in ArcGIS.

3.1.2 Digital Elevation Model

Topographic data was collected during the magnetic survey conducted by SGL (SGL, 2017). The survey acquisition parameters are identical to those described for the high-resolution magnetic data in Section 3.1.1.

Topographic data was processed by SGL and provided to SRK as GRD files. The data grid was then converted to an ERS image, and the data ranges, hill shading (using sun angles of 000°, 045°, and 315°), and colour ranges of the digital elevation model (DEM) were enhanced in ERMapper to highlight potential structures (Figure 5). Compressed raster images were created in ERMapper for use in ArcGIS.

3.1.3 High-resolution Digital Aerial Imagery

High resolution digital aerial imagery was obtained from the Ontario Ministry of Natural Resources Forest Resources Inventory (FRI) (Forest Resource Inventory digital aerial imagery: OMNR, 2009).

Digital aerial imagery was collected using a Leica ADS40 Airborne Digital Sensor. The ADS40 sensor captures multispectral bands simultaneously at the same true resolution, and therefore produces a 4-band, truly co-registered and equal resolution imagery (not pan sharpened) from the data acquisition. The spectral ranges and spatial resolution of each band are listed in Table 3.

Table 3: FRI Digital Aerial Imagery Band Ranges and Resolution

Band	Range (nm)	Resolution (m)
Panchromatic	465 - 680	0.2
Blue	428 - 492	0.4
Green	533 - 587	0.4
Red	608 - 662	0.4

Prior to release to the public, the imagery tiles are run through a bidirectional reflectance distribution function (BRDF) process to remove atmospheric distortions associated with sun angles. Subsequently, blocks of orthorectified tile imagery were compiled and processed to be normalized using the brightest and darkest values within the multi date acquisition. Each image consists of a mosaic of 5 by 5 km orthorectified tiles of 4-band data.

A natural colour composite of the FRI digital aerial imagery was created in ArcGIS and utilized for the lineament interpretations (Figure 6).

3.2 Lineament Interpretation Workflow

A structural lineament study of the Hornepayne area was conducted to identify the location and orientation of potential individual fractures or fracture zones and to evaluate their relative timing relationships within the context of the local and regional geological setting.

Lineaments were interpreted using a workflow designed to address issues of subjectivity and reproducibility that are inherent to any lineament interpretation. The workflow follows a set of detailed guidelines using the high-resolution airborne geophysical (magnetic) and high-resolution surficial (DEM and FRI digital aerial imagery) data sets described above. Throughout the report the term geophysical lineaments refers to structures interpreted from the high-resolution magnetic data. The interpretation guidelines involved three steps:

- Step 1: Independent lineament interpretation by two individual interpreters for each data set and assignment of certainty level (1, 2, or 3 representing low, medium and high certainty);
- Step 2: Integration of lineament interpretations for each individual data set and first determination of reproducibility;
- Step 3: Integration of lineament interpretations for the surficial data sets (DEM and digital aerial imagery) followed by integration of the combined surficial data set with the geophysical data set, with determination of coincidence in each integration step.

Each identified lineament feature was classified in an attribute table in ArcGIS. The description of the attribute fields used is included in Table 4. Fields 1 to 9, and Fields 19 and 20 are populated during Step 1. Fields 10 and 11 are populated during Step 2. Fields 12 to 18 are populated during Step 3.

The interpreted geophysical and final integrated lineaments were classified into four general categories based on a working knowledge of the structural history and bedrock geology of the Hornepayne area. These categories include form lines, unclassified, brittle and dyke lineaments, described as follows:

- **Form lines:** Features interpreted to represent the internal fabric of the rock units (including sedimentary or volcanic layering, tectonic foliation or gneissosity, and magmatic foliation). Form lines are typically characterized by semi-continuous linear to curvi-linear magnetic highs that appear to define the grain of the rock units. See Figure A1 for example.
- **Unclassified lineaments**: Linear to curvi-linear features that do not exhibit characteristics to easily form an interpretation, and are therefore unclassified. Possible interpretations may include ductile shear zones (intensification of foliation across a narrow zone) or brittle-ductile shear zones (intensification of foliation across a narrow zone with associated fracturing). Unclassified structures were typically characterized by curvi-linear magnetic lows and commonly truncated or offset the internal fabric of the rock (i.e., form lines). Alternatively, these unclassified structures may represent the internal fabric of the rock (foliation or gneissosity), in particular in domains where they are subparallel to the form lines, or possible brittle structures. Additional field investigations are required to determine the true nature of these lineaments. See Appendix A: Figure A2 for example.
- **Brittle lineaments:** Features interpreted as fractures (joints or joint sets, faults or fault zones, and veins or vein sets). This category also includes brittle partings interpreted to represent discontinuous re-activation parallel to the ductile fabric (e.g., form lines). Brittle lineaments are commonly characterized by continuous magnetic lows, offsets of magnetic highs, offset of form lines, and offset of unclassified lineaments, and breaks in topography and vegetation. At the desktop stage of the investigation, this category also includes features of unknown affinity. See Figure A3 for example.
- **Dyke lineaments**: Features interpreted as dykes, on the basis of their distinct character (e.g., scale orientation, geophysical signature and topographic expression). Dykes were dominantly interpreted from the magnetic data set, and are typically characterized by continuous linear magnetic highs. The interpretation of dykes is also combined with pre-existing knowledge of the bedrock geology of the study area. See Figure A4 for example.

A detailed description of the three workflow steps and the methodology for determining the associated attribute field for each interpreted lineament is provided below.

Table 4: Attribute Table Fields Populated for the Lineament Interpretation

ID	Attribute	Brief Description
1	Rev_ID	Reviewer initials
2	Feat_ID	Feature identifier
3	Data_typ	Data set used (MAG, DEM, FRI)
4	Feat_typ	Type of feature used to identify each lineament Digital Aerial Imagery: A. Lineaments drawn along straight or curved lake shorelines B. Lineaments drawn along straight or curved changes in intensity or texture (i.e., vegetation) C. Lineaments drawn down centre of thin rivers or streams D. Lineaments drawn along a linear chain of lakes E. Other (if other, define in comments) Digital Elevation Model: A. Lineaments drawn along straight or curved topographic valleys B. Lineaments drawn along straight or curved slope walls C. Other (if other, define in comments) Airborne Geophysics (magnetic and electromagnetic data): A. Lineaments drawn along straight or curved magnetic high B. Lineaments drawn along straight or curved magnetic low C. Lineaments drawn along straight or curved steep gradient D. Other (if other, define in comments)
5	Name	Name of feature (if known)
6	Certain	Value describing the interpreters confidence in the feature being related to bedrock structure (1-low, 2-medium or 3-high)
7	Length*	Length of feature is the sum of individual lengths of mapped polylines and is expressed in km
8	Width**	Width of feature; this assessment is categorized into 5 bin classes: A. < 100 metres B. 100 – 250 metres C. 250 – 500 metres D. 500 – 1,000 metres E. > 1,000 metres
9	Azimuth	Lineament orientation expressed as degree rotation between 0 and 180 degrees
10	Buffer_RA_1	Buffer zone width for first reproducibility assessment (in metres)
11	RA_1	Feature value (1 or 2) based on reproducibility assessment
12	Buffer_RA_2	Buffer zone width for coincidence assessment (in metres)
13	RA_2	Feature value (1, 2 or 3) based on coincidence assessment
14	MAG	Feature identified in geophysical data set (Y or Blank)
15	DEM	Feature identified in DEM data set (Y or Blank)
16	SAT	Feature identified in satellite imagery data set (Y or Blank)
17	F_Width	Final interpretation of the width of feature
18	Rel_age	Interpretation of relative age of feature, in accord with regional structural history
19	Comment	Comment field for additional relevant information on a feature
20	Object	Geological element identified, e.g., form lines, unclassified lineament, brittle lineament, dyke lineament.

* The length of each interpreted feature is calculated based on the sum of all segment lengths that make up that lineament.

** The width of each interpreted feature is determined by expert judgment and utilization of a GIS-based measurement tool. Width determination takes into account the nature of the feature as assigned in the Feature type (Feat_typ) attribute.

3.2.1 Step 1: Lineament Interpretation and Certainty Level

To accommodate the generation of the best possible unbiased lineament interpretation, two individual interpreters followed an identical process for structural lineament analysis during Step 1. The first step of the lineament interpretation was to have each individual interpreter independently produce GIS lineament maps, and detailed attribute tables, for each of the three data sets. Step 1 of the structural lineament analysis was conducted up to a scale of 1:25,000 and followed a designated workflow.

The interpretation of magnetic data followed a two-step process. The first step involved the drawing of form lines, otherwise known as tectono-stratigraphic lineaments (Figure 7). Form lines were drawn along linear to curvi-linear magnetic highs as seen in the high-resolution first vertical derivative magnetic data. Locally, where the magnetic contrast was low, the tilt angle derivative data were used to enhance magnetic features. The form lines were interpreted to trace the geometry of stratigraphy, or tectonic foliation within metavolcanic and metasedimentary rocks, and the internal fabric (foliation or magmatic layering) within granitoid batholiths and gneissic rocks. Magnetic highs associated with dykes (i.e., linear crosscutting magnetic highs in orientations identified in the literature as dyke orientations) were not included in this process.

Form line construction highlighted discontinuities between form lines (e.g., form lines intersecting or truncating) that may represent structures (faults, folds), unconformities, or intrusive contacts. The process of drawing form lines was instrumental in highlighting other lineaments in the magnetic data.

The second step involved drawing a structural base layer that represented all interpreted lineaments regardless of interpreted age, type (e.g., unclassified, brittle, or dyke), or kinematics. Evidence for lineaments was derived from several sources in the magnetic data, including discontinuities between form lines, offset of magnetic units, or the presence of linear magnetic lows or highs. The first vertical derivative magnetic data was used mainly with the tilt angle derivative data to further enhance this interpretation.

The lineament interpretation of DEM data involved tracing linear or curvi-linear features along topographic valleys, slope walls, and any other relevant features that were visible in a colour shaded DEM derived from the airborne geophysical survey data. Similarly, the lineament interpretation of digital aerial imagery involved tracing linear or curvi-linear features along visible shore lines, changes in colour intensity or texture (e.g., vegetation), linear rivers and streams, and along linear chains of features associated with lakes that were visible in the FRI imagery.

Lineaments from each of the data sets were assigned attributes by each interpreter to characterize what type of feature the lineament corresponded to, the interpreter's certainty that the lineament represented a bedrock structure, and the approximate width of the topographic feature.

Lineaments identified in the DEM and or the digital aerial imagery that were interpreted to be related to glacial events were excluded from the lineament interpretation data set. The following criteria were utilized to decide whether a DEM or digital aerial imagery lineament should be excluded:

- The lineament coincided with a mapped ice-flow feature, moraine, or esker;
- The lineament was parallel to known eskers or moraines and was marked by narrow, curving ridges;
- The lineament was parallel to the local ice flow direction and was accompanied by drumlin-shaped hills in the DEM data set.

The Step 1 lineament analysis resulted in the generation of one interpretation for each data set (e.g., magnetic, DEM, digital aerial imagery) for each interpreter, resulting in a total of six individual GIS layer-based interpretations. Where evident, lineament segments were merged, and lineament lengths calculated, resulting in final lineament lengths that corresponded to the sum of all merged segments.

During Step 1, identified lineaments were attributed with Fields 1 to 9, and Fields 19 and 20 (Comment and Object attribute) as listed in Table 4.

3.2.2 Step 2: Lineament Reproducibility Assessment 1 (RA_1)

During Step 2, individual lineament interpretations produced by each interpreter were compared for each data set (e.g., two individual DEM lineament interpretations). This included a reproducibility assessment based on the coincidence, or lack thereof, of the interpreted lineaments within a data set specific buffer zone. The two individual lineament interpretations for each data set were then integrated and a single interpretation was generated for each data set (Figure 8 to Figure 10). A discussion of the parameters used during this step follows.

Buffer Size Selection

Buffer sizes for lineaments in each data set were based on the magnetic grid resolution. It was determined using trial-and-error over a selected portion of the lineament interpretation that buffer sizes of five times the grid cell resolution provided a balanced result for assessing reproducibility.

A buffer of 125 metres (either side of the lineament) was generated for the magnetic data. This value is equivalent to five times the data set grid cell resolution (25 metres) of the high resolution magnetic data. Given that the DEM data was extracted from the same survey, the same buffer size was applied to the DEM data. A 125-metre buffer was applied to the digital aerial imagery data in order to be consistent with the magnetic and DEM buffer size.

The buffer size widths were included in the attribute fields of each interpretation file (Table 4). The buffers were used as an initial guide to determine coincidence between lineaments, with the expert judgement of the interpreter ultimately determining which lineaments were coincident.

Reproducibility Assessment

The generation of an integrated lineament interpretation for each data set, including the reproducibility assessment, followed a three-step process:

- Lineament buffers were generated for both individual Step 1 interpretations. The lead interpreter’s Step 1 lineaments were then overlain on top of these buffers, and all lineaments that occurred within overlapping buffers were carried forward and copied into a new file for Step 2. These lineaments were attributed with a reproducibility value (RA_1; Table 4) of two in the Step 2 attribute table. In addition, if two lineaments were deemed coincident, the highest certainty value from either lineament was carried forward. During this process, based upon insight gained from analyzing the separate interpretations together, the geometry of the lineament that was carried forward was occasionally adapted to better reflect the underlying data.
- The remaining lineaments in the lead Step 1 interpretation were then manually analyzed by both interpreters on the basis of the available imagery for each data set. In some instances, this included adapting the shape and extent of individual lineaments to increase the accuracy of spatial location or length of the lineament, and carrying the adapted lineament forward into the Step 2 interpretation file. These lineaments were attributed a RA_1 value of one in

the Step 2 attribute table. Where it was determined by the two interpreters that these features were not representative of potential bedrock structure, they were removed from the data set.

- Finally, the second Step 1 lineament interpretation was overlain on top of the Step 2 integrated file, and all remaining lineaments in the second interpreter's Step 1 interpretation were then manually analyzed by both interpreters on the basis of the available imagery for each data set. In some instances, this included adapting the shape and extent of individual lineaments to increase the accuracy of spatial location or length of the lineament, and carrying the adapted lineament forward into the Step 2 interpretation file. These lineaments were attributed a RA_1 value of one in the Step 2 attribute table. All remaining lineaments that were attributed a certainty value of one were analyzed by both interpreters, and removed if it was determined that these features were not representative of potential bedrock structures.

As specified above, the decision on whether or not to adapt the shape and extent of an individual lineament, or whether the lineament was carried forward to the next step was based on analysis of the specified lineament with the available imagery and a discussion between the two interpreters. If a lineament was drawn continuously by one interpreter but as individual, spaced, or disconnected segments by the other interpreter, the longer lineament, or the lineament that most accurately represented the underlying feature was carried forward to the Step 2 interpretation with a RA_1 value of two.

The resulting Step 2 interpretations for each data set (e.g., magnetics, DEM, and FRI digital aerial imagery) were then slightly refined to avoid any structurally inconsistent or geologically improbable relationships. Any modifications of lineaments were minor, took place within the limits of the assigned buffer zone, and respected the underlying data.

3.2.3 Step 3: Coincidence Assessment (RA_2)

During Step 3, the integrated lineament interpretations for each data set were amalgamated into one final interpretation. First, lineaments derived from the DEM and digital aerial imagery were merged to produce an integrated surficial lineament data set. Subsequently, the geophysical lineaments were integrated with the integrated surficial lineaments to produce a final integrated interpretation. A discussion of the parameters used during these steps follows below.

Surficial Lineament Integration

The FRI digital aerial imagery data have a resolution of 40 centimetres while the DEM data have a resolution of approximately 25 metres. Furthermore, the orientation of minor and intermediate topographic features as identified in the DEM can be ambiguous due to the resolution of the data, while these features could be drawn with greater precision from the FRI digital aerial imagery. Therefore, lineaments derived from the FRI data were used as the lead data set, and lineaments drawn from DEM data were used as the secondary data set.

A buffer of 125 metres (five times the resolution of the DEM data) was generated around the DEM lineaments and the FRI lineaments were overlain on top of this buffer. Similar to the procedure in RA_1, all lineaments that occurred within overlapping buffers were carried forward and copied into a new file. These lineaments were attributed with a RA_2 reproducibility value of two (RA_2; Table 4). In addition, if two lineaments were deemed coincident, the highest certainty value from either lineament was carried forward. During this process, based upon insight gained from analyzing the separate interpretations together, the geometry of the lineament that was carried forward was occasionally adapted within the boundaries of the buffer to better reflect the underlying data.

All remaining lineaments were then manually analyzed by both interpreters on the basis of the available imagery for each data set. In some instances, this included minor adaptations to the shape and extent of individual lineaments, within the limitations of the buffer, to increase the accuracy of spatial location, length of the lineament, and (or) preserve structural relationships. All these lineaments were then carried over and attributed with an RA_2 value of one in the attribute table (RA_2; Table 4). No lineaments were removed or significantly modified at this stage of the integration.

Final Lineament Integration

The geophysical data supplies important information regarding structures in the subsurface. Therefore, for this step of the interpretation, the lineaments derived from geophysical data were given precedence over lineaments derived from surficial data, since the latter primarily provide information regarding the surface expression of potential structures.

On this premise, all lineaments derived from the magnetic data were included in the final interpretation. A buffer of 125 metres (five times the resolution of the geophysical and DEM data) was generated around the integrated surficial lineaments, and the geophysical lineaments were overlain on top of this buffer. This buffer size was included as an attribute field for all interpreted lineaments (Buffer RA_2; Table 4). Similar to the procedure in RA_1, all lineaments that occurred within overlapping buffers were carried forward and copied into a new file. These lineaments were attributed with a RA_2 reproducibility value of two or three, depending on how many surficial data sets they were observed in (RA_2; Table 4). During this process, based upon insight gained from analyzing the separate interpretations together, the geometry of the lineament that was carried forward was occasionally adapted within the boundaries of the buffer, to better reflect the underlying data.

The following rules were applied for determining coincidence between the data set specific lineament maps:

- If any coincidence of lineaments occurred between the two lineament data sets, the longest lineament was carried forward and attributed as derived from two (or more) data sets, regardless of the length of overlap between the lineaments. This meant that if any part of a lineament derived from one data set was identified in another data set, it was considered that this lineament was reproduced. In addition, if two lineaments were deemed coincident, the highest certainty value from either lineament was carried forward.
- A lineament derived from topographic and (or) digital aerial imagery data that occurs within the buffer of a lineament derived from geophysical data is attributed as reproduced in the relevant data sets, if the orientation of the lineaments does not deviate significantly.
- Short (less than 500 metres) discontinuous topographic and satellite imagery data lineaments that are at low angles to geophysical data lineaments but extending outside the geophysical lineament buffer are considered to be coincident.
- Short (less than 500 metres) topographic and satellite imagery data lineaments that are at high angles to geophysical data lineaments, largely overlapped with the buffer zone from the geophysical data lineament, and have no further continuity (i.e., singular elements), are carried forward to the final interpretation (unlike previous Phase 2 interpretations). This was done on the basis that these short segments may represent a bedrock structure, and as such, should be contained within the final integrated data set.

All remaining lineaments were then manually analyzed by both interpreters on the basis of the available imagery for each data set. In some instances, this included minor adaptations to the shape and extent of individual lineaments, within the limitations of the buffer, to increase the accuracy of spatial location, length of the lineament, and or preserve structural relationships. All these lineaments were then carried over and attributed with an RA_2 value of one (or two if observed in both surficial data sets) in the attribute table (RA_2; Table 4). No lineaments were removed or significantly modified at this stage at this stage of the integration. This resulted in a combined interpretation with lineaments derived from the magnetic and surficial data sets.

During this process, each lineament was attributed with a text field highlighting in which data sets it was identified. The final reproducibility value (RA_2; Table 4) was then calculated as the sum of the number of data sets in which each lineament was identified. (i.e., a value of 1 to 3).

Subsequently, the relative age of each lineament was interpreted and populated in the attribute table (Rel_Age; Table 4). This incorporated a working knowledge of the structural history of the Hornepayne area, combined with an understanding of the fault characteristics in each lineament population (e.g., unclassified, brittle, dyke). The structural history of the area is described in Section 2.3, based on the existing literature.

3.2.4 Lineament Trends

An analysis of lineament trends reveals different sets of structures, which can then be related to the known structural history of the area. Lineament orientations were assessed for each data set as a whole, within individual subareas, and within distinct geological units, to determine the dominant lineament trends, and potential conjugate sets.

Lineament orientations (azimuth) were calculated using ET EasyCalculate 10, an add-in extension to ArcGIS. This add-in provides a function (polyline_GetAzimuth.cal) that calculates the azimuth of each polyline at a user-specified point and populates an assigned attribute field. SRK used the mid-point of each interpreted lineament to calculate the azimuth. A limitation is acknowledged, however, for calculating a single orientation for curvi-linear structures.

Rose diagrams are circular or semi-circular histograms that depict orientation (azimuthal) data and frequency for each data bin. The histogram peaks show the frequency of occurrence of lineament orientations within each bin. Rose diagrams were produced in Spheristat, with frequencies divided into 10-degree bins, and weighted by length. The length weighting uses a linear function directly related to the lineament length, whereby a lineament with a length of 2 kilometres will have twice the weighting of a lineament with a length of 1 kilometre.

3.2.5 Lineament Length

Lineament lengths were calculated using a simple geometrical calculation of the total length of the polyline in ArcGIS. The length distribution of the various integrated data sets was analyzed through a comparison of summary statistics, and histograms and cumulative frequency plots. Histograms and summary statistics were computed using the Stanford Geostatistical Modelling Software (SGeMS). Histogram bins were computed using arbitrary 500-metre bins.

There is no information available on the depth extent into the bedrock of the lineaments interpreted for the Hornepayne area. In the absence of available information, the interpreted length can be used as a proxy for the depth extent of the identified structures (Nur, 1982). A preliminary assumption may be that the longer interpreted lineaments in the Hornepayne area may extend to greater depths than the shorter interpreted lineaments. However, this is highly dependent on the style and structural history of a given fault.

3.2.6 Lineament Density

Lineament density analyses were conducted using the ArcGIS Analysis and Spatial Analyst toolsets, and included creating lineament line density plots and lineament intersection point density plots for the magnetic, surficial, and final integrated lineament data sets.

Lineament line density of all interpreted lineaments in the Hornepayne area was determined by examining the statistical density of individual lineaments using ArcGIS Spatial Analyst. A grid cell size of 50 metres and a search radius of 1.25 km were used (equivalent to half the size of the longest boundary of the minimum area size of a potential repository siting area). The spatial analysis used a circular search radius examining the lengths of polylines intersected within the circular search radius around each grid cell.

The lineament intersection point density of all intersecting lineaments in the Hornepayne area was determined by extracting all points where two or more lineaments intersected, and then calculating the statistical density of these intersection points. Lineament intersections were extracted using the ArcGIS Analysis Tools Intersect function. The density distribution of these points was then calculated in ArcGIS Spatial Analyst by defining a neighbourhood around each raster cell centre, calculating the number of points that fall within the neighbourhood, and dividing by the area of the neighbourhood. A grid cell size of 50 metres and a search radius of 1.25 km (equivalent to half the size of the longest boundary of the minimum area size of a potential siting area) were used.

4 Lineament Interpretation Results

The following sections describe the results of the lineament interpretation for the Hornepayne area based on analysis of the geophysical and surficial (DEM, FRI digital aerial imagery) data sets. Lineaments interpreted and integrated from the various data sets are presented below and in Figure 7 to Figure 13, including reproducibility (RA_1) and coincidence (RA_2) values. A summary of lineament statistics is presented in Appendix B.

4.1 Geophysical Lineaments (RA_1)

The interpretation of magnetic data allows for the identification of form lines, unclassified, brittle, and dyke lineaments. Form lines traced from the magnetic data set are shown in Appendix A: Figure A1 and Figure 7, and are interpreted to represent the internal fabric of the rock units, including the geometry of the stratigraphy of the metasedimentary rocks or the internal fabric (foliation and magmatic layering) within plutonic and gneissic rocks. Discontinuities between form lines highlight potential unclassified and brittle structures (potential shear zones and/or faults and fractures), unconformities, or intrusive contacts. Therefore, they constitute an essential data component that should be used along with the first vertical derivative of the magnetic data for interpreting unclassified, dyke, and brittle lineaments. A brief discussion of form lines is included in this report to provide context to the lineament interpretation, but form lines were not included in the statistical analyses of the lineament data sets.

Within the Hornepayne Phase 2 assessment area, a total of 678 geophysical lineaments were interpreted and classified as brittle, dyke, and unclassified lineaments. This includes lineaments that were identified and merged by the two interpreters based on interpretation from the geophysical data (Figure 8). Of the total number of geophysical lineaments, 126 were interpreted as brittle lineaments, 280 as dyke lineaments, and 272 were interpreted as unclassified lineaments,. The length of all geophysical lineaments ranges from 0.15 to 25.11 km, with a median of 2.79 km and a mean of 4.55 km. Of the total geophysical lineaments, the reproducibility assessment identified coincidence for 445 lineaments (66%; RA_1 = 2) and a lack of coincidence for 233 lineaments (34%; RA_1 = 1). Of the 678 lineaments interpreted, 333 (49%) were assigned the highest level of certainty (three), while 179 (26%) were assigned a moderate certainty value of two, and 166 (25%) were assigned a low certainty value of one.

Of the 126 brittle geophysical lineaments, the reproducibility assessment identified coincidence for 59 lineaments (47%; RA_1 = 2) and a lack of coincidence for 67 lineaments (53%; RA_1 = 1); 35 (28%) were assigned the highest level of certainty (three), while 51 (40%) were assigned a moderate certainty value of two, and 40 (32%) were assigned a low certainty value of one.

Of the 280 dyke geophysical lineaments, the reproducibility assessment identified coincidence for 247 lineaments (88%; RA_1 = 2) and a lack of coincidence for 33 lineaments (12%; RA_1 = 1); 244 (87%) were assigned the highest level of certainty (three), while 16 (6%) were assigned a moderate certainty value of two, and 20 (7%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. Appendix B presents a summary of geophysical lineaments statistics. All brittle, dyke and unclassified lineaments were included in the statistical analyses, and are shown in Appendix A: Figures A3 and A4, and A5.

Azimuth data weighted by length for the interpreted brittle lineaments display a dominant southeast-, to south-southeast-trending orientation (two high confidence peaks at 135° and 153°, respectively), as well as northeast and east-northeast-trending orientations (two medium to low confidence peaks at 056° and 076°, respectively) (see rose diagram inset in Figure 8 and Table 5). Southeast- to south-southeast-trending brittle lineaments are generally longer and more continuous than other lineament orientations. Northeast to east-northeast-trending brittle lineaments are commonly short and segmented.

Azimuth data weighted by length for the interpreted dyke lineaments display a dominant southeast (one high confidence peak at 140°) and a subordinate northeast orientation (one medium confidence peak at 036°) (see rose diagram inset in Figure 8 and Table 5). The southeast lineament orientation corresponds to the Matachewan dyke set, whereas the subordinate north to northeast lineament orientations correspond to the Biscotasing, Marathon, and Abitibi dyke sets. Southeast-trending Matachewan dyke lineaments are the most continuous and can occur in swarms or clusters that manifest as multiple, tight-spaced dyke lineaments. Northeast-trending Biscotasing lineaments and north-northeast-trending Marathon dyke lineaments are variably continuous, but less abundant than Matachewan dyke lineaments, and often occur as single isolated dyke lineaments. Two northeast-trending Abitibi dyke lineaments occur only in the southeastern part of Block A as more continuous and straighter lineaments than the older, northeast-trending Biscotasing dyke lineaments.

Azimuth data weighted by length for the interpreted unclassified lineaments display a dominant, broad east to east-northeast orientation, with one high confidence peak at 080° (see rose diagram inset in Figure 8 and Table 5). The east-west unclassified lineaments transect and locally displace dykes indicating possible reactivation along this fabric. The east- to east-northeast-trending unclassified lineaments are typically interpreted as long, continuous structures, however locally some variation exists in both lineament length and orientation that may provide evidence of tight folding.

Table 5: Summary of Geophysical Lineament Orientations for the Hornepayne Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	SSE-NNW	153	145 - 162	15.6	High
	SE-NW	135	129 - 142	12.5	High
	NE-SW	056	051 - 063	7.6	Medium - Low
	ENE-WSW	076	071 - 083	6.8	Medium - Low
Dyke	SE-NW	140	135 - 148	37.8	High
	NE-SW	036	017 - 044	7.7	Medium
Unclassified	E-W	080	060 - 095	25.2	High

Geophysical Lineaments - Block A

A total of 398 geophysical lineaments were interpreted in Block A (Figure 8a). Of these lineaments, 92 were interpreted as brittle lineaments, 158 as dyke lineaments, and 148 as unclassified lineaments. The length of geophysical lineaments within Block A ranges from 0.15 to 25.11 km, with a median length of 2.71 km and a mean length of 4.84 km. The assessment of reproducibility indicated that 278 (70%; RA_1 = 2) of the geophysical lineaments in Block A were coincident between both interpreters, whereas the remaining 120 (30%; RA_1 = 1) were identified by only one interpreter. Of the 398 lineaments interpreted in Block A, 195 (49%) were assigned the highest level of certainty (three), while 93 (23%) were assigned a certainty value of two, and 110 (28%) were assigned a certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature.

Azimuth data weighted by length for the interpreted brittle lineaments in Block A shows a dominant south-southeast trend (one high confidence peak at 153°), and subordinate southeast (one medium to high confidence peak at 134°) and east-northeast orientations (one medium confidence peak at 057°), with lesser defined trends in the east-west, north-south and northeast orientations (see rose diagram inset in Figure 8a and Table 6). In general, the style of the different orientations of brittle lineaments (i.e., length, continuity, etc.) closely resembles the style of the dyke lineaments in the equivalent orientations. The southeast and south-southeast brittle lineament orientations are similar to those of the dyke lineaments discussed below, however tend to be bisected by the southeast-trending dyke lineaments at a shallow angle. Although the north and northeast brittle lineament orientations are less pronounced, they tend to coincide well with the orientations of dyke lineaments discussed below.

Azimuth data weighted by length for the dyke lineaments in Block A highlight the dominant southeast-trending dykes (one high confidence peak at 140°), and to a lesser degree, northeast-trending dykes (one medium confidence peak at 039°) (see rose diagram inset in Figure 8a and Table 6). Rare north-south-trending dykes are also identified in the interpretation. These three orientations of interpreted dyke lineaments (southeast, north, and northeast) correspond to orientations of the Matachewan, Marathon, Biscotasing and Abitibi dyke swarms in the area (Figure 8a). The southeast-trending Matachewan dykes are most prominent and form clusters throughout the area, in particular the northeastern part of Block A. The north-trending Marathon dykes are rare, locally segmented, and occur in the south and central parts of Block A. The northeast-trending Biscotasing dykes tend to be relatively continuous, and occur as isolated lineaments. Although rare, the northeast-trending Abitibi dykes form relatively continuous lineaments which tend to be limited to the southeastern part of Block A. The Abitibi dykes tend to be distinguished from the Biscotasing dykes based on their more easterly trend and stronger magnetic response.

Unclassified lineaments and form lines within the northern portion of Block A form a pervasive east-west-trending (one high confidence peak at 088°) structural fabric that is adjacent to the Wawa and Quetico Subprovince boundary (Figure 8Figure 7a and Table 6). Further south the orientation of the fabric becomes slightly rotated to a more east-northeast trend. The east-west unclassified lineaments in the northern part of Block A appear to transect and locally displace dykes, indicating possible reactivation along this fabric.

Table 6: Summary of Geophysical Lineament Orientations for the Hornepayne Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	SSE-NNW	153	145 - 162	13.4	High
	SE-NW	134	131 - 142	12.4	Medium - High
	ENE-WSW	057	052 - 066	9.8	Medium
Dyke	SE-NW	140	132 - 148	39.0	High
	NE-SW	039	017 - 044	8.3	Medium
Unclassified	E-W	088	059 - 097	28.8	High

Geophysical Lineaments - Block B

A total of 280 geophysical lineaments were interpreted in Block B (Figure 8b). Of these lineaments, 34 were interpreted as brittle lineaments, 122 as dyke lineaments, and 124 were interpreted as unclassified lineaments. The lengths of geophysical lineaments within this block range from 0.31 to 24.78 km, with a median length of 2.86 km and a mean length of 4.15 km. Of the 280 lineaments interpreted in Block B, 138 (49%) were assigned the highest level of certainty (three), while 86 (31%) were assigned a moderate certainty value of two, and 56 (20%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 167 (60%; RA_1 = 2) of the geophysical lineaments in Block B were coincident between both interpreters, whereas the remaining 113 (40%; RA_1 = 1) were identified by only one interpreter.

Azimuth data weighted by length for the interpreted brittle lineaments in Block B are dominantly east-northeast-, southeast-, and south-southeast-trending, with three high confidence peaks at 075°, 140°, and 152°, respectively (see rose diagram inset in Figure 8b and Table 7). Although there is a relatively small number of brittle geophysical lineaments interpreted in Block B (34), the brittle lineaments tend to display similar characteristics as the dyke lineaments in the same orientations. The southeast-, to south-southeast-trending brittle lineaments tend to be subparallel to the Matachewan dyke lineaments, discussed below. The southeast-, to south-southeast-trending brittle lineaments show some degree of continuity, whereas rare northeast-trending lineaments tend to form short segments which appear to truncate against the interpreted Matachewan dyke lineaments. The dominant east-northeast lineament orientation, as shown on the length weighted rose diagram (see rose diagram inset in Figure 8b and Table 7) corresponds to a single east-northeast lineament that transects the central part of Block B. This lineament shows coincidence with the orientation of unclassified lineament trends and form line fabric interpreted through the area. In addition, this lineament shows clear dextral offset shown as displacement of several northwest-trending dyke lineaments, indicating some degree of reactivation along this structure sometime after dyke emplacement.

Azimuth data weighted by length for the interpreted dyke lineaments shows a dominant southeast orientation (one high confidence peak at 143°), and a subordinate northeast orientation (one medium to low confidence peak at 035°) within Block B (see rose diagram inset in Figure 8b and Table 7). The dominant southeast orientation corresponds to the orientation of Matachewan dykes which extend continuously through the assessment block (see rose diagram inset in Figure 8b). Interpreted dyke lineaments trending in a northeast orientation correspond to orientations of both the Marathon and Biscotasing dykes. The southeast-trending Matachewan dykes typically occur as clusters of several continuous long dyke lineaments throughout Block B. The Marathon dyke lineaments are typically shown as shorter lineaments that are segmented and disjointed in the north-central and western parts of Block B, with an individual occurrence of a continuous north-trending lineament in the eastern part of Block B. The interpreted Biscotasing dyke lineaments form clusters of continuous lineaments in the eastern and central parts of Block B.

Azimuth data weighted by length for the unclassified geophysical lineaments exhibit a dominant east-northeast orientation, with one high confidence peak at 070° (see rose diagram inset in Figure 8b and Table 7). Orientation of these lineaments is consistent with the interpretation of form lines within Block B. Although the east-northeast orientation is the dominant trend, locally, both the form lines and the unclassified lineaments show some degree of spatial variability in their orientations which may provide evidence of tight folding throughout Block B.

Table 7: Summary of Geophysical Lineament Orientations for the Hornepayne Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	ENE-WSW	075	072 - 080	22.2	High
	SSE-NNW	152	147 - 157	21.2	High
	SE-NW	140	130 - 144	17.8	High
Dyke	SE-NW	143	135 - 150	40.5	High
	NE-SW	035	026 - 045	6.5	Medium - Low
Unclassified	ENE-WSW	070	059 - 085	34.6	High

4.2 Surficial Lineaments

Surficial lineaments include lineaments interpreted from the DEM and FRI digital aerial imagery data sets, and are shown on Figure 9 and Figure 10, respectively. Unlike the lineaments identified from the magnetic data, surficial lineaments cannot be easily differentiated into unclassified, brittle, and dyke lineaments based solely upon their expression in surficial data. Therefore, all surficial lineaments are classified only by the data set from which they were identified (i.e., DEM lineament and FRI lineament). An overview of the results of the surficial lineament interpretation is provided below.

4.2.1 DEM Lineaments (RA_1)

A total of 310 DEM lineaments were interpreted within the Hornepayne Phase 2 lineament assessment area. This includes all lineaments that were identified and merged by the two interpreters based on interpretation from the DEM data (Figure 9). Of the 310 lineaments interpreted, 38 (12 %) were assigned the highest level of certainty (three), while 154 (50%) were assigned a moderate certainty value of two, and 118 (38%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. The length of all DEM lineaments ranges from 0.3 to 21.18 km, with a median of 2.33 km and a mean of 3.4 km. Of the total DEM lineaments, 150 lineaments were coincident between the two interpreters (48%; RA_1 = 2) and there was a lack of coincidence for 160 lineaments (52%; RA_1 = 1). These results are also discussed below.

Azimuth data weighted by length for the interpreted DEM lineaments display a dominant but broad north-northeast to east-northeast lineament set (two high confidence peaks at 048° and 063°, and one medium to high confidence peak at 032°) as well as a subordinate east-southeast to southeast orientation (two medium confidence peaks at 123° and 135°), and a minor east-west orientation (see rose diagram inset in Figure 9 and Table 8). Throughout the two subareas, northeast-trending DEM lineaments are typically abundant and continuous. However, the northeast orientation of the DEM lineaments is also coincident with the dominant trend of the glacial flow direction (Figure 3). East-southeast-, to southeast-trending DEM lineaments tend to be less abundant, are variable in length, and often segmented and disjointed. East-west-trending lineaments are sparse, moderately continuous, and in places are shown to terminate against northeast-trending lineaments. The abundance of DEM lineaments is directly influenced by the degree of topography in a given area, i.e., areas with subdued topography and a lack of elevation contrast impede the interpretation of DEM lineaments. This can be observed in the central and eastern parts of Block A and in the northern and eastern parts of Block B, where low relief regions (coloured blue in Figure 9) have a relatively low number of interpreted DEM lineaments.

Table 8: Summary of DEM Lineament Orientations for the Hornepayne Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
DEM	NE-SW	048	044 - 056	12.4	High
	ENE-WSW	063	059 - 068	10.6	High
	NNE-SSW	032	020 - 037	8.8	Medium - High
	SE-NW	135	130 - 145	7.1	Medium
	ESE-WNW	123	118 - 127	6.9	Medium

DEM Lineaments - Block A

A total of 175 DEM lineaments were interpreted in Block A (Figure 9a). The lengths of all DEM lineaments within this block range from 0.3 to 20.53 km, with a median length of 2.53 km and a mean length of 3.5 km. Of the 175 lineaments, 18 (10%) were assigned the highest level of certainty (three), while 84 (48%) were assigned a moderate certainty value of two, and 73 (42%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. Seventy-six (43%; RA_1 = 2) DEM lineaments in Block A were coincident between both interpreters, whereas the remaining 99 (57%; RA_1 = 1) were identified by one interpreter.

Azimuth data weighted by length for the DEM lineaments within Block A exhibit a broad north-northeast to east-northeast orientation with two high confidence peaks at 048° and 063°, and one medium to high confidence peak at 034°, as well as a subordinate southeast orientation (one medium confidence peak at 124°) (see rose diagram inset in Figure 9a and Table 9). In general, the dominant orientations of the identified lineament sets do not correspond well with the dominant geophysical lineament orientations previously discussed, with the exception of a single northeast-trending peak. A low number of DEM lineaments were interpreted in the south-central portion of Block A, due to subdued topography and the presence of overburden.

Table 9: Summary of DEM Lineament Orientations for the Hornepayne Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
DEM	ENE-WSW	063	058 - 068	15.6	High
	NE-SW	048	042 - 054	15.0	High
	NE-SW	034	031 - 036	10.3	Medium - High
	SE-NW	124	118 - 135	7.6	Medium

DEM Lineaments - Block B

A total of 135 DEM lineaments were interpreted in Block B (Figure 9b). The lengths of all DEM lineaments within this block range from 0.57 to 21.18 km, with a median length of 2.2 km and a mean length of 3.26 km. Of the 135 lineaments interpreted in Block B, 20 (15%) were assigned the highest level of certainty (three), while 70 (52%) were assigned a moderate certainty value of two, and 45 (33%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 74 (55%; RA_1 = 2) of the DEM lineaments in Block B were coincident between both interpreters, whereas the remaining 61 (45%; RA_1 = 1) were identified by one interpreter.

DEM lineaments within Block B display a spread of orientations forming various peaks including medium to high confidence peaks trending southeast and northeast (peaks at 138° and 050°, respectively), medium confidence peaks trending east-west and north-northeast (peaks at 087° and 027°, respectively), and medium to low confidence peaks trending east-southeast, east-northeast, and north-south (peaks at 119°, 076°, and 002°, respectively) (see rose diagram inset in Figure 9b and Table 10). Southeast-trending lineaments occur throughout Block B, and are generally continuous. The DEM lineaments in this orientation tend to be consistent with the orientation of dyke lineaments interpreted from the geophysical data. East-west to east-northeast-trending lineaments are generally continuous, whereas the northeast-trending lineaments occur sparsely throughout Block B with variable length and continuity. The north-south-trending lineaments occur in the central and western parts of Block B as linear to curvi-linear lineaments with moderate to low length and continuity. A low number of DEM lineaments were interpreted in the eastern and northern parts of Block B, due to subdued topography.

Table 10: Summary of DEM Lineament Orientations for the Hornepayne Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
DEM	SE-NW	138	132 - 148	9.8	Medium - High
	NE-SW	050	044 - 057	9.7	Medium - High
	E-W	087	082 - 093	9.3	Medium
	NNE-SSW	027	013 - 033	8.3	Medium
	ESE-WNW	119	115 - 124	6.6	Medium - Low
	ENE-WSW	076	074 - 079	6.5	Medium - Low
	N-S	002	000 - 007	5.8	Medium - Low

4.2.2 FRI Digital Aerial Imagery Lineaments (RA_1)

A total of 715 FRI lineaments were interpreted within the Hornepayne Phase 2 lineament assessment areas. These comprise lineaments that were identified and merged by the two interpreters based on interpretation from the FRI digital aerial imagery (FRI) data (Figure 10). Of the 715 lineaments interpreted, 40 (6 %) were assigned the highest level of certainty (three), while 281 (39%) were assigned a moderate certainty value of two, and 394 (55%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. The length of all FRI lineaments ranges from 0.07 to 7.68 km, with a median of 0.56 km and a mean of 0.76 km. Of the total FRI lineaments, the reproducibility assessment identified coincidence for 342 lineaments (48%; RA_1 = 2) and a lack of coincidence for 373 lineaments (52%; RA_1 = 1).

Azimuth data weighted by length for the interpreted FRI lineaments display a dominant northeast trend with a broad distribution of orientations (one high confidence peak at 035°), as well as a subordinate south-southeast spread of lineament orientations (one medium confidence peak at 152°) (see rose diagram inset in Figure 10 and Table 11). Throughout the two subareas, northeast-trending FRI lineaments are abundant, and tend to be relatively short compared to geophysics or DEM lineaments. However, similar to the DEM lineaments, the northeast orientation of the FRI lineaments is also coincident with the dominant trend of the glacial flow direction (Figure 3). South-southeast-trending FRI lineaments are also moderately abundant, variable in length, and in general tend to be slightly longer than the set of northeast-trending FRI lineaments, in particular within Block B. The abundance of FRI lineaments is directly influenced by the exposure of bedrock and quality of surficial features in a given area. Areas characterized by well-defined lake boundaries, breaks in vegetation, linear rivers, etc., often yield numerous FRI lineaments, versus areas with high overburden and subdued topographic relief, which impede the interpretation of digital aerial imagery lineaments. This can be observed in the two Hornepayne subareas, where regions of subdued topographic relief (such as the southwestern and northeastern parts of Block A, seen in Figure 10) typically have a relatively low number of interpreted FRI lineaments. Unlike the DEM or geophysical lineaments, the features observed in the FRI imagery are often short and discontinuous, due to the way in which bedrock features are expressed in digital aerial imagery.

Table 11: Summary of FRI Lineament Orientations for the Hornepayne Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
FRI	NE-SW	035	026 - 062	12.2	High
	SSE-NNW	152	147 - 157	7.1	Medium

FRI Lineaments - Block A

A total of 497 FRI lineaments were interpreted in Block A (Figure 10a). Of the 497 lineaments interpreted in Block A, 19 (4%) were assigned the highest level of certainty (three), while 209 (42%) were assigned a moderate certainty value of two, and 269 (54%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The lengths of all FRI lineaments within this block range from 0.07 to 4.38 km, with a median length of 0.53 km and a mean length of 0.71 km. A total of 224 (45%; RA_1 = 2) of the FRI lineaments in Block A were coincident between both interpreters, whereas the remaining 273 (55%; RA_1 = 1) were identified by one interpreter only.

Azimuth data weighted by length for the FRI lineaments within Block A exhibit a dominant but broad spread of northeast orientations (one high confidence peak at 040°), and a minor spread of lineaments in a east-southeast to south-southeast orientation forming minor peaks (see rose diagram inset in Figure 10a and Table 12). In general, FRI lineaments within Block A tend to be relatively short in length. In some cases, in particular in the central part of Block A, short discontinuous northeast-trending and southeast-trending lineaments occur along strike from each other and may represent the same underlying bedrock structure. East-southeast to south-southeast-trending lineaments tend to be shorter and less frequent than the northeast-trending lineaments, particularly in the southeastern half of the block and one of the minor orientation peaks is consistent with the trend of interpreted dyke lineaments suggesting that in some cases the FRI lineaments may be tracing the same structures. A low number of FRI lineaments were interpreted along a southwest-northeast-trending zone in the southern portion of Block A, due to the presence of abundant overburden.

Table 12: Summary of FRI Lineament Orientations for the Hornepayne Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
FRI	NE-SW	040	027 - 060	14.6	High

FRI Lineaments - Block B

A total of 218 FRI lineaments were interpreted in Block B (Figure 10b). Of the 218 lineaments interpreted in Block B, 21 (10%) were assigned the highest level of certainty (three), while 72 (33%) were assigned a moderate certainty value of two, and 125 (57%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The lengths of all FRI lineaments within this block range from 0.1 to 7.68 km, with a median length of 0.61 km and a mean length of 0.85 km. A total of 118 (54%; RA_1 = 2) of the FRI lineaments in Block B were coincident between both interpreters, whereas the remaining 100 (46%; RA_1 = 1) were identified by one interpreter only.

Azimuth data weighted by length for the FRI lineaments within Block B exhibit spread of orientations forming various peaks including a high confidence peak trending south-southeast (peak at 153°), medium to high confidence peaks trending north-northeast and southeast (peaks at 033° and 130°, respectively), and medium confidence peaks trending east-northeast and east-west (peaks at 059° and 080°, respectively) (see rose diagram inset in Figure 10b and Table 13). Southeast to south-southeast-trending lineaments tend to be relatively long and occur throughout Block B compared to north-northeast-trending lineaments. The north-northeast- to east-northeast-trending lineaments tend to have a slightly lower frequency within Block B but their orientations show a broad spread. In general, the north-northeast- to east-northeast-trending lineaments tend to occur as relatively short, discontinuous lineament segments. A low number of FRI lineaments were interpreted in the central portion of Block B, due to the presence of abundant overburden.

Table 13: Summary of FRI Lineament Orientations for the Hornepayne Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
FRI	SSE-NNW	153	143 - 157	11.3	High
	NNE-SSW	033	024 - 042	9.3	Medium - High
	SE-NW	130	125 - 140	9.0	Medium - High
	ENE-WSW	059	051 - 069	8.3	Medium
	E-W	080	074 - 083	7.3	Medium

4.3 Integrated Surficial Lineaments (RA_2)

The lineaments interpreted based on DEM and FRI digital aerial imagery data were integrated into a single set of surficial lineaments following the methodology outlined in Section 3. Similar to the interpretation of DEM and FRI lineaments, surficial lineaments cannot be differentiated into unclassified, brittle, and dyke lineaments based solely upon their expression in surficial data, and are, therefore, all classified as surficial lineaments. The integrated surficial lineaments are shown in Figure 11 on the mapped bedrock geology based on the Ontario Geological Survey (OGS 2011). The figure also shows mapped faults and mapped dykes, based on either field mapping evidence or an interpretation from historic aeromagnetic data. An overview of the results of the integrated surficial lineaments is provided below and summarized in Appendix B.

The integration of DEM and FRI lineaments yielded a total of 703 surficial lineaments (Figure 11). The merging of DEM and FRI lineaments resulted in lineaments of new lengths, and in some cases an individual lineament may appear either shorter or longer than its original interpreted length. The length of all surficial lineaments ranges from 0.1 to 22.77 km, with a median of 1.04 km and a mean of 1.95 km. Of the 703 integrated surficial lineaments, 56 (8 %) were assigned the highest level of certainty (three), while 296 (42%) were assigned a moderate certainty value of two, and 351 (50%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. A total of 146 lineaments (21%; RA_2 = 2) were coincident in both the DEM and FRI data sets, whereas 557 lineaments only occurred in one of the two data sets (79%; RA_2 = 1).

Azimuth data weighted by length for the integrated surficial lineaments display a broad set of northeast- to east-northeast-trending lineaments (three high confidence peaks at 038°, 050°, and 062°), as well as a subordinate set of southeast-trending lineaments (two medium to low confidence peaks at 132° and 146°). These broad lineament sets are also punctuated by minor east-west- and north-south-trending orientations (see rose diagram inset in Figure 11 and Table 14). The longer surficial lineaments are largely inherited from the integrated DEM lineaments, whereas many of the shorter and discontinuous surficial lineaments are inherited from the FRI imagery lineaments. Variation in the length of lineaments from the DEM and FRI lineament data sets is due to the way in which bedrock features manifest in these respective data sets.

Table 14: Summary of Integrated Surficial Lineament (RA_2) Orientations for the Hornepayne Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Integrated Surficial Lineaments	NE-SW	038	033 - 043	11.9	High
	NE-SW	050	046 - 058	11.1	High
	ENE-WSW	062	059 - 067	9.1	High
	SE-NW	132	123 - 137	6.5	Medium - Low
	SE-NW	146	139 - 149	6.1	Medium - Low

Throughout the two subareas the northeast-trending surficial lineaments tend to be most abundant and exhibit longer lineaments. It is noted, however, that this northeast orientation is also consistent with the dominant trend of glaciation (Figure 3). Southeast-trending surficial lineaments are also relatively abundant, and show variable lengths, which are locally segmented and disjointed. This lineament orientation is consistent with interpreted dyke lineament from the geophysical data set and in general longer lineaments in this orientation tend to exploit the same structures. The abundance of surficial lineaments tends to be directly influenced by the intensity of surficial expression in a given area, i.e., presence of topographic relief, vegetation changes, linear lakeshores, etc. In areas of subdued surficial expression, fewer and shorter lineaments have been interpreted and integrated into the surficial lineament data set. These areas include a southern portion of Block A, and along the northeastern and eastern borders of Blocks B.

Integrated Surficial Lineaments - Block A

A total of 450 integrated surficial lineaments were interpreted in Block A (Figure 11a). Of the 450 lineaments interpreted in Block A, 23 (5%) were assigned the highest level of certainty (three), while 187 (42%) were assigned a moderate certainty value of two, and 240 (53%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The lengths of all surficial lineaments within this block range from 0.11 to 22.77 km, with a median length of 0.89 km and a mean length of 1.85 km. A total of 93 (21%; RA_2 = 2) of the surficial lineaments in Block A were coincident between both the DEM and FRI lineament data sets, whereas the remaining 357 (79%; RA_2 = 1) were only identified in a single surficial data set.

Azimuth data weighted by length for the surficial lineaments within Block A exhibit a broad distribution of lineaments trending in a northeast to east-northeast orientation (three high confidence peaks at 038°, 050°, and 062°) and a subordinate set of lineaments in a southeast orientation (one medium to low confidence peak at 132°) (see rose diagram inset in Figure 11a and Table 15). In general, the northeast-trending surficial lineaments are most abundant and show a wide variability in their lengths. This orientation is consistent with the dominant trend of glaciation. In addition, two minor lineament trends are also apparent with north-south and east-west orientations.

Table 15: Summary of Integrated Surficial Lineament (RA_2) Orientations for the Hornepayne Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Integrated Surficial Lineaments	NE-SW	038	035 - 043	14.0	High
	NE-SW	050	046 - 057	13.0	High
	ENE-WSW	062	059 - 065	11.2	High
	SE-NW	132	123 - 139	6.1	Medium - Low

Integrated Surficial Lineaments - Block B

A total of 253 integrated surficial lineaments were interpreted in Block B (Figure 11b). Of the 253 lineaments interpreted in Block B, 33 (13%) were assigned the highest level of certainty (three), while 109 (43%) were assigned a moderate certainty value of two, and 111 (44%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The length of all integrated surficial lineaments within this block range from 0.1 to 21.1 km, with a median length of 1.25 km and a mean length of 2.11 km. A total of 53 (21%; RA_2 = 2) of the integrated surficial lineaments in Block B were coincident between both data sets, whereas the remaining 200 (79%; RA_2 = 1) were only identified in a single surficial data set.

Azimuth data weighted by length for the integrated surficial lineaments within Block B exhibit a broad spread of orientations forming various peaks including medium to high confidence peaks trending northeast and southeast (peaks at 036° and 143°, respectively), medium confidence peaks trending northeast and east-west (peaks at 050° and 081°, respectively), and a medium to low confidence peak trending north-south (peak at 002°) (see rose diagram inset in Figure 11b and Table 16). Northeast to east-west-trending lineaments tend to be most abundant within Block B. Southeast-trending surficial lineaments are also relatively abundant, and show variable lengths, which are locally segmented and disjointed. This lineament orientation shares a similar orientation with the interpreted dyke lineament from the geophysical data set, and often exploits the same structures. North-northeast-trending lineaments are less abundant, but when present, are moderately long and continuous.

Table 16: Summary of Integrated Surficial Lineament (RA_2) Orientations for the Hornepayne Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
	SE-NW	143	125 - 148	8.8	Medium - High
Integrated	NE-SW	036	022 - 042	8.7	Medium - High
Surficial	E-W	081	069 - 089	8.2	Medium
Lineaments	NE-SW	050	045 - 056	8.1	Medium
	N-S	002	356 - 010	6.6	Medium - Low

4.4 Integrated Final Lineaments (RA_2)

The final integrated lineament data set produced by merging all lineaments interpreted from the geophysical (Figure 12) and surficial (DEM and aerial imagery, Figure 11) data is presented in Figure 13. Based upon the geophysical interpretation, and the geological understanding of the area, the final integrated lineaments were differentiated into brittle, dyke and unclassified lineaments. An overview of the results of the final integrated lineaments is provided below, summarized in Appendix B, and presented in Figure 13.

The integration of geophysical and surficial lineament sets produced a total of 1274 final integrated lineaments (Figure 13), of which 674 were interpreted as brittle lineaments, 282 as dyke lineaments, and 318 were interpreted as unclassified lineaments. The length of all final integrated lineaments ranges from 0.1 to 26.76 km, with a median of 1.7 km and a mean of 3.19 km. Of the 1274 final integrated lineaments, 401 (31 %) were assigned the highest level of certainty (three), while 450 (35%) were assigned a certainty value of two, and 423 (33%) were assigned a certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. The reproducibility assessment identified coincidence in all three data sets for 88 lineaments (7%; RA_2 = 3), and coincidence in two out of three data sets for 254 lineaments (20%; RA_2 = 2). A total of 932 (73%) lineaments were not coincident with any other data set (RA_2 = 1).

Azimuth data weighted by length for brittle lineaments within the final integrated lineament set exhibit a spread of orientations, amongst which a broad northeast to east-northeast orientation (one high confidence peak at 040°, and one medium to low confidence peak at 070°), and a broad east-southeast to south-southeast orientation (one medium to high confidence peak at 140°, one medium confidence peak at 115°, and one medium to low confidence peak at 153°) are dominant (see rose diagram inset in Figure 13 and Table 17). These lineament orientations exhibit some similarity to the orientations of the interpreted dyke lineaments which display a well-defined southeast trend (one high confidence peak at 143°), a subordinate northeast trend (one medium to high confidence peak at

034°) and a minor north-south trend (see rose diagram inset in Figure 13 and Table 17). These southeast-trending lineaments are interpreted to correspond to dykes of the Matachewan swarm, which are the most continuous, and typically occur in clusters that manifest as multiple tight-spaced dyke lineaments. Minor north- and northeast-trending orientations are also present that are interpreted to correspond to dykes of the Marathon, and Biscotasing swarms, respectively. The northeast-trending dyke lineaments are continuous and long, but less abundant that Matachewan dykes, and often occur as single isolated dyke lineaments. The north-trending dyke lineaments are sporadic, and are commonly segmented and disjointed. Dykes interpreted as part of the Abitibi swarm occur in the area, but tend to form two lineaments located in the southeastern part of Block A.

Azimuth data weighted by length for the unclassified lineaments within the final integrated lineament set exhibit a broad east-west to east-northeast orientation (one high confidence peak at 080°) (see rose diagram inset in Figure 7b and Table 17). The orientation of these lineaments is generally consistent with the interpretation of form lines within the Hornepayne lineament assessment area and is oriented parallel to sub-parallel to the pervasive east-trending structural fabric that is adjacent to the Wawa and Quetico Subprovince boundary. Locally, both the form lines and the unclassified lineaments show some degree of spatial variability in their orientations. In particular, unclassified lineaments and form lines within the northern portion of Block A form a pervasive east-trending structural fabric that is adjacent to the Wawa and Quetico Subprovince boundary (Figure 7a). Further south the orientation of the fabric becomes rotated to a more east-northeast trend.

Table 17: Summary of Integrated Final Lineament (RA_2) Orientations for the Hornepayne Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	040	027 - 059	10.3	High
	SE-NW	140	128 - 147	7.7	Medium - High
	ESE-WNW	115	111 - 123	6.8	Medium
	ENE-WSW	070	067 - 073	6.4	Medium - Low
	SSE-NNW	153	151 - 160	6.3	Medium - Low
Dyke	SE-NW	143	135 - 149	42.8	High
	NE-SW	034	013 - 043	8.6	Medium - High
Unclassified	E-W	080	060 - 094	24.3	High

Final Integrated Lineaments - Block A

A total of 779 final integrated lineaments were interpreted in Block A (Figure 13a). Of these lineaments, 453 were interpreted as brittle lineaments, 159 as dyke lineaments, and 167 as unclassified lineaments. The lengths of the final integrated lineaments within this block range from 0.11 to 25.11 km, with a median length of 1.67 km and a mean length of 3.24 km. Of the 779 lineaments interpreted in Block A, 225 (29%) were assigned the highest level of certainty (three), while 269 (35%) were assigned a moderate certainty value of two, and 285 (37%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The reproducibility assessment identified coincidence in all three data sets for 53 lineaments (7%; RA_2 = 3), and coincidence in two out of three data sets for 152 lineaments (20%; RA_2 = 2). A total of 574 (73%) lineaments were not coincident with any other data set (RA_2 = 1).

Interpreted brittle lineaments within Block A exhibit a spread of orientations, amongst which a northeast orientation (two high confidence peaks at 040° and 054°), and a broad east-southeast to south-southeast orientation (one medium to high confidence peak at 141°, and two medium to low confidence peaks at 159° and 120°) are dominant (see rose diagram inset in Figure 13a and Table 18). In addition, a minor, but well-defined north-trending lineament set is evident (Figure 13a). The southeast orientation corresponds well with the main orientation of dyke lineaments. The northeast orientations of brittle lineaments are oblique to northeast-trending dykes, however the peak orientation of northeast-trending dykes does fall within the range of northeast-trending of northeast-trending brittle lineaments (Table 18).

Dyke lineaments within Block A include a dominant southeast orientation (one high confidence peak at 140°), corresponding to the Matachewan dykes, and a subordinate northeast orientation (one medium to high confidence peak at 034°) corresponding to the Biscotasing dykes (see rose diagram inset in Figure 13a and Table 18). Similar to the geophysical lineaments within Block A, the southeast-trending Matachewan dykes are long, continuous, abundant, and occur in spaced clusters, while the Biscotasing and Marathon dykes are long, continuous, and occur in narrower clusters. The Abitibi dykes occur as two lineaments in the southeastern part of the block.

Unclassified lineaments within Block A form a pervasive east-west, to east-northeast-trending (three high confidence peaks at 090°, 080°, and 063°) structural fabric that is adjacent to and subparallel to the Wawa and Quetico Subprovince boundary (Figure 13a and Table 18). Further south the orientation of the fabric becomes rotated to a more east-northeast trend.

Table 18: Summary of Integrated Final Lineament (RA_2) Orientations for the Hornepayne Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	040	033 - 047	12.1	High
	NE-SW	054	051 - 064	9.7	High
	SE-NW	141	128 - 149	7.7	Medium - High
	SSE-NNW	159	153 - 165	6.4	Medium - Low
	ESE-WNW	120	116 - 125	5.8	Medium - Low
Dyke	SE-NW	140	135 - 148	40.4	High
	NE-SW	034	013 - 042	9.6	Medium - High
Unclassified	E-W	090	086 - 095	24.4	High
	E-W	080	072 - 084	22.1	High
	ENE-WSW	063	056 - 067	16.0	High

Final Integrated Lineaments - Block B

A total of 495 final integrated lineaments were interpreted in Block B (Figure 13b). Of these lineaments, 221 were interpreted as brittle lineaments, 123 as dyke lineaments, and 151 were interpreted as unclassified lineaments. The lengths of the final integrated lineaments within this block range from 0.1 to 26.76 km, with a median length of 1.74 km and a mean length of 3.13 km. Of the 495 lineaments interpreted in Block B, 178 (36%) were assigned the highest level of certainty (three), while 181 (37%) were assigned a moderate certainty value of two, and 138 (28%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The reproducibility assessment identified coincidence in all three data sets for 35 lineaments (7%; RA_2 = 3), and coincidence in two out of three data sets for 102 lineaments (21%; RA_2 = 2). A total of 358 (72%) lineaments were not coincident with any other data set (RA_2 = 1).

The azimuth data weighted by length for the interpreted brittle lineaments within Block B exhibit a broad spread of orientations with several peaks observed including one high confidence peak trending east-southeast (peak at 115°), two medium to high confidence peaks trending northeast, and east-northeast (peaks at 050° and 072°, respectively), and three medium confidence peaks trending north-northeast, south-southeast, and southeast (peaks at 033°, 152°, and, 140°, respectively) (see rose diagram inset in Figure 13b and Table 19). The southeast orientation roughly corresponds to the orientation of the Matachewan dyke lineaments.

Dyke lineaments within Block B exhibit a dominant southeast orientation (one high confidence peak at 145°) corresponding to the Matachewan dykes, and subordinate north-northeast (one medium to low confidence peak at 020°), and northeast (one medium to low confidence peak at 035°) orientations corresponding to the Marathon and Biscotasing dykes, respectively (see rose diagram inset in Figure 13b and Table 19). The southeast-trending Matachewan dykes are the dominant orientation of dyke lineament interpreted in Block B. These lineaments occur as clusters with a high density of continuous and long dyke lineaments throughout Block B, and form particularly dense clusters in the central and eastern parts of Block B. The north-trending Marathon dyke lineaments tend to be sparsely distributed through Block B, but where present tend to be relatively short and segmented, with the exception of a single north-trending dyke lineament with extends through the entire block. The northeast-trending dyke lineaments corresponding to the Biscotasing dyke swarm tend to form relatively small clusters of lineaments within the eastern and central parts of Block B and elsewhere are isolated.

Azimuth data weighted by length for the unclassified integrated lineaments exhibit a dominant, broad east to east-northeast orientation (one high confidence peak at 068°) within Block B that is subparallel to the Wawa and Quetico Subprovince boundary (see rose diagram inset in Figure 13b and Table 19).

Table 19: Summary of Integrated Final Lineament (RA_2) Orientations for the Hornepayne Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	ESE-WNW	115	110 - 120	10.5	High
	NE-SW	050	042 - 057	9.3	Medium - High
	ENE-WSW	072	065 - 078	8.8	Medium - High
	NNE-SSW	033	029 - 040	8.0	Medium
	SSE-NNW	152	148 - 156	7.9	Medium
	SE-NW	140	132 - 145	7.6	Medium
Dyke	SE-NW	145	137 - 149	47.9	High
	NE-SW	035	030 - 039	6.6	Medium - Low
	NNE-SSW	020	017 - 023	6.2	Medium - Low
Unclassified	ENE-WSW	068	062 - 087	29.0	High

5 Discussion

This lineament interpretation provides an understanding of potential structures within the bedrock units of the Hornepayne Phase 2 lineament assessment areas. The results of the lineament interpretations, including lineament reproducibility, orientation, length, and density are discussed below. The relationship of the integrated lineament data sets relative to the regional structural history and their relative ages are also discussed.

5.1 Lineament Reproducibility (RA_1) and Coincidence (RA_2)

Lineament reproducibility and coincidence are assessed in several steps during the analysis (as outlined in Section 3). First, the two individual interpretations for each data set are integrated to produce single data set specific (RA_1) interpretations. During this step, the reproducibility (RA_1 value) of each lineament is assessed (as outlined in Section 3.2.2). Following this, in the third step of the interpretation, the individual data set interpretations are integrated to produce the final integrated (RA_2) data set. During this step, the coincidence (RA_2 value) between lineaments identified in the various data sets was evaluated (as outlined in Section 3.2.3). A breakdown of all reproducibility and coincidence values is presented in Section 4 and Appendix B.

The evaluation of RA_1 data for all subareas and lineament types (brittle, dyke, unclassified, DEM, FRI) reveal a moderate to high reproducibility between interpreters for the geophysical lineaments (66% of lineaments RA_1=2) and a moderate reproducibility for the DEM (48% of lineaments RA_1=2) and FRI lineaments (48% of lineaments RA_1=2). The overall lower reproducibility for the DEM and FRI lineaments relative to the other data sets can be attributed to the subtle nature of the features defining the DEM and FRI lineaments. For example, subtle changes in vegetation in the FRI data set and subtle topographic features in overall low topographic relief portions of the DEM data set. Furthermore, the two interpreters had varying interpretations regarding whether northeast-trending topographic (DEM and FRI) lineaments represent bedrock or glacial features.

Reproducibility values (RA_1) are relatively consistent between lineaments types and subareas (Blocks A, and B), with the exception of dyke lineaments identified from the geophysical data set, which exhibited a higher than average reproducibility (RA_1 = 88% for dyke lineaments in all subareas). The high reproducibility for dyke lineaments is expected, as their geophysical signatures are typically well-defined (long, continuous magnetic highs), and therefore easily interpreted. In addition, other long well-defined geophysical lineaments were also typically reproduced. Low lineament reproducibility values are the result of differences in the individual lineament interpretations from each interpreter for the same data set, and can be attributed to the judgement and subjectivity of the expert carrying out the interpretation.

Coincidence between lineaments identified from the DEM and FRI data sets was evaluated for the second reproducibility assessment (RA_2). Overall, a total of 21% of the surficial lineaments were interpreted in both the DEM and FRI data sets. The coincidence between lineaments of these data sets is in part explained by the fact that lineaments interpreted from the FRI imagery and the digital elevation data represent surficial expressions of the same bedrock feature. For example, a lineament drawn along a stream channel shown on the FRI imagery is expected to be coincident with a lineament that captures the trend of the associated topographic valley expressed in the digital elevation data. The lack of coincidence between the two surficial data sets may be the result of several factors, including the difference in resolution and the different styles in which structures manifest in the DEM and FRI data sets. The DEM data were collected during the magnetic survey

(25 m grid cell size) and is a much lower resolution than the FRI imagery (0.4 m resolution). Therefore, a structure that is apparent in the FRI imagery may not be apparent in the DEM data. Alternatively, a structure present in the DEM data may be represented as multiple structures within the higher resolution FRI data. The way in which bedrock structures are expressed in the DEM and FRI data set may also account for the lack of coincidence. For example, certain structures observed in the DEM data may be obscured by vegetation in the FRI data, and conversely, structures defined by a change in vegetation in the FRI data may not have a topographic expression in the DEM data.

The coincidence assessment (RA_2) between geophysical and surficial features revealed that 36% of the interpreted geophysical lineaments were also interpreted in at least one of the two surficial data sets. In general, RA_2 values for the final integrated data reveal a low coincidence between surficial and magnetic lineaments. For all subareas, only 7% of the final integrated lineaments were identified in all three data sets, and 20% of the final integrated lineaments were identified in two of the three data sets.

The final integrated lineament data set can be further assessed to identify coincidence between data sets for each of the specific types of lineaments (i.e., brittle, dyke and unclassified). For the 674 brittle lineaments interpreted in the final integrated lineament data set, 9% of the lineaments were identified in all three data sets, and 19% of the lineaments were identified in two of the three data sets. The remaining 73% of the lineaments lack any coincidence and were only identified in a single data set. In particular, over half of the brittle lineaments that are lacking coincidence with any other data set are derived from the FRI data.

In addition, it is apparent that interpreted dyke lineaments from the geophysical data set also had some sort of surficial lineament expression. Considering the 282 dyke lineaments interpreted, 18% of these lineaments were coincident with at least one of the two surficial data sets, and 13% where interpreted in both surficial data sets.

For the 318 unclassified lineaments interpreted in the final integrated lineament data set, 9% of the lineaments were identified in all three data sets, and 1% were identified in two of the three data sets. The remaining 67% of the lineaments lack any coincidence and were only identified in a single data set. From the total number of unclassified lineaments, 86% of these lineaments were interpreted using the geophysical data set.

The lack of coincidence between different sets of lineaments may be attributed to multiple factors, including:

- Deeper structures identified in the magnetic data may not have a surficial expression;
- Certain structures identified in the magnetic data may have a subdued or no surficial expression (i.e., competent non-recessive unclassified shear zones);
- Surface expression of geophysical lineaments may be masked by the presence of overburden (e.g., large river valleys covered by Quaternary sediments);
- Structures identified in the surficial data may not extend to significant depths and therefore may not be recognizable in the magnetic data;
- Structures identified in the surficial data may not possess sufficient magnetic susceptibility contrast to be recognized in the magnetic data.

Considering the above factors, it is necessary to objectively analyze the results of the RA_2 assessment with the understanding that RA_2 = 1 does not necessarily imply a low degree of confidence that the specified lineament represents a true bedrock structure.

Lineaments that were coincident in two or three data sets were commonly long and continuous. Within the magnetic data, these lineaments were defined by continuous magnetic lows or highs, whereas in the surficial data sets, these lineaments were defined by continuous topographic valleys, long linear lakes and vegetation changes.

5.2 Lineament Trends

The orientations of the dominant lineaments sets within the Hornepayne Phase 2 assessment area can be observed visually (Figure 7 to Figure 13), and via length weighted azimuth plots (see rose diagram insets in Figure 8Figure 7 to Figure 13, and Table 5 to Table 19). Length weighted lineament azimuth plots within the Hornepayne assessment area provide an indication of lineament sets with preferred azimuths. In some cases, there are similarities and differences observed between the lineament trends identified in each of the data sets. A summary of lineament orientation data for all subareas is presented in Appendix A: Figure A5.

Lineaments identified from both the geophysical and surficial data sets within the Hornepayne area reveal various broadly distributed orientations, which in general include a southeast trend, a broad northeast to east-northeast, and a subordinate east trend.

Length weighted orientation data for the geophysical lineaments tend to exhibit two dominant peaks in a southeast trend, with minor peaks in northeast and east-northeast orientations (Figure 12 and Table 5). These geophysical lineaments can also be subdivided into orientation sets based on the lineament type (i.e. brittle, dyke, unclassified lineaments). The dyke lineament orientations exhibit two well-defined peaks that are trending southeast (one high confidence peak at 140°), and northeast (one medium confidence peak at 036°), which can be attributed to the Matachewan, and Biscotasing dyke swarms, respectively. North-trending dykes associated with the Marathon dyke swarm are not well represented on the rose diagrams. The southeast-trending Matachewan dyke lineaments are most prominent, consisting of a high frequency of dyke lineament that are long and continuous. These dyke lineaments often occur as clusters of tightly spaced dyke lineaments, separated by km-scale zones without interpreted dyke lineaments. In contrast, both the north-trending Marathon and northeast-trending Biscotasing dyke lineaments tend to be most sporadic and are typically widely spaced and distributed throughout the assessment area. Length weighted orientation data for the brittle lineaments show greater spread of orientations than the dyke orientation data (Figure 12 and Table 5). A high confidence peak at 135° is coincident with the southeast-trending Matachewan dyke swarm, however brittle lineaments subparallel to the Biscotasing, Marathon and Abitbi dyke swarms are not well represented. Additional orientations observed for the brittle lineaments include one high confidence peak trending south-southeast (peak at 153°), and two medium to low confidence peaks trending northeast, and east-northeast (peaks at 056° and 076, respectively).

For the most part, the interpreted surficial lineaments tend to show similar general trends that are shown in the geophysical lineament data set (Figure 11 and Figure A5). The most prominent surficial lineament orientations include a dominant but broad northeast- to east-northeast trend, with three high confidence peaks at 038°, 050°, and 062°, and a subordinate southeast trend, with two medium to low confidence peaks at 132° and 146° (Table 14). Minor east-west- and north-south-trending orientations are also present. Some of the surficial lineament trends are coincident with orientations of the Matachewan, Marathon, and Biscotasing dyke swarms. The dominant northeast orientation of surficial lineaments coincides with the dominant trend of glaciation (seen in Figure 3). Surficial lineaments interpreted in this orientation (Figure 11) were not traced along surficial features distinctive of glaciation (e.g., drumlins, eskers, etc.), and are therefore not interpreted as bedrock features.

As expected, the final integrated lineament data set exhibits generally similar trends as seen in the geophysical and surficial data sets. The dominant orientations of the interpreted brittle lineaments from the final integrated lineaments are mostly consistent with the orientations of interpreted dyke lineaments derived from the geophysical data set, with brittle lineaments exhibiting one, broad, northeast-trending, high confidence peak at 040°, and one southeast-trending, medium to high confidence peak at 140° (Figure 12 and Table 17). The southeast-trending lineaments set is best defined within the geophysical data set, including the orientation of both brittle and dyke lineaments, and tend to be represented as a broader distribution of orientations within the integrated surficial lineament data set. Whereas, the northeast-trending lineaments tend to be best defined from the integrated surficial data set as a dominant but broad distribution of orientations. This orientation is also apparent in the geophysical lineaments but is expressed as a number of minor peaks in the rose diagram (Figure 12).

Based upon the differences in abundance, length, and through-going nature of lineaments between the geophysical and surficial lineaments, it may be postulated that the southeast-trending lineaments represent the most significant orientation imaged by the geophysical data, whereas northeast-trending lineaments represent the best developed orientation of brittle structures expressed on the surface. The orientations of both the northeast- and northwest-trending lineaments appear to be consistent with the orientations of mapped faults in the vicinity of the Hornepayne area.

5.2.1 Relationship between Lineament Sets and Regional Stress Field

The principal neotectonic stress orientation in central North America is generally oriented approximately east-northeast (63 degrees ± 28 degrees; Zoback, 1992) although anomalous stress orientations have also been reported in the mid-continent that include a 90-degree change in azimuth of the maximum compressive stress axis (Brown et al., 1995) and a north-south maximum horizontal compressive stress (Haimson, 1990). Local variations, and other potential complicating factors involved in characterizing crustal stresses, including the effect of shear stress by mantle flow at the base of the lithosphere (Bokelmann, 2002; Bokelmann and Silver, 2002), the degree of coupling between the North American plate and the underlying mantle (Forte et al., 2010), the effects of crustal depression and Holocene rebound, and the influence of the thick lithospheric mantle root under the Canadian Shield, make it premature to correlate the regional neotectonic stress orientation with the orientation of interpreted lineaments.

However, it is possible to broadly speculate on the potential behavior of the identified lineaments if they were to be reactivated by the regional east-northeast neotectonic stress regime. Two dominant orientations of lineaments were interpreted: northwest and a northeast. Should the identified lineaments be reactivated under the current stress regime, the northwest oriented lineaments would likely reactivate as reverse dip-slip to oblique-slip faults, and the northeast and east to east-northeast oriented lineaments would likely reactivate as normal dip-slip to oblique-slip faults. This would imply that the northwest lineaments would be reactivated under shear stress and northeast and east to east-northeast lineaments would be reactivated under tensile stress.

5.3 Lineament Length

Interpreted geophysical, surficial and final integrated lineaments classified by length are presented in Figure 14, Figure 15 and Figure 16. The distributions of lineament lengths are displayed on histograms and cumulative frequency plots where the x-axis represents the bin lengths for the lineaments (km) and the y-axis represents the cumulative percentage frequency of interpreted lineaments contained within that length bin (see inset plots on Figure 14 to Figure 16), and summarized in Appendix A: Figure A6, and Appendix B. Lineament lengths displayed and reported in the figures, statistical tables, and histogram plots only reflect the length of the portion of the lineament that is contained within the individual lineament assessment blocks (i.e., any portion of a lineament that is contained within Block A or B). Therefore, the lineament lengths do not necessarily reflect the full length of all lineaments, as lineaments were only traced within the assessment area and could extend beyond its borders.

Overall, lineament lengths for the geophysical brittle and dyke, surficial, and final integrated lineaments display a similar histogram distribution, whereby the majority of lineaments are less than 5 km in length. Approximately 69% of the geophysical brittle and dyke lineaments and approximately 92% of the surficial lineaments have lengths which are less than 5 km. In general, the geophysical brittle and dyke contain a higher number of long lineaments relative to the integrated surficial lineaments. This is most apparent for lineaments in the 5-10 km range, which were less commonly interpreted from the surficial data sets (Figure 14 to Figure 16, and Appendix A: Figure A6).

The comparison of median and mean values for all geophysical, surficial, and final integrated lineaments reveals a roughly similar length distribution as described above (Appendix B, Figure 14). The geophysical lineaments exhibit the longest overall mean (4.55 km) and median (2.79 km), whereas the FRI lineaments exhibit the shortest mean (0.76 km) and median (0.56 km). As described above, this is likely due to the style in which bedrock structures are represented in the geophysical data set (long and continuous lineaments) versus in surficial data sets (short discontinuous and segmented lineaments). The final integrated lineaments exhibit an intermediate mean (3.19 km) and median (1.7 km), as would be expected as these lineament are the result of the combination of the slightly longer geophysical and slightly shorter surficial lineaments (Figure 16).

The difference in length between lineaments interpreted from geophysical and surficial data sets can in part be explained by the nature of the lineaments interpreted from each data set. From the geophysical data, lineaments are typically characterized by long continuous magnetic lows or highs (dykes, for example). Conversely, surficial lineaments are typically characterized by a combination of breaks in topography, vegetation and bedrock, and elongated lakes. These surficial features are not as continuous as the lineaments interpreted from geophysical data, often due to their interruption by overburden. This resulted in the interpretation of shorter surficial lineaments relative to the geophysical lineaments.

Analysis of lineament length relative to coincidence values for all final integrated lineaments indicate that lineaments coincident in all three data sets (RA_2=3) are typically longer (mean = 8.55 km, median = 7.57 km) than lineaments reproduced in two (RA_2=2; mean = 4.78 km, median = 2.98 km) or only one (RA_2_1; mean = 2.52 km, median = 1.98 km) data sets. This is to be expected, as lineaments observed in all three data sets are more likely to represent significant bedrock structures.

Similarly, an analysis of lineament length relative to certainty values for the final integrated lineaments indicate that lineaments with the highest certainty value (3), are typically longer (mean = 5.77 km, median = 3.78 km), than those with lower certainty values of 2 (mean = 2.54 km, median = 1.65 km) and 1 (mean = 1.52 km, median = 0.99 km). Again, this is to be expected as the highest certainty lineaments often represent significant bedrock structures that may have a considerable length extent.

Lineament lengths relative to the dominant lineament orientations suggest that long brittle and dyke lineaments from the final integrated lineament data set, for example with lengths greater than 5 km, are preferentially oriented towards the northwest and northeast. These orientations correspond to the two broadly distributed lineament orientation sets. Of these lineament, the majority of these correspond to long and continuous dykes of the Matachewan and Biscotasing dyke swarms interpreted from the geophysical data, with the Matachewan dykes being most common. Although not as abundant, the brittle lineaments with lengths greater than 5 km show a similar dominant orientation as the longer dyke lineaments. Although it is apparent that the northeast-trending set of surficial lineaments tend to have a higher number of longer lineaments, as noted previously, this orientation of surficial lineament is also coincident with the orientation of glaciation. In contrast, the orientations of shorter lineaments such as those that are less than 5 km tends to be widely variable.

Although there is no information available on the depth extent of the interpreted lineaments for the Hornepayne Phase 2 assessment area, the length information described above can be used as a proxy for depth extent. Therefore, a preliminary assumption may be that the longer interpreted lineaments may extend to greater depths than the shorter interpreted lineaments.

5.4 Density

Analyses of lineament and lineament intersection density were conducted for the Hornepayne Phase 2 Assessment areas, as described in Section 3.2.6, and are presented in Figure 17 to Figure 21 (lineament density) and Figure 22 to Figure 27 (lineament intersection density).

5.4.1 Lineament Density

An analysis of lineament density for each data set and block is presented below and in Figure 17 to Figure 21. Locally, lineament densities appear to be lower at the margins of the assessment areas. This arises as lineaments are only traced to the margins of the assessment area, and when generating density plots, this can result in an apparent low lineament density around the border of each block.

Geophysical Lineament Density

As the nature of unclassified lineaments may be variable (potential to represent ductile shear zones, brittle-ductile shear zones or the internal fabric of the rock units, etc), density analyses for these lineaments were conducted separately. Figure 17 shows the lineament density of the brittle and dyke lineaments, and Figure 18 includes the unclassified lineaments in the calculation of lineament density.

Throughout the two subareas, lineament density analyses of brittle and dyke lineaments reveal a relatively uniform lineament density, and a number of discrete zones of elevated lineament density. In particular, high lineament densities are apparent in the southern half of Block A, and narrower northwest-trending zones through the eastern, central, and western parts of Block B (Figure 17). Zones of elevated lineament density occur within the Black-Pic batholith in Block A and metasedimentary rocks in Block B and are typically the result of clusters of tightly spaced brittle and (or) dyke lineaments, and the intersection of these lineament clusters. By including the unclassified lineaments in the density calculation, the lineament density becomes elevated in multiple areas, particularly in the northern half of Block A, where it is interpreted to form a broad east-trending domain parallel to the subprovince boundary. Within Block B, the lineament density in several discrete areas becomes elevated owing to the local abundance of east-trending unclassified lineaments (Figure 18).

The density of brittle and dyke lineaments in Block A is moderate to high in the southeastern half, and moderate to low in the northwestern half (Figure 17a). Zones of elevated lineament density in the southeastern portion of Block A occur west of West Larkin Lake, Loon Lake and to the southeast of Bayfield Lake, and tend to coincide with areas where clusters of Biscotasing and Marathon dykes and parallel brittle faults intersect the northwest-trending Matachewan dykes. In general, the western and northwestern portions of Block A show relatively lower lineament density, which is most likely due to a decrease in the presence of dykes interpreted in these areas. In particular, areas of low lineament density are most pronounced to the west of Bayfield Lake, as well as an isolated area between Loon Lake and West Larkin Lake. Incorporating the unclassified lineaments into the calculation of lineament density results in an increase in the lineament density along the northern half of Block A (Figure 18a). In particular, the higher density in this area is due to the abundance of unclassified lineaments interpreted along the tectonic boundary between the Wawa and Quetico subprovinces.

The density of brittle and dyke lineaments within Block B exhibit two distinct zones of high to moderate lineament density (Figure 18b). In this Block, areas of high lineament density tend to be consistent with areas of a high density of interpreted dykes, in particular clusters of Matachewan dykes. In general, very few brittle lineaments have been interpreted from the geophysical data within this block due to the low magnetic response of the bedrock. A few areas of lower lineament density have been identified, most significantly a northwest-trending band located northwest of Hans Lake. The lower lineament density in this area tends to result from significantly fewer dykes interpreted in this area. Incorporating the unclassified lineaments into the calculation of lineament density for Block B locally results in an increase in the lineament density (Figure 18b). Within Block B, the lineament density in several discrete areas becomes elevated owing to the local abundance of east-trending unclassified lineaments which are locally coincident with areas of elevated response in the magnetic data. In particular, the area previously identified as lower density immediately northwest of Hans Lake is interpreted to have a high concentration of unclassified lineaments.

Surficial Lineament Density

Lineament density plots for integrated surficial lineaments for two subareas reveal multiple zones of elevated lineament density (Figure 19). Zones of elevated lineament densities coincide with areas that show topographic relief in the digital elevation data. The density of surficial lineaments is also in part related to the lack of overburden. In order to properly assess surficial lineament density, it is necessary to take into account the location of surficial features (river valleys, glacial till cover, etc.), as the ability to interpret surficial lineaments was limited in these areas.

The density of surficial lineaments in Block A is relatively low and uniform throughout the southern part of the Block, with minor zones of slightly elevated lineament density. The northern portion of the Block shows much more variability and its lineament density is generally higher (Figure 19a). Certain low lineament density areas, such as the area along the southwestern boundary of Block A and the area forming a northeast-trending low density zone between Bayfield Lake and West Larkin Lake are coincident with areas of extensive glacial overburden, where the ability to interpret surficial lineaments is limited.

The density of surficial lineaments in Block B is characterized by a broad and continuous high surficial lineament density covering most of the central and southwestern portion of the block. The area of highest lineament density occurs near Lennon Lake and continues eastward, following along the extensive east-northeast-trending zone. The largest area of higher lineament density occurs in the area to the west of Hans Lake. Several discrete lower lineament density zones are also apparent, most significantly, the large low density area located along the eastern portion of the block (Figure 19b). The presence of moraine deposits in the northeastern, southeastern, and southwestern parts of the block, and of glaciolacustrine plains in the northwestern part of the block may account for the low surficial lineament density in those areas.

Final Integrated Lineament Density

The final integrated lineaments result from the integration of the geophysical and surficial lineaments. Therefore, these lineaments can be classified into brittle and dyke lineaments, and a set of unclassified lineaments. Similar to the geophysical lineament density analyses, unclassified lineaments were analyzed separately and are presented on separate figures. Figure 20 shows the lineament density of the brittle and dyke lineaments from the final integrated lineament data set, and Figure 21 includes the unclassified lineaments in the calculation of lineament density.

Lineament density analyses of the final integrated brittle and dyke lineament reveal a highly variable distribution with multiple well-defined zones of elevated lineament density (Figure 20). Similar to the geophysical lineaments, zones of higher lineament density correspond to tight-spaced northeast-, north-, and northwest-trending brittle and dyke lineaments, and the intersection of these lineament orientations.

The density of final integrated brittle and dyke lineaments within Block A shows significant variability with some well-defined areas of lower lineament density (Figure 20a). The areas of highest lineament density occur in broad zones located between Loon Lake and Bayfield Lake, southeast of Buffalo Island Lake, and a large zone northwest of West Larkin Lake. In general, these areas tend to form two discontinuous northwest-trending zones that coincide with bands of tightly spaced Matachewan dykes. A broad area west of Bayfield Lake displays a generally low final integrated lineament density when considering only brittle and dyke lineaments. This broad low density area extends north of McCoy Lake and south of White Owl Lake. In addition, a small area between West Larkin Lake and Loon Lake show a low lineament density near the narrow portion of the Strickland pluton. However, it is apparent that large parts of the areas with lower lineament density are covered by overburden deposits, which may have limited the interpretation of surficial lineaments. By adding the unclassified lineaments to the final lineament density calculation, the density becomes elevated within a broad zone which covered the northern half of Block A where the pervasive unclassified lineaments are interpreted parallel to the subprovince boundary (Figure 21a). In particular, the broad area previously identified as low density to the west of Bayfield Lake now shows an elevated density of unclassified lineaments. However, at this stage, it is not certain whether these lineaments represent tectonic fabric, brittle-ductile or brittle features. Geological mapping will help to further characterize the nature of these features.

The density of final integrated brittle and dyke lineaments within Block B predominantly shows a relatively high lineament density with some well-defined areas of lower lineament density (Figure 20b). In general, the areas of high lineament density coincide with areas with bands of tightly spaced Matachewan dykes, similar to high density areas observed in Block A. The large area between Hans Lake and Bear Lake shows a continuous zone of high lineament density, which extends along the southern boundary of the block, and also northwest along a cluster of the tightly spaced Matachewan dykes. Elsewhere, smaller well-defined high lineament density areas are locally distributed, including the area around Lennon Lake, and the area north of Hans Lake continuing to the northern boundary of the block. Areas of lower lineament density are also apparent in the final integrated lineament density, most significantly in the northwestern corner of Block B. Unclassified lineaments are interpreted in several discrete areas within Block B. By adding the unclassified lineaments to the final lineament density calculation, the density within these areas becomes elevated (Figure 21b). In particular, the northwestern corner of Block B previously identified as an area of lower density contains a high number of unclassified lineaments which results in an elevated lineament density. Similar to within Block A, it is not certain whether these lineaments represent tectonic fabric, brittle-ductile or brittle features and therefore unclassified lineaments in Block B will need to be characterized during geological mapping.

5.4.2 Lineament Intersection Density

An analysis of lineament intersection density for each data set and block is presented below and in Figure 22 to Figure 26.

Geophysical Lineament Intersection Density

As the character of the unclassified lineaments is unknown at this stage, two separate lineament intersection density analyses were conducted. Figure 22 shows lineament intersection density of only brittle and dyke lineaments interpreted in the geophysical data. Figure 23 incorporates the distribution of unclassified lineaments into this lineament intersection density analyses. In general, areas of elevated lineament intersection densities are typically due to the intersection of tightly spaced clusters of dyke lineaments (Figure 22).

The brittle and dyke lineament intersection density within Block A can be generally subdivided into an area of relatively high density in the southeast and lower density in the northwest part of the block. The highest brittle and dyke lineament intersection densities occur as fairly extensive zones located southeast of Bayfield Lake, northwest and southeast of West Larkin Lake and immediately to the east of Loon Lake (Figure 22a). In the northwestern portion of Block A brittle and dyke lineament intersection densities are uniformly low with the exception of a few distinct locations with elevated density values. It is apparent that although there is a relatively high density of geophysical lineaments, in particular interpreted dyke lineaments, they typically all share similar northwest orientations and therefore do not intersect each other resulting in a lower intersection density. When also considering the distribution of unclassified lineaments within Block A (Figure 23a), the intersection density increases significantly along the northern portion of the block. This increase is largely due to the high density of dyke lineaments intersecting with the pervasive east-west-trending unclassified lineaments in proximity to the subprovince boundary. The area south of McCoy, Bayfield and West Larkin Lakes now displays a relatively low intersection density where fewer unclassified lineaments have been interpreted.

The brittle and dyke lineament intersection density within Block B is dominated by a relatively low lineament intersection density with few distinct areas of elevated density (Figure 22b). Two broad areas of elevated density are evident within Block B, located in the south-central portion of the block and also located approximately 5 km north of Hans Lake. In addition, a prominent east-northeast-trending zone of elevated brittle and dyke lineament intersection density transects the entire block. In general, along this zone higher intersection densities tend to occur where tightly spaced dyke lineaments are intersecting the dominant east-northeast-trending brittle lineament. On the other hand, the remaining portions of the block displays uniformly low lineament intersection density (Figure 22b). In particular, broad low intersection densities are shown in the northwestern corner of the block, in the area south of Lennon and Bear Lakes, and in the area to the northwest of Hans Lake. These areas tend to be either devoid of interpreted brittle and dyke lineaments, or in some cases, contain a high density of dyke lineaments that share the same orientations and do not intersect each other. When considering the distribution of unclassified lineaments within Block B (Figure 23b), the intersection densities vary depending on where the unclassified lineaments have been interpreted. In general, several distinct areas show elevated intersection densities that exist within a northwest-trending zone. These areas mainly comprise intersections between the tightly spaced northwest-trending Matachewan dykes and the east-west-trending unclassified lineaments. As a result, the area around Hans Lake and the northwestern portion of the block are most significantly impacted which now display an elevated intersection density.

Surficial Lineament Intersection Density

Lineament intersection density for the integrated surficial lineaments shown in Figure 24 displays a very similar pattern as the surficial lineament density (Figure 19). Similar to the surficial lineament density, the surficial lineament intersection density is in part influenced by the distribution of overburden deposits. In order to properly assess the surficial lineament intersection density it is necessary to take into account the location of surficial features that may have limited the lineament interpretation (e.g., river valleys, glacial till cover, etc.).

The intersection density of surficial lineaments in Block A is generally uniform and low in the southeastern portion, and elevated in the northwestern portion of the block (Figure 24a). This distribution of intersection density is consistent with the distribution of lineament density previously discussed. Areas of lower surficial lineament intersection density throughout the southern parts of the block partly correspond to areas covered by glacial outwash and glaciolacustrine plains, and by organic deposits (Figure 2), as well generally display low topographic relief (Figure 5). In these areas, it is likely that overburden units and gentle topography limit the interpretation of surficial lineaments. The northern portion of the block displays more variability in topography and therefore a higher number of interpreted surficial lineaments. The majority of the areas of elevated lineament intersection density are the result of the intersections between the dominant northwest and northeast lineament trends.

The intersection density of surficial lineaments in Block B is generally dominated by high intersection density in the southcentral to southwestern part of the block, and displays broad low intersection density along the eastern portion of the block (Figure 24b). Highest intersection density occurs in the area near Lennon Lake and a broad discontinuous area immediately west of Hans Lake. The eastern portion of Block B shows a broad distribution of lower surficial lineament intersection density. The distribution of overburden units (Figure 3) and the low topographic relief (Figure 5) likely result in fewer surficial lineaments interpreted in this area.

Final Integrated Lineament Intersection Density

The following section describes the intersection density for the final integrated lineament data set based on lineaments that are interpreted as brittle, dyke and unclassified from the geophysical and surficial data sets (DEM and FRI). Intersection density for the final integrated brittle and dyke lineaments are shown in Figure 25. Since the nature of the unclassified lineaments is unknown at this stage (e.g., brittle-ductile shear zones, internal fabric of the rock units, etc.) they are not included in this lineament intersection density calculation. However, the influence of the unclassified lineaments on the intersections with the brittle and dyke lineaments is presented in Figure 26.

The intersection density from the final integrated brittle and dyke lineament within Block A shows a variable distribution of densities with several well-defined areas with high density. The areas of highest lineament intersection densities occur approximately 5 km southeast of Bayfield Lake, 3 km south of Government Lakes, and in the areas to the southeast and northwest of West Larkin Lake (Figure 25a). These areas of high lineament intersection density tend to be dominated by tightly spaced northwest-trending dyke lineaments intersecting with other interpreted brittle and dyke lineaments. Several areas of lower intersection density are distributed throughout Block A, most significantly in the area around Buffalo Island Lake. The low intersection density areas typically are coincident with a lower density of lineaments, or contain lineaments that share similar orientations and do not intersect each other. When also considering the distribution of unclassified lineaments within Block A (Figure 23a), the intersection density increases significantly along the northern portion of the block. This increase is largely due to the high density of dyke lineaments intersecting with the pervasive east-west-trending unclassified lineaments in proximity to the subprovince boundary. The area south of McCoy, Bayfield and West Larkin Lakes now displays a relatively low intersection density where fewer unclassified lineaments have been interpreted.

The intersection density from the final integrated brittle and dyke lineaments within Block B shows a variable distribution of intersections with few distinct areas of elevated density (Figure 25b). A few areas of elevated density are evident throughout the block, located in the south-central portion of the block, in the area around Lennon Lake, approximately 8 km east of Elgie Lake, and also located approximately 5 km north of Hans Lake. In addition, a prominent east-northeast-trending zone of elevated brittle and dyke lineament intersection density transects the entire block, which occurs where tightly spaced dyke lineaments are intersecting the dominant east-northeast-trending brittle lineament. The remaining portions of the block display a lower intersection density (Figure 25b). In particular, broad low intersection densities are shown in the northwestern corner of the block, in the area south of Lennon Lake, and in the area to the northwest of Hans Lake. These areas tend to be either devoid of interpreted brittle and dyke lineaments, or in some cases, contain a high density of dyke lineaments that share the same orientations and do not intersect each other. When considering the distribution of unclassified lineaments within Block B (Figure 26b), the intersection densities vary depending on where the unclassified lineaments have been interpreted. In general, several distinct areas show elevated intersection densities that exist within a northwest-trending zone following the set of tightly spaced northwest-trending Matachewan dykes intersecting with the east-west-trending unclassified lineaments. As a result, the area around Hans Lake and the northwestern portion of the block are most significantly impacted which now display an elevated intersection density. Alternatively, the area in the northwest corner of the block tends to display the lowest density of final integrated lineaments.

5.5 Lineament Truncation and Relative Age Relationships

The structural history of the Hornepayne area, outlined in Section 2.3, provides a framework that may aid in constraining the relative age relationships of the interpreted bedrock lineaments. Previous work in and around the Hornepayne area identified six regionally distinguishable deformation episodes (D_1 – D_6) that are inferred to have overprinted the bedrock geological units of the area. The lineament interpretation is roughly consistent with regional observations, however, certain deformation events described in the literature could not be distinguished in the interpreted lineaments (D_1 to D_2), and other deformation events could not be separated and were therefore grouped together (i.e., D_2 to D_4, and D_5 and D_6).

As summarized in Section 2.3, D_1 to D_4 developed a compositional layering that may include gneissosity and isoclinal folds between ca. 2.719 and ca. 2.691 Ga, and D_2-D_4 produced the dominant brittle-ductile structures observed within the greenstone belts, including steep-dipping foliations, isoclinal folds, and thrust faults between ca. 2.691 and ca. 2.673 Ga.

Details of structural features associated with the D_5 and D_6 deformation events are limited in the literature to brittle and brittle-ductile faults of various scales and orientations (Lin 2001; Muir 2003). Within the Hemlo greenstone belt, certain D_5 and D_6 faults offset the Marathon, and Biscotasing dyke swarms (all ca. 2.2 Ga; Muir, 2003), and as such, D_5 and D_6 faults in the nearby Hemlo region may have developed after ca. 2.2 Ga. However, since there are no absolute age constraints on specific events, the entire D_5-D_6 interval of brittle deformation can only be constrained to a post-2.673 Ga timeframe that may include many periods of re-activation attributable to any of several post-Archean tectonic events. In addition, while no evidence was observed for dyke emplacement postdating brittle deformation, the lack of constraint on the age of fault development does not preclude this possibility.

Of the 1,274 final integrated lineaments, 318 were attributed as unclassified lineaments, 674 were classified as brittle lineaments, and 282 were classified as dyke lineaments (Figure 27). Based on the character of the unclassified lineaments, they are interpreted to represent structures formed during D_1-D_4 episodes. The unclassified lineaments were recognized predominantly from the geophysical data by their curvi-linear to anastomosing geometry, and their concordance with interpreted form lines. As discussed in Section 3.2, these lineaments may in certain locations represent the internal fabric of the rock units rather than ductile or brittle-ductile shear zones. These structures define a semi-continuous approximately east-west zone of brittle-ductile deformation in the Black-Pic batholith in the northern part of Block A, in proximity to the tectonic boundary between the Wawa and Quetico subprovinces, which grade into more discontinuous and spaced, curvi-linear to anastomosing lineaments in the southwest part of the block. In Block B, unclassified lineaments define east-northeast–trending continuous lineaments and shorter curvi-linear lineaments, and are densest in the northwestern and southeastern parts of the block.

In general, the unclassified lineaments are interpreted as D_1-D_4 which represents the oldest generation of interpreted lineament (likely Archean) and may locally show some evidence of offset and/or truncation by younger brittle lineaments (Figure 27, 27a, and 27b). In a few cases the D_2-D_4 unclassified lineaments may have been reactivated and can be observed truncating and (or) offsetting D_5-D_6 brittle lineaments. In these cases, the D_2-D_4 unclassified lineaments were reattributed as D_5-D_6 brittle lineaments as they reactivated under a younger regime of brittle deformation. Structures associated with D_1 deformation include gneissosity identified as unclassified lineaments in the interpretation.

The interpreted brittle lineaments in the final integrated data set are observed in broad northwest and northeast orientations, subparallel to the dominant dyke orientations. Despite the geometric relationship between dyke and brittle lineaments, the relative ages of the brittle lineaments does not appear to correlate with the age of emplacement of the dykes (i.e., brittle lineaments subparallel to the youngest dyke generation do not consistently offset or truncate brittle lineaments subparallel to older dyke generations). Rather, brittle lineaments of all orientations tend to offset and truncate, and are offset and truncated by all other brittle and dyke lineaments (described in Section 4). As a result, brittle lineaments could not systematically be differentiated into different generations of brittle deformation, and were therefore classified into the same broad generation of brittle deformation, D_5-D_6.

Of the 282 final integrated dyke lineaments, four distinct dyke populations can be identified, including 167 dyke lineaments corresponding to the 2.473 Ga northwest-trending Matachewan dyke swarm (Buchan and Ernst, 2004), 75 dyke lineaments corresponding to the 2.167 Ga. northeast-trending Biscotasing dyke swarm (Hamilton et al., 2002), 38 dyke lineaments corresponding to the 2.121 Ga. north-trending Marathon dyke swarm (Buchan et al., 1996; Hamilton et al., 2002) , and 2 dyke lineaments corresponding to the 1.14 Ga Abitibi dyke swarm (Ernst and Buchan, 1993). As discussed, dyke lineaments may locally truncate and offset, and may be truncated and offset by all possible orientations of brittle lineaments.

Considering these possible relationships, one or several of the following scenarios are possible:

- Dyke emplacement preceded the interpreted brittle faulting, and brittle faults subsequently exploited weaknesses developed in subparallel orientations
- Dyke swarms exploited and were emplaced along pre-existing faults
- Dykes and faults were generated coevally in subparallel orientations
- Brittle faults were reactivated syn- or post-dyke emplacement

Apart from these timing constraints, there are no additional absolute age constraints for aforementioned phases of deformation.

5.5.1 Mapped Structure and Lineament Relationships

Three unnamed faults have been mapped within the two Hornepayne lineament assessment areas (Figure 2), in addition to several unnamed faults mapped outside of the assessment areas. Two of the three mapped faults within the assessment areas were at least partially reproduced in the lineament interpretation. The relationship of mapped faults relative to the final integrated lineaments can be seen in Figure 27.

The only mapped fault in Block A is an unnamed northwest-trending fault that is mapped near the northern boundary of the block, extending from the Government Lakes area to the east-central part of the block. Only a short segment of this unnamed fault coincides with an interpreted brittle lineament. However, this fault is also adjacent to a cluster of closely spaced Matachewan dyke lineaments that shares a similar northwest trend. Other northwest and northeast-trending faults have been mapped near, but outside of the boundaries of the Block A lineament assessment area. In general, the orientation of these mapped faults are consistent with the dominant, but broad orientations of the final integrated lineaments. North of the Block A boundary two east-west-trending faults have been mapped that are located within the zone of the Quetico-Wawa subprovince boundary. The orientations of these faults is, in general, consistent with the pervasive east-west trend of unclassified lineaments interpreted within the northern part of Block A, and southern part of Block B.

The northeast-trending Shekak River fault is mapped in the area immediately northeast of Block A. A southwest extension of the Shekak River fault was reproduced in the lineament interpretation parallel to but to the south of West Larkin Lake, in the east-central part of the block.

Two unnamed faults are mapped within Block B, including one northwest-trending and one northeast-trending fault (Figure 2 and Figure 27b). The northwest-trending fault is only coincident with two Matachewan dykes for a few hundred meters. The remaining length of the mapped fault does not appear to coincide with any interpreted lineament.

The northeast-trending mapped fault crosses the southern boundary of Block B, and its trace terminates 1 km before intersecting with the eastern boundary of the block. This mapped fault does not appear to coincide with any of the interpreted lineaments, with the exception of few very short segments. The fault tends to cross through the interpreted unclassified lineaments at a small angle but there does not appear to be a direct relationship. This fault shows a similar orientation as the northeast-trending Biscotasing dykes, however, it appears to display a more easterly direction. Other northwest and northeast-trending faults have been previously mapped to the south and west of the Block B lineament assessment area. In general, the orientation of these mapped faults are consistent with the dominant, but broad orientations of the final integrated lineaments.

Multiple dykes had been previously interpreted throughout the two Hornepayne subareas from regional-scale geophysical data (Figure 2; Ontario Geological Survey, 2011). These dykes are general coincident with interpreted dyke lineaments, however certain discrepancies exist due to the higher resolution of the geophysical data set used in this assessment. The most noticeable discrepancy is that a single previously interpreted dyke from the regional-scale data is most often recognized as a series of tightly spaced dyke lineaments within the higher resolution geophysical data (Figure 27). This was most evident for the northwest-trending Matachewan dykes that are often manifested in the high resolution geophysical data as a series of tight-spaced dyke lineaments.

6 Summary of Results

This report documents the source data, workflow, and results from a lineament interpretation of geophysical (magnetic) and surficial (DEM and FRI digital aerial imagery) data sets acquired as part of Phase 2 Preliminary Assessments for the Hornepayne area. The lineament analysis provides an interpretation of the location and orientation of possible individual brittle, dyke, and unclassified lineaments on the basis of remotely sensed data, and helps to evaluate their relative timing relationships within the context of the regional geological setting. The workflow involves a three step process that was designed to address the issues of subjectivity and reproducibility. The distribution of lineaments in the area of Hornepayne reflects the bedrock structure, resolution of the data sets used, and surficial cover.

Within the Hornepayne Phase 2 assessment area, a total of 678 geophysical lineaments, 310 DEM lineaments, and 715 FRI lineaments were interpreted by the two interpreters (RA_1) from their respective data sets. Merging the lineaments derived from the DEM and FRI data resulted in a total of 703 surficial lineaments (RA_2). Merging the surficial lineaments with those derived from the geophysical data resulted in a total of 1274 final integrated lineaments (RA_2).

The reproducibility assessment (RA_1) revealed a moderate to high coincidence between interpreters for all three data sets (i.e., 66% for the geophysical lineaments, 48% for the DEM lineaments, and 48% for the FRI lineaments). The variability between interpreters could be attributed to the resolution of the data sets and the judgement of the expert carrying out the interpretation. In general, longer and higher certainty lineaments were identified more often by both interpreters, as well as dyke lineaments (which are more easily interpreted due to their distinct geophysical signature).

The coincidence assessment (RA_2) revealed a moderate to low coincidence between surficial lineaments interpreted from the DEM and FRI data sets (i.e., 21% of lineaments were coincident in both surficial data sets). Similarly, the final integrated lineaments revealed a low coincidence between lineaments interpreted from the three data sets (i.e., 7% of lineaments were coincident with all three data sets, 20% of lineaments were coincident in at least one other data set, and 73% of lineaments lacked coincidence with other data sets). The variability between lineaments derived from the different data sets could be attributed to multiple factors, including deeper structures identified in the magnetic data that may not have a surface expression, surficial features that may not extend to depth, features identified in the surficial data that may not possess sufficient magnetic susceptibility contrast to be recognized in the magnetic data, the masking of surface expressions of magnetic lineaments by the presence of overburden, and the differing resolution of the various data sets. Similar to RA_1, longer and higher certainty lineaments were more often coincident in the various data sets.

An analysis of lineament orientations revealed an overall consistency between the orientations of lineaments identified in the various data sets, which suggests that lineaments interpreted from all three data sets are identifying the same sets of structures. Lineament orientations within the Hornepayne area reveal dominant northwest and northeast trends. The northwest and northeast lineament orientations are distributed throughout the Hornepayne Phase 2 assessment areas, and correspond to dyke lineaments of the Matachewan, Marathon, Biscotasing, and Abitibi dyke swarms, and subparallel brittle lineaments. Brittle and dyke lineaments occur both as clusters of tight-spaced lineaments and in isolation. East-trending unclassified lineaments define multiple isolated domains of brittle-ductile deformation in the northern part of Block A, near the boundary between the Quetico and Wawa subprovinces, and east- to east-northeast–trending unclassified lineaments occur predominantly in the northwestern and southeastern parts of Block B

Evaluation of lineament length data for the geophysical brittle and dyke, surficial, and final integrated lineaments reveals roughly the same distribution, where more than 80% of lineaments are less than 5 km in length. In general, the geophysical brittle and dyke, and final integrated lineament sets contain more long lineaments relative to the integrated surficial lineaments due to the style in which bedrock structures are manifested within these data sets. Lineaments that were reproduced in all three data sets (RA_2=3), and lineaments with the highest certainty value (3) typically represent the longest lineaments (i.e., greater than 5 km). Long surficial, brittle, and dyke lineaments trend predominantly northwest, north, and northeast, corresponding to the major dyke sets and subparallel brittle structures. Long surficial lineaments trend dominantly towards the northeast, which is also coincident with the orientation of glaciation.

The geophysical lineament density of brittle and dyke lineaments reveals a relatively low and uniform background lineament density and zones of elevated lineament density, particularly in the southeastern part of Block A, and eastern and central parts of Block B. Zones of elevated lineament density are typically the result of clusters of tight-spaced brittle and (or) dyke lineaments, and the intersection of different orientations of lineament clusters. High lineament density zones occur forming a northeast-trending zone in the southeastern part and smaller discrete zones in the northeastern part of Block A, and forming two discontinuous northwest-trending zones in the eastern and central parts of Block B. Unclassified lineament density plots reveal several distinct brittle-ductile domains, including a broad east-west–trending domain along the northern part of Block A, in proximity to the tectonic boundary between the Wawa and Quetico subprovinces and a northeast-trending zone through Block B

The integrated surficial lineament density throughout both subareas reveals a relatively low and uniform background lineament density, and multiple zones of moderately elevated lineament density. Similar to the geophysical data, zones of elevated lineament densities typically occur along or at the intersection of tight-spaced northwest- and northeast-trending surficial lineaments in the northwestern half of Block A, and forming a subtle northeast-trending zone that includes three discrete higher density zones in Block B. The density of surficial lineaments is in part related to the presence of overburden that may obscure the interpretation of surficial lineaments related to bedrock structures. For example, limited surficial lineaments were interpreted along the eastern part of Block B, in an area of abundant glacial deposits.

The final integrated lineament density throughout all subareas is generally similar to the geophysical lineament density analyses. For unclassified lineaments, lineament density is nearly identical to the results of the geophysical density analyses, revealing a broad east-west-trending domain in the northern part of Block A, a narrower northeast-trending zone through the central part of Block A, and a northwest-trending zone of discontinuous high density through the central part of Block B. Lineament density analyses of the final integrated brittle and dyke lineaments reveals two prominent zones of high lineament density in the south-central and northeastern parts of Block A, and a northeast-trending zone corresponding to the zone of the most continuous northeast-trending brittle lineaments interpreted density in Block B. Similar to the other data sets, zones of high lineament density correspond to tight-spaced northeast-, north-, and northwest-trending brittle and dyke lineaments, and the intersection of these lineament clusters.

Six main regionally distinguishable deformation episodes (D_1-D_6) are recognized in the Hornepayne Phase 2 assessment areas, and can be used to constraint the relative age relationships of the interpreted lineaments. The final interpreted lineaments can be classified within the structural history into successive stages of ductile, brittle-ductile and brittle deformation, including: 318 D_1-D_4

(unclassified) lineaments and 674 D_5-D_6 (brittle) lineaments. A total of 282 dyke lineaments were also interpreted throughout the assessment areas.

D_2-D_4 unclassified lineaments were recognized predominantly from the geophysical data by their curvi-linear character and the truncation of form lines. These lineaments may represent the internal fabric of the rock units including the more intense fabric along ductile or brittle-ductile shear zones. Unclassified lineaments define distinct zones of deformation within the three subareas. As the unclassified lineaments are the oldest generation of interpreted structure, they are often offset and or truncated by younger brittle lineaments. Locally the unclassified lineaments were also reactivated, in which case they were classified as D_5-D_6 brittle lineaments.

D_5-D_6 brittle lineaments were observed in three dominant orientations: northwest, north, and northeast, subparallel to the dominant dyke orientations. Brittle lineaments of all orientations are observed to offset and truncate, and be offset and truncated by all other brittle and dyke lineament orientations. As a result, brittle lineaments cannot systematically be differentiated into different generations. Therefore, all brittle lineaments were classified into the same broad D_5-D_6 generation of brittle deformation. The complexity and inconsistency of the structural relationships observed between all brittle lineaments suggest a protracted deformation history that likely includes multiple generations of brittle reactivation.

Interpreted brittle faults show only partial coincidence with each of the three mapped faults intersecting the Hornepayne Phase 2 assessment areas, whereas interpreted dykes show good coincidence with previously mapped and interpreted dykes.

Of the 282 final integrated dyke lineaments, three distinct dyke populations can be identified, including 167 dyke lineaments corresponding to the 2.473 Ga northwest-trending Matachewan dyke swarm, 75 dyke lineaments corresponding to the 2.167 Ga. northeast-trending Biscotasing dyke swarm, 38 dyke lineaments corresponding to the 2.121 Ga. north-trending Marathon dyke swarm, and 2 dyke lineaments corresponding to the 1.14 Ga Abitibi dyke swarm. Dyke lineaments locally truncate and offset, and are truncated and offset by all orientations of brittle lineaments.

7 References

Barnett, P.J. 1992. Quaternary Geology of Ontario; In: Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, p.1010-1088.

Berman, R.G., Easton, R.M. and Nadeau, L. 2000. A New Tectonometamorphic Map of the Canadian Shield: Introduction; The Canadian Mineralogist, v. 38, p.277-285.

Berman, R.G., Sanborn-Barrie, M., Stern, R.A. and Carson, C.J. 2005. Tectonometamorphism at ca. 2.35 and 1.85 Ga: In: the Rae Domain, western Churchill Province, Nunavut, Canada: Insights from structural, metamorphic and in situ geochronological analysis of the southwestern Committee Bay Belt; The Canadian Mineralogist, v. 43, p.409-442.

Bleeker, W. and Hall, B. 2007. The Slave Craton: Geology and metallogenic evolution; In Goodfellow, W.D., ed., Mineral Deposits of Canada: A Synthesis of Major Deposit-Types, District Metallogeny, the Evolution of Geological Provinces, and Exploration Methods: Geological Association of Canada, Mineral Deposits Division, Special Publication No. 5, p.849-879.

Bokelmann, G.H.R. 2002. Which forces drive North America?, Geology, v.30, p.1027-1030

Bokelmann, G.H.R. and Silver, P.G. 2002. Shear Stress at the Base of Shield Lithosphere. Geophysical Research Letters, v. 29, p.61-64

Breaks, F.W. and Bond, W.D. 1993. The English River Subprovince – An Archean Gneiss Belt: Geology, geochemistry and associated mineralization; Ontario Geological Survey, Open File Report 5846, v. 1, 483p.

Brown, A., Everitt, R.A., Martin C.D. and Davison, C.C. 1995. Past and future fracturing In AECL research areas in the Superior Province of the Canadian Precambrian Shield, with emphasis on the Lac Du Bonnet Batholith; Whiteshell Laboratories, Pinawa, Manitoba

Buchan, K.L. and Ernst, R.E. 2004. Diabase dyke swarms and related units in Canada and adjacent regions. Geological Survey of Canada, Map 2022A, scale 1:5,000,000.

Buchan, K.L., Halls, H.C. and Mortensen, J.K. 1996. Paleomagnetism, U-Pb geochronology, and geochemistry of Marathon dykes, Superior Province, and comparison with the Fort Frances swarm. Canadian Journal of Earth Sciences, v. 33, pp.1583-1595.

Coates, M.E. 1970. Geology of the Killala-Vein Lake area; Ontario Department of Mines, Geological Report 81, 35p.

Corfu, F., Stott, G.M. and Breaks, F.W. 1995. U-Pb geochronology and evolution of the English River subprovince, an Archean low P – high T metasedimentary belt in the Superior Province. Tectonics, v. 14, p.1220-1233.

Corrigan, D., Galley, A.G. and Pehrsson, S. 2007. Tectonic evolution and metallogeny of the southwestern Trans-Hudson Orogen, in Goodfellow, W.D., ed., Mineral Deposits of Canada: A Synthesis of Major Deposit-Types, District Metallogeny, the Evolution of Geological

Provinces, and Exploration Methods: Geological Association of Canada, Mineral Deposits Division, Special Publication No. 5, p.881-902.

Easton, R.M. 2000a. Metamorphism of the Canadian Shield, Ontario, Canada. I. The Superior Province; The Canadian Mineralogist, v. 38, p.287-317.

Easton, R.M. 2000b. Metamorphism of the Canadian Shield, Ontario, Canada. II. Proterozoic metamorphic history; The Canadian Mineralogist, v. 38, p.319-344.

Ernst, R.E. and Buchan, K.L. 1993. Paleomagnetism of the Abitibi dyke swarm, southern Superior Province, and implications for the Logan Loop; Canadian Journal of Earth Sciences, v. 30, p.1886-1897.

Forte, A., Moucha, R., Simmons, N., Grand, S., and Mitrovica, J., 2010. Deep-mantle contributions to the surface dynamics of the North American continent. Tectonophysics, v. 481, p. 3–15.

Fraser, J.A. and Heywood, W.W. (editors) 1978. Metamorphism in the Canadian Shield; Geological Survey of Canada, Paper 78-10, 367p G. Stott, Pers. Comm, 2013).

Gartner, J.F., and D.F. McQuay. 1980. Hornepayne Area (NTS 42F/SE), Districts of Algoma and Cochrane. Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 46.

Geddes, R.S. and Kristjansson. F.J. 1986. Quaternary geology of the Hornepayne area, Districts of Thunder Bay and Algoma; Ontario Geological Survey, Map P.2988, Geological Series-Preliminary Map, scale 1:50,000.

Geddes, R.S., Bajc, A.F. and Kristjansson, F.J. 1985. Quaternary Geology of the Hemlo Region, District of Thunder Bay; In: Summary of Field Work, 1985, Ontario Geological Survey, Ontario Geological Survey, Miscellaneous Paper 126, p.151-154.

Geofirma, 2013. Phase 1 Geoscientific Desktop Preliminary Assessment of Potential Suitability for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel. Township of Hornepayne, Ontario. Report prepared by Geofirma Engineering Ltd. for NWMO, November 2014. APM-REP-06144-0003. Report available at www.nwmo.ca.

Haimson, B.C. 1990. Scale effects in rock stress measurements. In Proceedings international workshop on scale effects in rock masses, Loen, AA Balkema, Rotterdam, p.89-101.

Halls, H.C., Stott, G.M., Ernst, R.E. and Davis, D.W., 2006. A Paleoproterozoic mantle plume beneath the Lake Superior region; p.23-24 In: Institute on Lake Superior Geology, 52nd Annual Meeting Sault Ste Marie, Ontario, Part 1, Program and Abstracts.

Hamilton, M.A., David, D.W., Buchan, K.L. and Halls H.C. 2002. Precise U-Pb dating of reversely magnetized Marathon diabase dykes and implications for emplacement of giant dyke swarms along the southern margin of the Superior Province, Ontario. Geological Survey of Canada, Current Research 2002-F6, 10p.

Jackson, S.L. 1998. Stratigraphy, structure and metamorphism; Part 1, p.1--58, in S.L. Jackson, G.P. Beakhouse and D.W. Davis, Geological Setting of the Hemlo Gold Deposit; an Interim Progress Report, Ontario Geological Survey, Open File Report 5977, 121p.

JDMA (J.D. Mollard and Associates [2010] Ltd.), 2013. Phase 1 Geoscientific Desktop Preliminary Assessment, Terrain and Remote Sensing Study, Township of Hornepayne, Ontario. Prepared for Geofirma Engineering Ltd. and Nuclear Waste Management Organization (NWMO). NWMO Report Number: APM-REP-06144-0004

Jolly, W.T. 1978. Metamorphic history of the Archean Abitibi Belt; In: Metamorphism in the Canadian Shield; Geological Survey of Canada, Paper 78-10, p.63-78.

Kettles, I.M. and Way Nee, V. 1998. Surficial geology, Vein Lake, Ontario; Geological Survey of Canada, Map 1921A, scale 1:50,000.

Kraus, J. and Menard, T. 1997. A thermal gradient at constant pressure: Implications for low- to medium-pressure metamorphism in a compressional tectonic setting, Flin Flon and Kisseynew domains, Trans-Hudson Orogen, Central Canada; The Canadian Mineralogist, v. 35, p.1117-1136.

Lin, S. 2001. Stratigraphic and Structural Setting of the Hemlo Gold Deposit, Ontario, Canada. Economic Geology, v. 96, pp. 477-507.

Menard, T. and Gordon, T.M. 1997. Metamorphic P-T paths from the Eastern Flin Flon Belt and Kisseynew Domain, Snow Lake, Manitoba; The Canadian Mineralogist, v. 35, p.1093-1115.

Muir, T.L. 2003. Structural evolution of the Hemlo greenstone belt in the vicinity of the world-class Hemlo gold deposit. Canadian Journal of Earth Sciences, v. 40, pp.395-430.

Osmani, I.A. 1991. Proterozoic mafic dyke swarms in the Superior Province of Ontario. Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 1, pp.661-681.

OMNR (Ontario Ministry of Natural Resources), 2009. Forest Information Manual – Forest Resources Inventory Technical Specifications.

Pan, Y., Fleet, M.E., Williams, H.R., 1994. Granulite-facies metamorphism in the Quetico Subprovince, north of Manitouwadge, Ontario. Can. J. Earth Sci. 31, pp.1427-1439.

Pease, V., Percival, J., Smithies, H., Stevens, G. and Van Kranendonk, M. 2008. When did plate tectonics begin? Evidence from the orogenic record; In: Condie, K.C. and Pease, V., eds., When Did Plate Tectonics Begin on Earth? Geological Society of America Special Paper 440, pp.199-228.

Percival, J.A. 1989. A regional perspective of the Quetico metasedimentary belt, Superior Province, Canada, Canadian Journal of Earth Sciences, v. 26, pp.677-693.

Percival, J.A., Sanborn-Barrie, M., Skulski, T., Stott, G.M., Helmstaedt, H. and White, D.J. 2006. Tectonic evolution of the western Superior Province from NATMAP and Lithoprobe studies; Can. J. Earth Sciences v. 43, pp.1085-1117.

Percival, J.A. and Sullivan, R.W. 1988. Age constraints on the Quetico belt, Superior Province, Ontario; In: Radiogenic and Isotope Studies: Report 2; Geological Survey of Canada, Paper 88-2, p.97-107.

Percival, J.A. and Williams, H.R. 1989. Late Archean Quetico accretionary complex, Superior Province, Canada. Geology, v. 17, pp.23-25.

Percival, J.A., Sanborn-Barrie, M., Skulski, T., Stott, G.M., Helmstaedt, H. and White, D.J. 2006. Tectonic evolution of the western Superior Province from NATMAP and Lithoprobe studies; Can. J. Earth Sciences v. 43, pp.1085-1117.

Peterson, V.L., and Zaleski, E. 1999. Structural history of the Hornepayne greenstone belt and its volcanogenic Cu-Zn massive sulphide deposits, Wawa Subprovince, south-central Superior Province; Can. Jour. of Earth Sciences, v. 36, pp.605-625.

Polat, A., Kerrich, R. and Wyman, D.A. 1998. The late Archean Schreiber–Hemlo and Hornepayne–Dayohessarah greenstone belts, Superior Province: collages of oceanic plateaus, oceanic arcs, and subduction–accretion complexes; Tectonophysics, 289, pp.295-326.

Polat, A. 1998. Geodynamics of the Late Archean Wawa Subprovince greenstone belts, Superior Province, Canada. PhD Thesis, Department of Geological Sciences, University of Saskatchewan, Saskatoon, 249p.

Powell, W.G., Carmichael, D.M. and Hodgson, C.J. 1993. Thermobarometry in a subgreenschist to greenschist transition in metabasites of the Abitibi greenstone belt, Superior Province, Canada; J. Metamorphic Geology, v. 11, pp.165-178.

Prest, V.K. 1970. Quaternary geology of Canada; in Geology and Economic Minerals of Canada, Geological Survey of Canada, Economic Geology Report no.1, Fifth Edition, pp.675-764.

SGL (Sander Geophysics Limited). 2017. Phase 2 Geoscientific Preliminary Assessment, Acquisition, Processing and Interpretation of High-Resolution Airborne Geophysical Data, Township of Hornepayne and Area, Ontario. Prepared for Nuclear Waste Management Organization (NWMO). NWMO Report Number: APM-REP-01332-0205.

Siragusa, G.M. 1977. Geology of the Kabinakagami Lake area, District of Algoma; Ontario Division of Mines, Geoscience Report 159, 39p., accompanied by Map 2355, scale 1:63,360 or 1 inch to 1 mile.

Stott, G.M. 1999. Precambrian geology of the Dayohessarah Lake area, Hornepayne, Ontario; Ontario Geological Survey, Open File Report 5984, 54p.

SRK, 2015a. Phase 2 Geoscientific Preliminary Assessment, Lineament Interpretation, The Town of Creighton, Saskatchewan. Report prepared for NWMO, February 2015. Report available at www.nwmo.ca.

SRK, 2015b. Phase 2 Geoscientific Preliminary Assessment, Lineament Interpretation, The Town of Ignace, Ontario. Report prepared for NWMO, February 2015. Report available at www.nwmo.ca.

SRK, 2015c. Phase 2 Geoscientific Preliminary Assessment, Lineament Interpretation, The Town of Schreiber, Ontario. Report prepared for NWMO, February 2015. Report available at www.nwmo.ca.

Sutcliffe, R.H. 1991. Proterozoic Geology of the Lake Superior Area. In: Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 1, pp.627-658.

Williams, H.R. and Breaks, F.W. 1989. Geological studies in the Hornepayne-Hornepayne area; Ontario Geological Survey, Miscellaneous Paper 146, p.p79-91.

Williams, H.R. and F.W. Breaks, 1996. Geology of the Hornepayne-Hornepayne region, Ontario; Ontario Geological Survey, Open File Report 5953, 138p.

Williams, H. R., Stott, G.M., Heather, K.B., Muir, T.L. and Sage, R.P. 1991. Wawa Subprovince; In: Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 1, p.485-525.

Williams, H.R., 1989. Geological studies in the Wabigoon, Quetico and Abitibi-Wawa subprovinces, Superior Province of Ontario, with emphasis on the structural development of the Beardmore-Geraldton Belt, Ontario Geological Survey, Open File Report 5724, 189p.

Zaleski, E. and Peterson, V.L. 1993. Geology of the Hornepayne greenstone belt, Ontario; Geological Survey of Canada, Open File 2753, scale 1:25,000.

Zaleski E. and V.L. Peterson, 1995. Depositional setting and deformation of massive sulfide deposits, iron-formation, and associated alteration in the Manitouwadge greenstone belt, Superior Province, Ontario; Economic Geology, Vol. 90(8), p.2244-2261.

Zaleski, E., Peterson, V.L., and van Breemen, 0, 1995. Geological and age relationships of the margins of the Hornepayne greenstone belt and the Wawa-Quetico subprovince boundary, northwestern Ontario. Current Research 1995-C, Geological Survey of Canada, pp.35-44.

Zaleski, E., van Breemen O. and Peterson, V.L. 1999. Geological evolution of the Hornepayne greenstone belt and the Wawa-Quetico subprovince boundary, Superior Province, Ontario, constrained by U-Pb zircon dates of supracrustal and plutonic rocks. Canadian Journal of Earth Sciences, v. 36, pp.945-966.

Zoback, M.L., 1992. First- and second-order patterns of stress in the lithosphere: the world stress map project; Journal of Geophysical. Research, 97, p.11,703-11,728.

APPENDIX A – Additional Supporting Figures

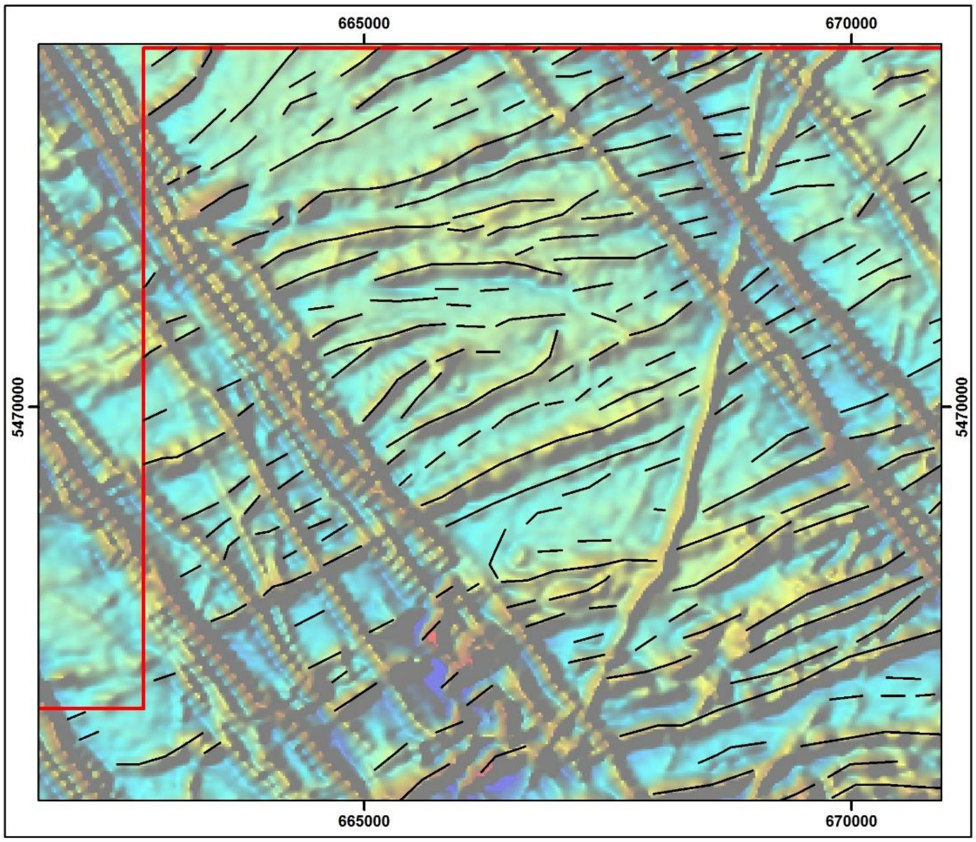


Figure A1: Example of Form Lines from the Hornepayne Area

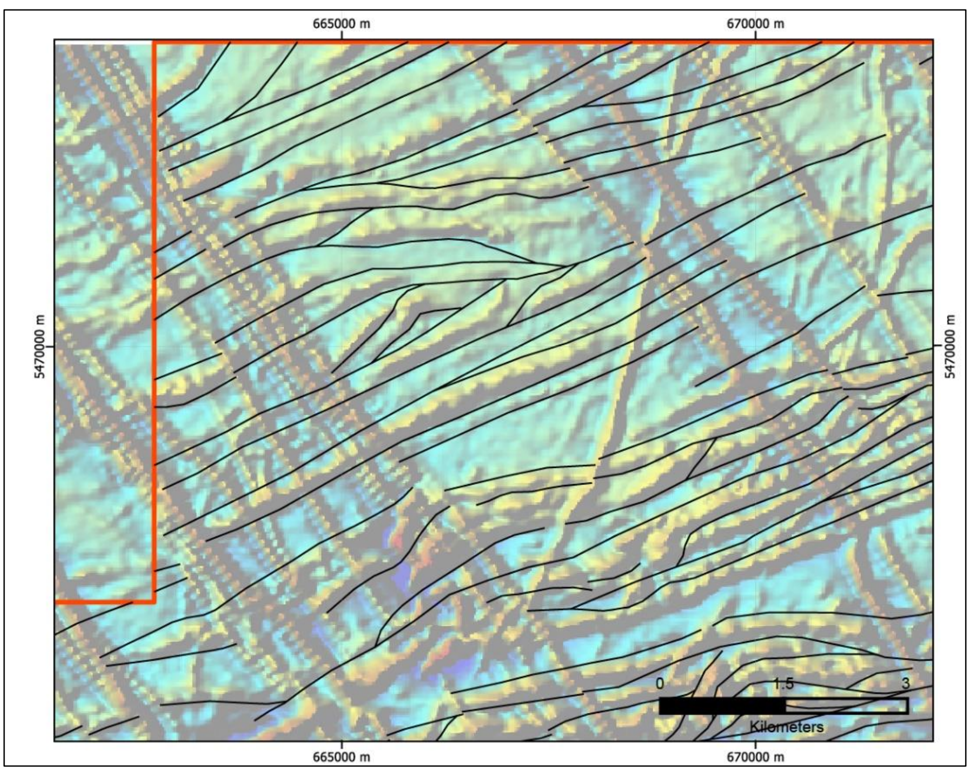


Figure A2: Example of Unclassified Lineaments from the Hornepayne Area

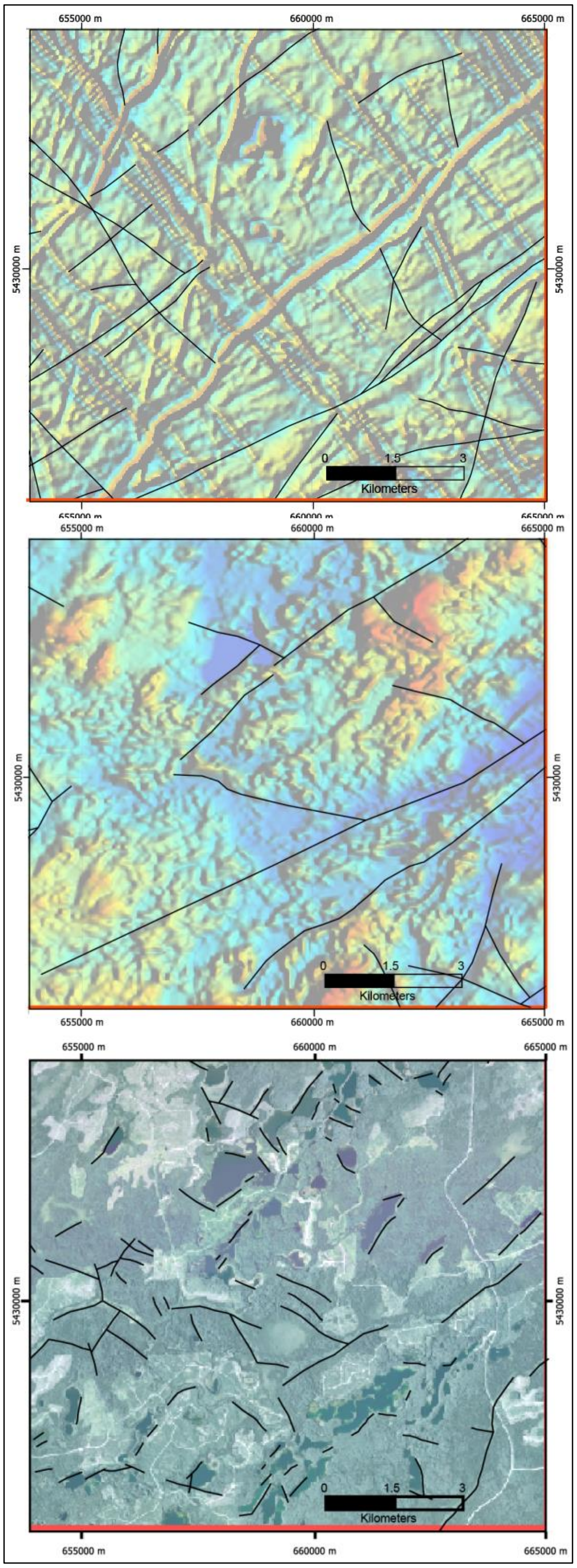


Figure A3: Example of Brittle Lineaments from the Same Location in the Hornepayne Area

Top, middle and bottom show brittle lineaments manifested in magnetic, DEM and FRI data sets, respectively.

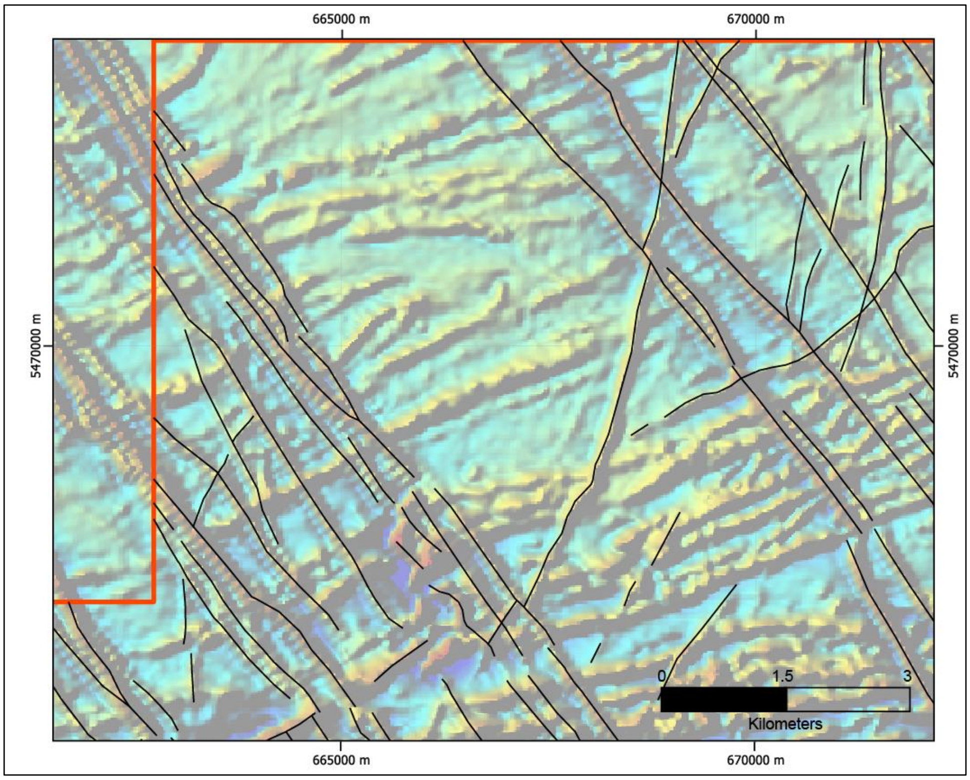
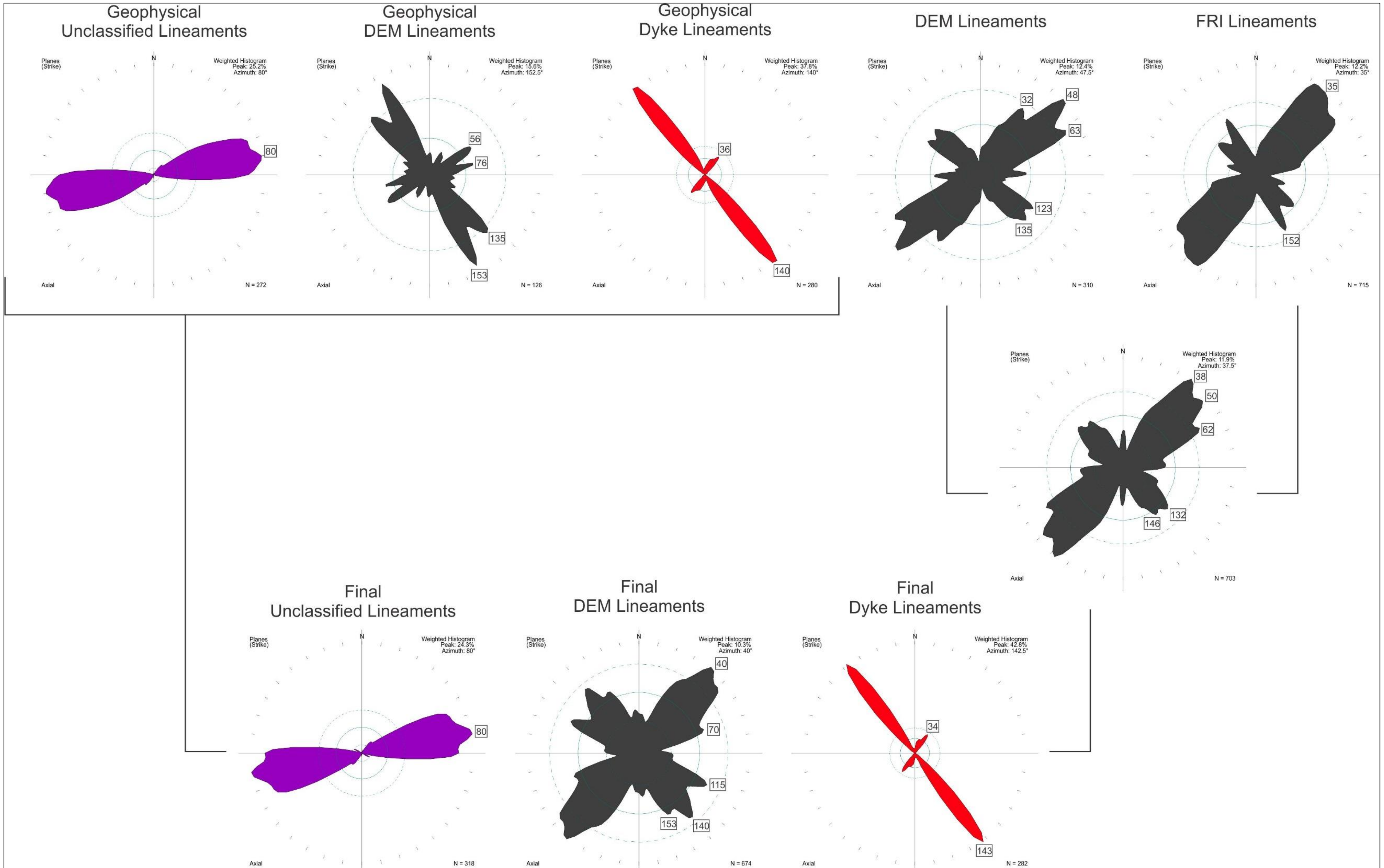


Figure A4: Example of Dyke Lineaments from the Hornepayne Area

Figure A5: Summary of Lineament Orientations for all Subareas of the Hornepayne Phase 2 Assessment Area



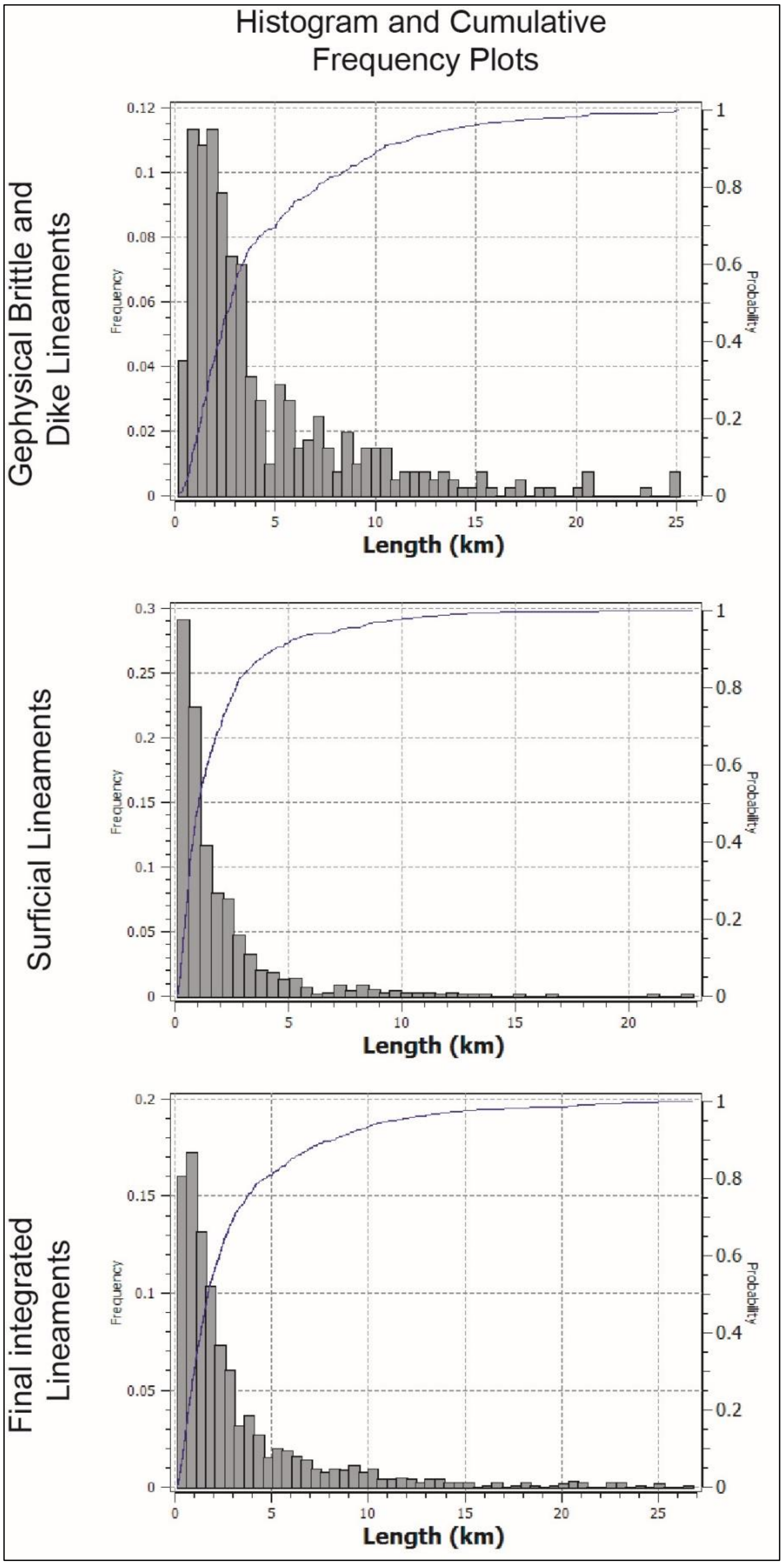


Figure A6: Summary of Length Statistics for all subareas of the Hornepayne Phase 2 Assessment Area

APPENDIX B - Summary of Lineament Statistics

Table B1: Summary of Geophysical Lineament Statistics

	All Subareas	All Subareas – Unclassified	All Subareas - Brittle	All Subareas - Dyke	Block A – All	Block A – Unclassified	Block A - Brittle	Block A – Dyke	Block B – All	Block B – Unclassified	Block B - Brittle	Block B – Dyke
Total Number of Lineaments	678	272	126	280	398	148	92	158	280	124	34	122
Max Length (km)	25.11	24.07	24.78	25.11	25.11	23.12	17.95	25.11	24.78	24.07	24.78	15.09
Minimum Length (km)	0.15	0.55	0.73	0.15	0.15	0.55	0.73	0.15	0.31	0.55	0.74	0.31
Median Length (km)	2.79	2.72	2.37	3.04	2.71	2.47	2.38	3.22	2.86	3.05	2.17	2.9
Mean Length (km)	4.55	4.7	3.15	5.04	4.84	5.13	3.13	5.55	4.15	4.18	3.21	4.38
Certainty 1 (number)	166	106	40	20	110	69	29	12	56	37	11	8
Certainty 1 (percent)	24%	39%	32%	7%	28%	47%	32%	8%	20%	30%	32%	7%
Certainty 2 (number)	179	112	51	16	93	51	36	6	86	61	15	10
Certainty 2 (percent)	26%	41%	40%	6%	23%	34%	39%	4%	31%	49%	44%	8%
Certainty 3 (number)	333	54	35	244	195	28	27	140	138	26	8	104
Certainty 3 (percent)	49%	20%	28%	87%	49%	19%	29%	89%	49%	21%	24%	85%
RA1 = 2 (number)	445	139	59	247	278	82	49	147	167	57	10	100
RA1 = 2 (percent)	66%	51%	47%	88%	70%	55%	53%	93%	60%	46%	29%	82%
RA1 = 1 (number)	233	133	67	33	120	66	43	11	113	67	24	22
RA1 = 1 (percent)	34%	49%	53%	12%	30%	45%	47%	7%	40%	54%	71%	18%

Table B2: Summary of DEM Lineament Statistics

	All Subareas	Block A	Block B
Total Number of Lineaments	310	175	135
Max Length (km)	21.18	20.53	21.18
Minimum Length (km)	0.3	0.3	0.57
Median Length (km)	2.33	2.53	2.2
Mean Length (km)	3.4	3.5	3.26
Certainty 1 (number)	118	73	45
Certainty 1 (percent)	38%	42%	33%
Certainty 2 (number)	154	84	70
Certainty 2 (percent)	50%	48%	52%
Certainty 3 (number)	38	18	20
Certainty 3 (percent)	12%	10%	15%
RA1 = 2 (number)	150	76	74
RA1 = 2 (percent)	48%	43%	55%
RA1 = 1 (number)	160	99	61
RA1 = 1 (percent)	52%	57%	45%

Table B3: Summary of FRI Lineament Statistics

	All Subareas	Block A	Block B
Total Number of Lineaments	715	497	218
Max Length (km)	7.68	4.38	7.68
Minimum Length (km)	0.07	0.07	0.1
Median Length (km)	0.56	0.53	0.61
Mean Length (km)	0.76	0.71	0.85
Certainty 1 (number)	394	269	125
Certainty 1 (percent)	55%	54%	57%
Certainty 2 (number)	281	209	72
Certainty 2 (percent)	39%	42%	33%
Certainty 3 (number)	40	19	21
Certainty 3 (percent)	6%	4%	10%
RA1 = 2 (number)	342	224	118
RA1 = 2 (percent)	48%	45%	54%
RA1 = 1 (number)	373	273	100
RA1 = 1 (percent)	52%	55%	46%

Table B4: Summary of Integrated Surficial Lineament Statistics

	All Subareas	Block A	Block B
Total Number of Lineaments	703	450	253
Max Length (km)	22.77	22.77	21.1
Minimum Length (km)	0.1	0.11	0.1
Median Length (km)	1.04	0.89	1.25
Mean Length (km)	1.95	1.85	2.11
Certainty 1 (number)	351	240	111
Certainty 1 (percent)	50%	53%	44%
Certainty 2 (number)	296	187	109
Certainty 2 (percent)	42%	42%	43%
Certainty 3 (number)	56	23	33
Certainty 3 (percent)	8%	5%	13%
RA2 = 2 (number)	146	93	53
RA2 = 2 (percent)	21%	21%	21%
RA2 = 1 (number)	557	357	200
RA2 = 1 (percent)	79%	79%	79%

Table B5: Summary of Final Integrated Lineament Statistics

	All Subareas	All Subareas – Unclassified	All Subareas – Brittle	All Subareas – Dyke	Block A	Block A – Unclassified	Block A – Brittle	Block A – Dyke	Block B	Block B – Unclassified	Block B – Brittle	Block B – Dyke
Total Number of Lineaments	1274	318	674	282	779	167	453	159	495	151	221	123
Max Length (km)	26.76	24.07	26.76	25.11	25.11	23.12	17.96	25.11	26.76	24.07	26.76	15.09
Minimum Length (km)	0.1	0.37	0.1	0.15	0.11	0.55	0.11	0.15	0.1	0.37	0.1	0.31
Median Length (km)	1.7	2.46	1.14	3.06	1.67	2.68	1.07	3.16	1.74	2.34	1.3	2.97
Mean Length (km)	3.19	4.33	1.87	5.07	3.24	4.86	1.82	5.57	3.13	3.73	1.99	4.43
Certainty 1 (number)	423	108	295	20	285	63	210	12	138	45	85	8
Certainty 1 (percent)	33%	34%	44%	7%	37%	38%	46%	8%	28%	30%	38%	7%
Certainty 2 (number)	450	145	289	16	269	68	195	6	181	77	94	10
Certainty 2 (percent)	35%	46%	43%	6%	35%	41%	43%	4%	37%	51%	43%	8%
Certainty 3 (number)	401	65	90	246	225	36	48	141	178	29	42	105
Certainty 3 (percent)	31%	20%	13%	87%	29%	22%	11%	89%	36%	19%	19%	85%
RA2 = 3 (number)	88	28	23	37	53	18	17	18	35	10	6	19
RA2 = 3 (percent)	7%	9%	3%	13%	7%	11%	4%	11%	7%	7%	3%	15%
RA2 = 2 (number)	254	59	145	50	152	28	93	31	102	31	52	19
RA2 = 2 (percent)	20%	19%	22%	18%	20%	17%	21%	19%	21%	21%	24%	15%
RA2 = 1 (number)	932	231	506	195	574	121	343	110	358	110	163	85
RA2 = 1 (percent)	73%	73%	75%	69%	74%	72%	76%	69%	72%	73%	74%	69%

Table B6: Summary of Final Integrated Brittle and Dyke Lineament Length Statistics

	All Subareas		Block A		Block B	
	Mean length (kilometres)	Median length (kilometres)	Mean length (kilometres)	Median length (kilometres)	Mean length (kilometres)	Median length (kilometres)
Certainty 1	1.07	0.77	1.08	0.71	1.07	0.84
Certainty 2	1.95	1.37	1.91	1.35	2.03	1.42
Certainty 3	5.25	3.42	5.77	3.74	4.59	3.00
RA2 = 3	8.26	7.42	8.28	7.32	8.24	7.70
RA2 = 2	4.36	2.74	4.57	2.74	4.00	2.79
RA2 = 1	1.93	1.12	1.89	1.04	2.00	1.29

Figures

Figure 1: Location and Overview of the Hornepayne Area

Figure 2: Bedrock Geology of the Hornepayne Area

Figure 3: Terrain Features of the Hornepayne Area

Figure 4: Pole Reduced Magnetic Data (First Vertical Derivative) of the Hornepayne Area

Figure 5: Digital Elevation Data of the Hornepayne Area

Figure 6: Forest Resource Inventory Digital Aerial Imagery of the Hornepayne Area

Figure 7: Form lines from Pole Reduced Magnetic Data of the Hornepayne Area
Figure 7a: Form lines from Pole Reduced Magnetic Data of the Hornepayne Area – Block A

Figure 7b: Form lines from Pole Reduced Magnetic Data of the Hornepayne Area – Block B

Figure 8: Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

Figure 8a: Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block A

Figure 8b: Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block B

Figure 9: Interpreted Lineaments from Digital Elevation Data of the Hornepayne Area

Figure 9a: Interpreted Lineaments from Digital Elevation Data of the Hornepayne Area – Block A

Figure 9b: Interpreted Lineaments from Digital Elevation Data of the Hornepayne Area – Block B

Figure 10: Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Hornepayne Area

Figure 10a: Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Hornepayne Area – Block A

Figure 10b: Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Hornepayne Area – Block B

Figure 11: Interpreted Lineaments from Surficial Data of the Hornepayne Area

Figure 11a: Interpreted Lineaments from Surficial Data of the Hornepayne Area – Block A

Figure 11b: Interpreted Lineaments from Surficial Data of the Hornepayne Area – Block B

Figure 12: Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

Figure 12a: Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block A

Figure 12b: Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block B

Figure 13: Select Final Integrated Lineaments of the Hornepayne Area

Figure 13a: Select Final Integrated Lineaments of the Hornepayne Area – Block A

Figure 13b: Select Final Integrated Lineaments of the Hornepayne Area – Block B

Figure 14: Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Hornepayne Area

Figure 14a: Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Hornepayne Area – Block A

Figure 14b: Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Hornepayne Area – Block B

Figure 15: Interpreted Lineaments (by Length) from Surficial Data of the Hornepayne Area

Figure 15a: Interpreted Lineaments (by Length) from Surficial Data of the Hornepayne Area – Block A

Figure 15b: Interpreted Lineaments (by Length) from Surficial Data of the Hornepayne Area – Block B

Figure 16: Final Integrated Lineaments (by Length) of the Hornepayne Area

Figure 16a: Final Integrated Lineaments (by Length) of the Hornepayne Area – Block A

Figure 16b: Final Integrated Lineaments (by Length) of the Hornepayne Area – Block B

Figure 17: Lineament Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

Figure 17a: Lineament Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block A

Figure 17b: Lineament Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block B

Figure 18: Lineament Density for all Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

Figure 18a: Lineament Density for all Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block A

Figure 18b: Lineament Density for all Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block B

Figure 19: Lineament Density for Interpreted Lineaments from Surficial Data of the Hornepayne Area

Figure 19a: Lineament Density for Interpreted Lineaments from Surficial Data of the Hornepayne Area – Block A

Figure 19b: Lineament Density for Interpreted Lineaments from Surficial Data of the Hornepayne Area – Block B

Figure 20: Lineament Density for Final Integrated Unclassified Lineaments of the Hornepayne Area

Figure 20a: Lineament Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area – Block A

Figure 20b: Lineament Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area – Block B

Figure 21: Lineament Density for all Final Integrated Lineaments of the Hornepayne Area

Figure 21a: Lineament Density for all Final Integrated Lineaments of the Hornepayne Area – Block A

Figure 21b: Lineament Density for all Final Integrated Lineaments of the Hornepayne Area – Block B

Figure 22: Lineament Intersection Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

Figure 22a: Lineament Intersection Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block A

Figure 22b: Lineament Intersection Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block B

Figure 23: Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

Figure 23a: Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block A

Figure 23b: Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area – Block B

Figure 24: Lineament Intersection Density for Interpreted Surficial Lineaments of the Hornepayne Area

Figure 24a: Lineament Intersection Density for Interpreted Surficial Lineaments of the Hornepayne Area – Block A

Figure 24b: Lineament Intersection Density for Interpreted Surficial Lineaments of the Hornepayne Area – Block B

Figure 25: Lineament Intersection Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area

Figure 25a: Lineament Intersection Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area – Block A

Figure 25b: Lineament Intersection Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area – Block B

Figure 26: Lineament Intersection Density for All Final Integrated Lineaments of the Hornepayne Area

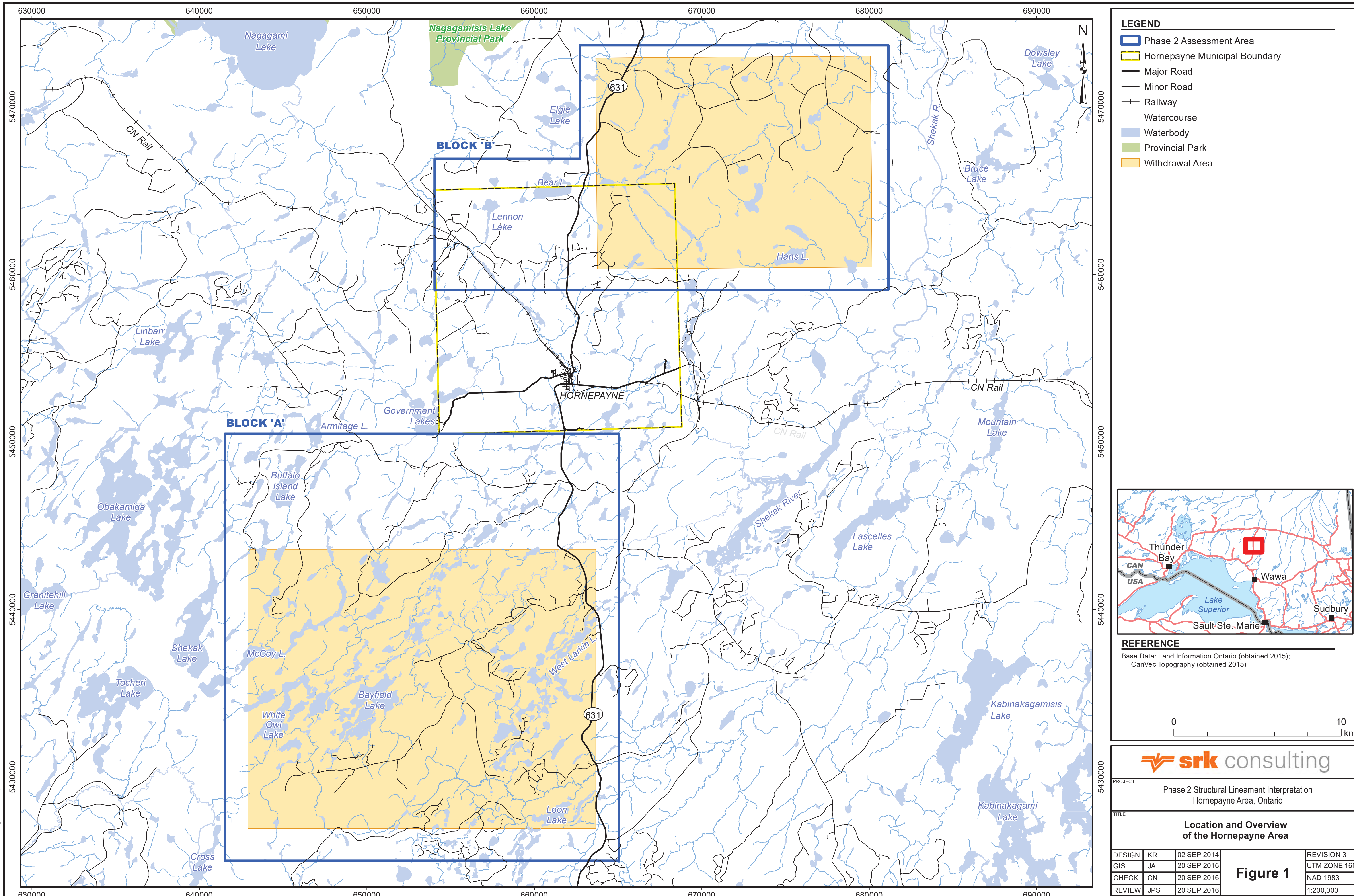
Figure 26a: Lineament Intersection Density for All Final Integrated Lineaments of the Hornepayne Area – Block A

Figure 26b: Lineament Intersection Density for All Final Integrated Lineaments of the Hornepayne Area – Block B

Figure 27: Lineament Truncations and Relative Age Relationships of the Hornepayne Area

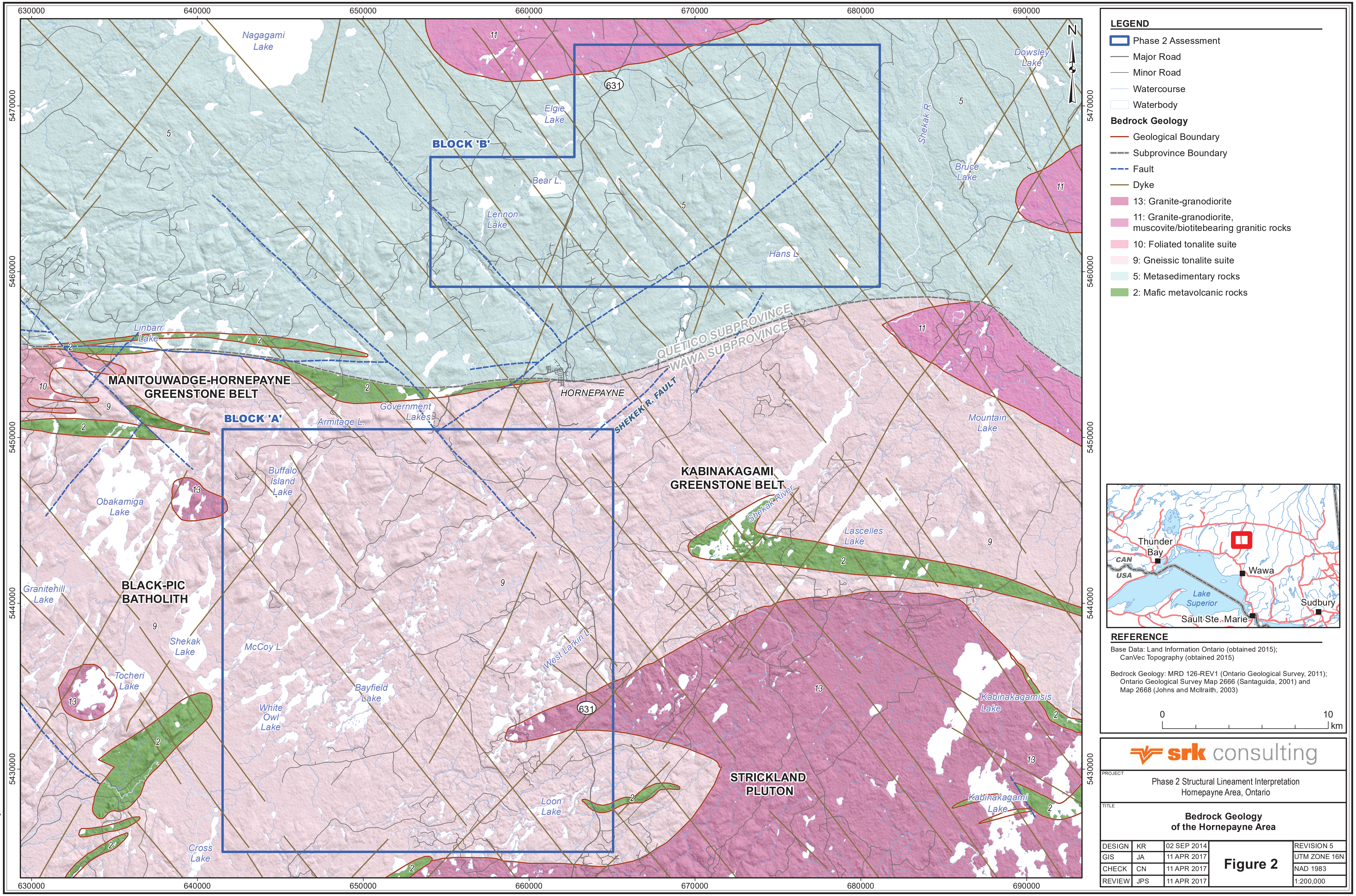
Figure 27a: Lineament Relative Age Relationships of the Hornepayne Area – Block A

Figure 27b: Lineament Relative Age Relationships of the Hornepayne Area – Block B



Location and Overview of the Hornepayne Area

Figure 1



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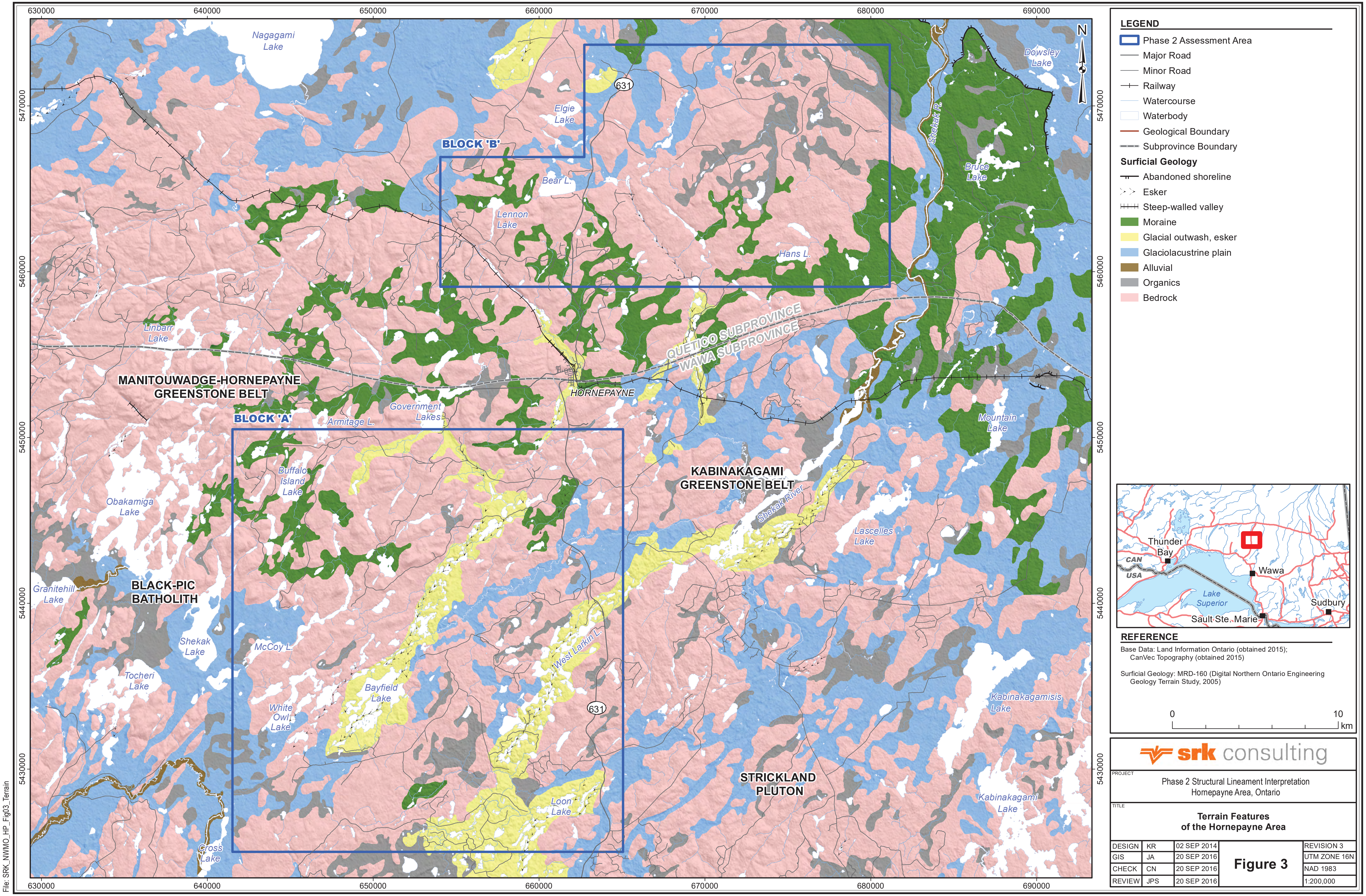
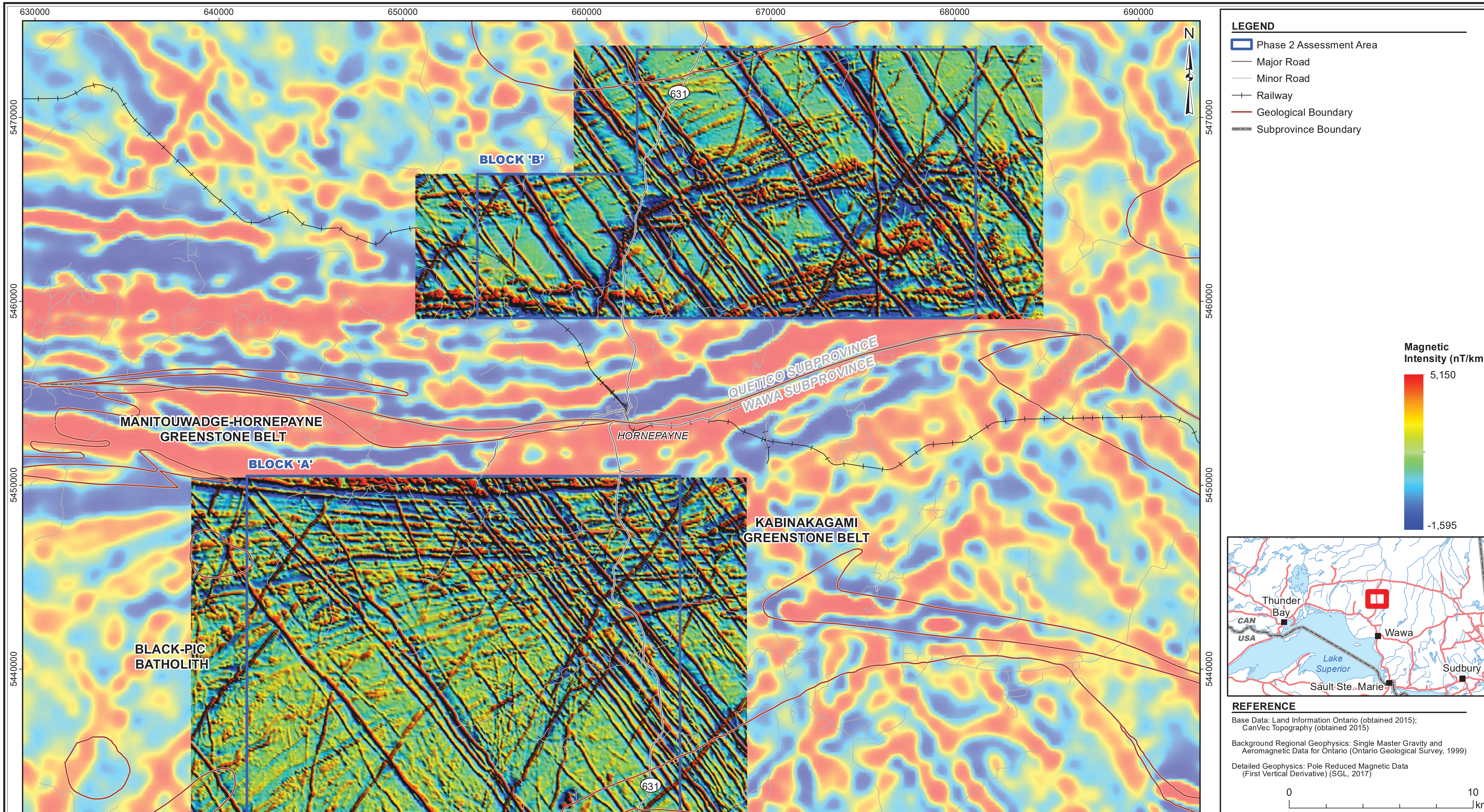

LEGEND
Phase 2 Assessment Area
Major Road
Minor Road
Railway
Watercourse
Waterbody
Geological Boundary
Subprovince Boundary
Surficial Geology
Abandoned shoreline
Esker
Steep-walled valley
Moraine
Glacial outwash, esker
Glaciolacustrine plain
Alluvial
Organics
Bedrock
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Surficial Geology: MRD-160 (Digital Northern Ontario Engineering Geology Terrain Study, 2005)
0
10
km
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Terrain Features
of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 3
REVISION 3
UTM ZONE 16N
NAD 1983
1:200,000
N
630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
Nagagami Lake
Elgie Lake
631
BLOCK 'B'
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Shekak R.
Bruce Lake
Linbarr Lake
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
HORNEPAYNE
Government Lakes
Armitage L.
BLOCK 'A'
Mountain Lake
Buffalo Island Lake
KABINAKAGAMI GREENSTONE BELT
Shekak River
Obakamiga Lake
Lascelles Lake
Granitehill Lake
BLACK-PIC BATHOLITH
Shekak Lake
McCoy L.
West Larkin L.
Tocheri Lake
Bayfield Lake
White Owl Lake
631
Kabinakagamisis Lake
STRICKLAND PLUTON
Loon Lake
Kabinakagami Lake
Cross Lake
File: SRK_NWMO_HP_Fig03_Terrain



srk consulting

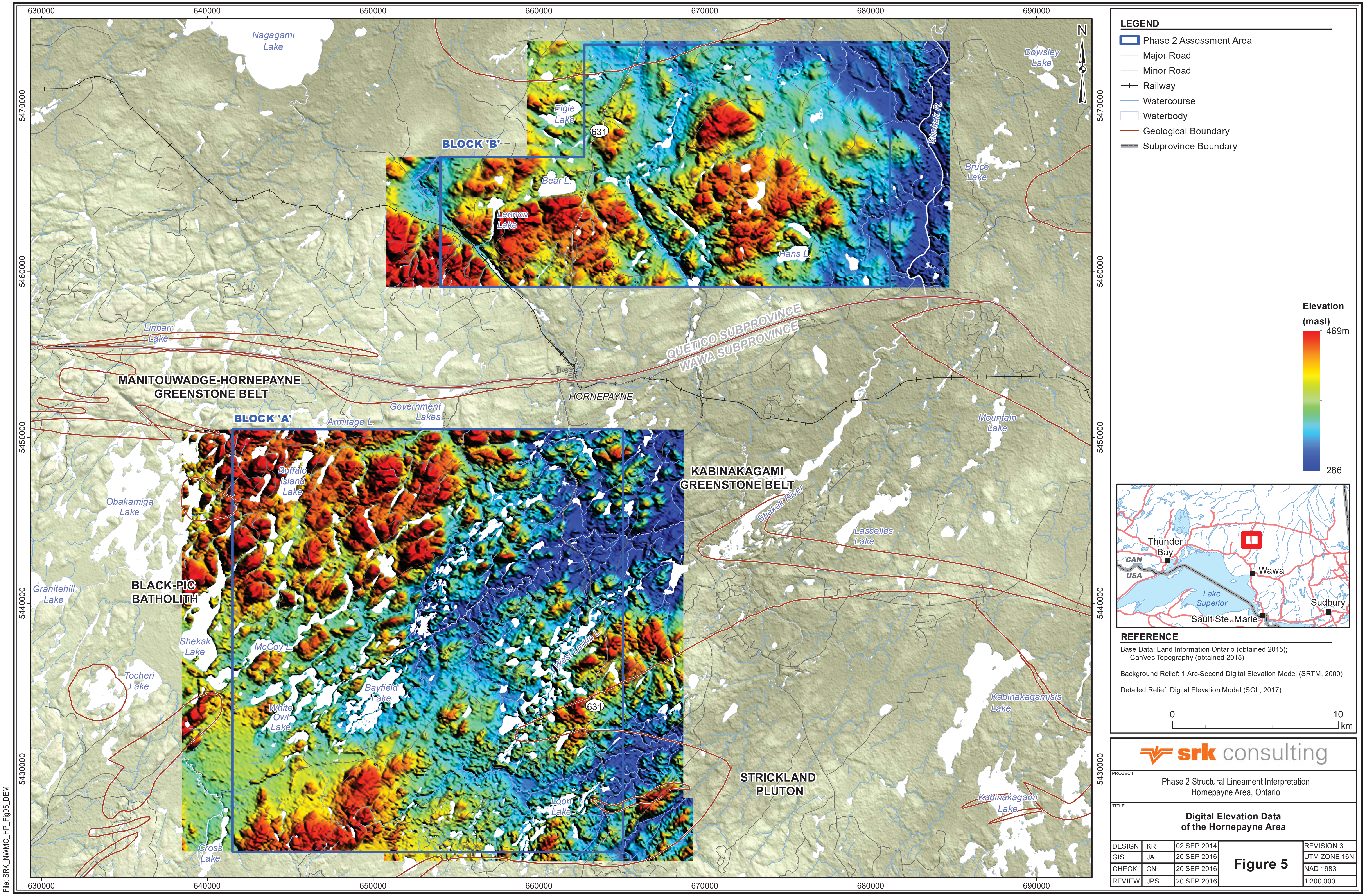
PROJECT

Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

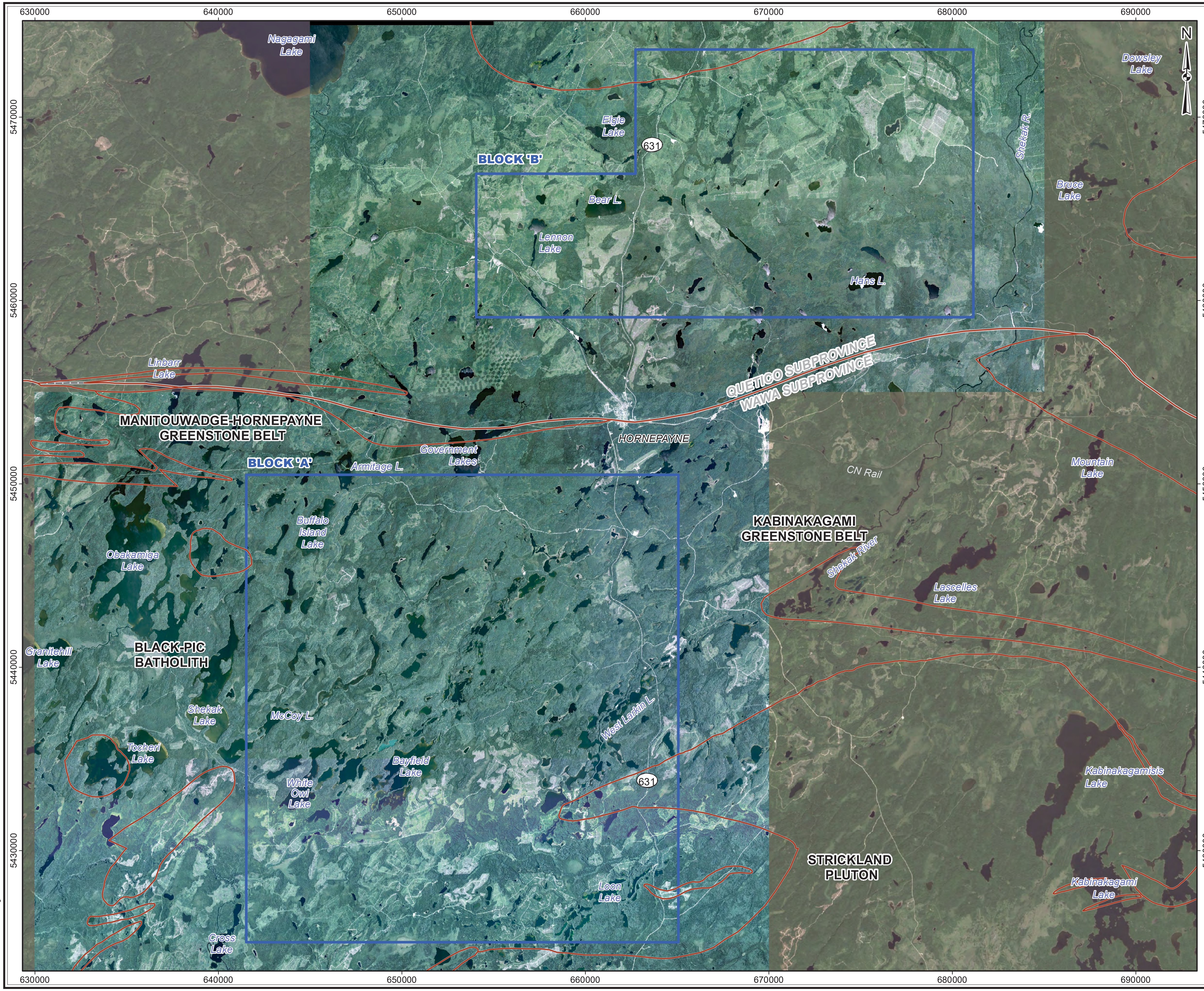
TITLE

Pole Reduced Magnetic Data (First Vertical Derivative) of the Hornepayne Area

DESIGN	KR	02 SEP 2014	**Figure 4**	REVISION 3
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:200,000



630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
Nagagami Lake
Elgie Lake
631
BLOCK 'B'
Bear L.
Lennon Lake
Hans L.
Shekak R.
Dowsley Lake
Bruce Lake
Linbarr Lake
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
HORNEPAYNE
Government Lakes
Armitage L.
BLOCK 'A'
Buffalo Island Lake
Mountain Lake
KABINAKAGAMI GREENSTONE BELT
Shekak River
Lascelles Lake
Obakamiga Lake
Granitehill Lake
BLACK-PIC BATHOLITH
Shekak Lake
McCoy L.
West Larkin L.
Tocheri Lake
Bayfield Lake
White Owl Lake
Kabinakagamisis Lake
STRICKLAND PLUTON
Loon Lake
Kabinakagami Lake
Cross Lake
N
LEGEND
Phase 2 Assessment Area
Major Road
Minor Road
Railway
Watercourse
Waterbody
Geological Boundary
Subprovince Boundary
Elevation (masl)
469m
286
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Background Relief: 1 Arc-Second Digital Elevation Model (SRTM, 2000)
Detailed Relief: Digital Elevation Model (SGL, 2017)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Digital Elevation Data
of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 5
REVISION 3
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig05_DEM



File: SRK_NWMO_HP_Fig06_SAT

LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Subprovince Boundary

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Imagery: Pan-sharpened LandSAT-8 (LP DAAC, 2015)

Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery (Land Information Ontario, 2007-2011)

0 10 km

srk consulting

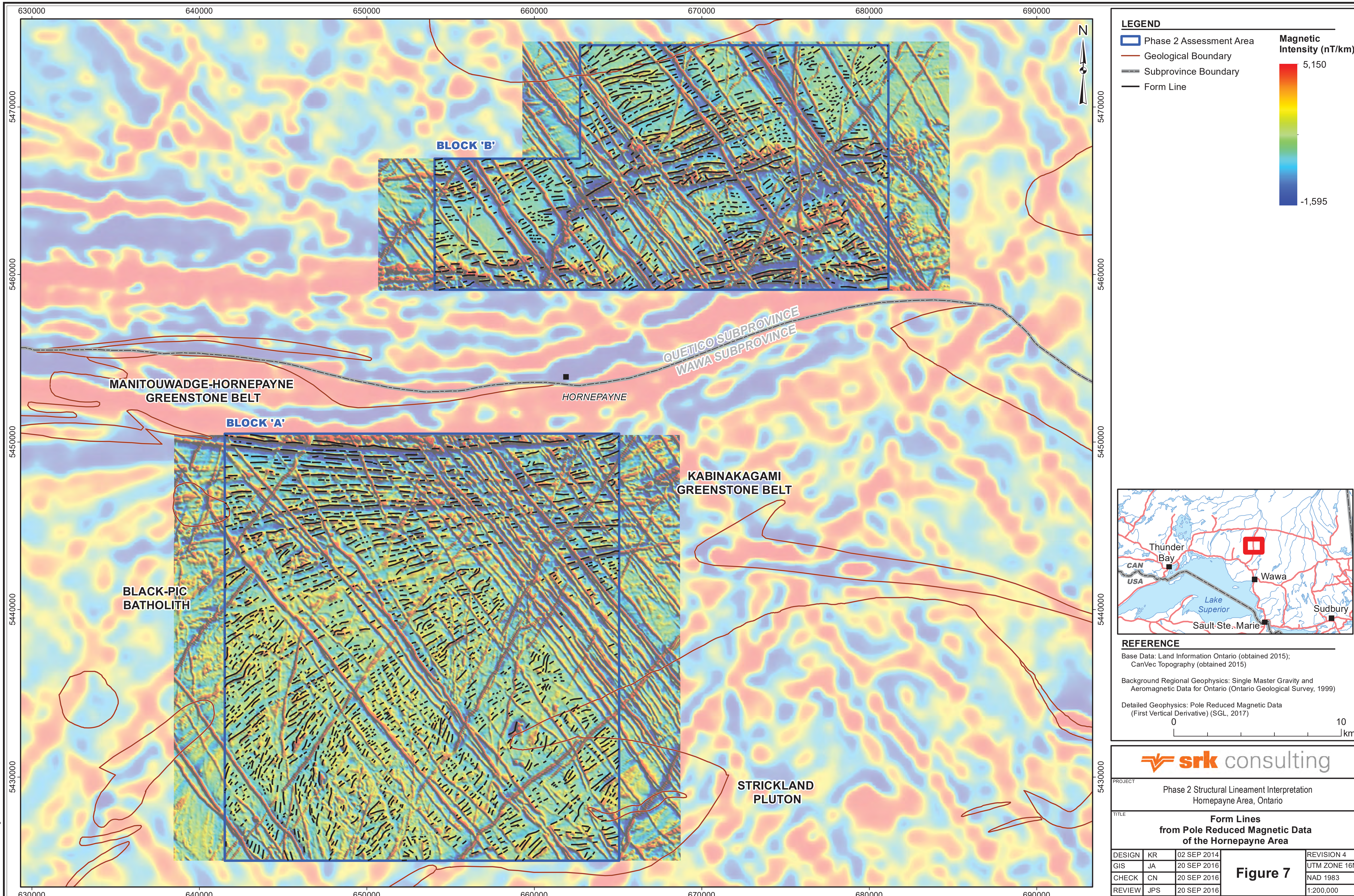
PROJECT

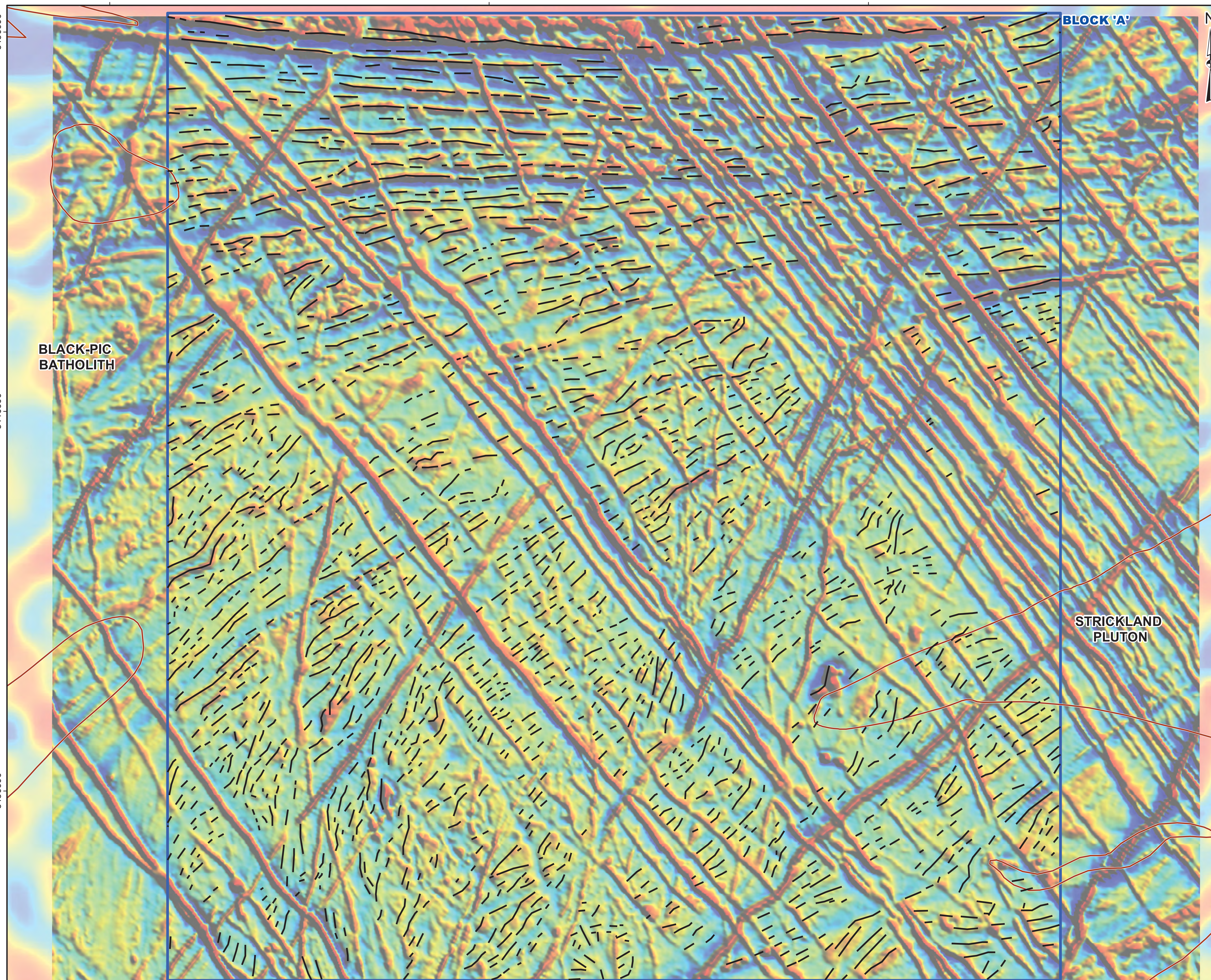
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Forest Resource Inventory Digital Aerial Imagery of the Hornepayne Area

DESIGN	KR	02 SEP 2014	Figure 6	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:200,000

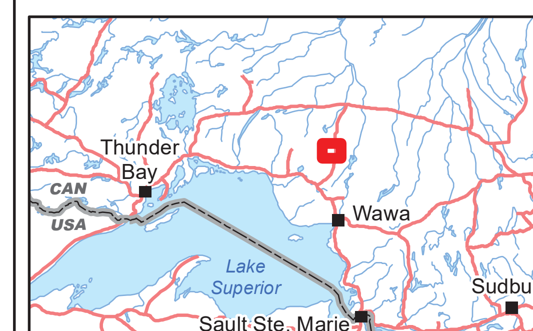

LEGEND
Phase 2 Assessment Area
Geological Boundary
Subprovince Boundary
Form Line
Magnetic Intensity (nT/km)
5,150
-1,595
N
BLOCK 'B'
BLOCK 'A'
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
HORNEPAYNE
KABINAKAGAMI GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)
Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Form Lines
from Pole Reduced Magnetic Data
of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 7
REVISION 4
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fg07_Formlines



LEGEND

Phase 2 Assessment Area
Geological Boundary
Formline

Magnetic Intensity (nT/km)
5,150
-1,595



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 5 km

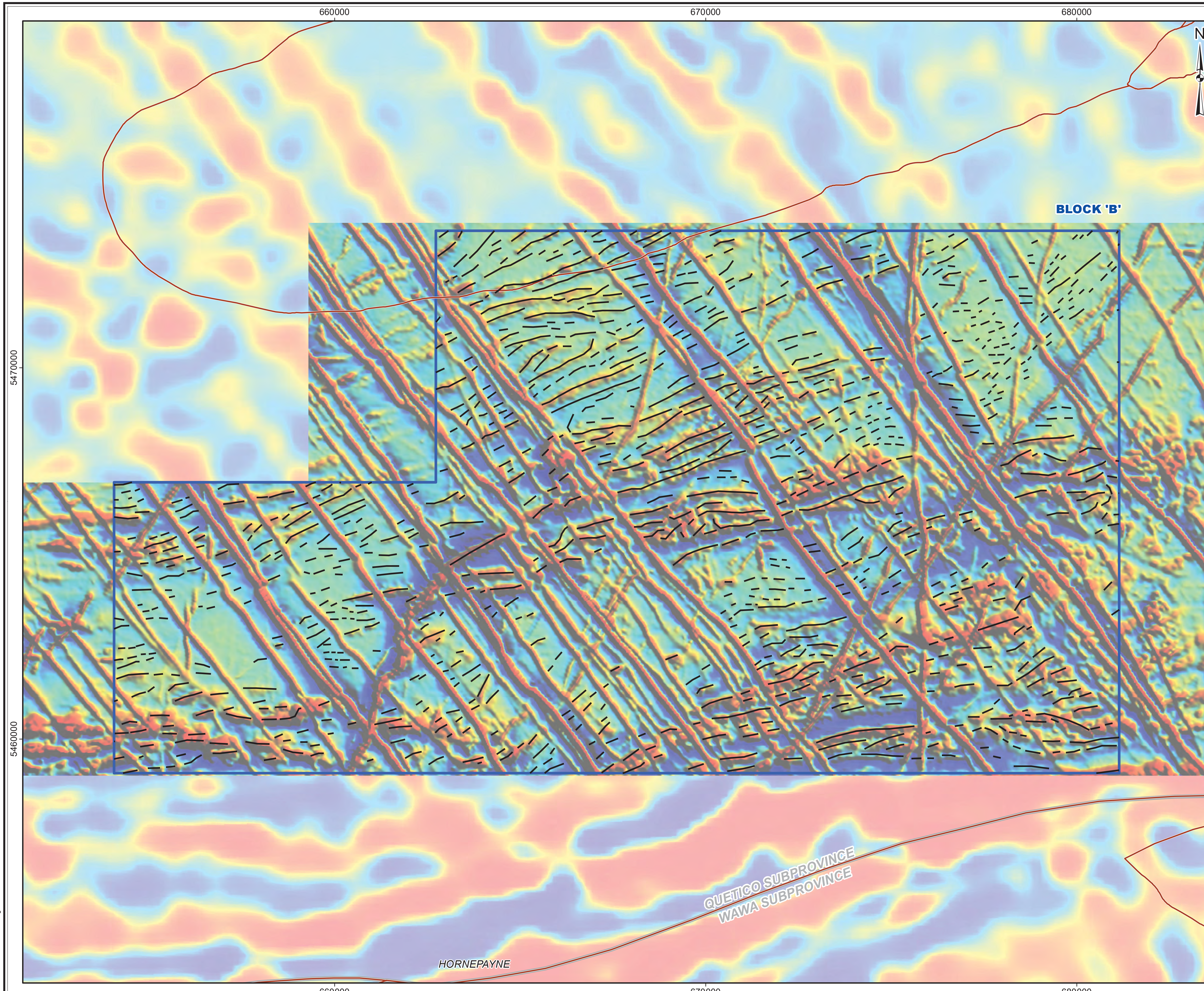
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Form Lines from Pole Reduced Magnetic Data of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 7a**	REVISION 4
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig07a_Formlines



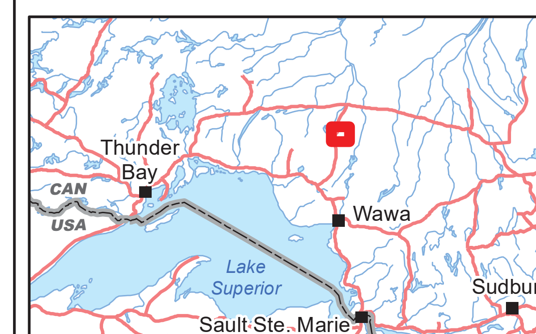
LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Subprovince Boundary
- Formline

Magnetic Intensity (nT/km)

5,150

-1,595



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 5 km

srk consulting

PROJECT

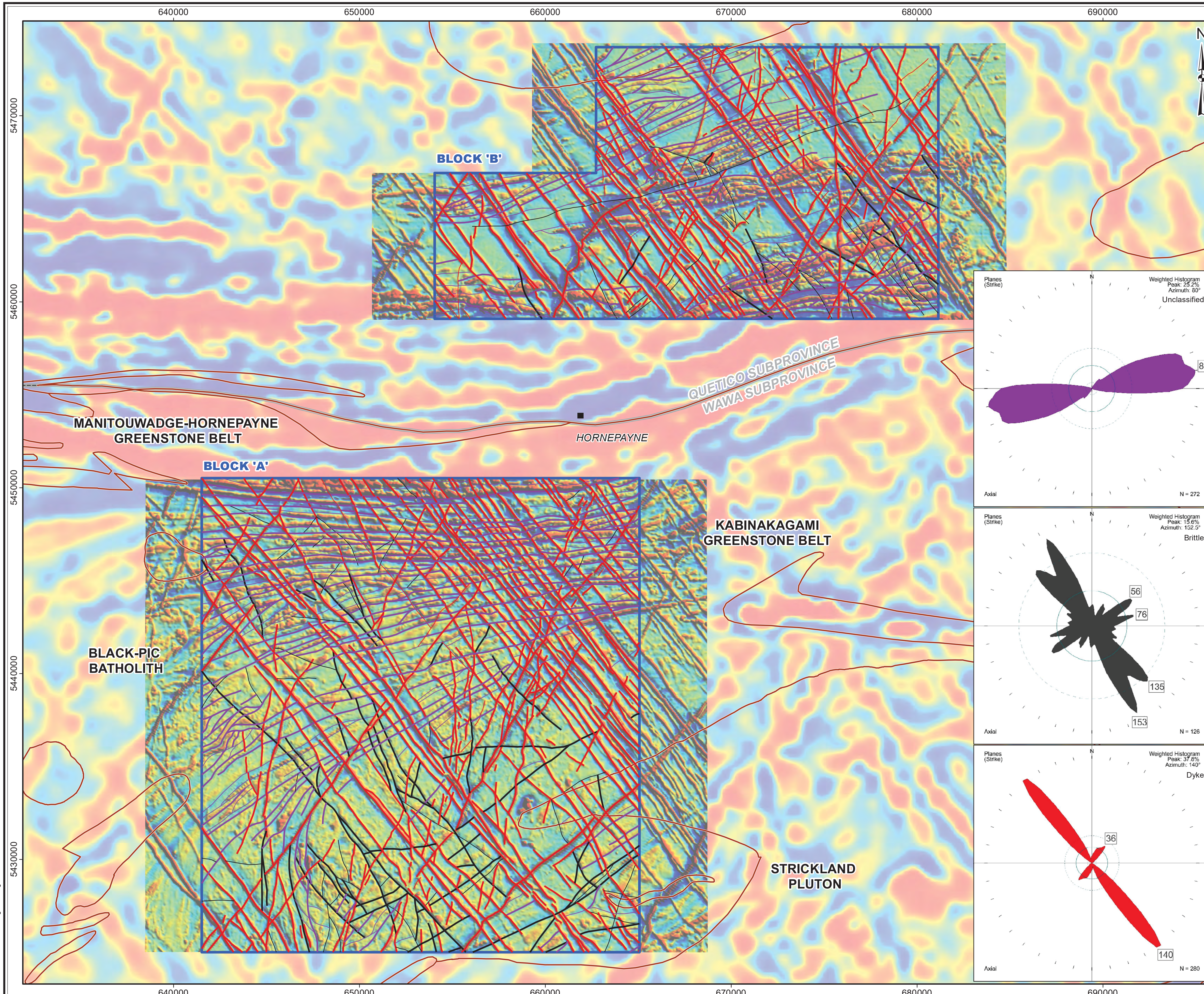
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Form Lines from Pole Reduced Magnetic Data of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 7b**	REVISION 4
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig07b_Formlines



LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Subprovince Boundary

Unclassified Lineament (RA 1)
- 1
- 2

Brittle Lineament (RA 1)
- 1
- 2

Dyke Lineament (RA 1)
- 1
- 2

Magnetic Intensity (nT/km)
5,150
-1,595

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

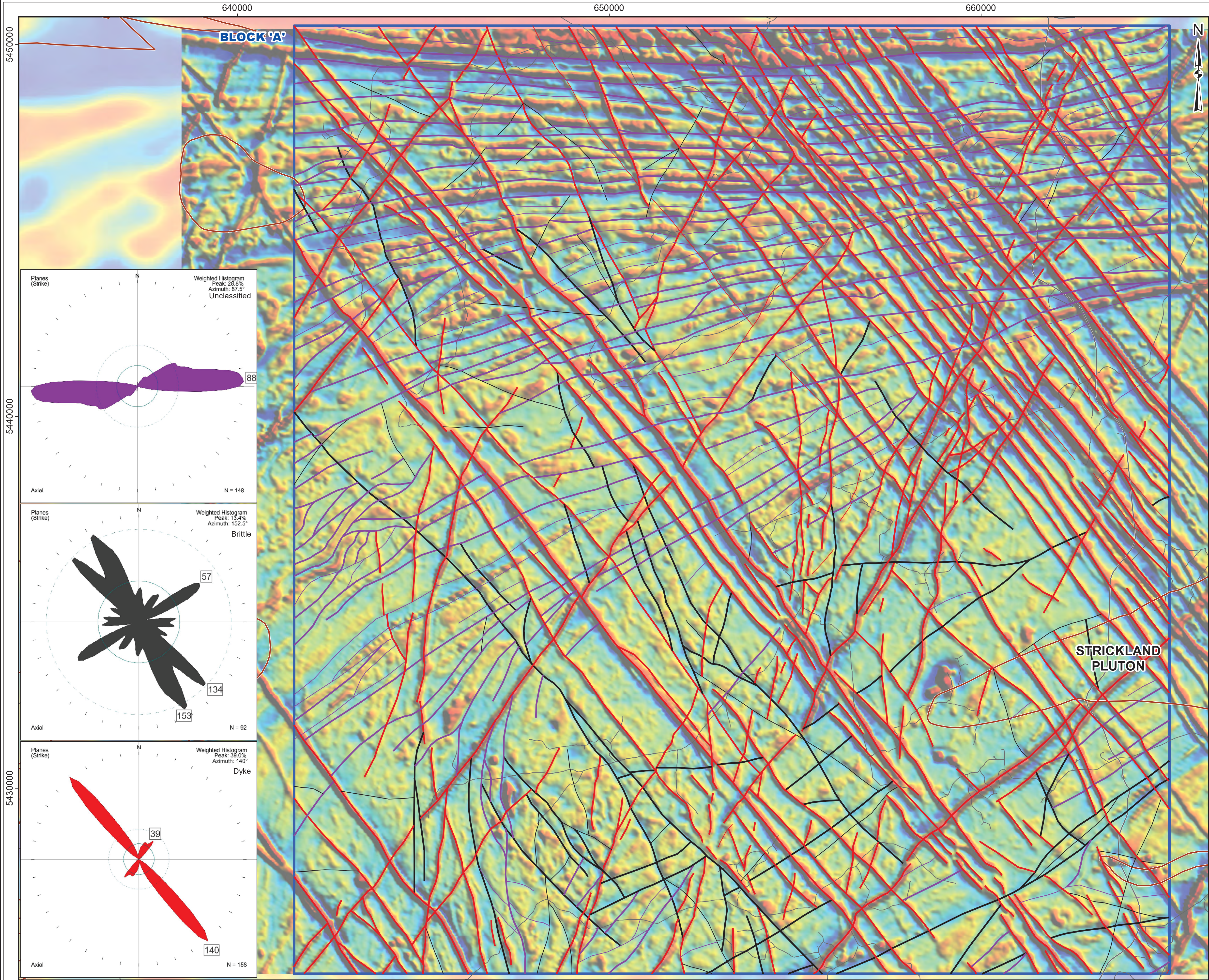
0 10 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

DESIGN	KR	02 SEP 2014	**Figure 8**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:200,000



LEGEND

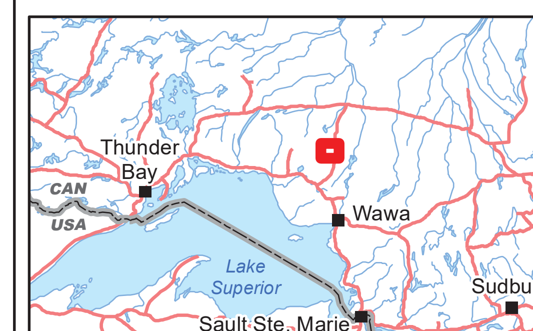
- Phase 2 Assessment Area
- Major Road
- Minor Road
- Geological Boundary

Unclassified Lineament (RA 1)
- 1
- 2

Brittle Lineament (RA 1)
- 1
- 2

Dyke Lineament (RA 1)
- 1
- 2

Magnetic Intensity (nT/km)
5,150
-1,595



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

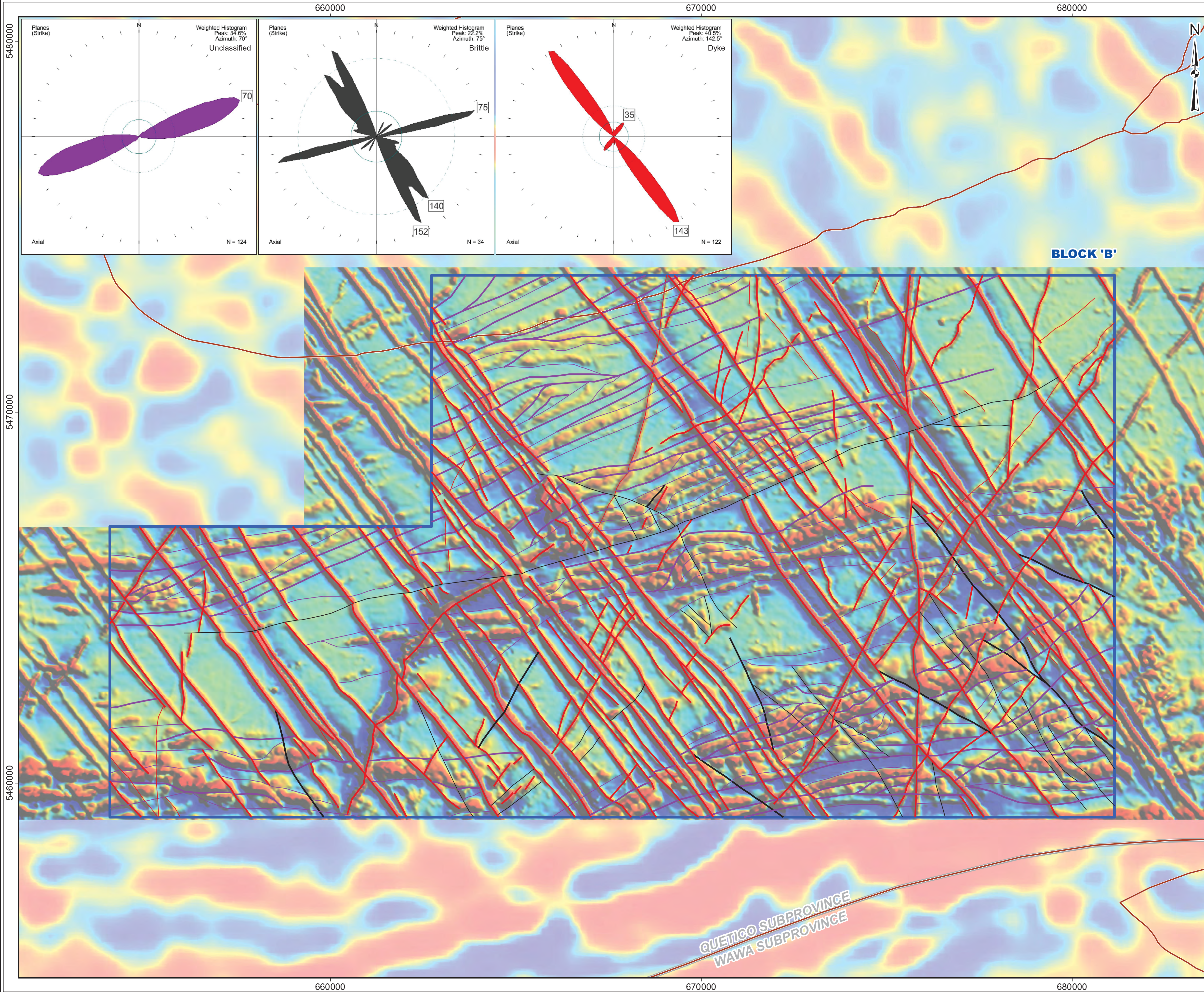
0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	Figure 8a	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:100,000



LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Subprovince Boundary

Unclassified Lineament (RA 1)

- 1
- 2

Brittle Lineament (RA 1)

- 1
- 2

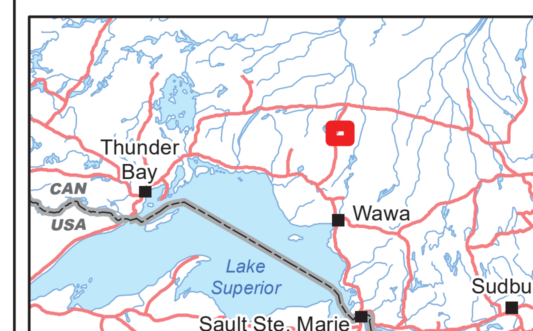
Dyke Lineament (RA 1)

- 1
- 2

Magnetic Intensity (nT/km)

5,150

-1,595



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 5 km

srk consulting

PROJECT

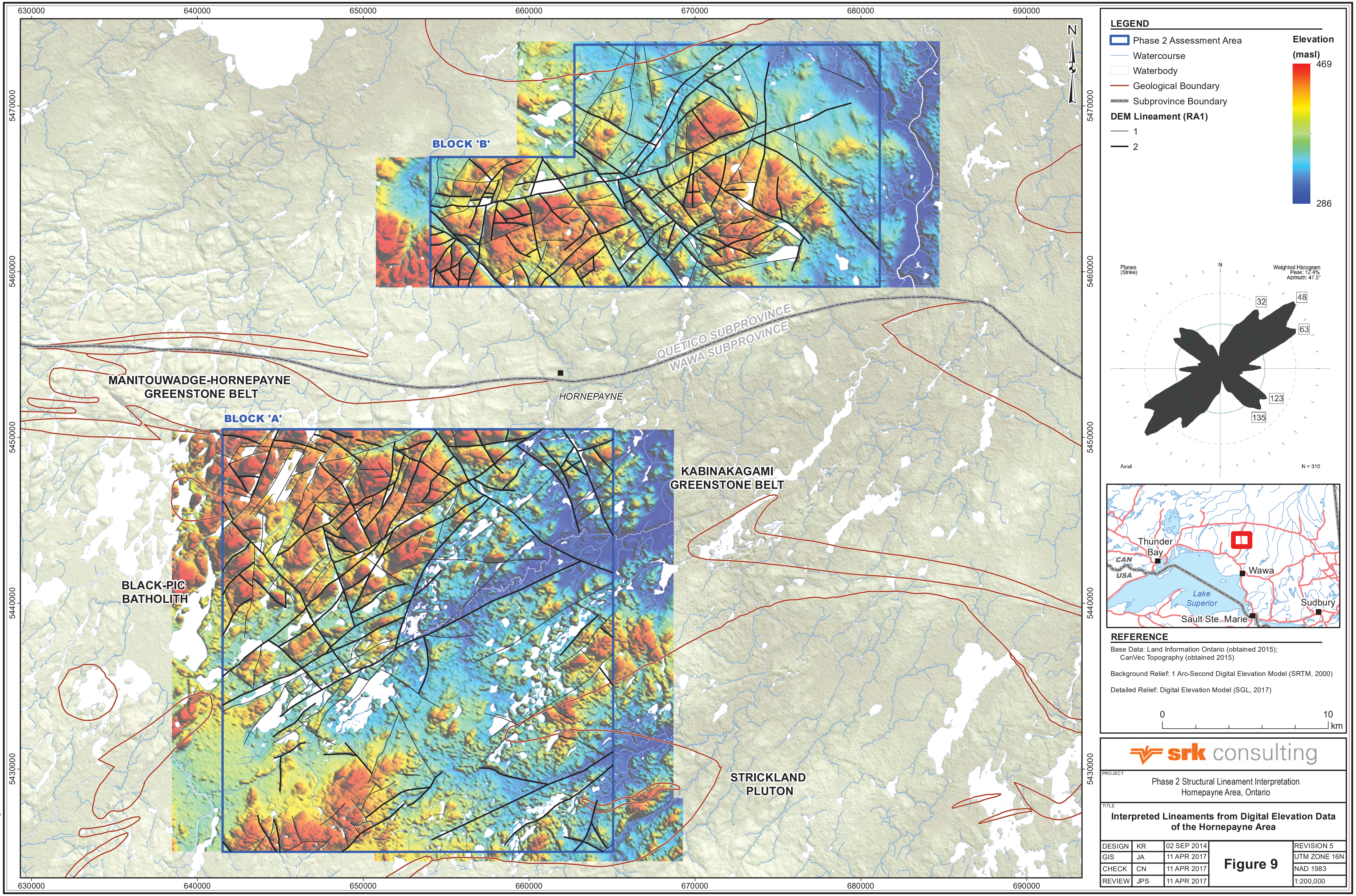
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

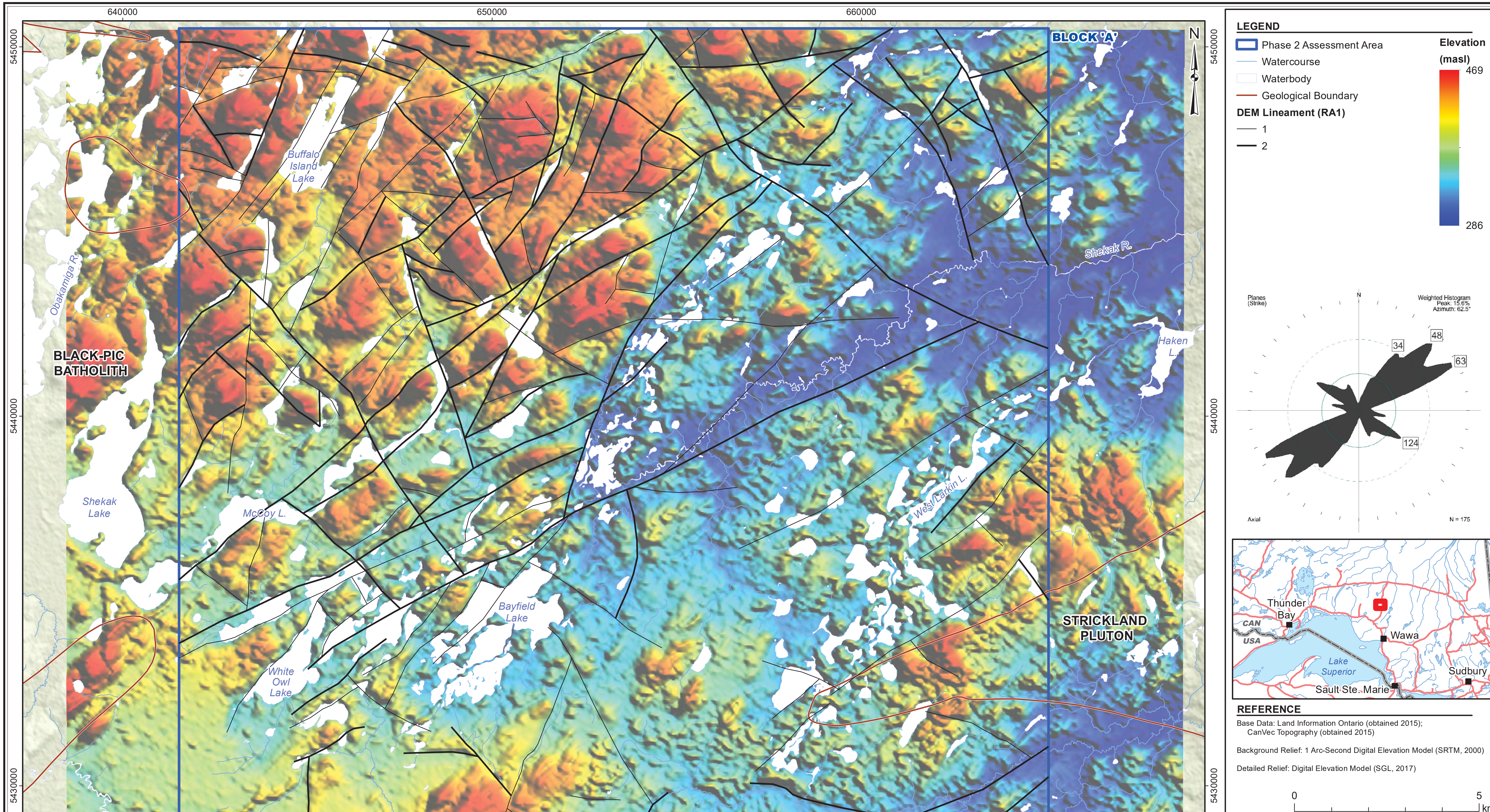
Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	Figure 8b	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:100,000

File: SRK_NWMO_HP_Fig08b_MagRA1



LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Geological Boundary
Subprovince Boundary
DEM Lineament (RA1)
1
2
Elevation (masl)
469
286
BLOCK 'B'
BLOCK 'A'
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
HORNEPAYNE
KABINAKAGAMI GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
N
Planes (Strike)
Weighted Histogram Peak: 12.4% Azimuth: 47.5°
32
48
63
123
135
Axial
N = 310
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Background Relief: 1 Arc-Second Digital Elevation Model (SRTM, 2000)
Detailed Relief: Digital Elevation Model (SGL, 2017)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Interpreted Lineaments from Digital Elevation Data of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 11 APR 2017
CHECK CN 11 APR 2017
REVIEW JPS 11 APR 2017
Figure 9
REVISION 5
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig09_DemRA1



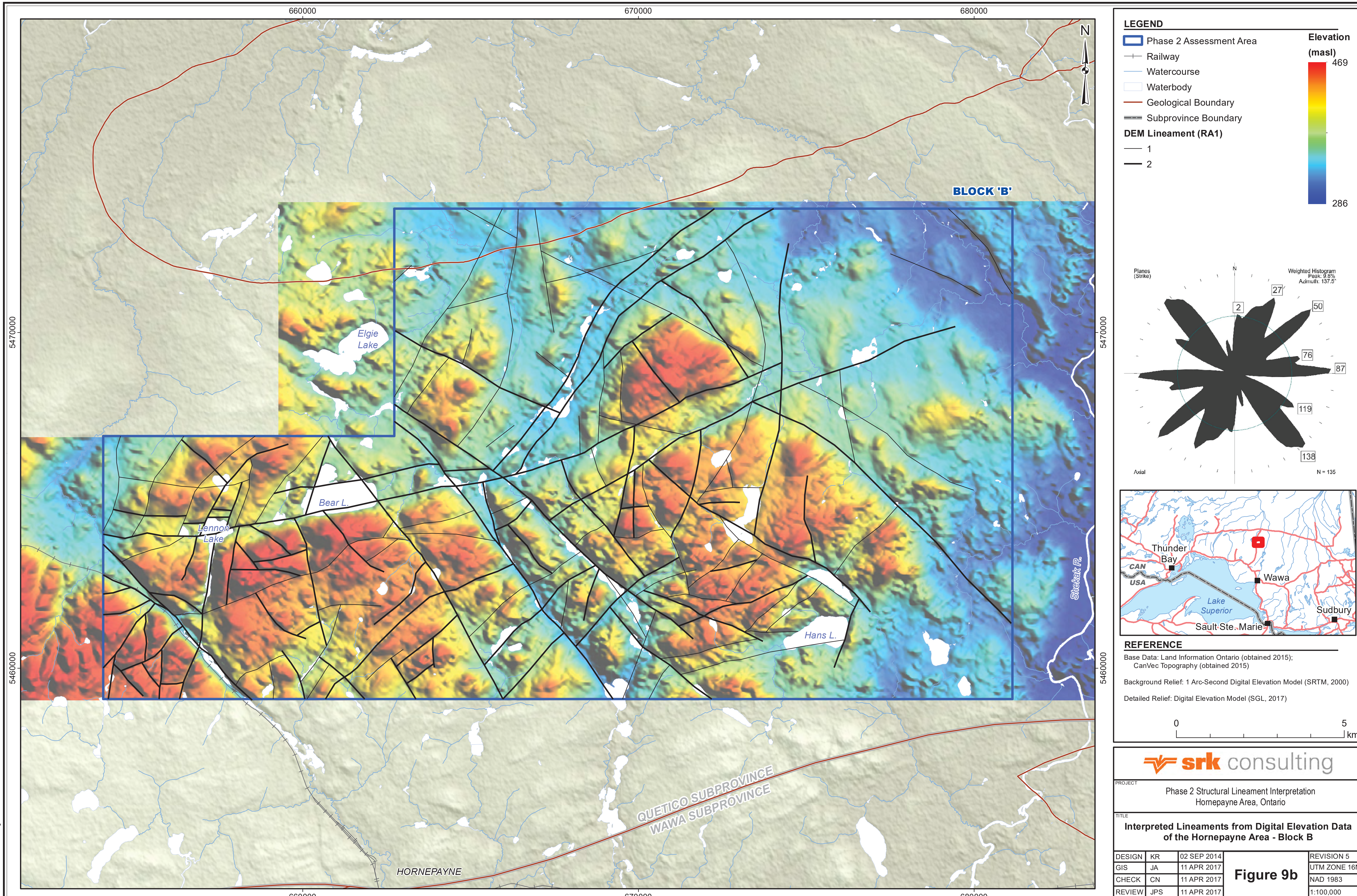
srk consulting

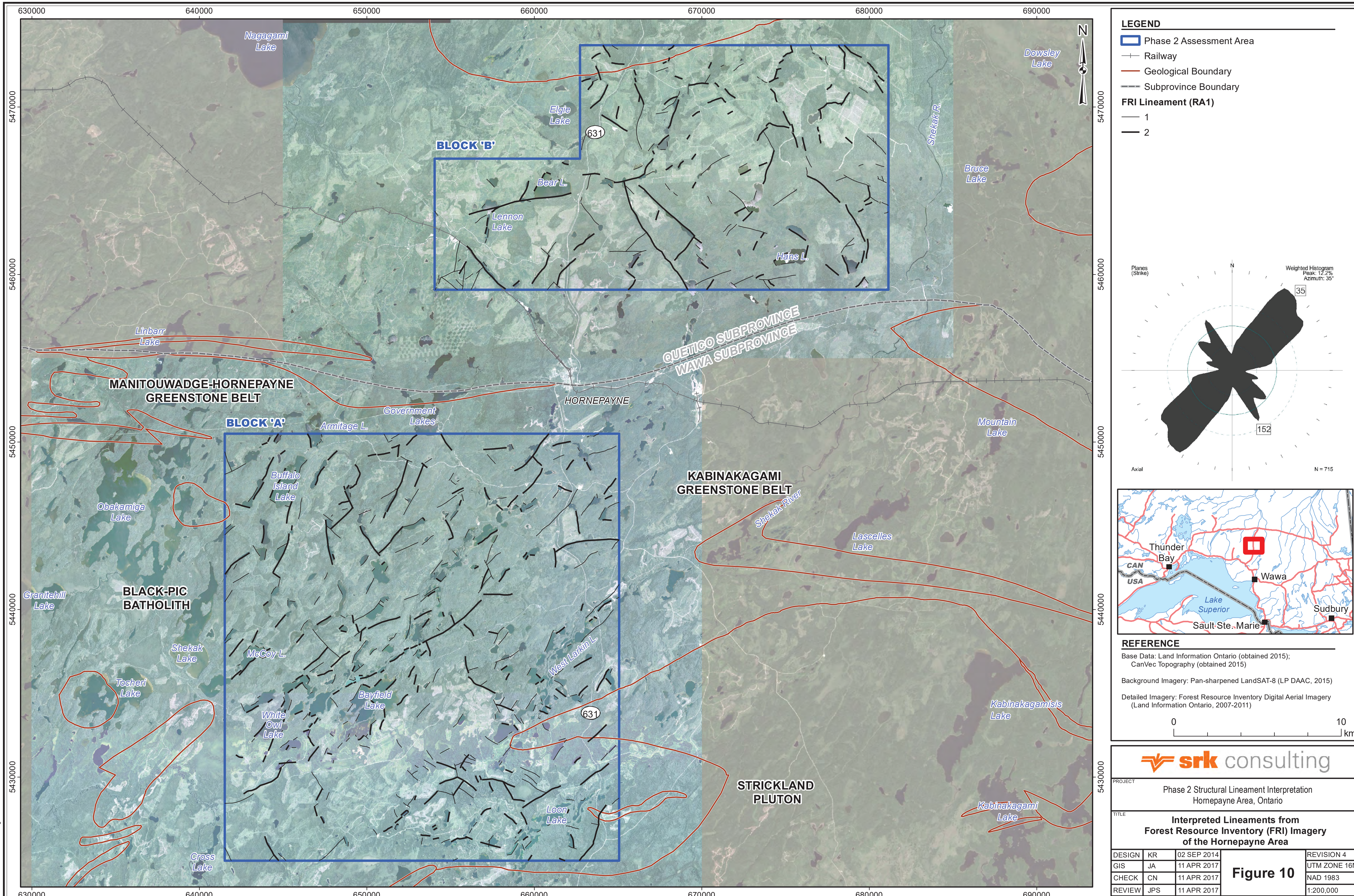
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Interpreted Lineaments from Digital Elevation Data of the Hornepayne Area - Block A

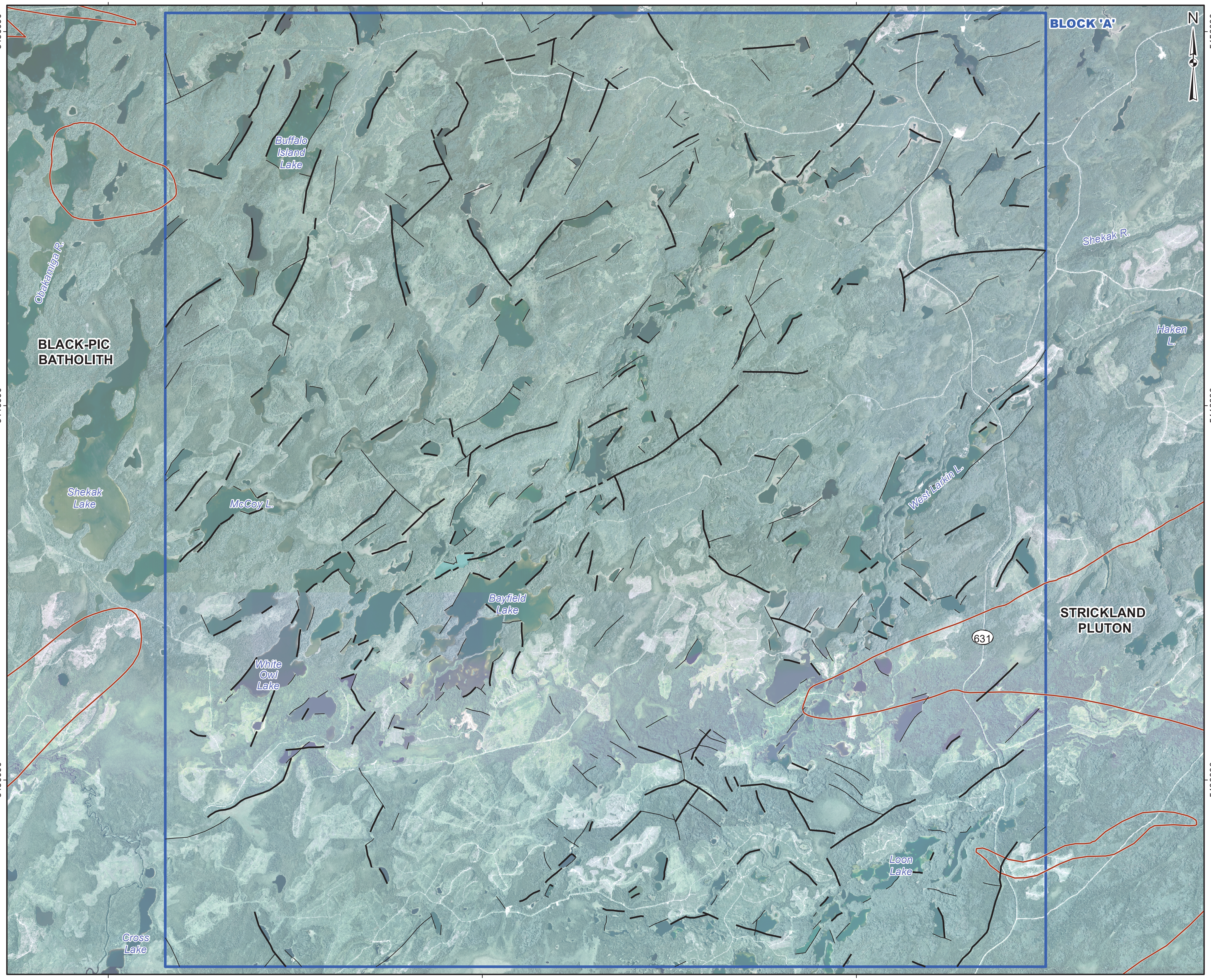
DESIGN	KR	02 SEP 2014	Figure 9a	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:100,000

File: SRK_NWMO_HP_Fig09a_DemRA1


660000
670000
680000
5470000
5460000
BLOCK 'B'
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Shekak R.
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
HORNEPAYNE
N
LEGEND
Phase 2 Assessment Area
Railway
Watercourse
Waterbody
Geological Boundary
Subprovince Boundary
DEM Lineament (RA1)
1
2
Elevation (masl)
469
286
Planes (Strike)
Weighted Histogram
Peak: 9.8%
Azimuth: 137.5°
N
2
27
50
76
87
119
138
Axial
N = 135
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Background Relief: 1 Arc-Second Digital Elevation Model (SRTM, 2000)
Detailed Relief: Digital Elevation Model (SGL, 2017)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Interpreted Lineaments from Digital Elevation Data of the Hornepayne Area - Block B
DESIGN KR 02 SEP 2014
GIS JA 11 APR 2017
CHECK CN 11 APR 2017
REVIEW JPS 11 APR 2017
Figure 9b
REVISION 5
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig09b_DemRA1



LEGEND
Phase 2 Assessment Area
Railway
Geological Boundary
Subprovince Boundary
FRI Lineament (RA1)
1
2
BLOCK 'A'
BLOCK 'B'
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
KABINAKAGAMI GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
HORNEPAYNE
Nagagami Lake
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Bruce Lake
Shekak R.
Linbarr Lake
Government Lakes
Armitage L.
Buffalo Island Lake
Obakamiga Lake
Granitehill Lake
Shekak Lake
Tocheri Lake
McCoy L.
Bayfield Lake
White Owl Lake
West Larkin L.
Loon Lake
Cross Lake
Shekak River
Lascelles Lake
Mountain Lake
Kabinakagamisis Lake
Kabinakagami Lake
631
630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
N
Planes (Strike)
Weighted Histogram
Peak: 12.2%
Azimuth: 35°
35
152
Axial
N = 715
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Background Imagery: Pan-sharpened LandSAT-8 (LP DAAC, 2015)
Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery (Land Information Ontario, 2007-2011)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 11 APR 2017
CHECK CN 11 APR 2017
REVIEW JPS 11 APR 2017
Figure 10
REVISION 4
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig10_SATra1

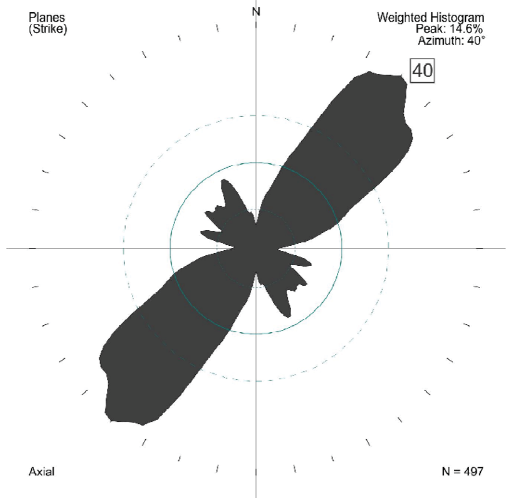


LEGEND

- Phase 2 Assessment Area
- Geological Boundary

FRI Lineament (RA1)

- 1
- 2



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery
(Land Information Ontario, 2007-2011)

0 5 km

srk consulting

PROJECT

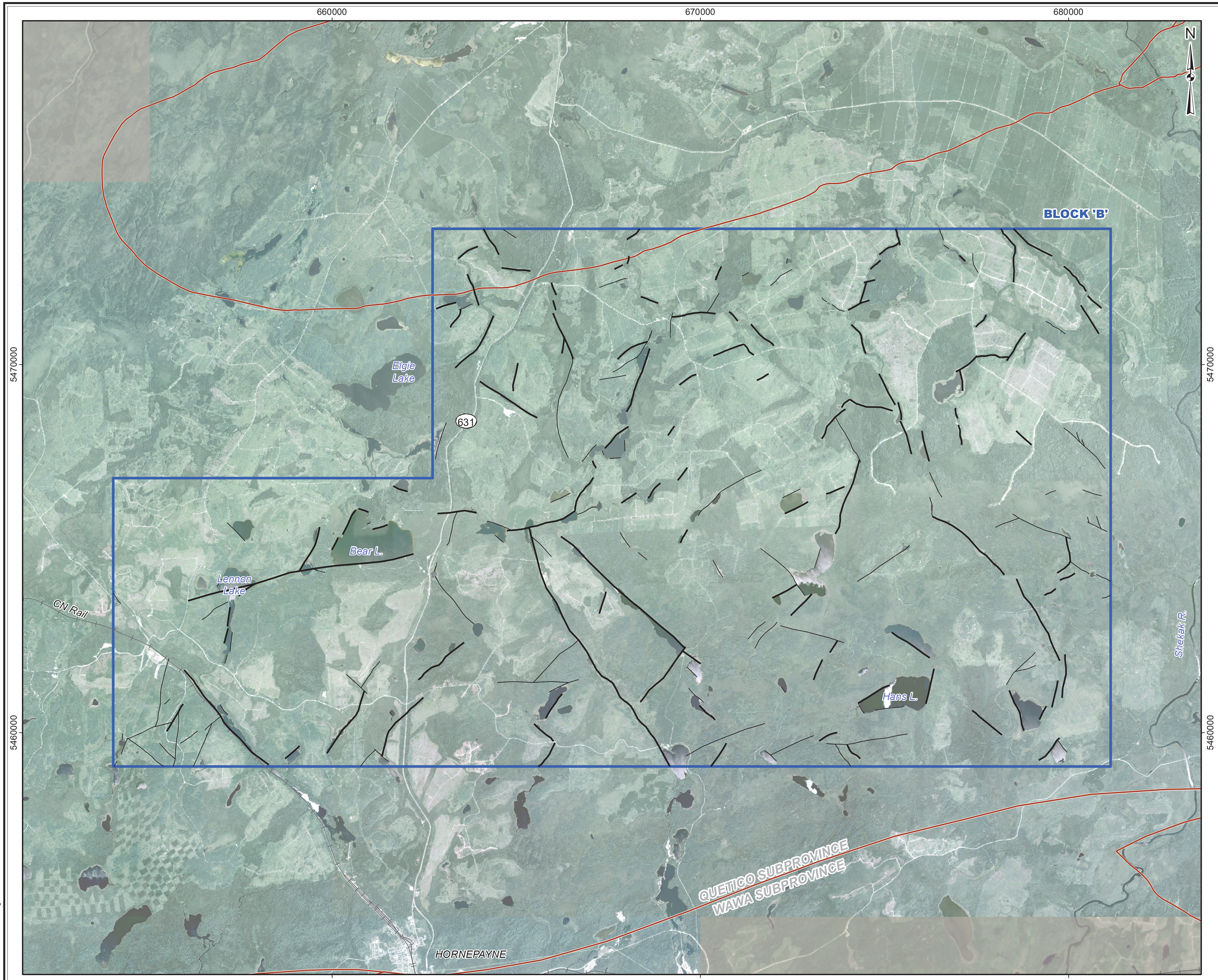
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 10a**	REVISION 4
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:100,000

File: SRK_NWMO_HP_Fig10a_SATra1

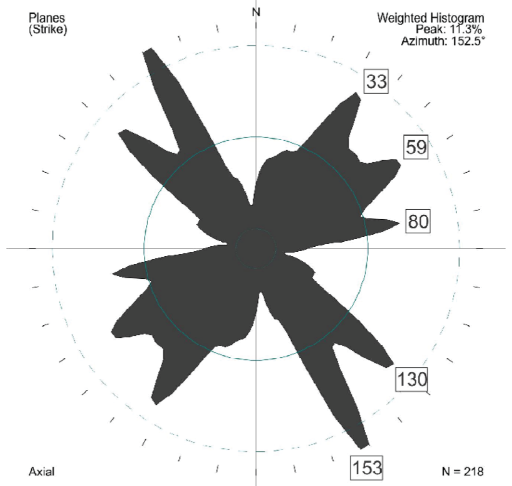


LEGEND

- Phase 2 Assessment Area
- Railway
- Geological Boundary
- Subprovince Boundary

FRI Lineament (RA1)

- 1
- 2



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Background Imagery: Pan-sharpened LandSAT-8 (LP DAAC, 2015)

Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery
(Land Information Ontario, 2007-2011)

0 5 km

srk consulting

PROJECT

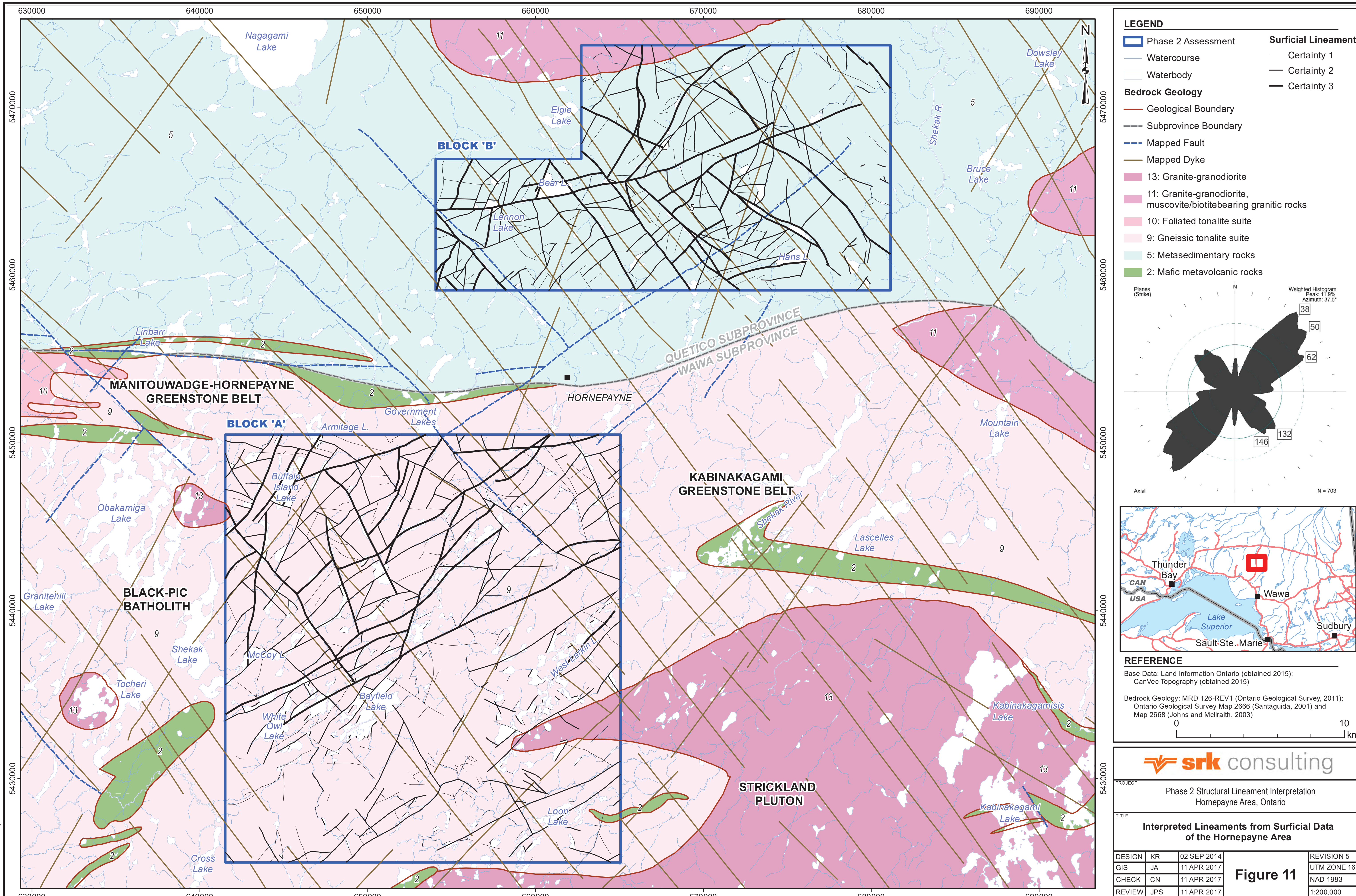
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

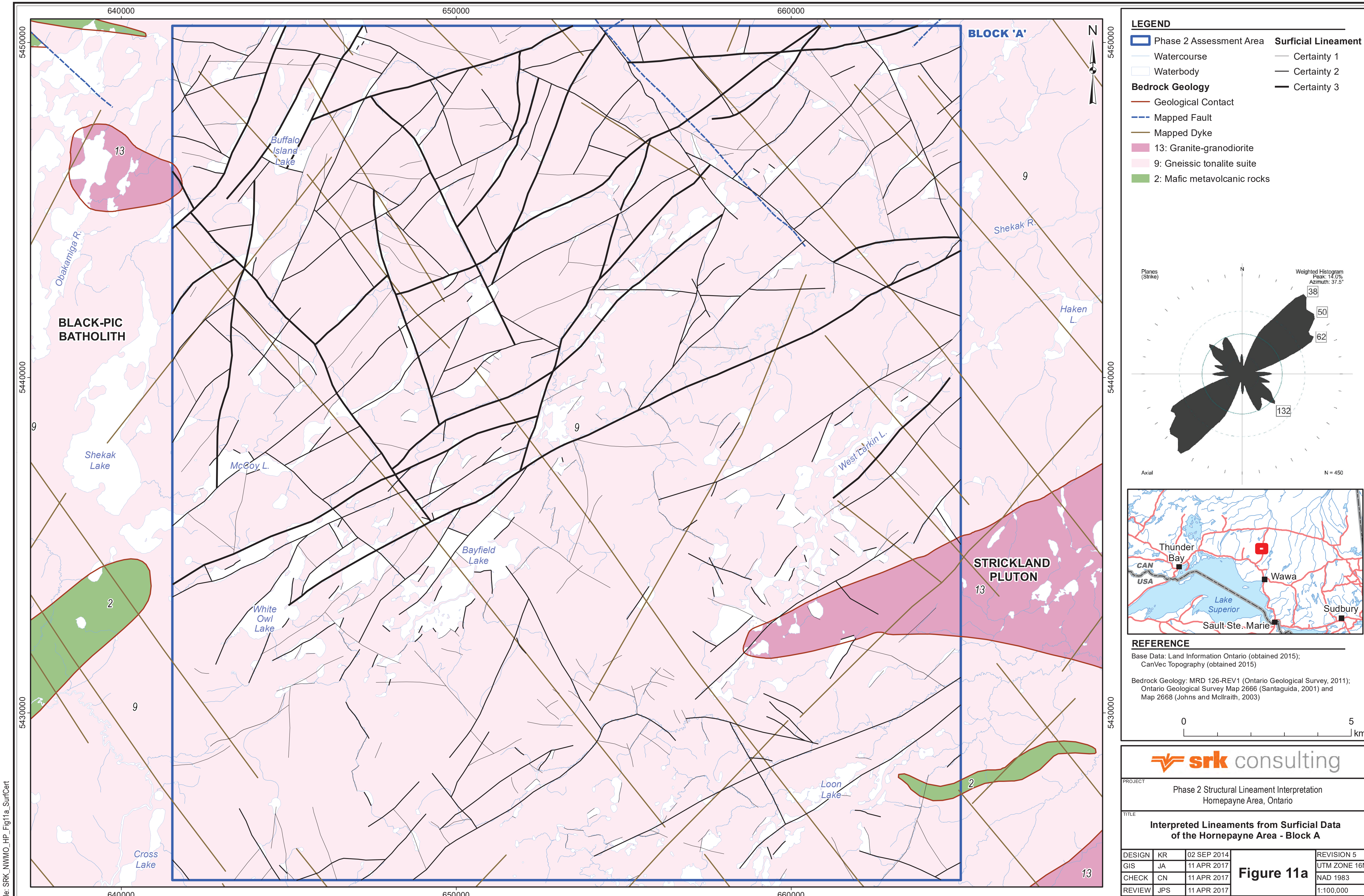
Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	Figure 10b	REVISION 4
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:100,000

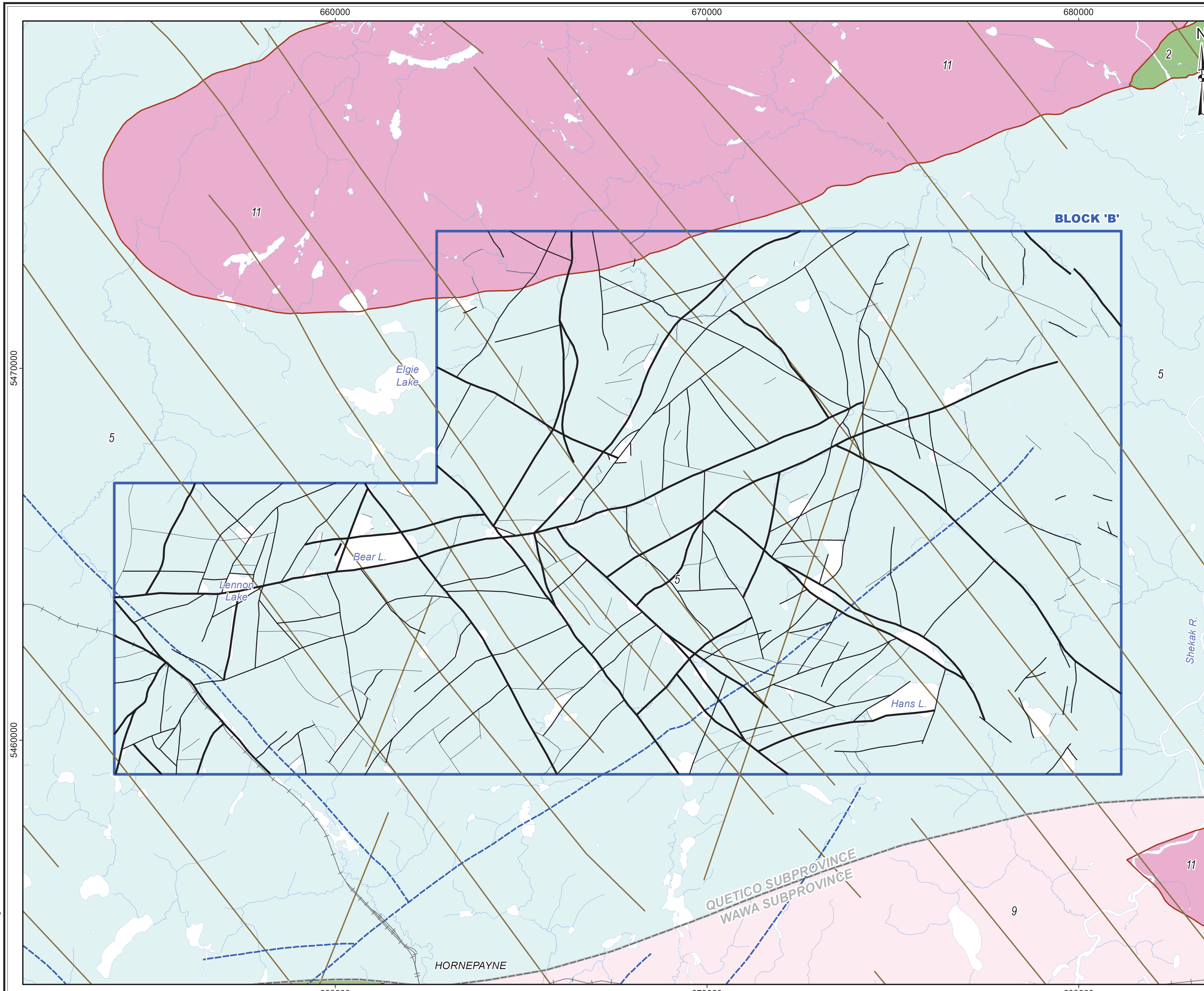
File: SRK_NWMO_HP_Fig10b_SATra1



File: SRK_NWMO_HP_Fig11_SurfCert



640000
650000
660000
5450000
5440000
5430000
BLOCK 'A'
N
Buffalo Island Lake
13
Obakamiga R.
BLACK-PIC BATHOLITH
9
Shekak Lake
McCoy L.
9
9
Shekak R.
Haken L.
West Larkin L.
Bayfield Lake
White Owl Lake
2
9
STRICKLAND PLUTON
13
2
Loon Lake
Cross Lake
13
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Contact
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks
Surficial Lineament
Certainty 1
Certainty 2
Certainty 3
Planes (Strike)
N
Weighted Histogram
Peak: 14.0%
Azimuth: 37.5°
38
50
62
132
Axial
N = 450
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Interpreted Lineaments from Surficial Data of the Hornepayne Area - Block A
DESIGN KR 02 SEP 2014
GIS JA 11 APR 2017
CHECK CN 11 APR 2017
REVIEW JPS 11 APR 2017
Figure 11a
REVISION 5
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig11a_SurfCert



LEGEND

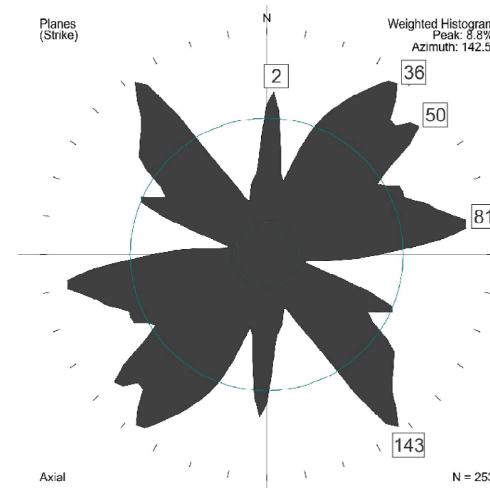
- Phase 2 Assessment
- Railway
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Surficial Lineament

- Certainty 1
- Certainty 2
- Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2666 (Santaguida, 2001) and
Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

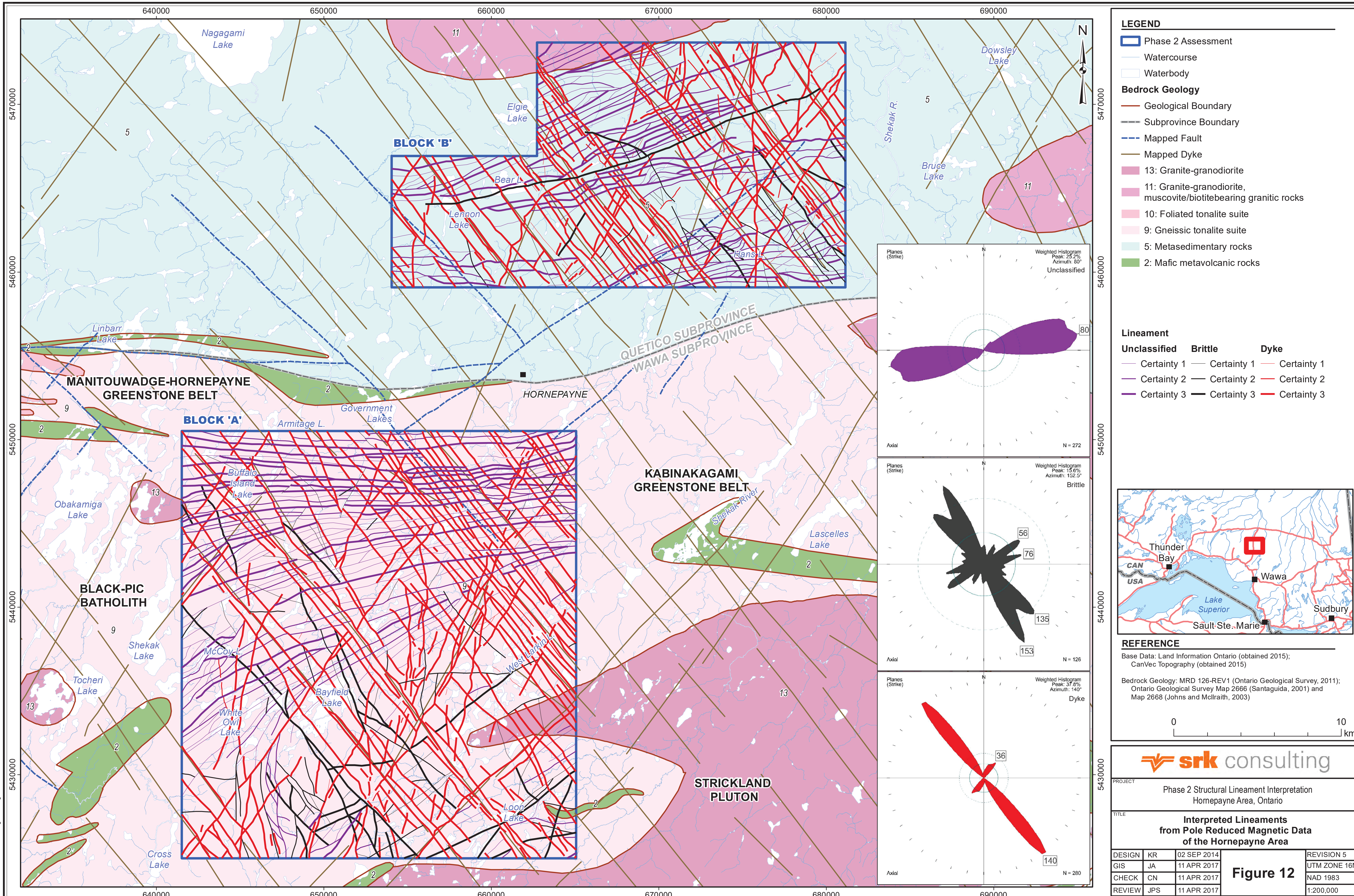
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

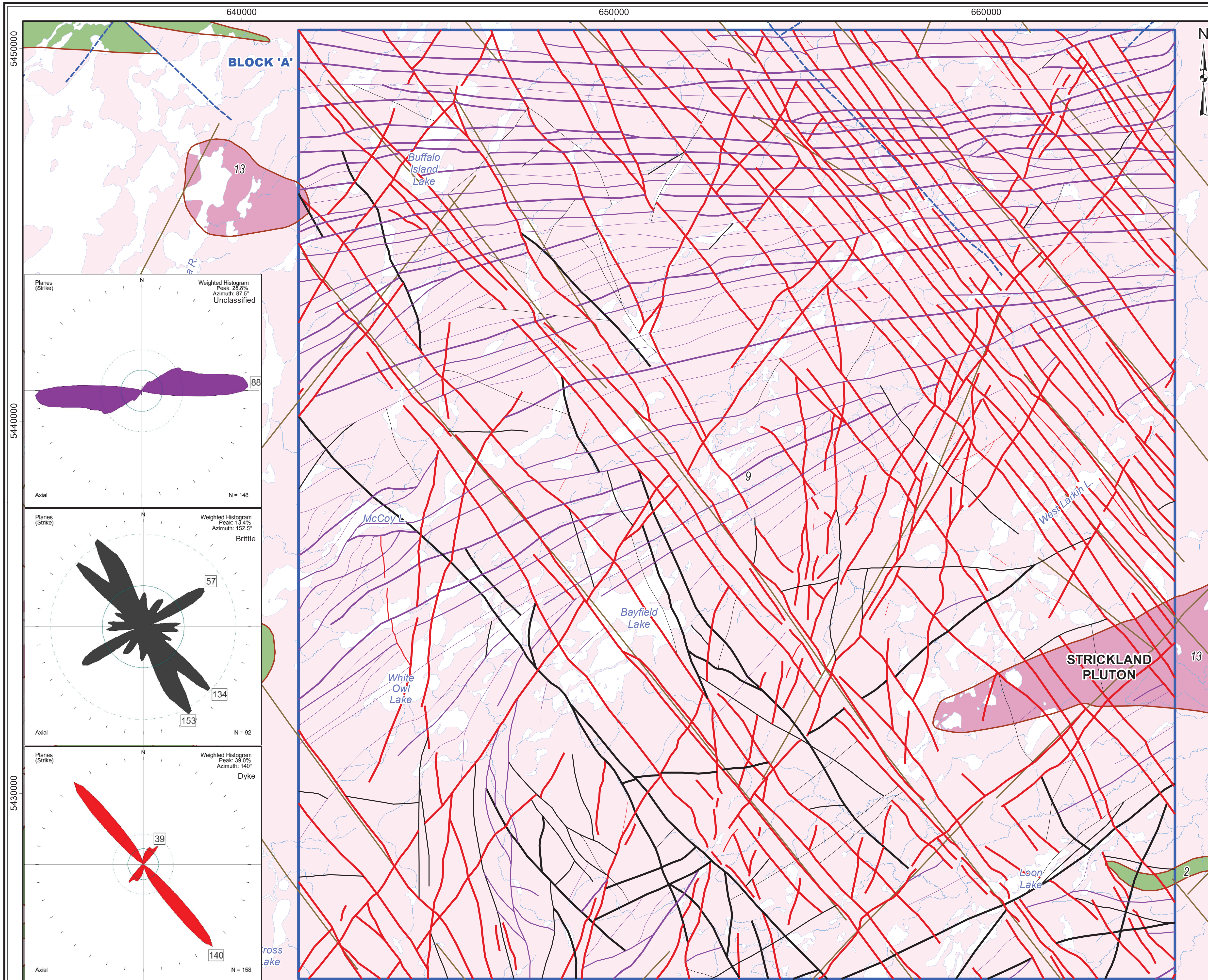
Interpreted Lineaments from Surficial Data of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 11b**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:100,000

File: SRK_NWMO_HP_Fig11b_SurfCert



File: SRK_NWMO_HP_Fig12_MagCert



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 9: Gneissic tonalite suite
- 2: Mafic metavolcanic rocks

Unclassified Lineament

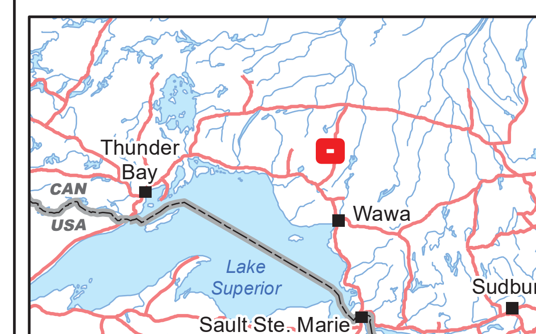
- Certainty 1
- Certainty 2
- Certainty 3

Brittle Lineament

- Certainty 1
- Certainty 2
- Certainty 3

Dyke Lineament

- Certainty 1
- Certainty 2
- Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

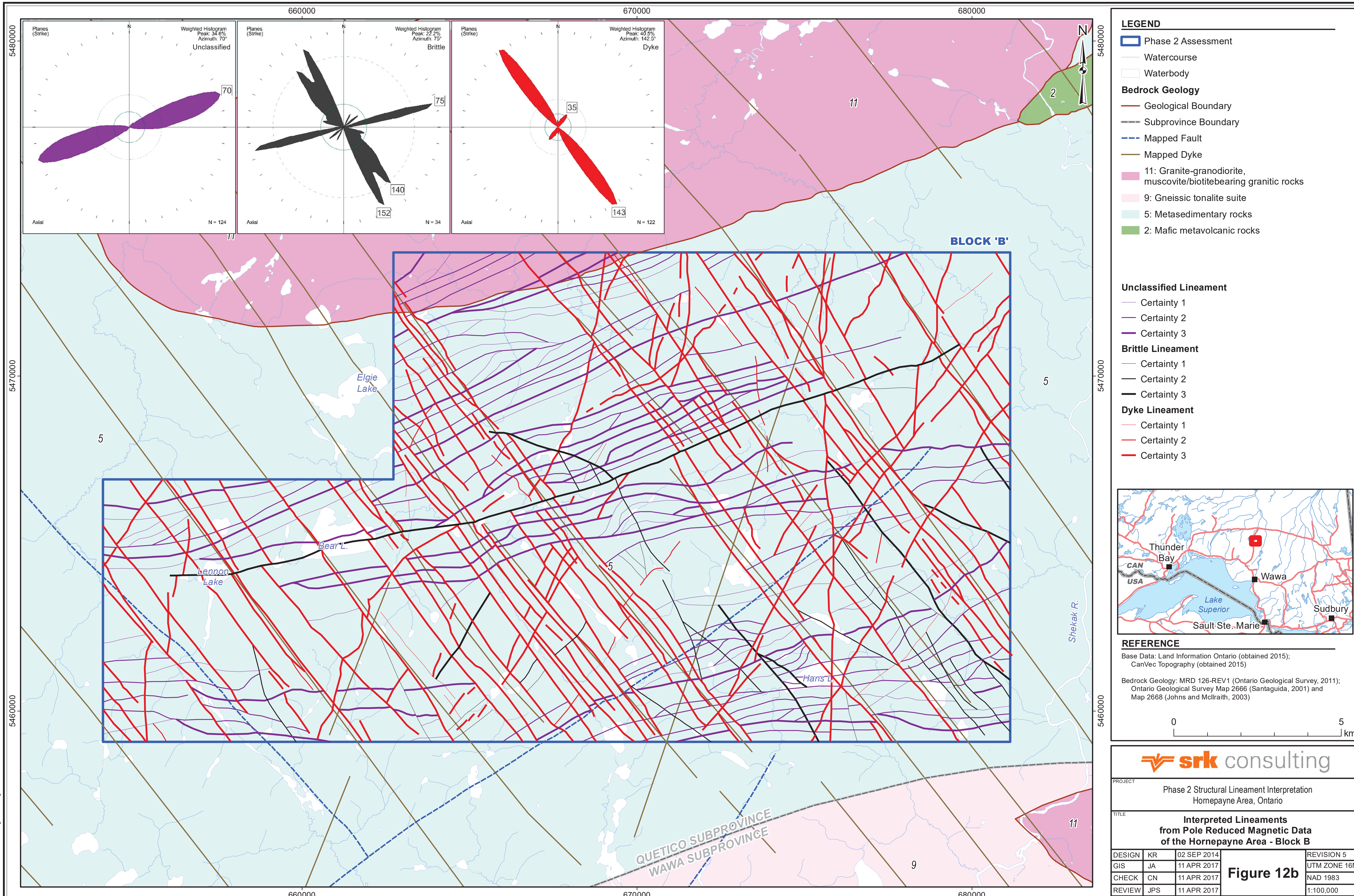
PROJECT

Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

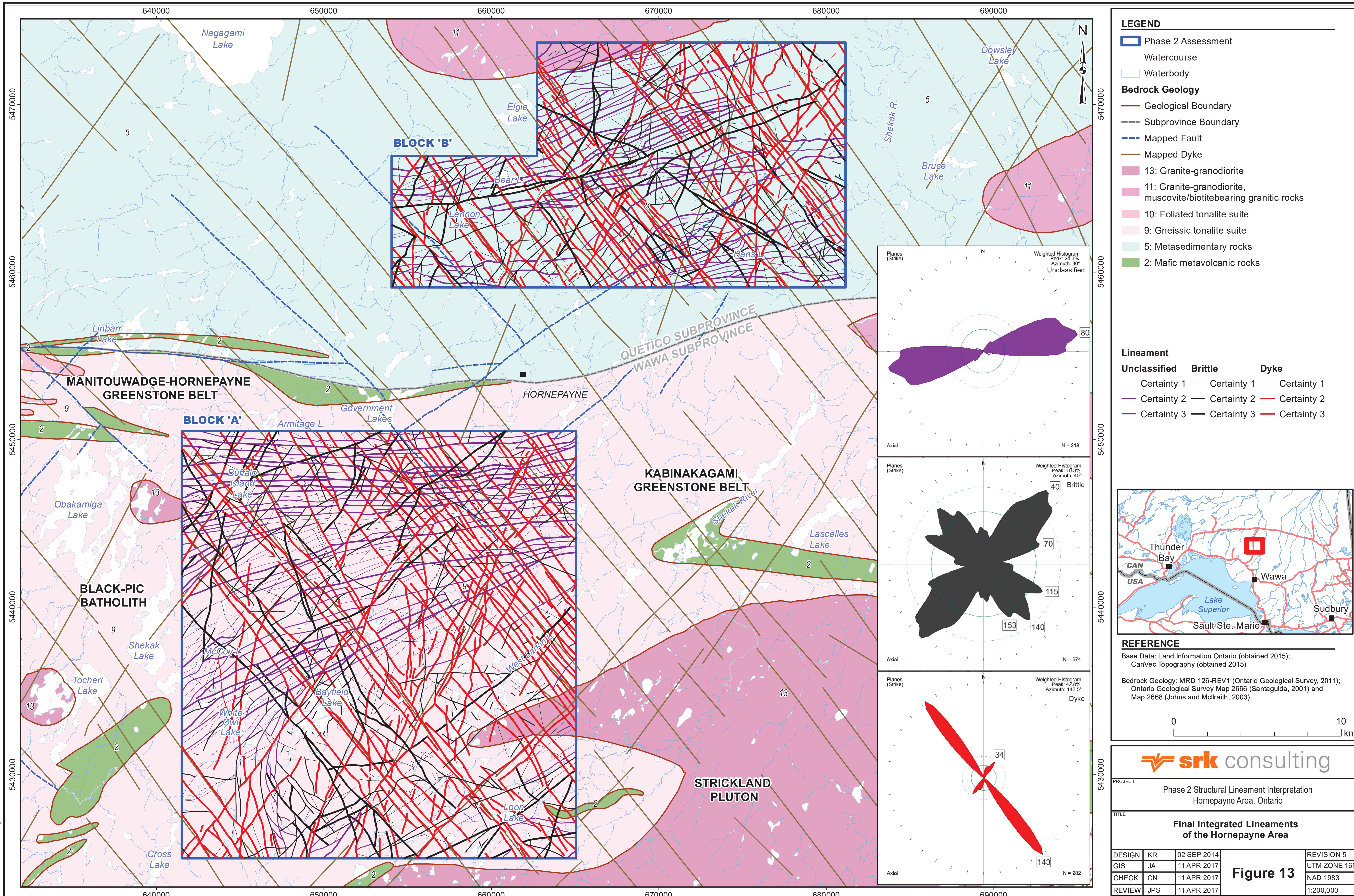
TITLE

Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block A

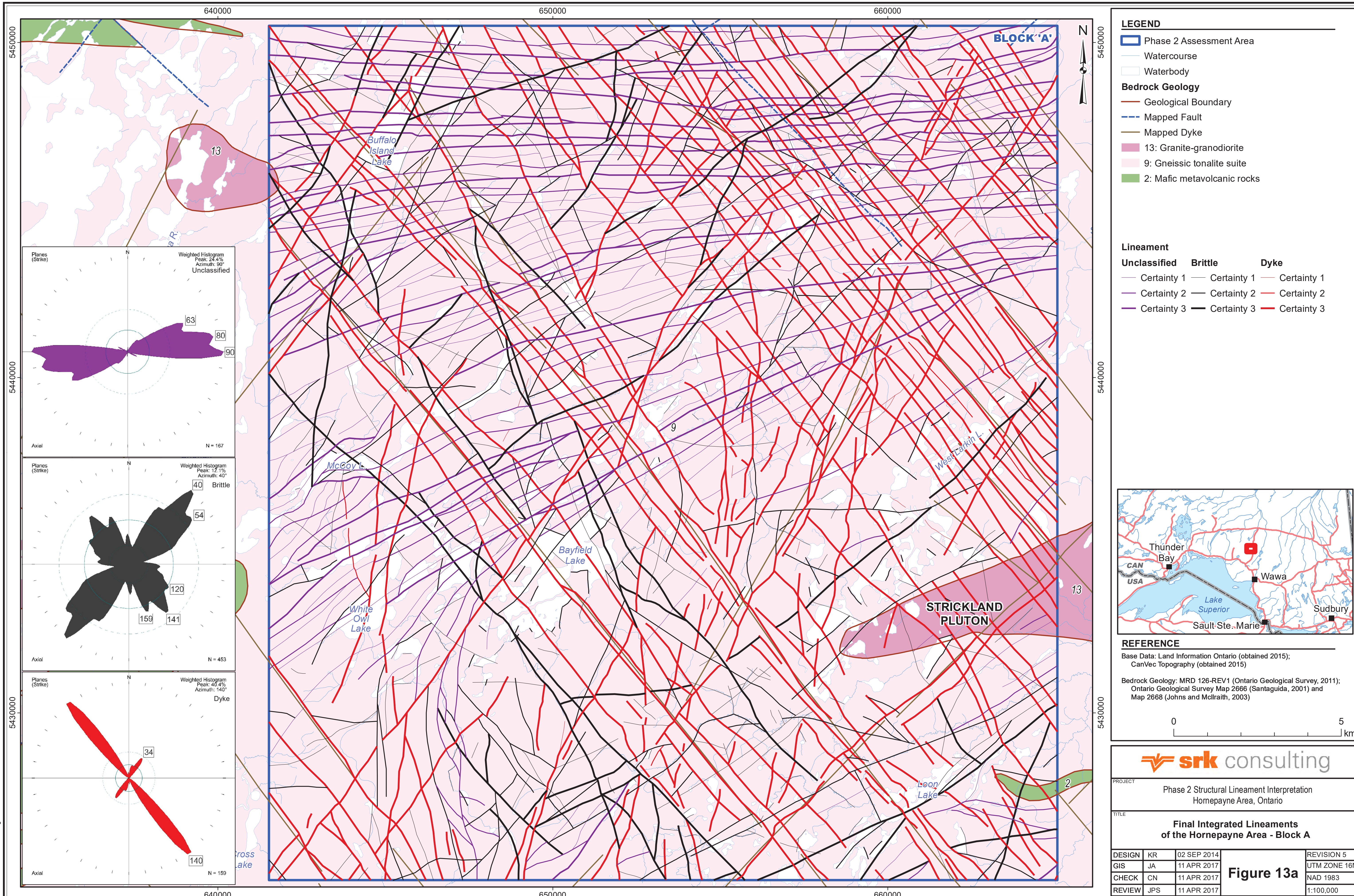
DESIGN	KR	02 SEP 2014	**Figure 12a**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:100,000



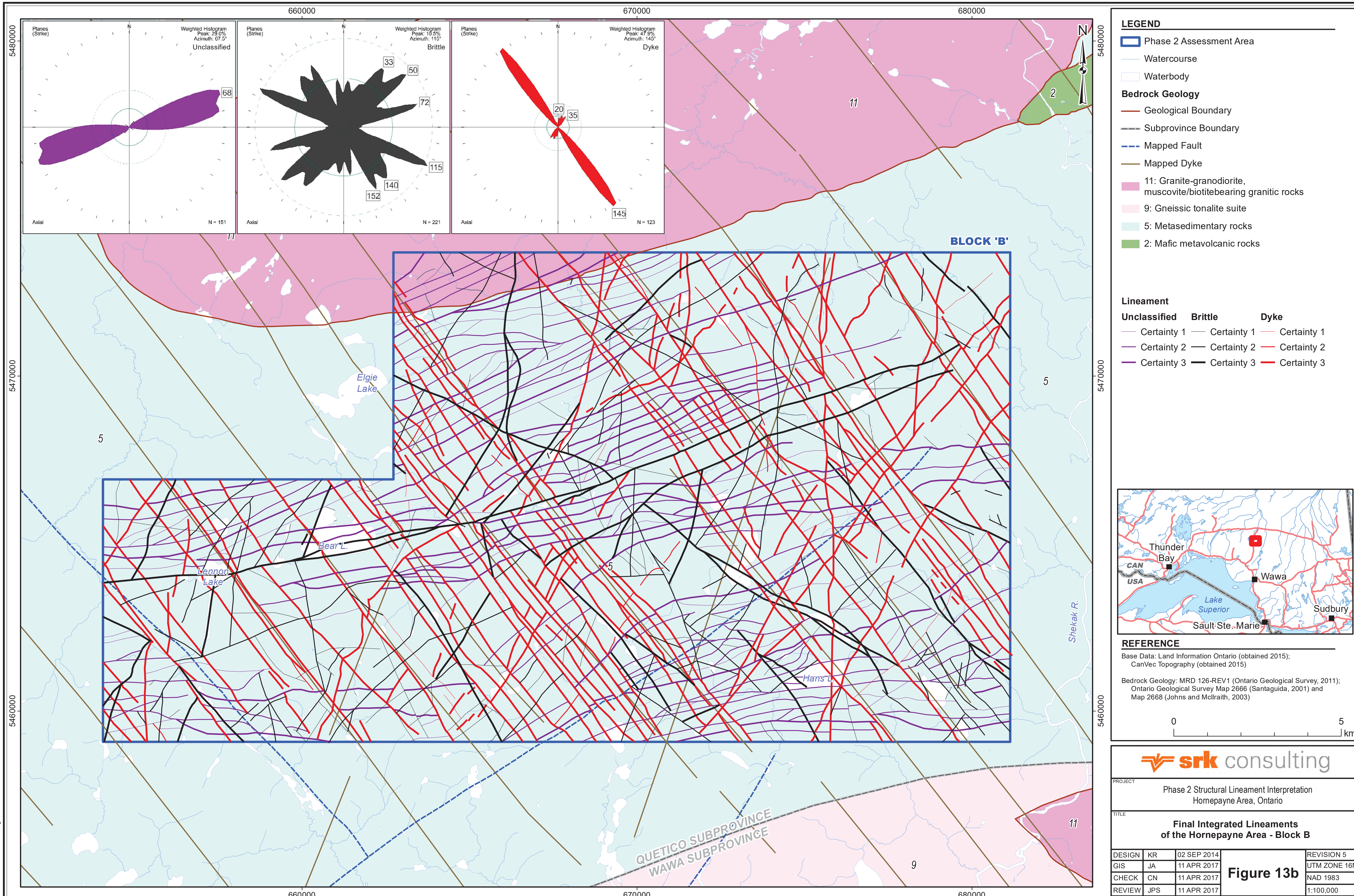
LEGEND
Phase 2 Assessment
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Unclassified Lineament
Certainty 1
Certainty 2
Certainty 3
Brittle Lineament
Certainty 1
Certainty 2
Certainty 3
Dyke Lineament
Certainty 1
Certainty 2
Certainty 3
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0 5 km
BLOCK 'B'
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Shekak R.
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
Unclassified
Brittle
Dyke
Axial
N = 124
N = 34
N = 122
660000
670000
680000
5480000
5470000
5460000
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block B
DESIGN KR 02 SEP 2014
GIS JA 11 APR 2017
CHECK CN 11 APR 2017
REVIEW JPS 11 APR 2017
Figure 12b
REVISION 5
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig12b_MagCert



LEGEND
Phase 2 Assessment
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
10: Foliated tonalite suite
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Lineament
Unclassified
Brittle
Dyke
Certainty 1
Certainty 2
Certainty 3
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Final Integrated Lineaments of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 11 APR 2017
CHECK CN 11 APR 2017
REVIEW JPS 11 APR 2017
Figure 13
REVISION 5
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig13_FinalCert
BLOCK 'A'
BLOCK 'B'
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
KABINAKAGAMI GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
HORNEPAYNE
Nagagami Lake
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Bruce Lake
Shekak R.
Linbarr Lake
Government Lakes
Armitage L.
Buffalo Island Lake
Obakamiga Lake
Shekak River
Lascelles Lake
McCoy L.
Bayfield Lake
West Larkin L.
White Owl Lake
Shekak Lake
Tocheri Lake
Loon Lake
Cross Lake
Thunder Bay
Wawa
Sudbury
Sault Ste. Marie
Lake Superior
CAN
USA
Planes (Strike)
Weighted Histogram
Unclassified
N = 318
Brittle
N = 674
Dyke
N = 282
Axial
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000



BLOCK 'A'
N
640000
650000
660000
5450000
5440000
5430000
Buffalo Island Lake
McCoy L.
Bayfield Lake
White Owl Lake
West Larkin L.
Loon Lake
Cross Lake
STRICKLAND PLUTON
13
9
2
Planes (Strike)
Weighted Histogram Peak: 24.4% Azimuth: 90°
Unclassified
63
80
90
Axial
N = 167
Planes (Strike)
Weighted Histogram Peak: 12.1% Azimuth: 40°
Brittle
40
54
120
159
141
Axial
N = 453
Planes (Strike)
Weighted Histogram Peak: 40.4% Azimuth: 140°
Dyke
34
140
Axial
N = 159
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks
Lineament
Unclassified
Certainty 1
Certainty 2
Certainty 3
Brittle
Certainty 1
Certainty 2
Certainty 3
Dyke
Certainty 1
Certainty 2
Certainty 3
Thunder Bay
Wawa
CAN
USA
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Final Integrated Lineaments of the Hornepayne Area - Block A
DESIGN KR 02 SEP 2014
GIS JA 11 APR 2017
CHECK CN 11 APR 2017
REVIEW JPS 11 APR 2017
Figure 13a
REVISION 5
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig13a_FinalCert



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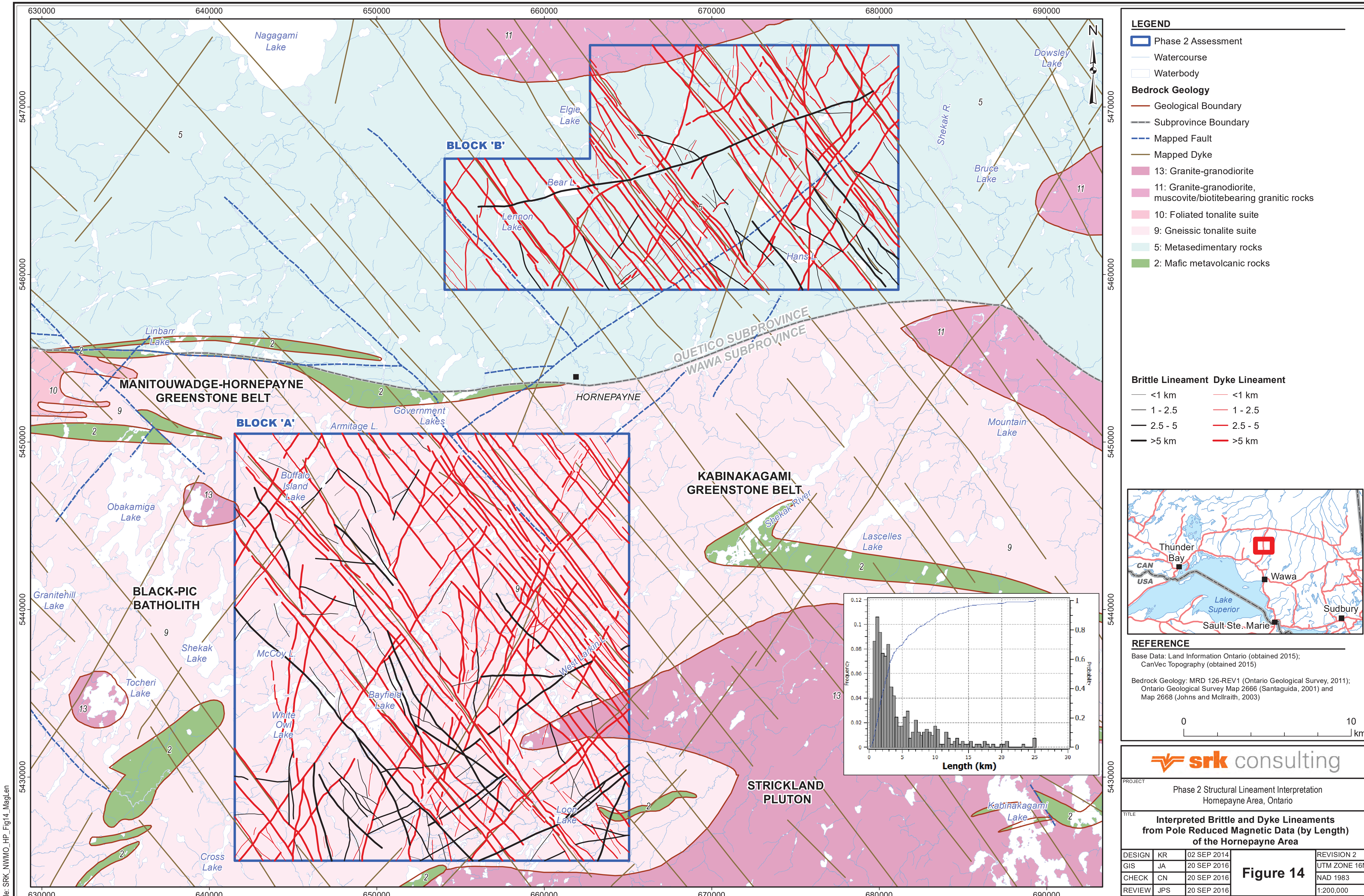
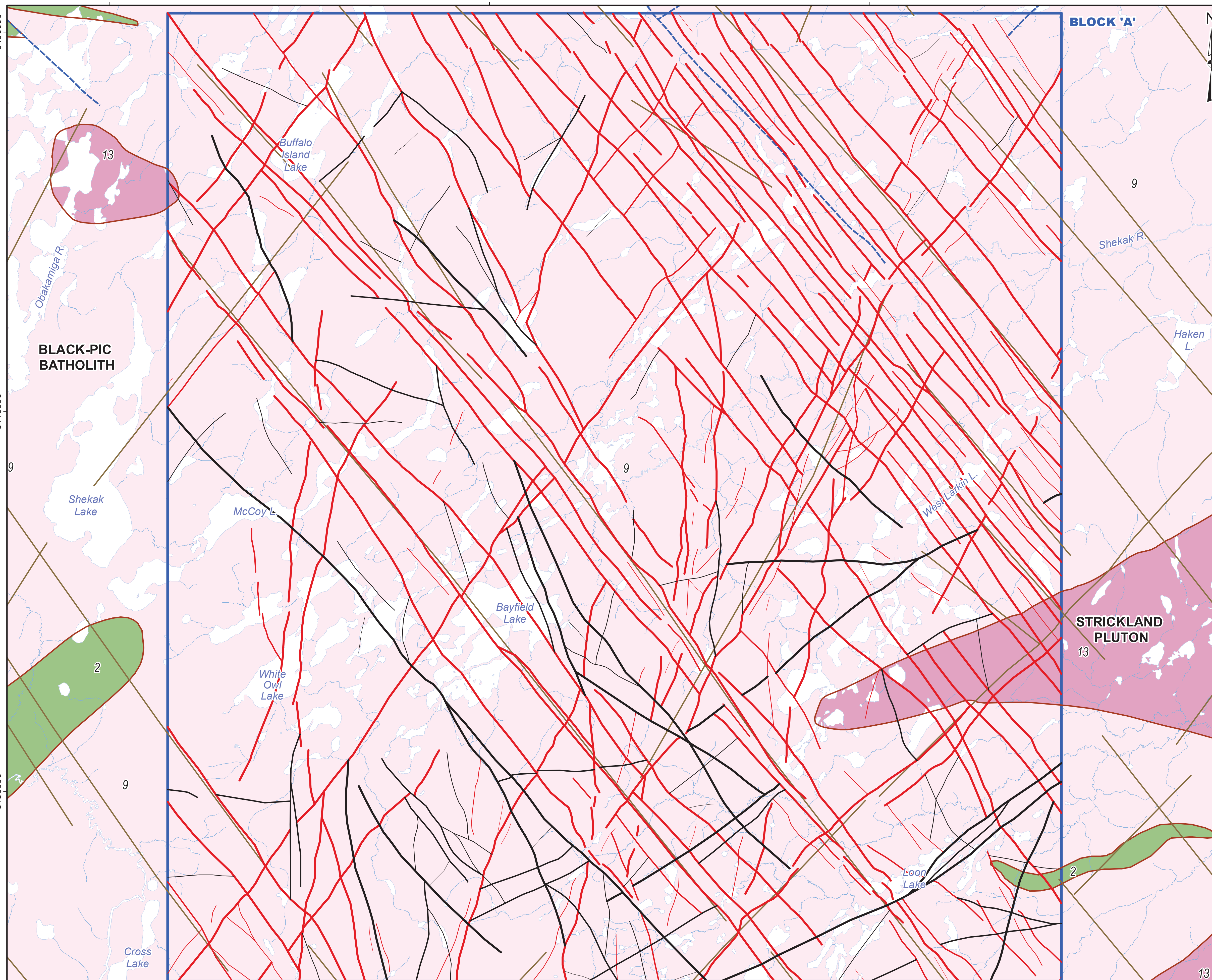

LEGEND
Phase 2 Assessment
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
10: Foliated tonalite suite
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Brittle Lineament
Dyke Lineament
<1 km
1 - 2.5
2.5 - 5
>5 km
BLOCK 'B'
BLOCK 'A'
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
KABINAKAGAMI GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
HORNEPAYNE
Nagagami Lake
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Bruce Lake
Shekak R.
Linbarr Lake
Government Lakes
Armitage L.
Buffalo Island Lake
Obakamiga Lake
Granitehill Lake
Shekak Lake
Tocheri Lake
McCoy L.
Bayfield Lake
White Owl Lake
West Larkin L.
Loon Lake
Cross Lake
Shekak River
Lascelles Lake
Mountain Lake
Kabinakagami Lake
N
630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
Frequency
Probability
Length (km)
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation Hornepayne Area, Ontario
TITLE
Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 14
REVISION 2
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig14_MagLen



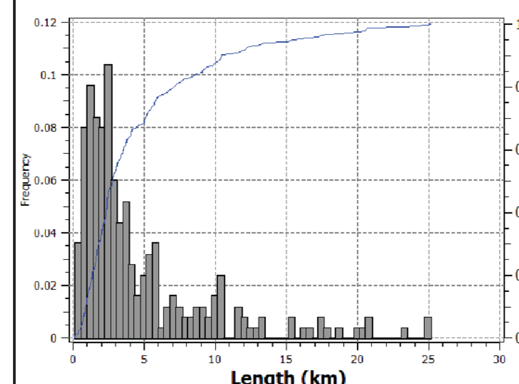
LEGEND

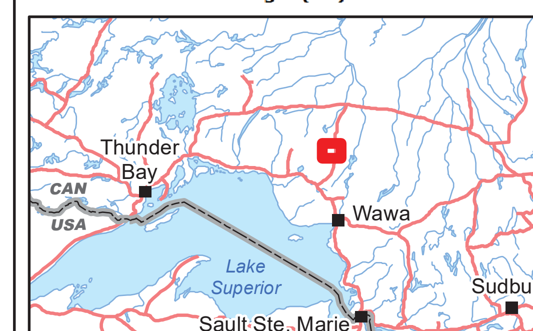
- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 9: Gneissic tonalite suite
- 2: Mafic metavolcanic rocks

Brittle Lineament	Dyke Lineament
<1 km	<1 km
1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5
>5 km	>5 km





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

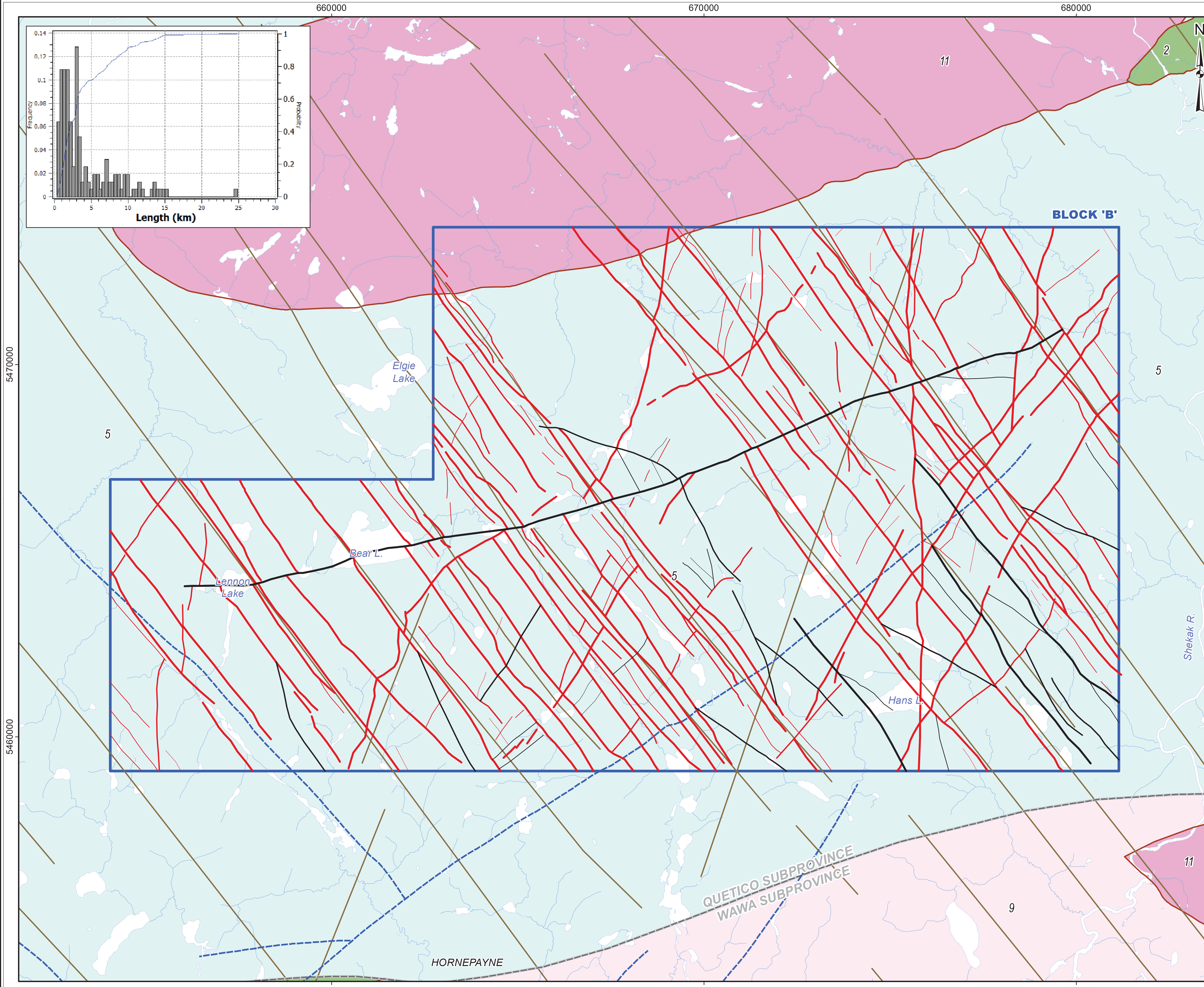
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	Figure 14a	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig14a_MagLen



LEGEND

- Phase 2 Assessment
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Brittle Lineament	Dyke Lineament
<1 km	<1 km
1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5
>5 km	>5 km

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

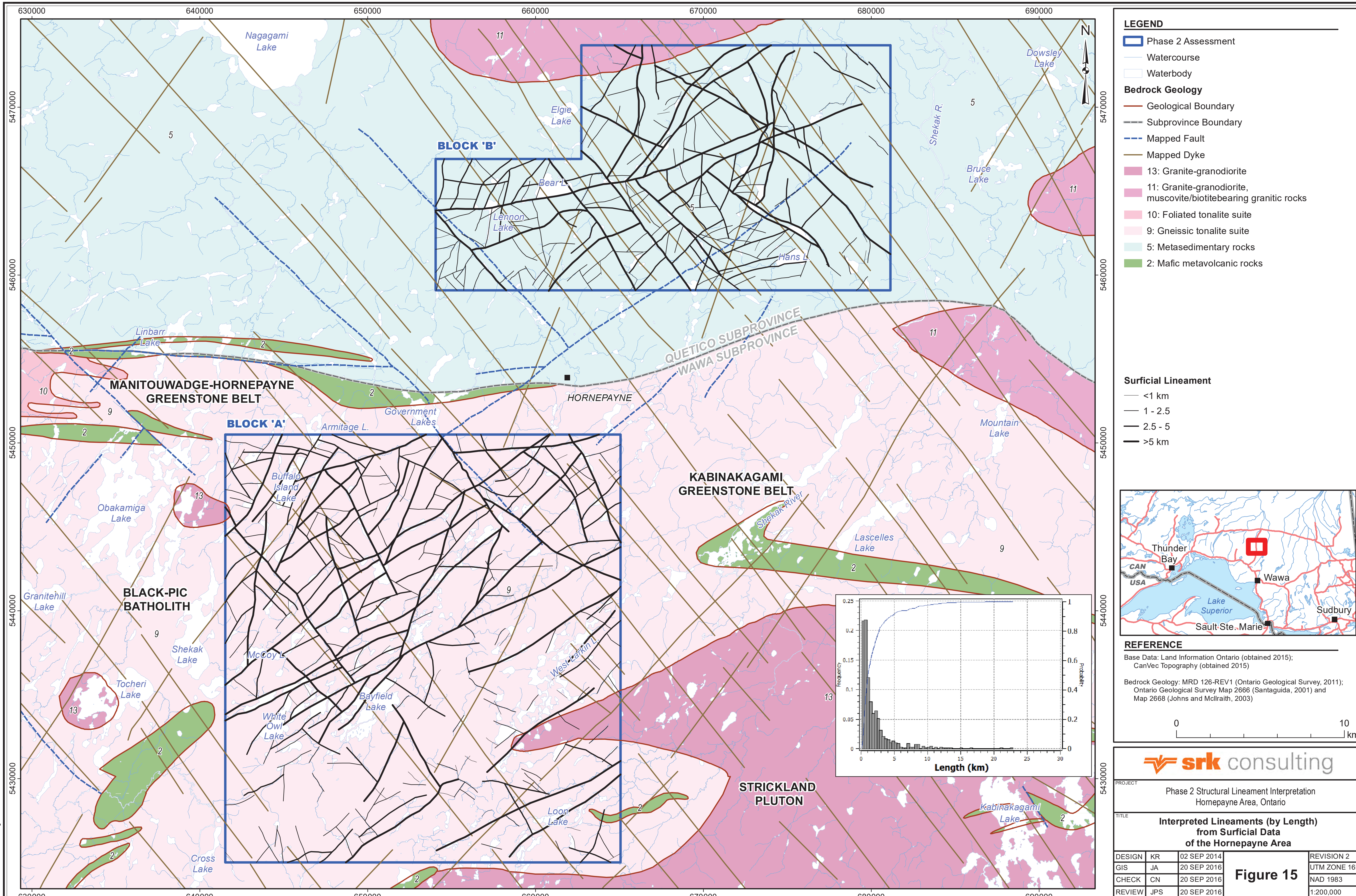
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	Figure 14b	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig14b_MagLen

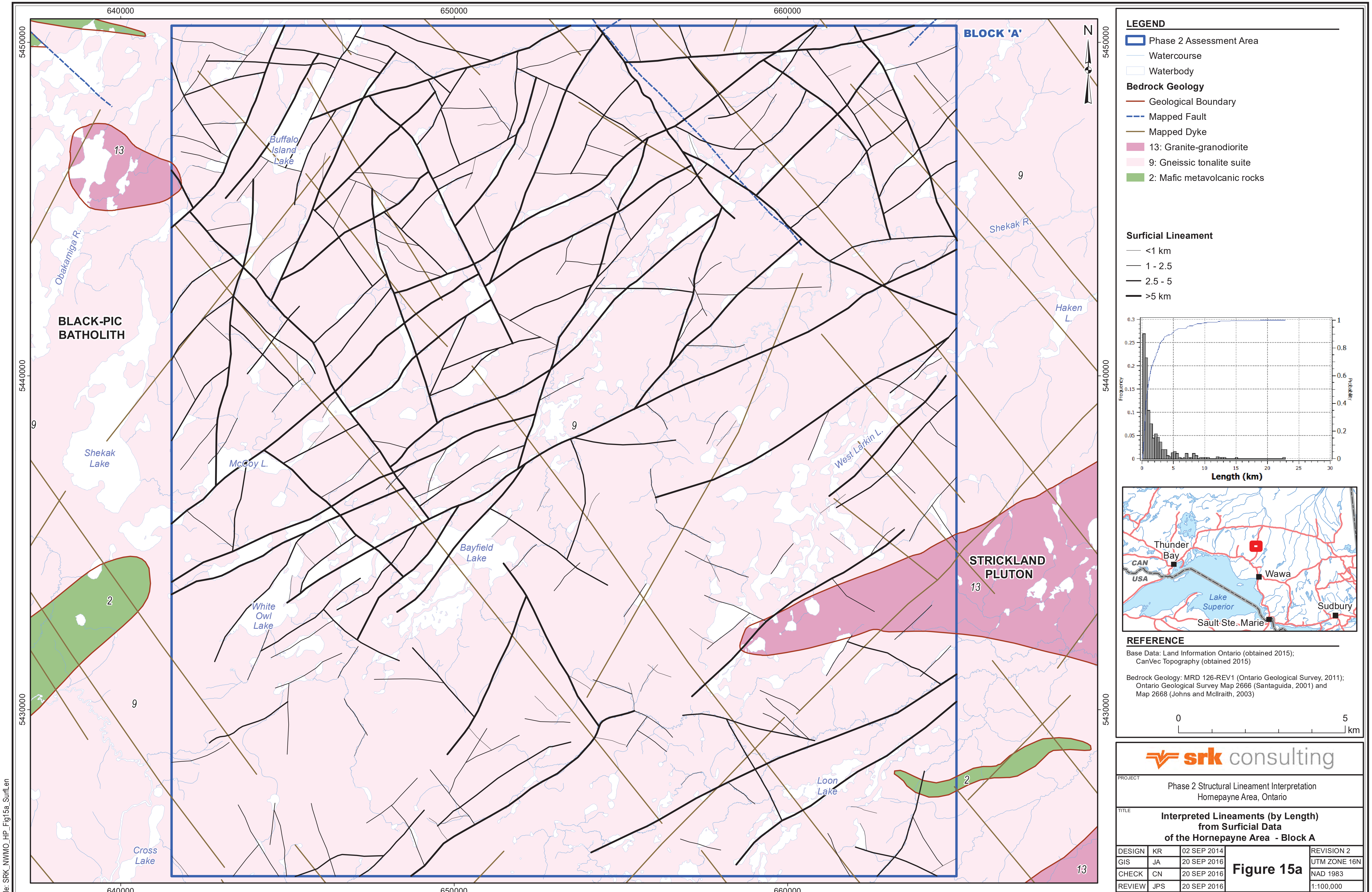


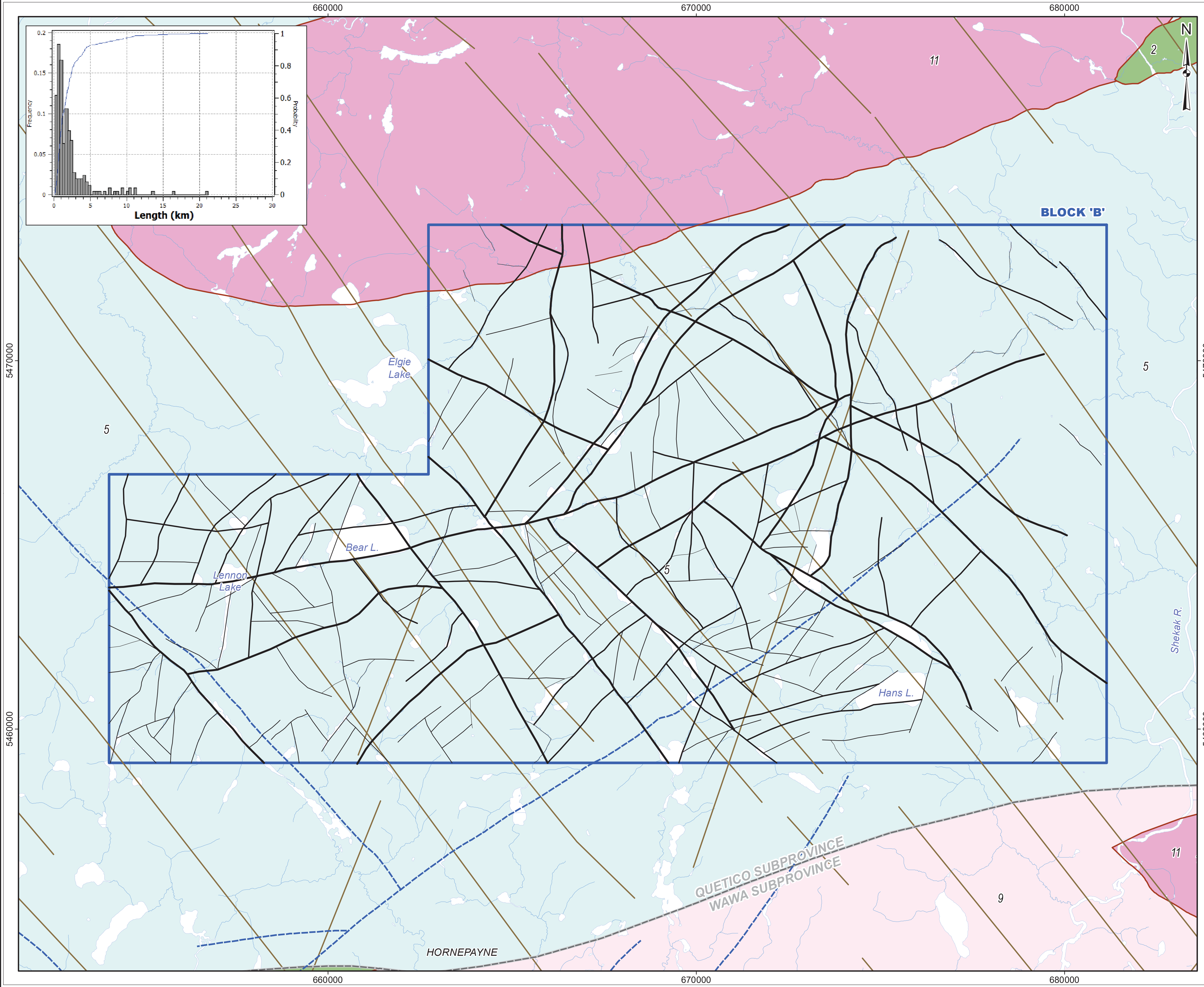
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Interpreted Lineaments (by Length) from Surficial Data of the Hornepayne Area

DESIGN	KR	02 SEP 2014	Figure 15	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:200,000


BLOCK 'A'
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
Buffalo Island Lake
McCoy L.
Bayfield Lake
White Owl Lake
West Larkin L.
Shekak R.
Haken L.
Shekak Lake
Obakamiga R.
Cross Lake
Loon Lake
640000
650000
660000
5450000
5440000
5430000
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks
Surficial Lineament
<1 km
1 - 2.5
2.5 - 5
>5 km
Length (km)
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Interpreted Lineaments (by Length) from Surficial Data of the Hornepayne Area - Block A
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 15a
REVISION 2
UTM ZONE 16N
NAD 1983
1:100,000



LEGEND

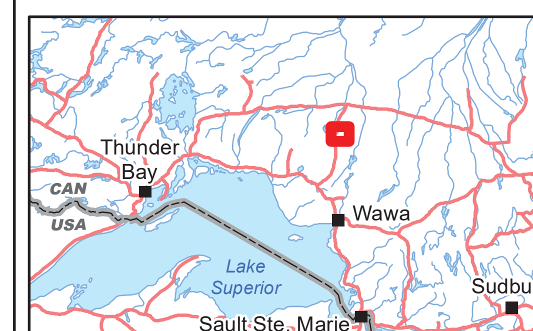
- Phase 2 Assessment
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Surficial Lineament

- <1 km
- 1 - 2.5
- 2.5 - 5
- >5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

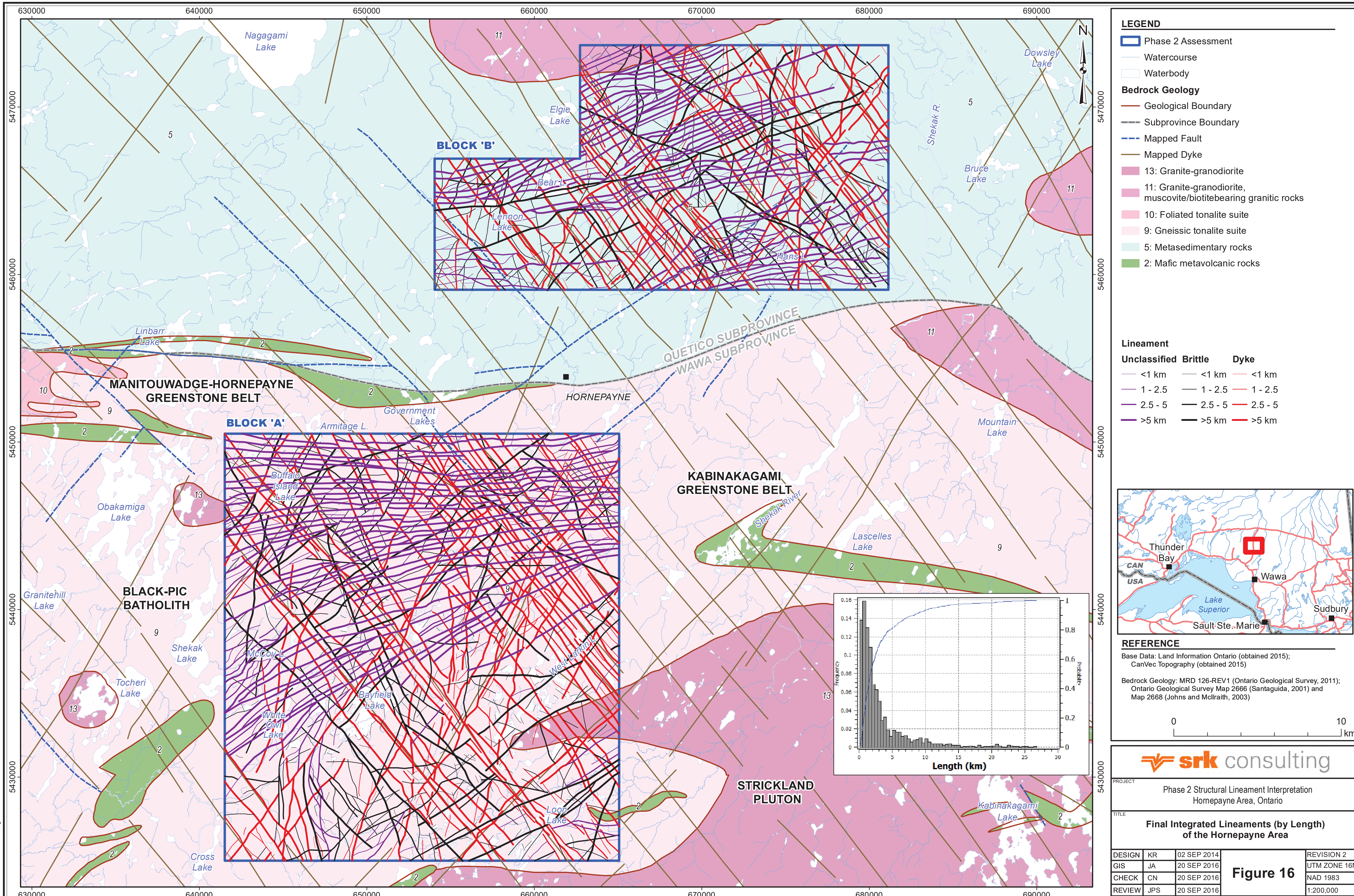
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Interpreted Lineaments (by Length) from Surficial Data of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	Figure 15b	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig15b_SurfLen


LEGEND
Phase 2 Assessment
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
10: Foliated tonalite suite
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Lineament
Unclassified Brittle Dyke
<1 km
1 - 2.5
2.5 - 5
>5 km
BLOCK 'B'
BLOCK 'A'
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
HORNEPAYNE
KABINAKAGAMI GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
Nagagami Lake
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Shekak R.
Bruce Lake
Linbarr Lake
Government Lakes
Armitage L.
Mountain Lake
Buffalo Island Lake
Obakamiga Lake
Shekak River
Lascelles Lake
Granitehill Lake
Shekak Lake
McCoy L.
West Larkin L.
Tocheri Lake
Bayfield Lake
White Owl Lake
Loon Lake
Cross Lake
Kabinakagami Lake
Length (km)
Frequency
Probability
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0 10 km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation Hornepayne Area, Ontario
TITLE
Final Integrated Lineaments (by Length) of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 16
REVISION 2
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig16_FinalLen

LEGEND

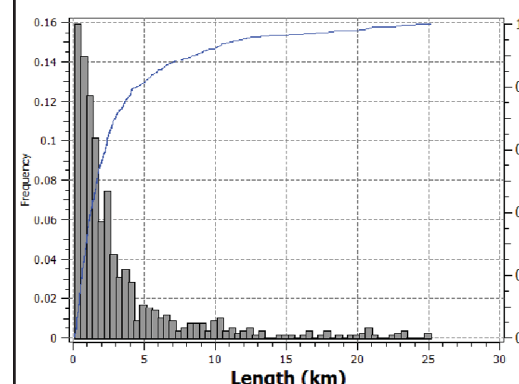
Phase 2 Assessment Area
Watercourse
Waterbody

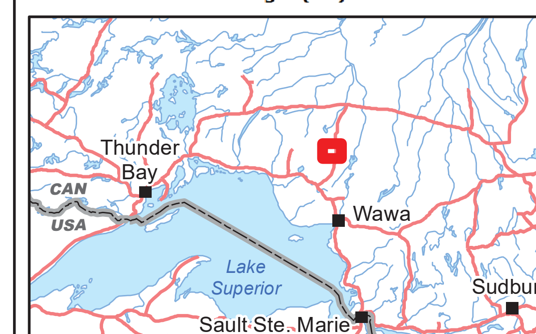
Bedrock Geology

Geological Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks

Lineament

Unclassified	Brittle	Dyke
<1 km	<1 km	<1 km
1 - 2.5	1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5	2.5 - 5
>5 km	>5 km	>5 km





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

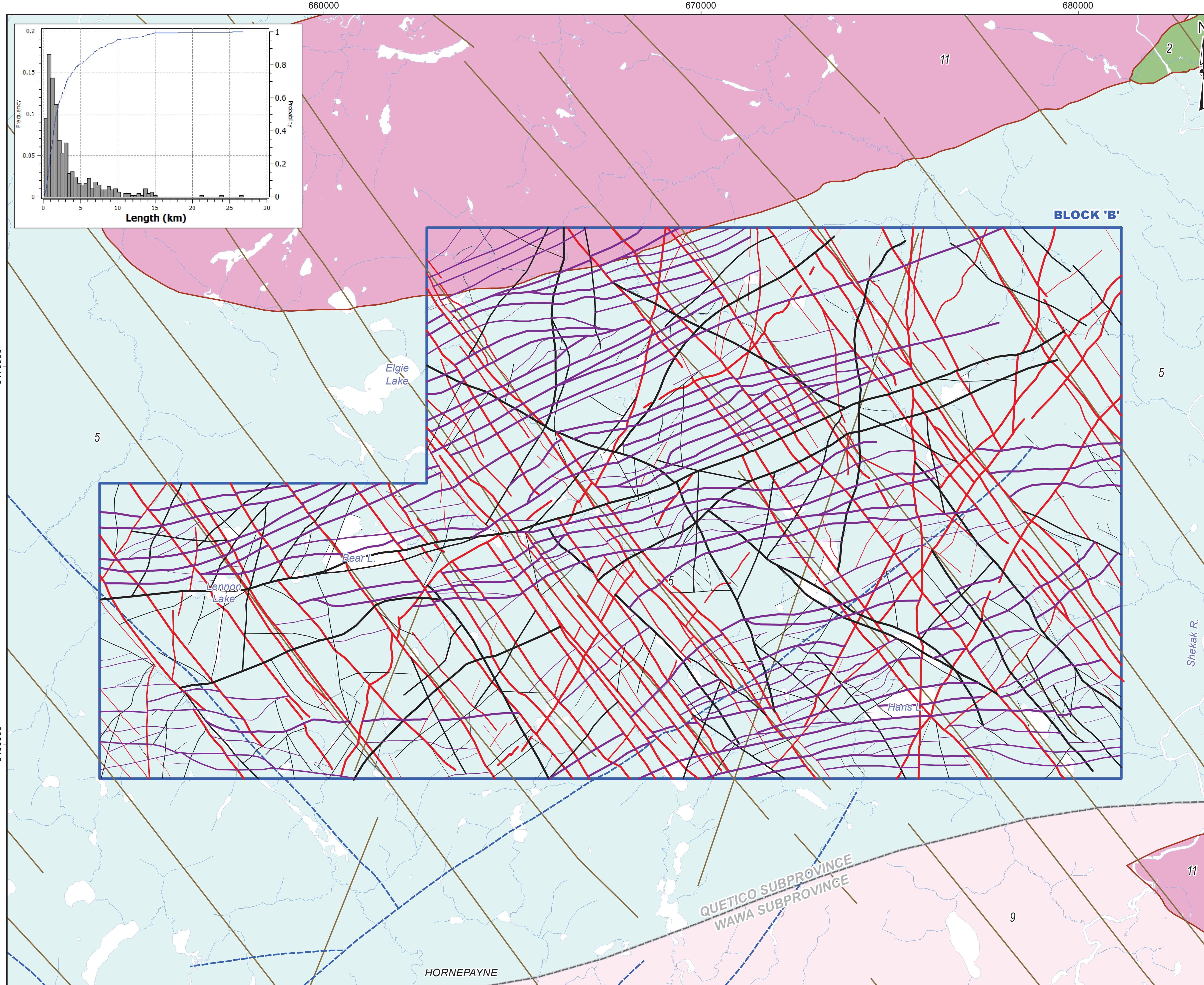
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Final Integrated Lineaments (by Length) of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 16a**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig16a_FinalLen



LEGEND

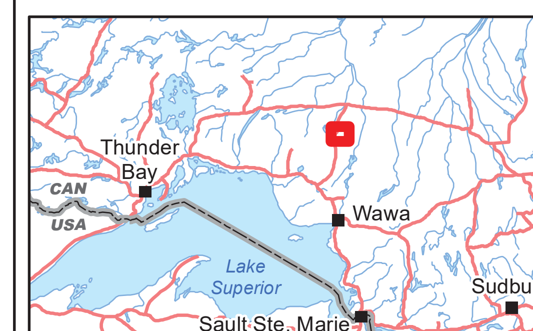
Phase 2 Assessment
Watercourse
Waterbody

Bedrock Geology

Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks

Lineament

Unclassified	Brittle	Dyke
<1 km	<1 km	<1 km
1 - 2.5	1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5	2.5 - 5
>5 km	>5 km	>5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

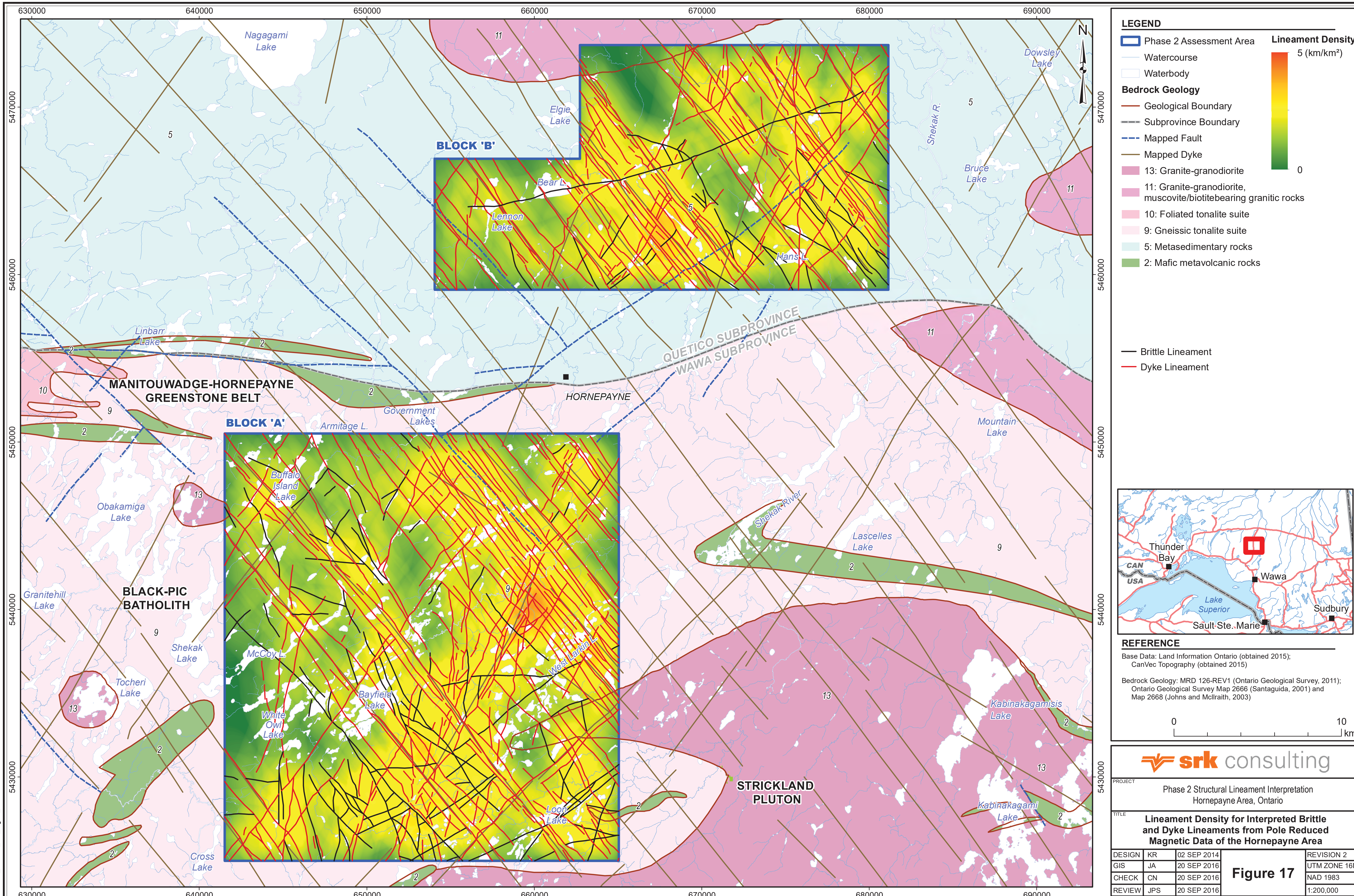
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Final Integrated Lineaments (by Length) of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	Figure 16b	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig16b_FinalLen

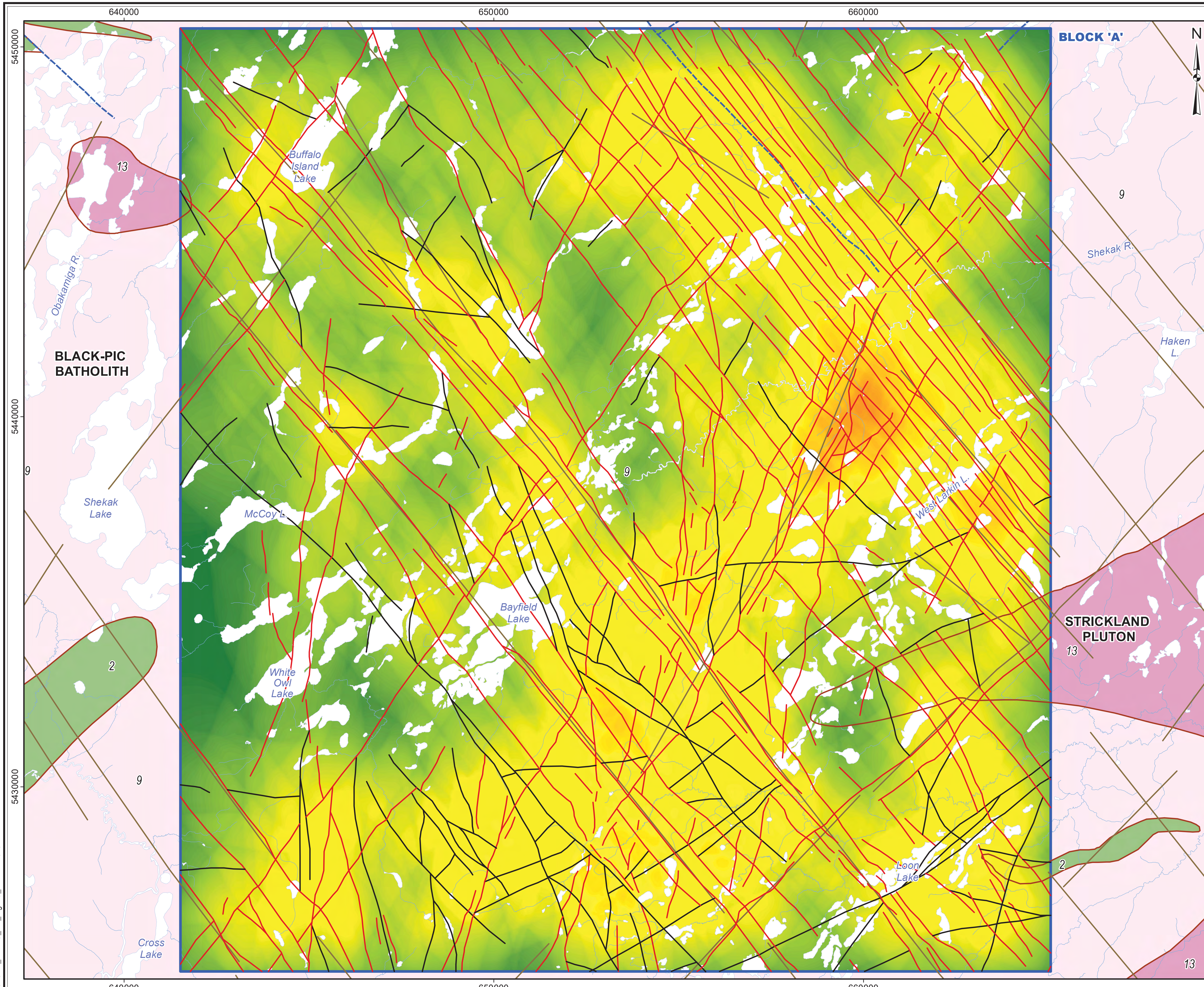


srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Lineament Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

DESIGN	KR	02 SEP 2014	**Figure 17**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:200,000



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 9: Gneissic tonalite suite
- 2: Mafic metavolcanic rocks

Lineament Density

High : 5

Low : 0

- Brittle Lineament
- Dyke Lineament

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

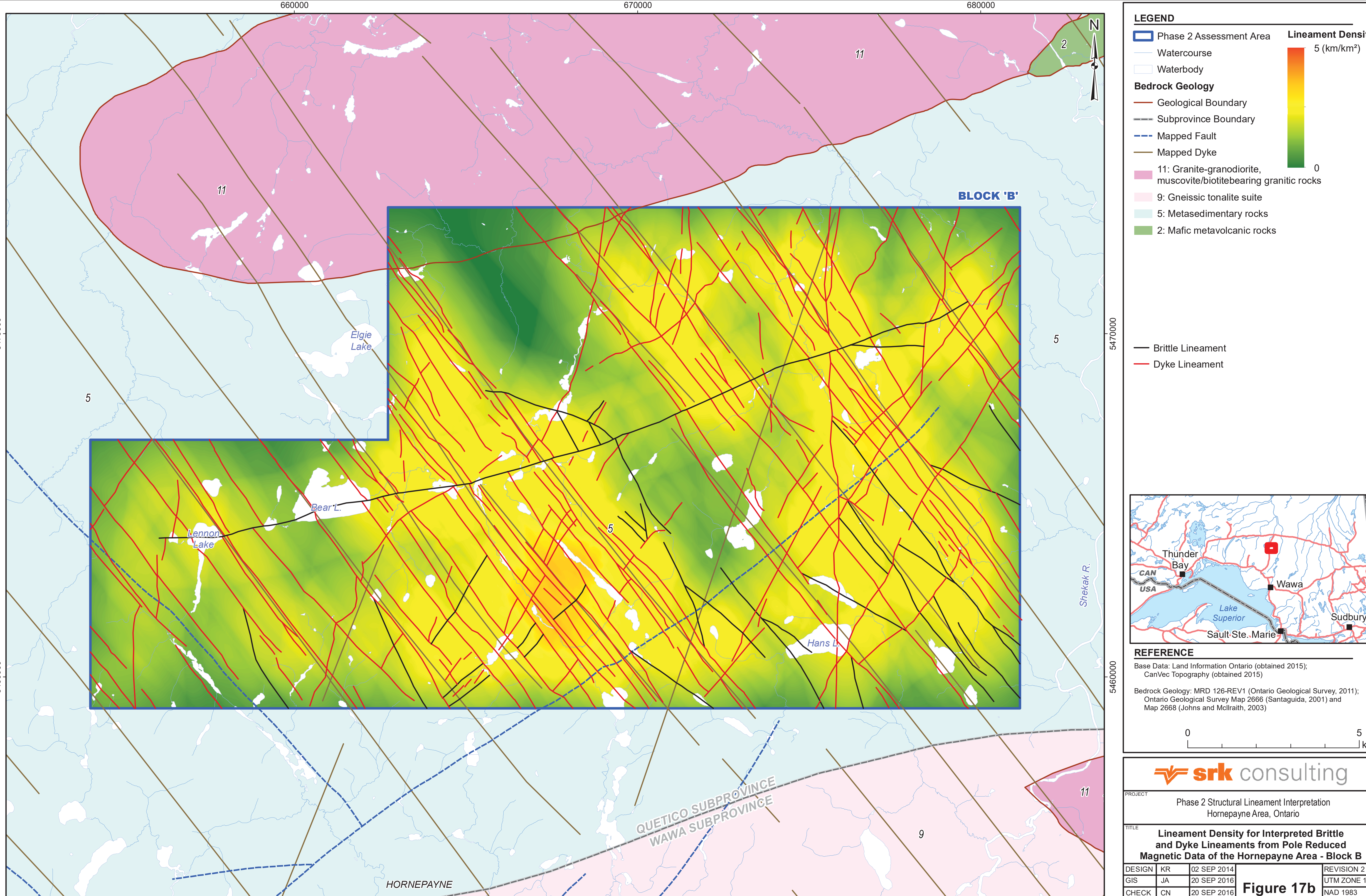
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Lineament Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 17a**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig17a_mBDLinDens



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

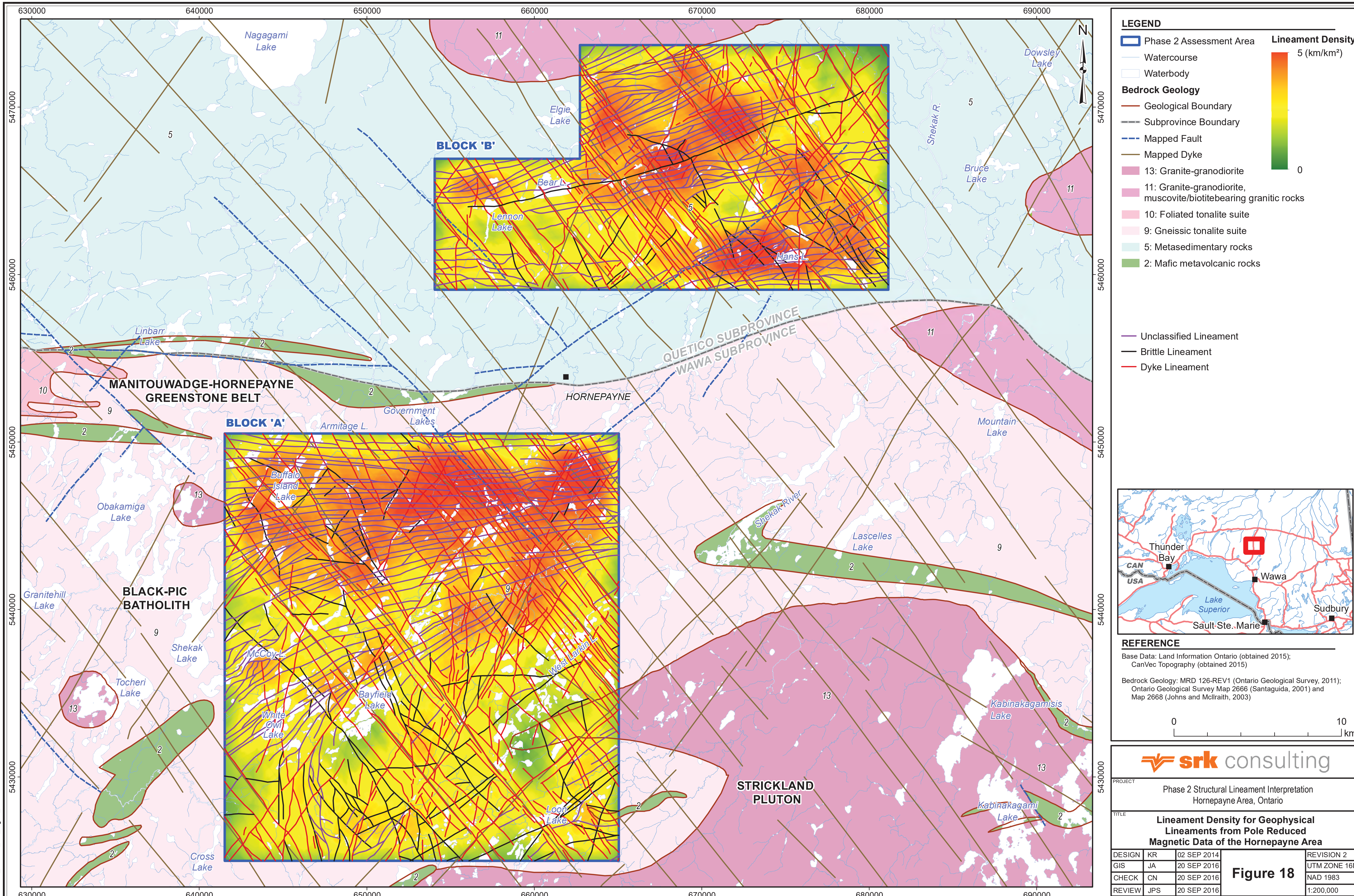
TITLE

Lineament Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block B

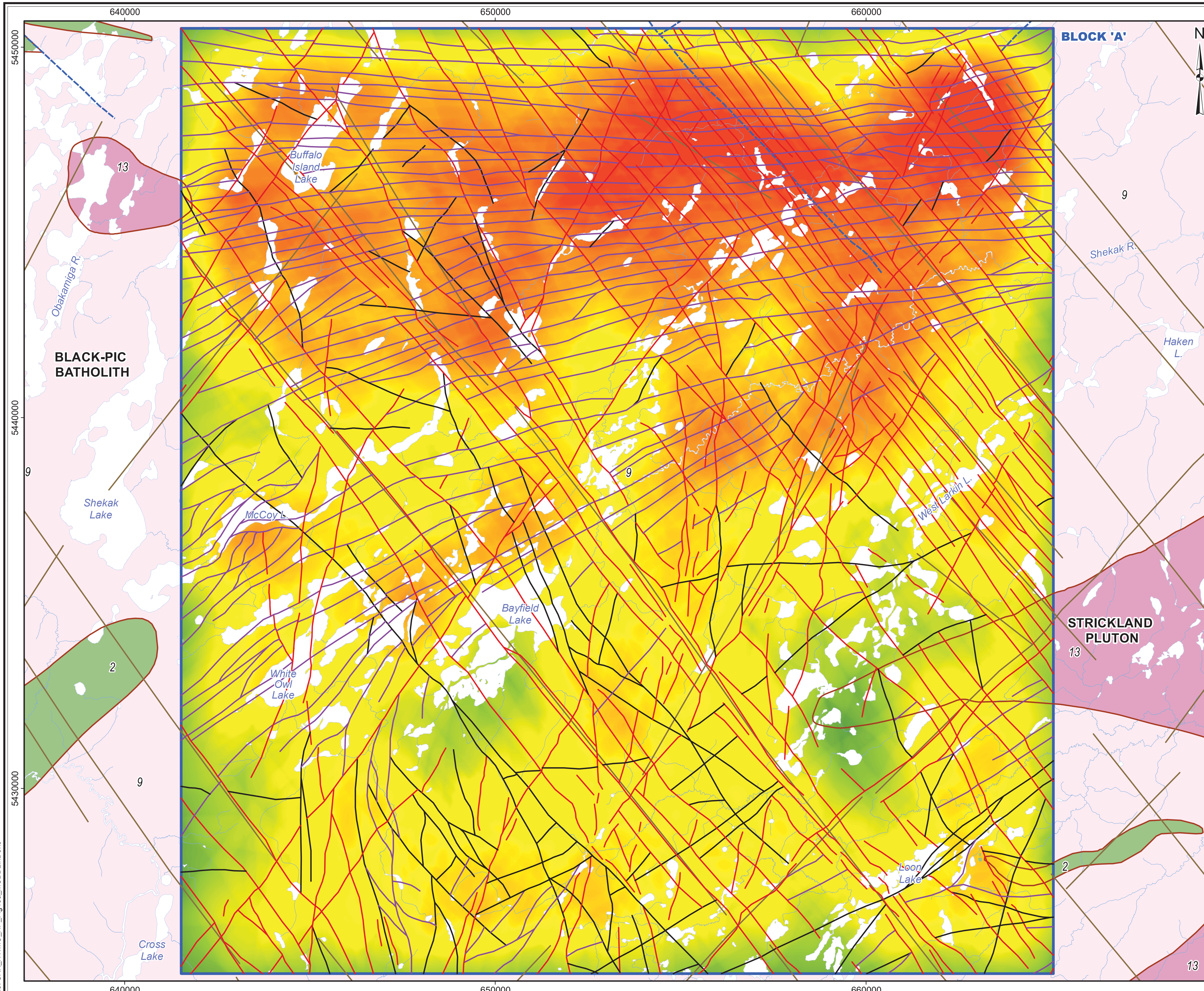
DESIGN	KR	02 SEP 2014	REVISION 2
GIS	JA	20 SEP 2016	UTM ZONE 16N
CHECK	CN	20 SEP 2016	NAD 1983
REVIEW	JPS	20 SEP 2016	1:100,000

Figure 17b

File: SRK_NWMO_HP_Fig17b_mBDLinDens



BLOCK 'B'
BLOCK 'A'
Nagagami Lake
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Shekak R.
Bruce Lake
Linbarr Lake
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
HORNEPAYNE
Government Lakes
Armitage L.
Mountain Lake
Buffalo Island Lake
Obakamiga Lake
Shekak River
Lascelles Lake
Granitehill Lake
BLACK-PIC BATHOLITH
Shekak Lake
McCoy L.
West Larkin L.
Tocheri Lake
Bayfield Lake
White Owl Lake
Kabinakagamisis Lake
STRICKLAND PLUTON
Loon Lake
Kabinakagami Lake
Cross Lake
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
10: Foliated tonalite suite
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Lineament Density
5 (km/km²)
0
Unclassified Lineament
Brittle Lineament
Dyke Lineament
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0 10 km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation Hornepayne Area, Ontario
TITLE
Lineament Density for Geophysical Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 18
REVISION 2
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig18_mUBDLinDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

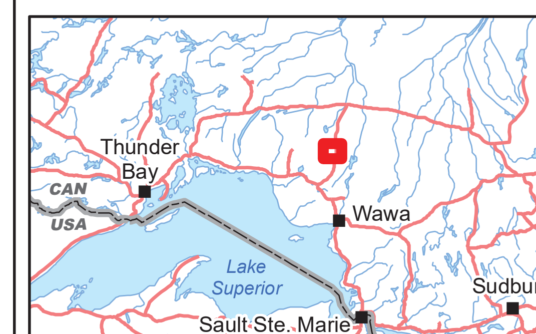
- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 9: Gneissic tonalite suite
- 2: Mafic metavolcanic rocks

Lineament Density

5 (km/km²)

0

- Unclassified Lineament
- Brittle Lineament
- Dyke Lineament



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

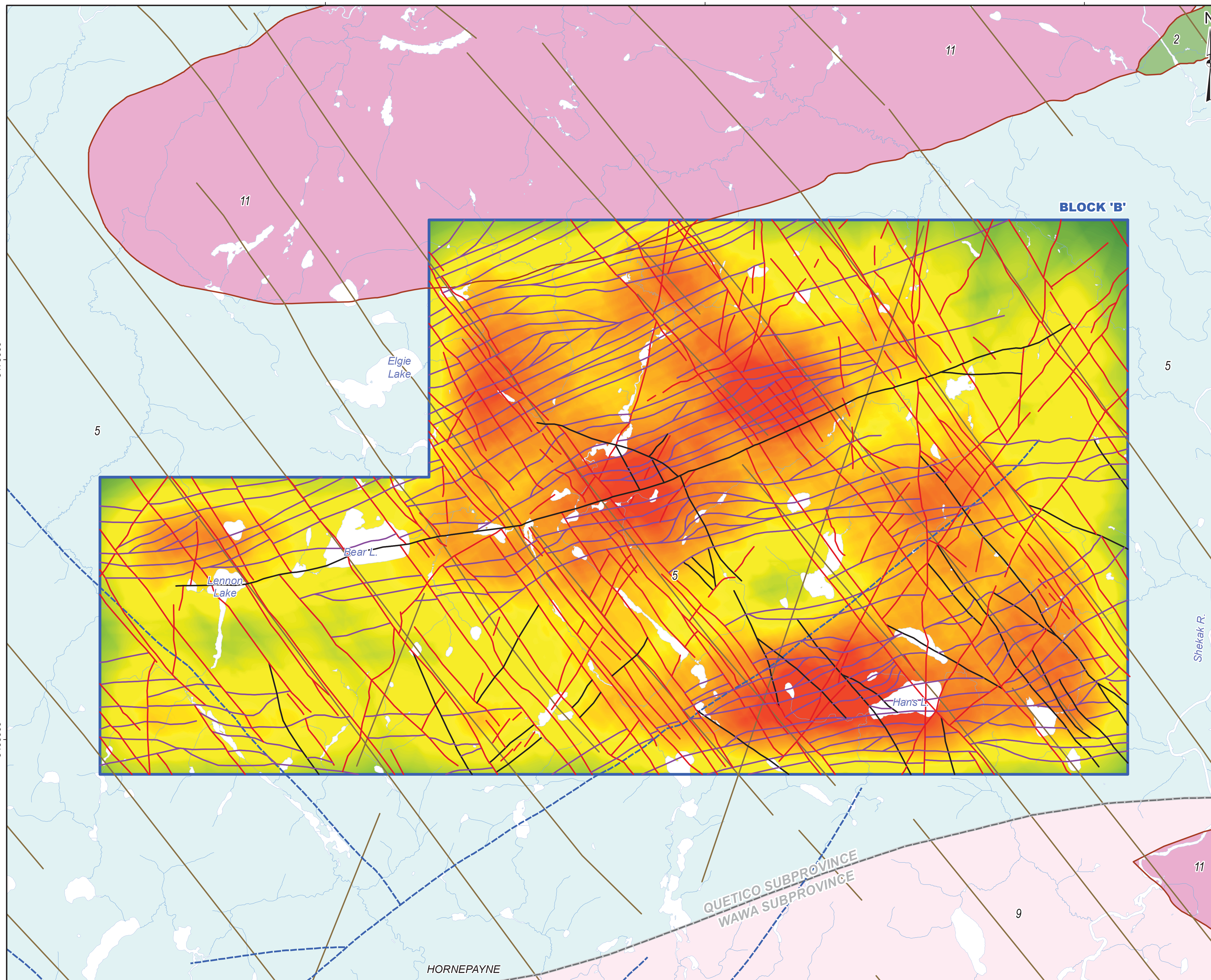
PROJECT

Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Lineament Density for Geophysical Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 18a**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

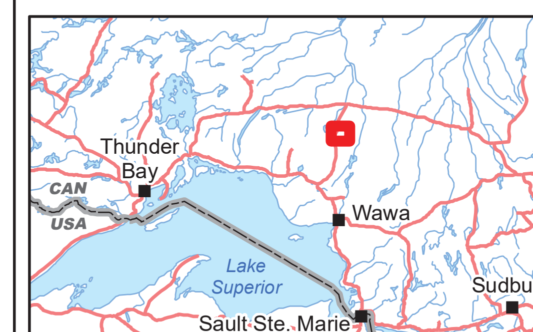
- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Lineament Density

5 (km/km²)

0

- Unclassified Lineament
- Brittle Lineament
- Dyke Lineament



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

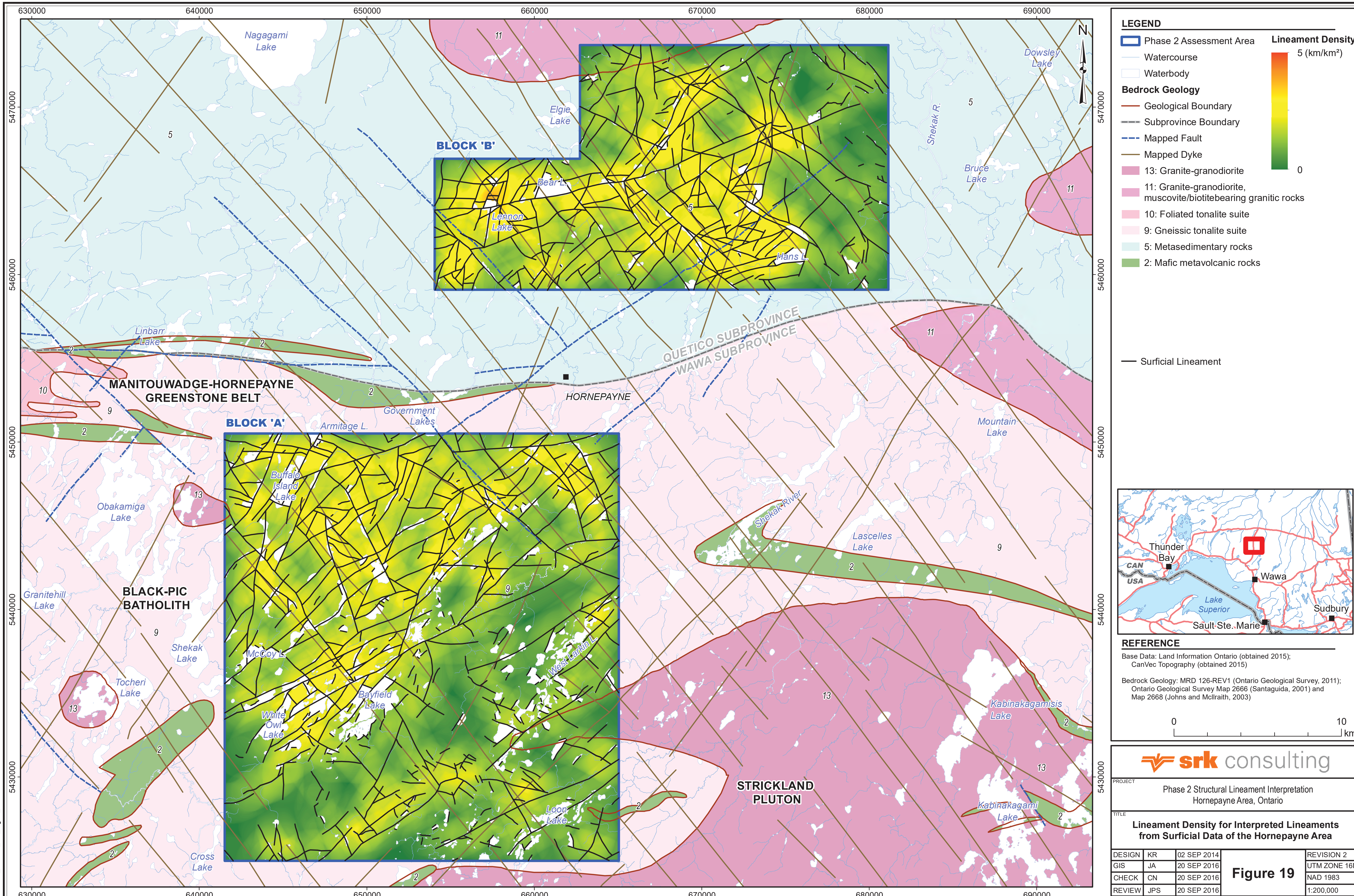
PROJECT

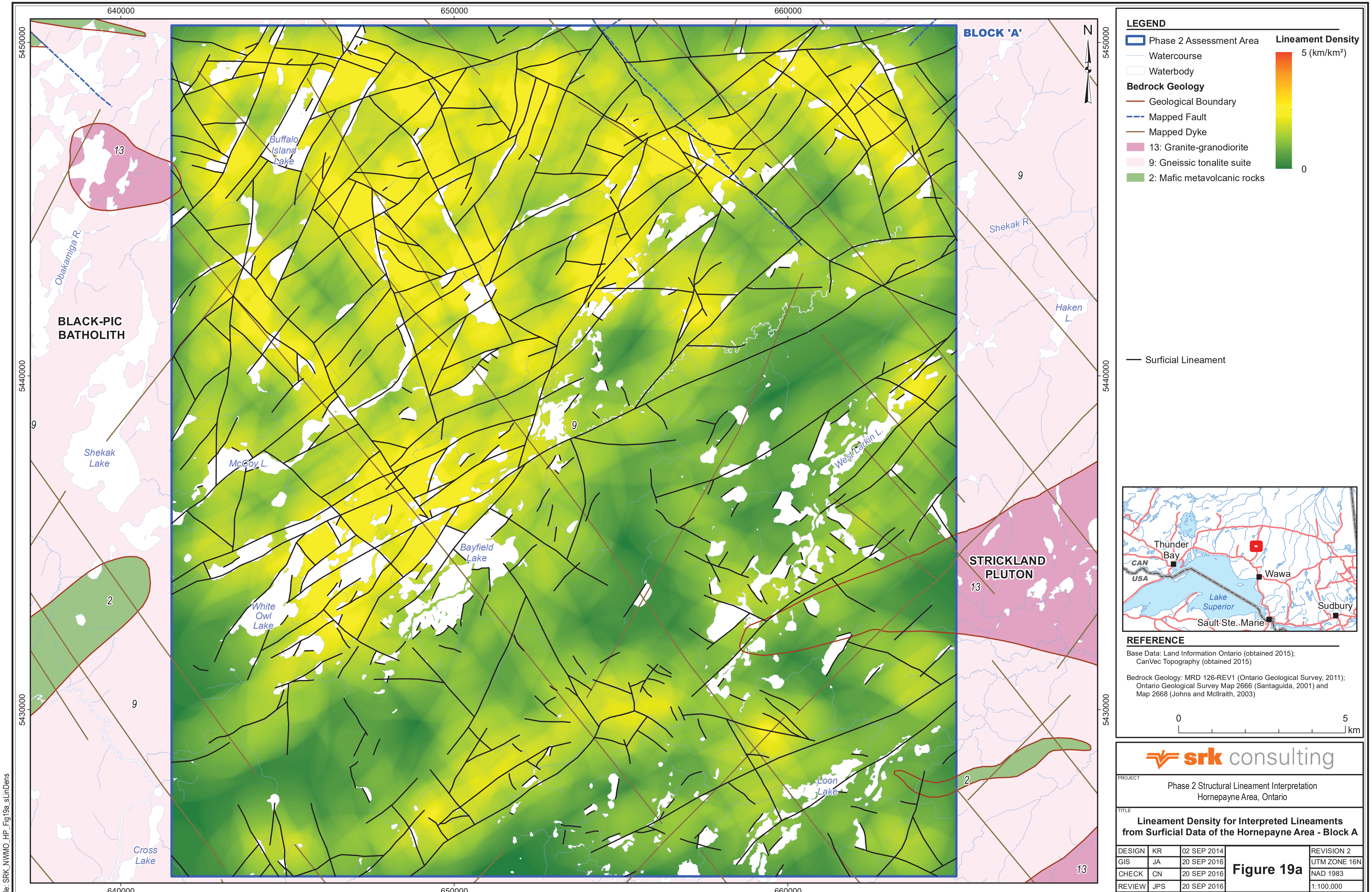
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

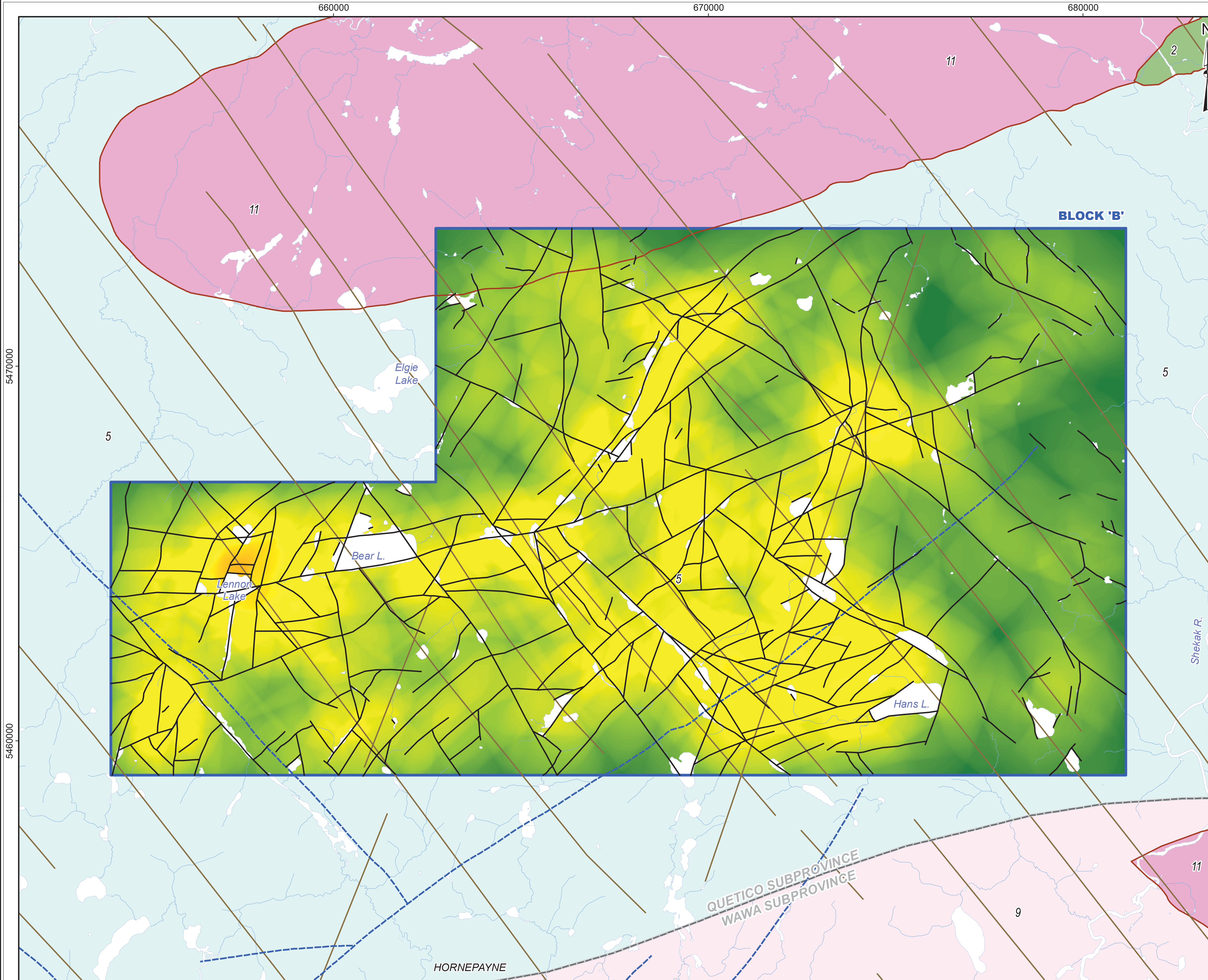
Lineament Density for Geophysical Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 18b**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000


LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
10: Foliated tonalite suite
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Lineament Density
5 (km/km²)
0
Surficial Lineament
BLOCK 'B'
BLOCK 'A'
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
HORNEPAYNE
Nagagami Lake
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Bruce Lake
Shekak R.
Linbarr Lake
Government Lakes
Armitage L.
Mountain Lake
Buffalo Island Lake
Obakamiga Lake
Shekak River
Lascelles Lake
Granitehill Lake
Shekak Lake
Tocheri Lake
McCoy L.
West Larkin L.
Bayfield Lake
White Owl Lake
Kabinakagamisis Lake
Kabinakagami Lake
Loon Lake
Cross Lake
630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
N
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Density for Interpreted Lineaments from Surficial Data of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 19
REVISION 2
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig19_sLinDens



BLOCK 'A'
640000
650000
660000
5450000
5440000
5430000
N
Buffalo Island Lake
BLACK-PIC BATHOLITH
Obakamiga R.
Shekak Lake
McCoy L.
Bayfield Lake
White Owl Lake
Cross Lake
West Larkin L.
Loon Lake
Shekak R.
Haken L.
STRICKLAND PLUTON
13
9
2
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks
Lineament Density
5 (km/km²)
0
Surficial Lineament
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Density for Interpreted Lineaments from Surficial Data of the Hornepayne Area - Block A
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 19a
REVISION 2
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig19a_sLinDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

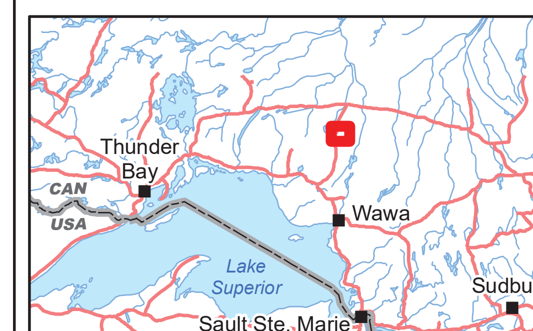
- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Lineament Density

5 (km/km²)

0

- Surficial Lineament



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

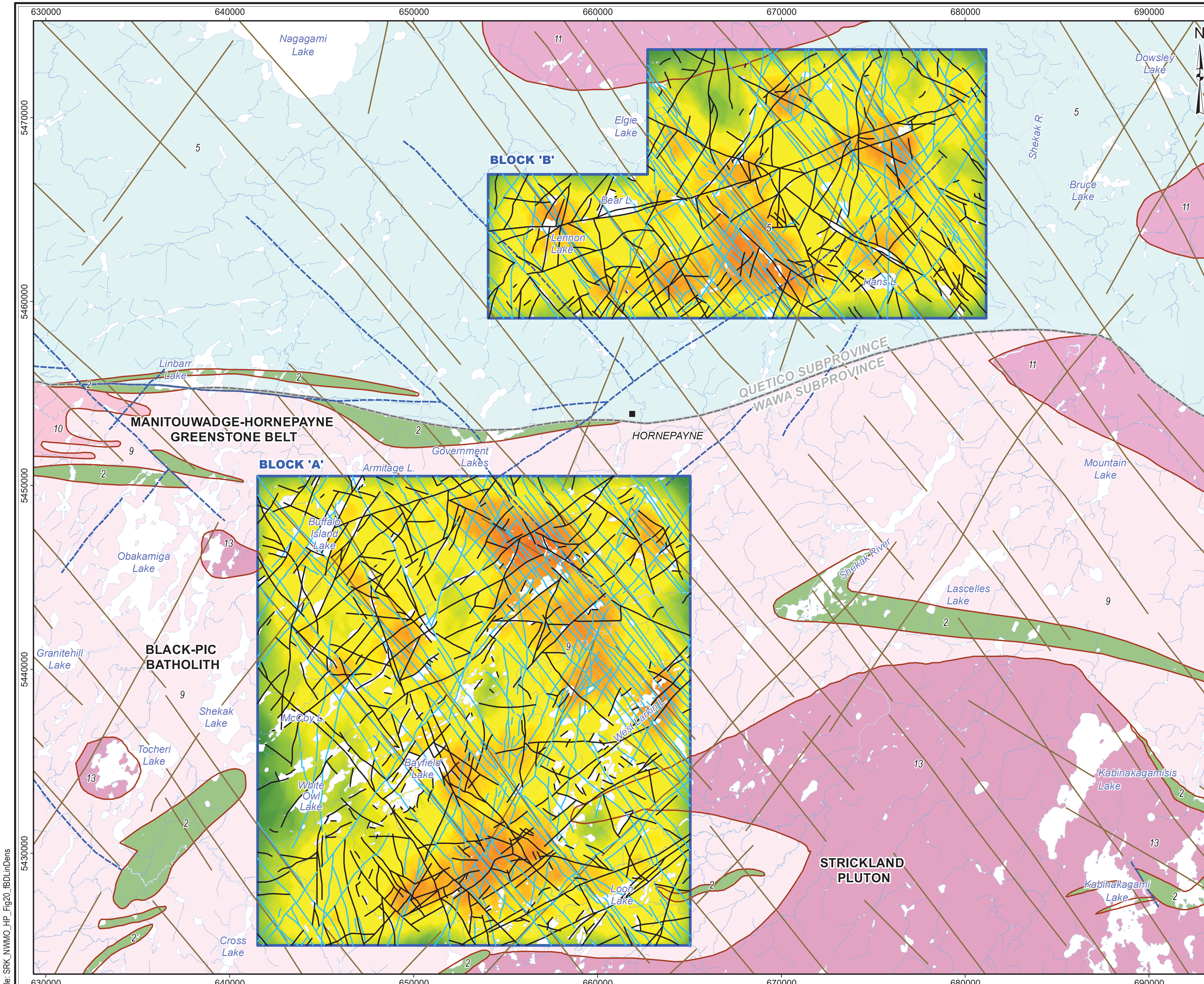
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Lineament Density for Interpreted Lineaments from Surficial Data of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	Figure 19b	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig19b_sLinDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Lineament Density

5 (km/km²)

0

- Brittle Lineament
- Dyke Lineament

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 — 10 km

srk consulting

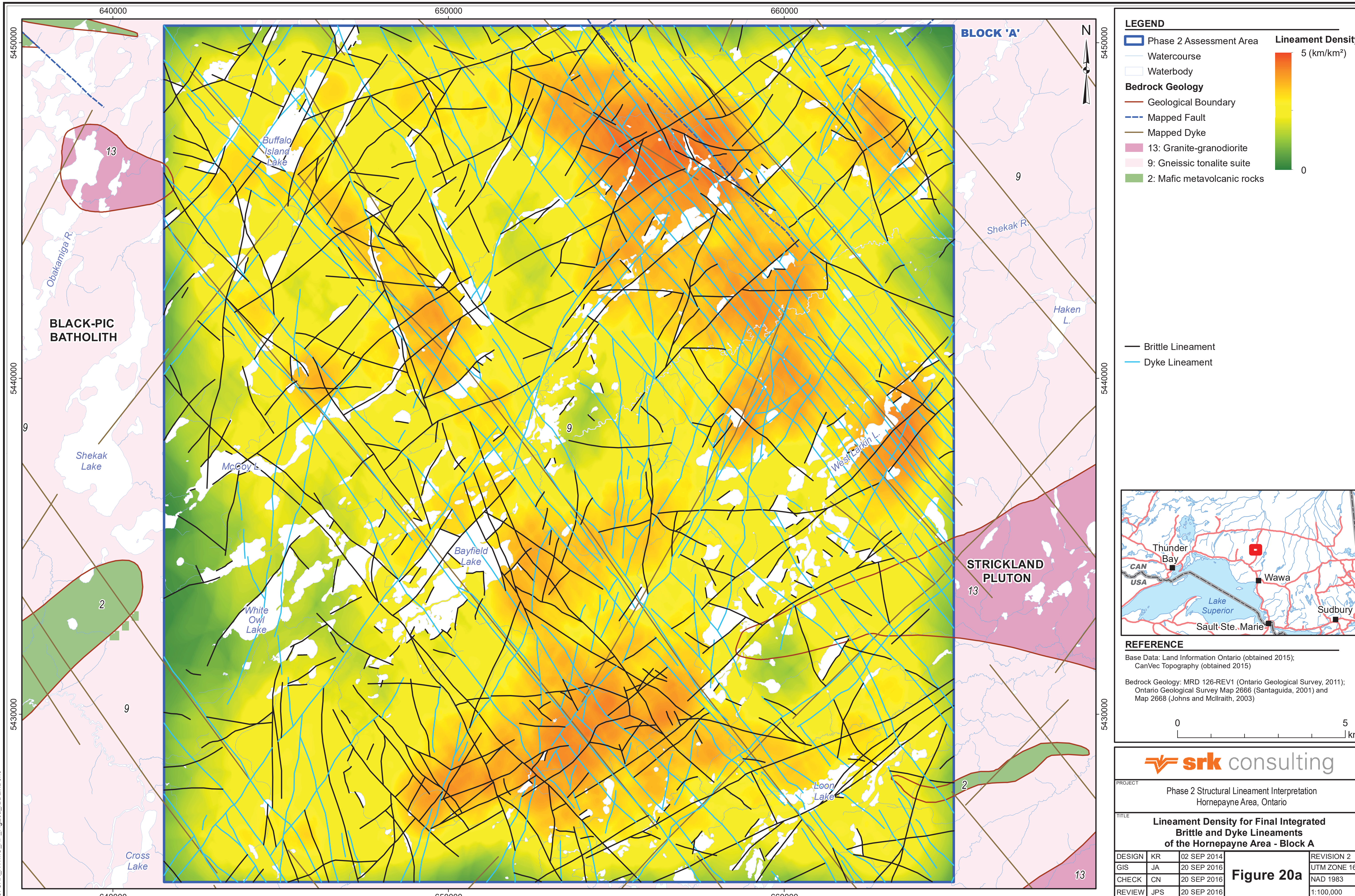
PROJECT

Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Lineament Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area

DESIGN	KR	02 SEP 2014	Figure 20	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:200,000



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

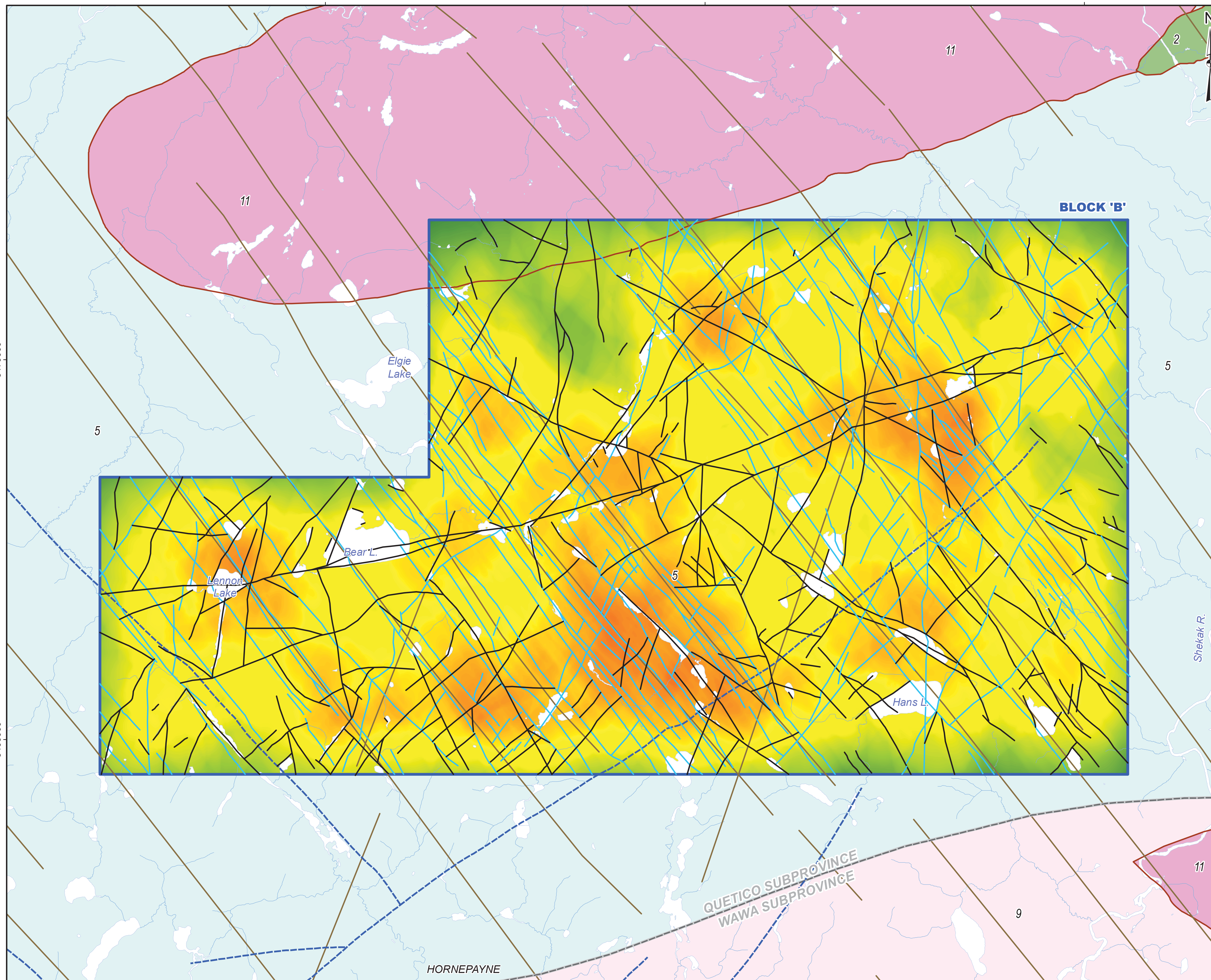
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE
Lineament Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	Figure 20a	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig20a_fBDLinDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

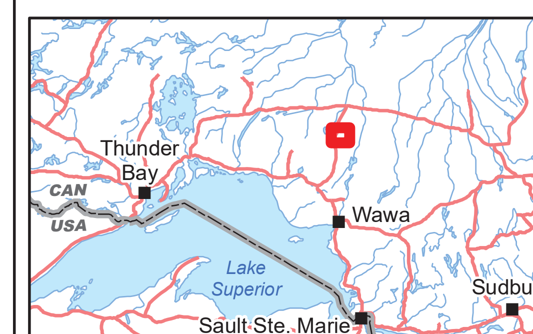
- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Lineament Density

5 (km/km²)

0

- Brittle Lineament
- Dyke Lineament



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

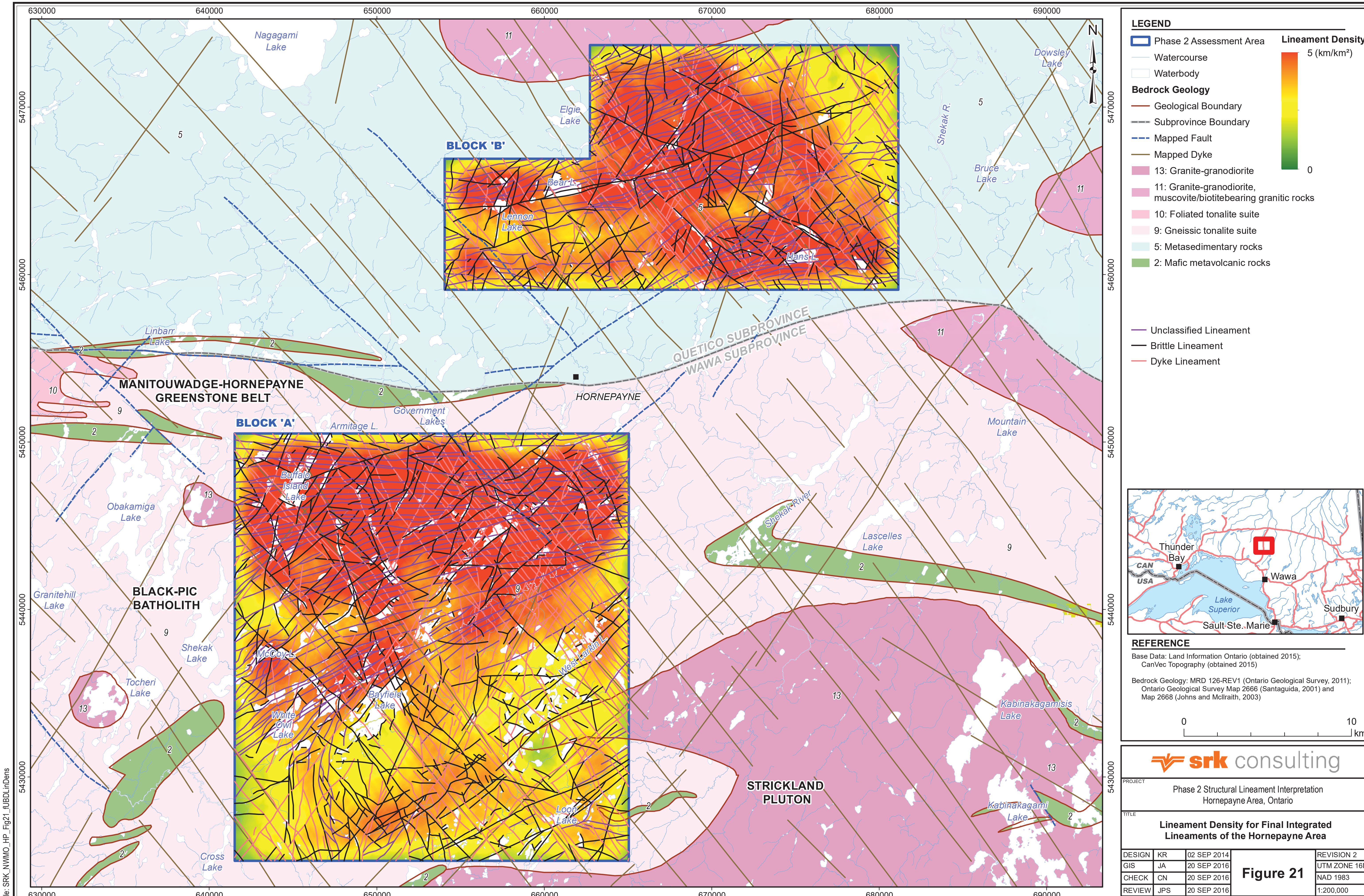
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

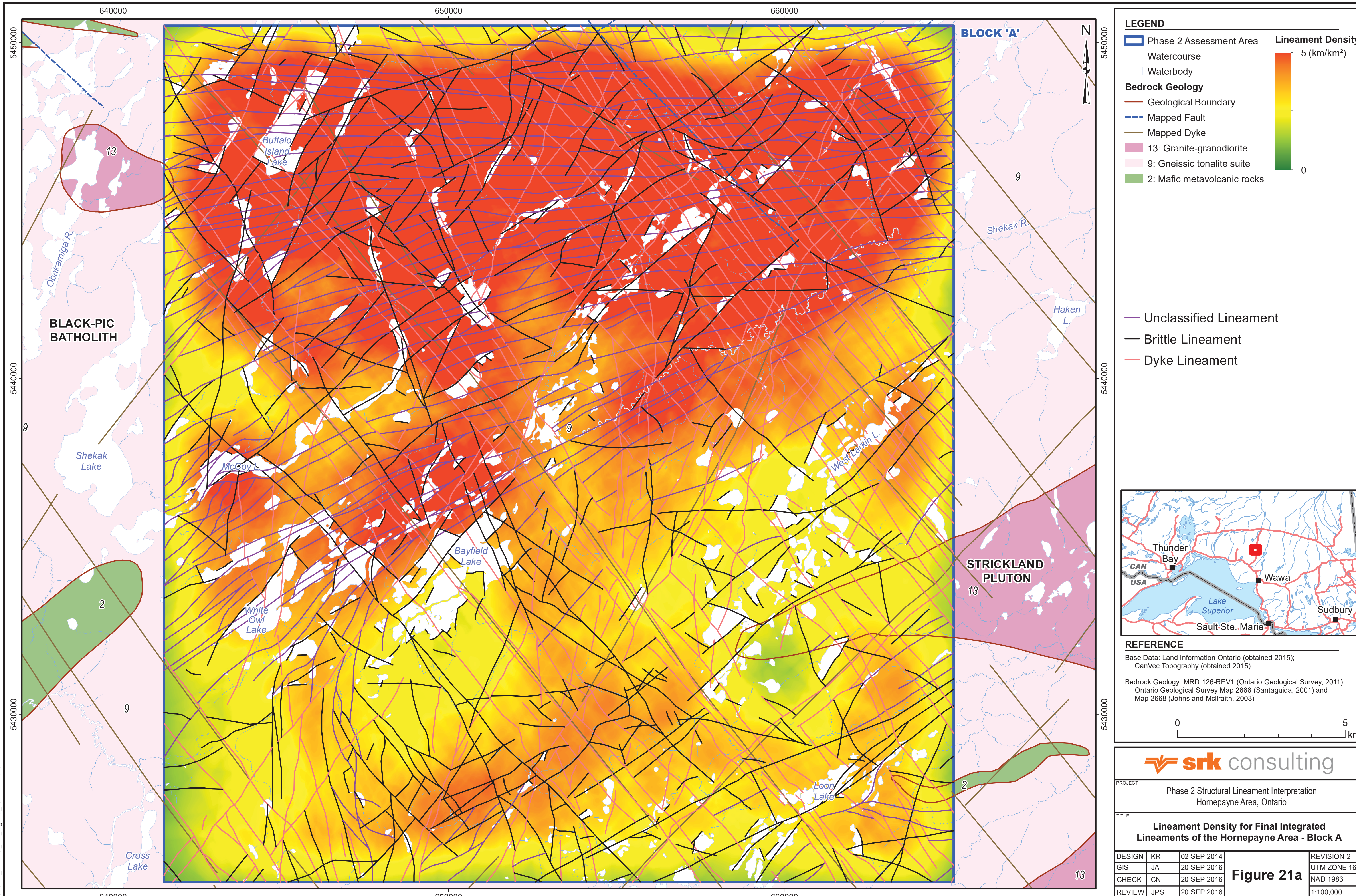
Lineament Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 20b**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

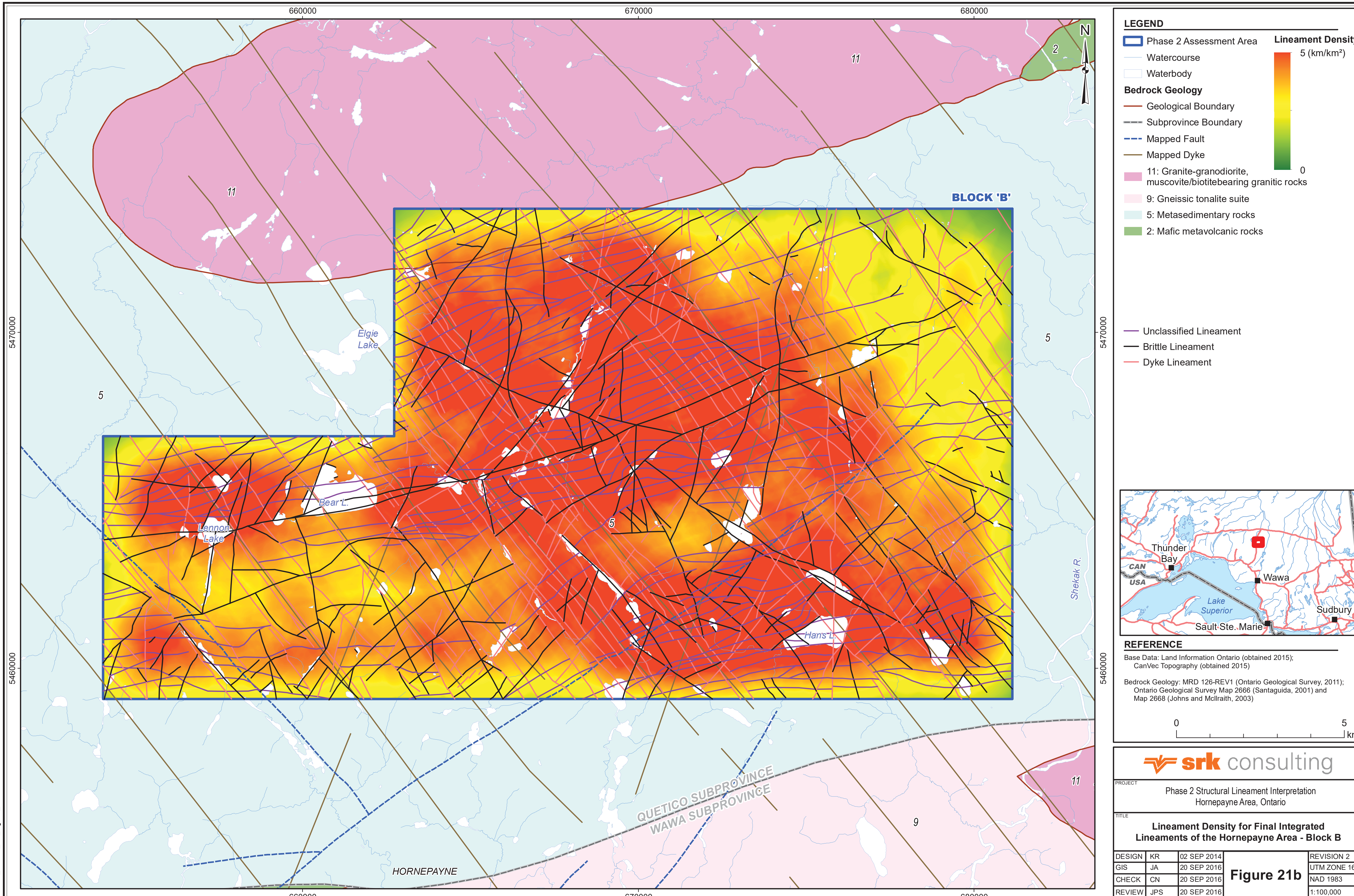
File: SRK_NWMO_HP_Fig20b_fBDLinDens



BLOCK 'B'
BLOCK 'A'
Nagagami Lake
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Shekak R.
Bruce Lake
Linbarr Lake
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
HORNEPAYNE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
Government Lakes
Armitage L.
Mountain Lake
Buffalo Island Lake
Obakamiga Lake
Shekak River
Lascelles Lake
Granitehill Lake
BLACK-PIC BATHOLITH
Shekak Lake
McCoy L.
West Larkin L.
Tocheri Lake
Bayfield Lake
White Owl Lake
Kabinakagamisis Lake
STRICKLAND PLUTON
Loon Lake
Kabinakagami Lake
Cross Lake
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
10: Foliated tonalite suite
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Lineament Density
5 (km/km²)
0
Unclassified Lineament
Brittle Lineament
Dyke Lineament
Thunder Bay
Wawa
CAN
USA
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0 10 km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Density for Final Integrated Lineaments of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 21
REVISION 2
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig21_fUBDLinDens



LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks
Lineament Density
5 (km/km²)
0
Unclassified Lineament
Brittle Lineament
Dyke Lineament
BLOCK 'A'
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
Buffalo Island Lake
McCoy L.
Bayfield Lake
White Owl Lake
West Larkin L.
Loon Lake
Shekak Lake
Shekak R.
Haken L.
Obakamiga R.
Cross Lake
Thunder Bay
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
CAN
USA
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0 5 km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Density for Final Integrated Lineaments of the Hornepayne Area - Block A
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 21a
REVISION 2
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig21a_fUBDLinDens



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

srk consulting

PROJECT

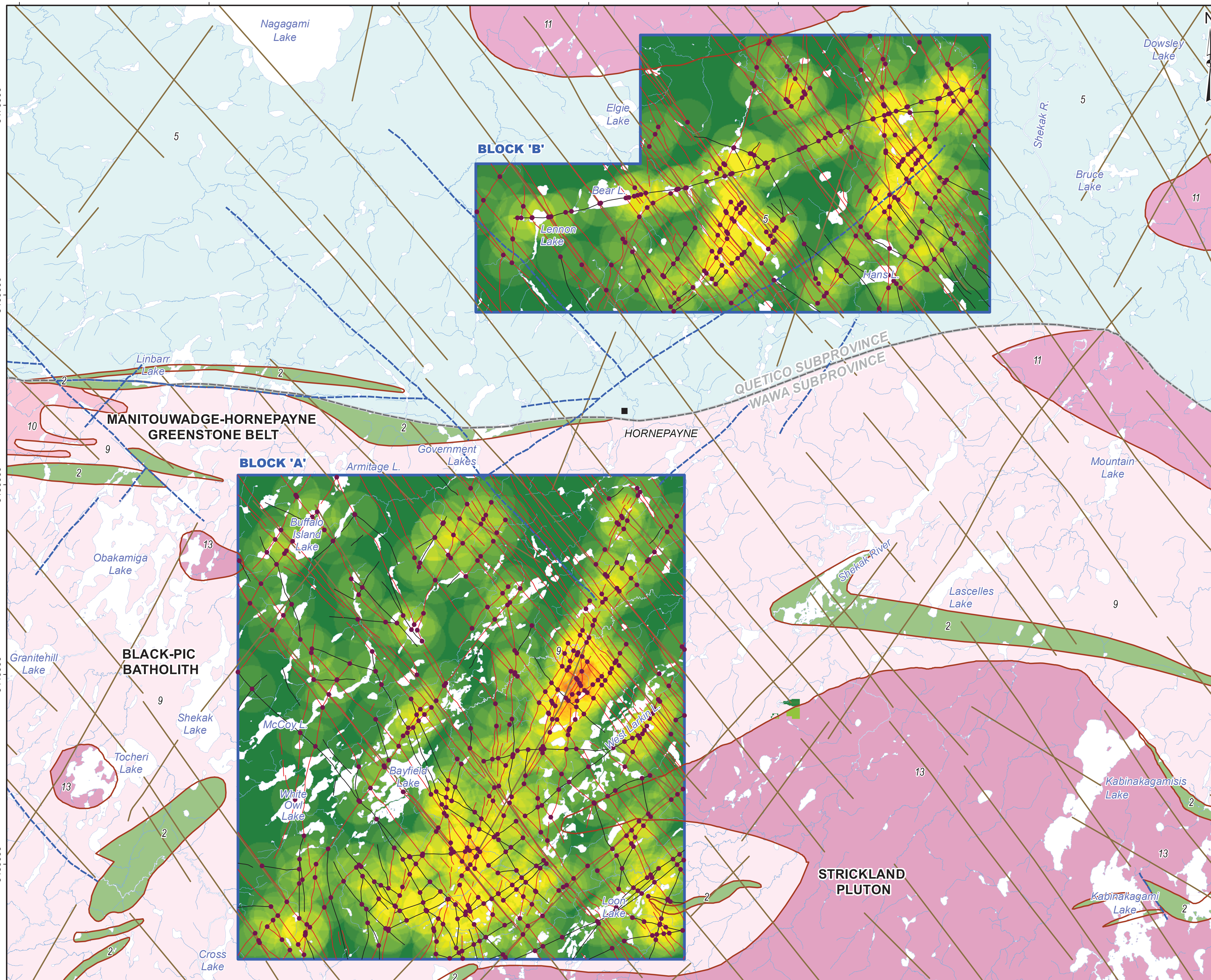
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Lineament Density for Final Integrated Lineaments of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	Figure 21b	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig21b_fUBDLinDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

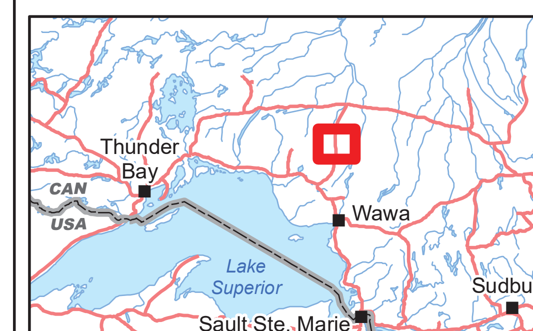
- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Intersection Density

5 (/km²)

0

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 10 km

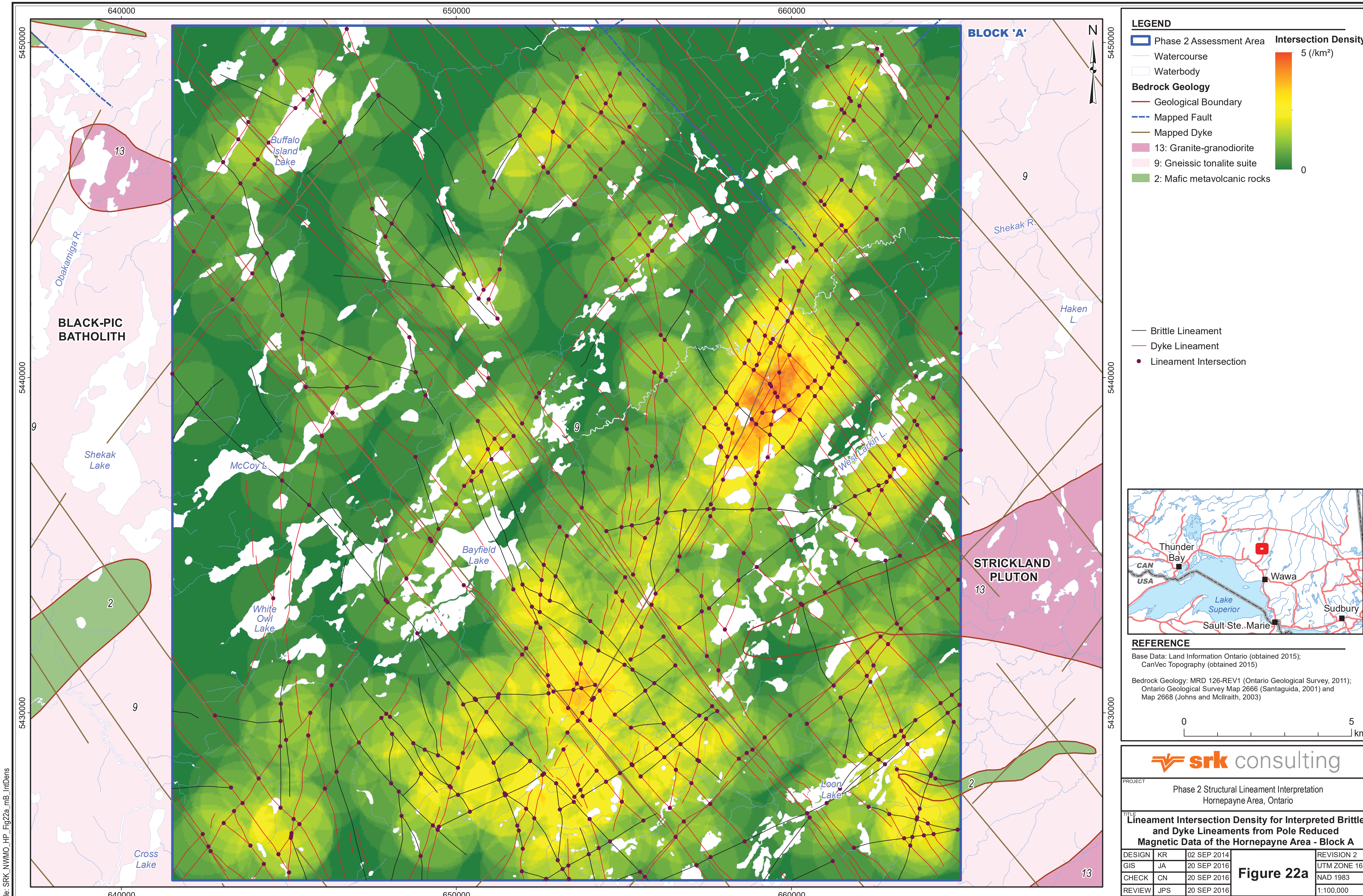
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

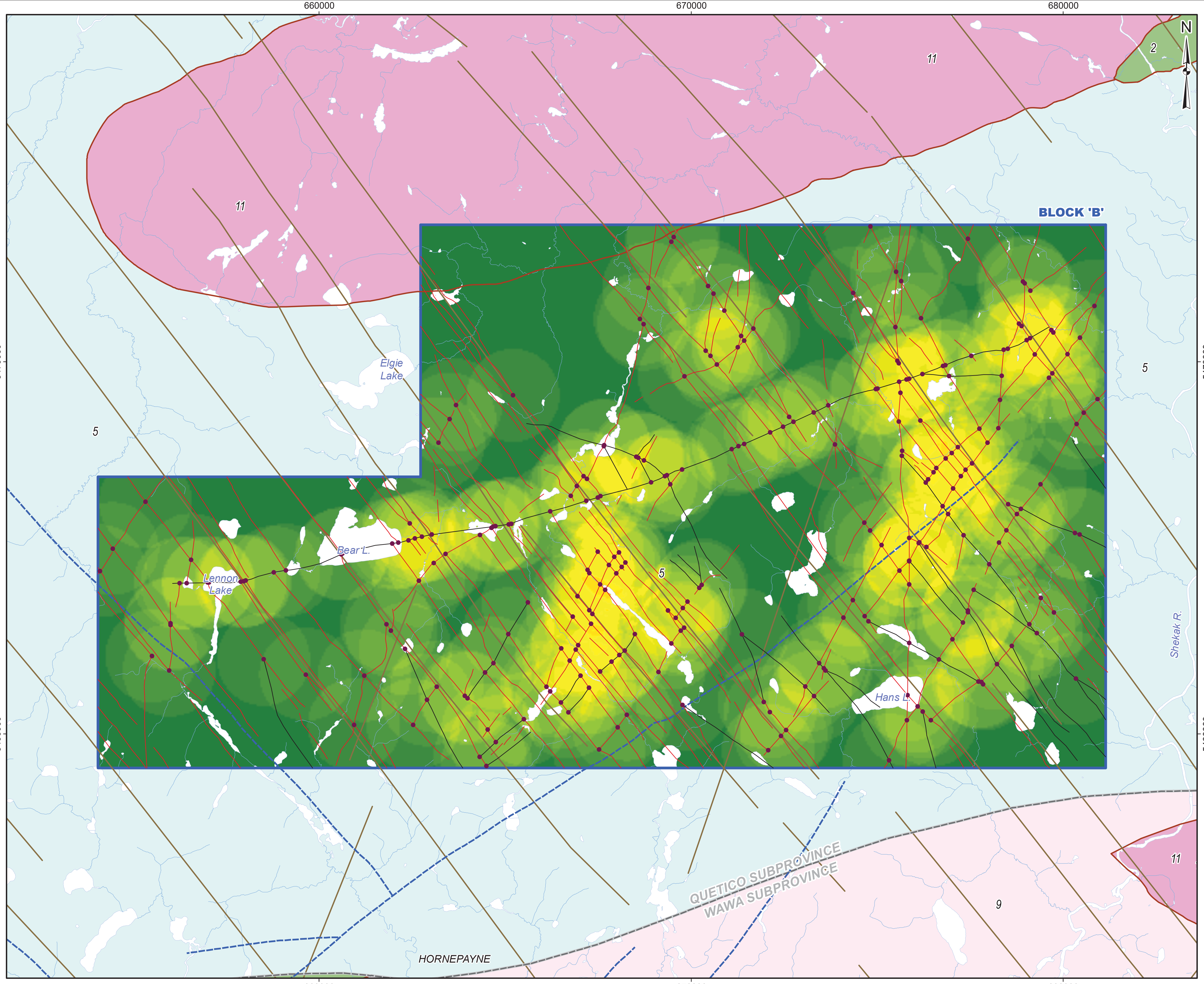
TITLE
Lineament Intersection Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area

DESIGN	KR	02 SEP 2014	**Figure 22**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:200,000

File: SRK_NWMO_HP_Fig22_mB_IntDens



BLOCK 'A'
N
640000
650000
660000
5450000
5440000
5430000
Buffalo Island Lake
Obakamiga R.
BLACK-PIC BATHOLITH
Shekak Lake
McCoy L.
Bayfield Lake
White Owl Lake
Cross Lake
Loon Lake
West Larkin L.
Shekak R.
Haken L.
STRICKLAND PLUTON
13
9
2
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks
Intersection Density
5 (/km²)
0
Brittle Lineament
Dyke Lineament
Lineament Intersection
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Intersection Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block A
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 22a
REVISION 2
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig22a_mB_IntDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

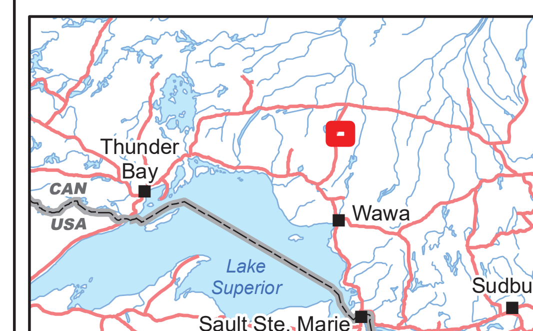
- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Intersection Density

5 (/km²)

0

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

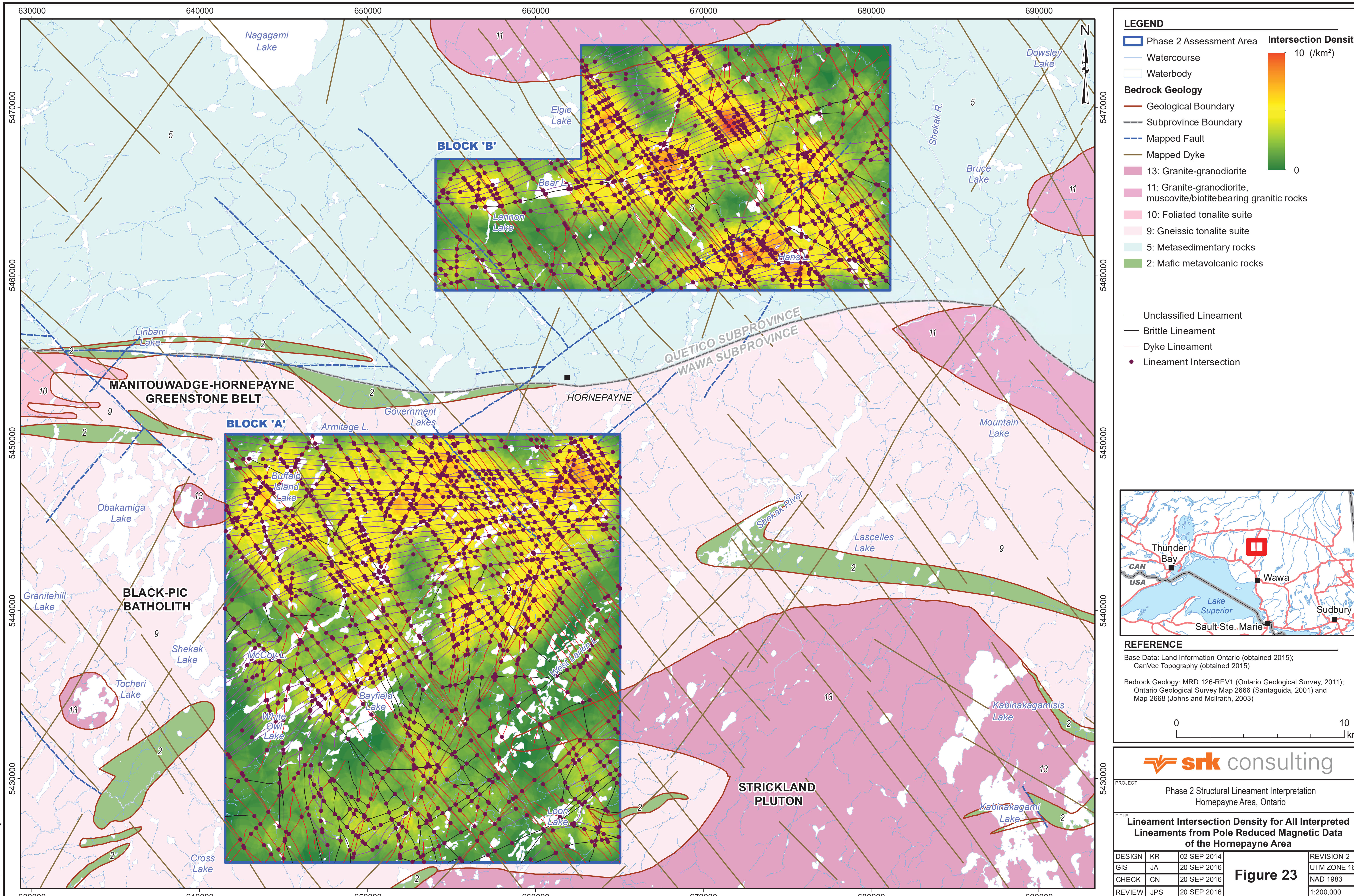
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Lineament Intersection Density for Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 22b**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig22b_mB_IntDens



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

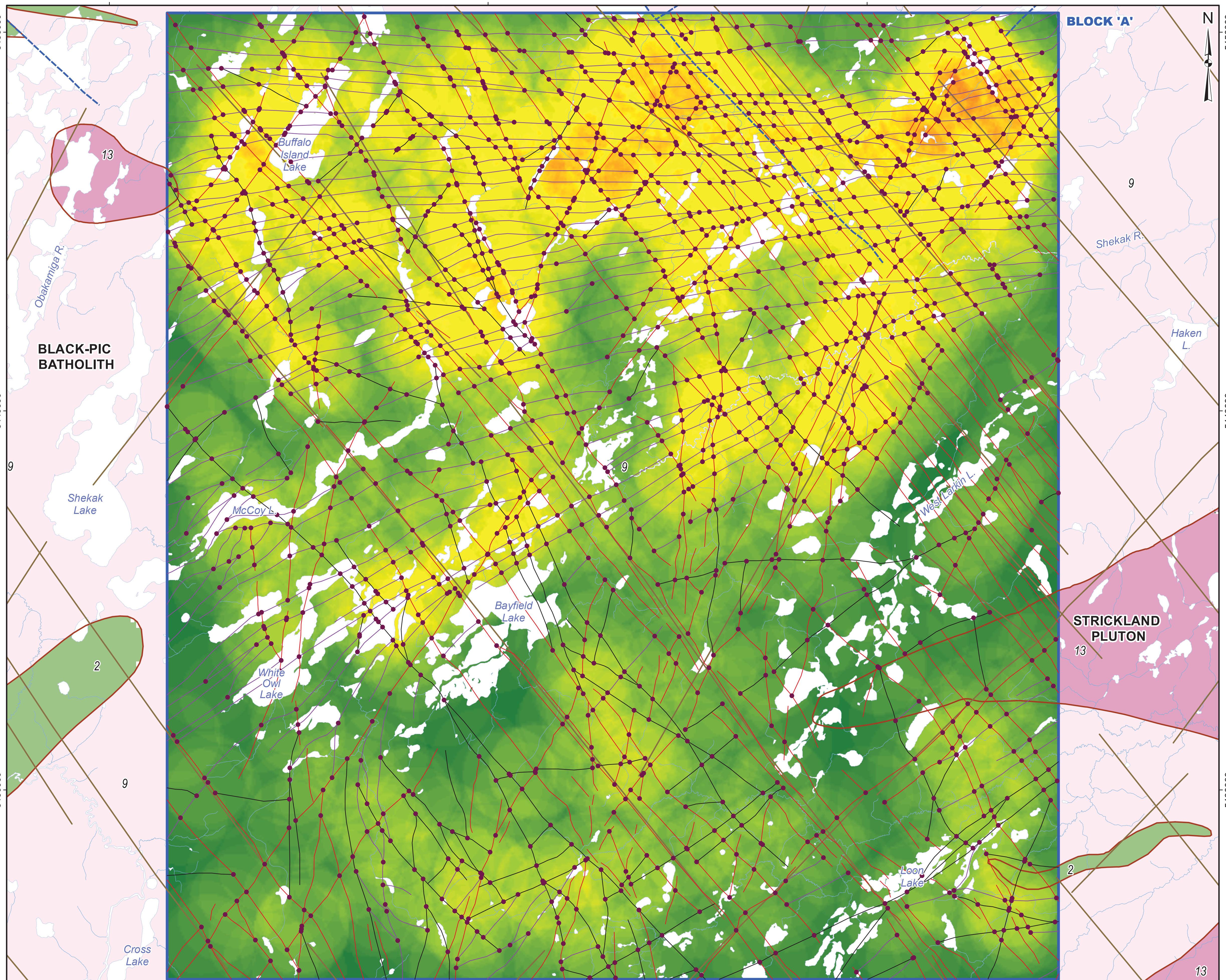
srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation Hornepayne Area, Ontario

TITLE: **Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area**

DESIGN	KR	02 SEP 2014	Figure 23	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:200,000

File: SRK_NWMO_HP_Fig23_mALL_IntDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 9: Gneissic tonalite suite
- 2: Mafic metavolcanic rocks

Intersection Density

10 (/km²)

0

- Unclassified Lineament
- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

Thunder Bay, CAN, USA, Wawa, Lake Superior, Sudbury, Sault Ste. Marie

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

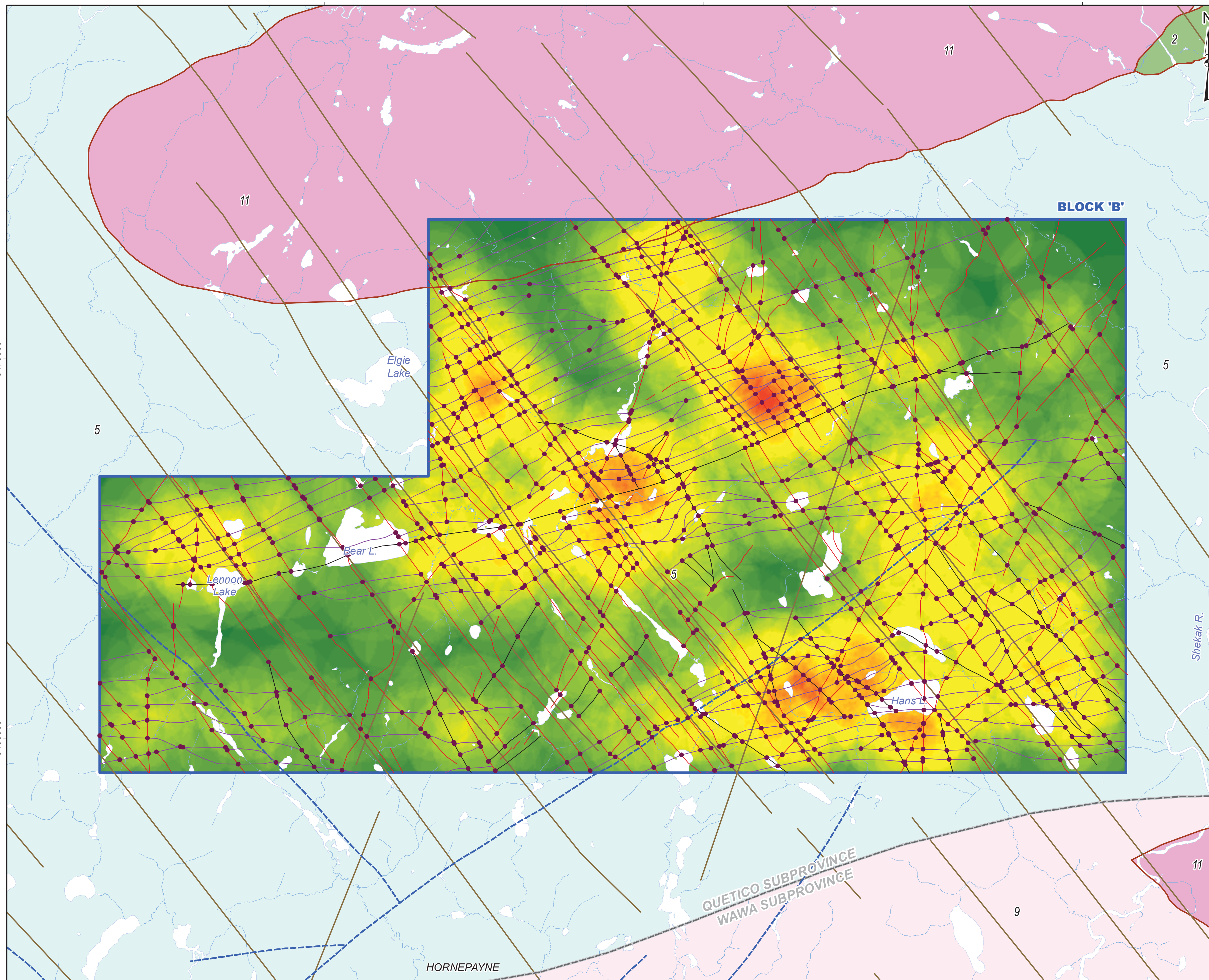
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	Figure 23a	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig23a_mALL_IntDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Intersection Density

10 (/km²)

0

- Unclassified Lineament
- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

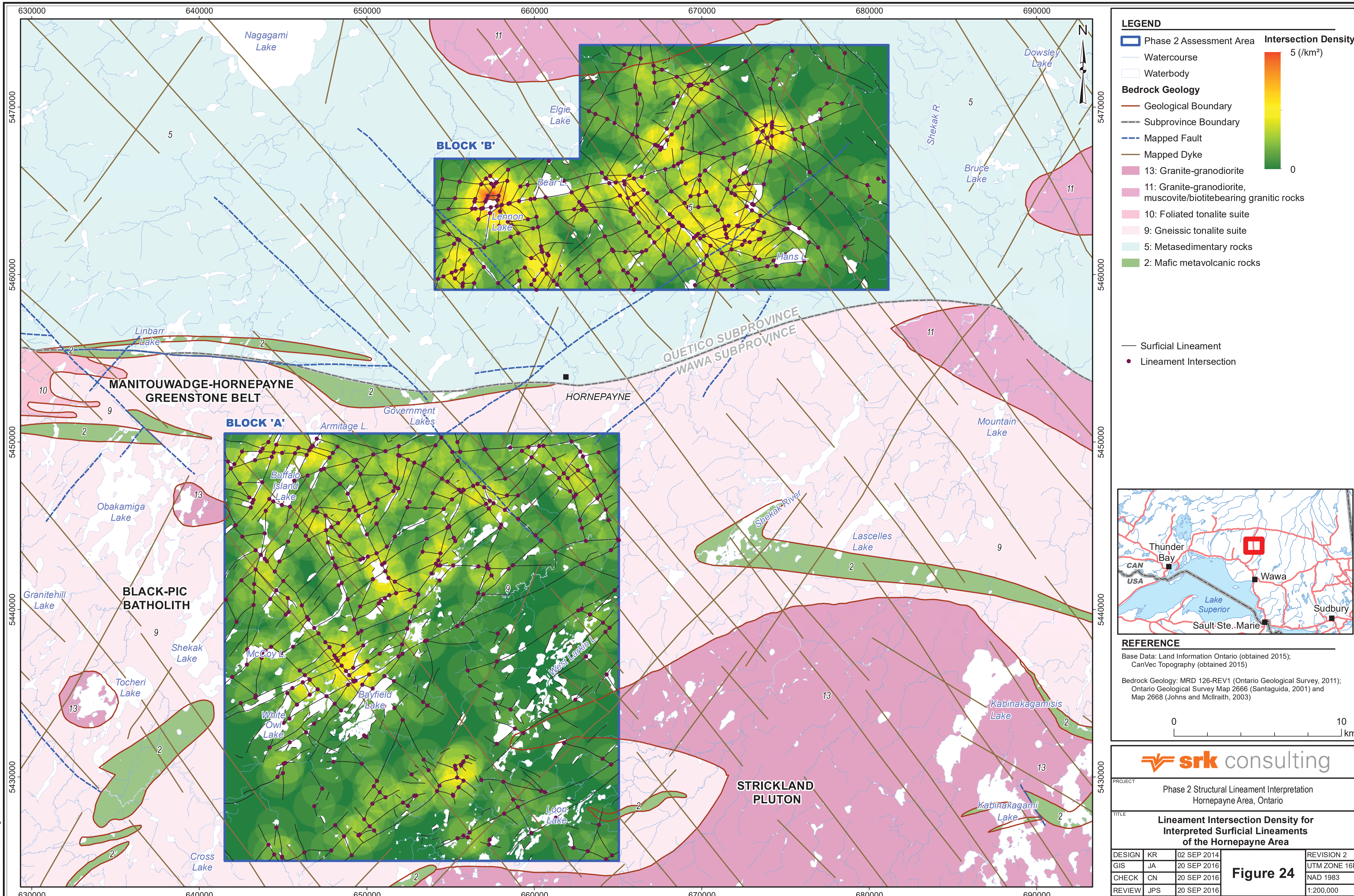
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

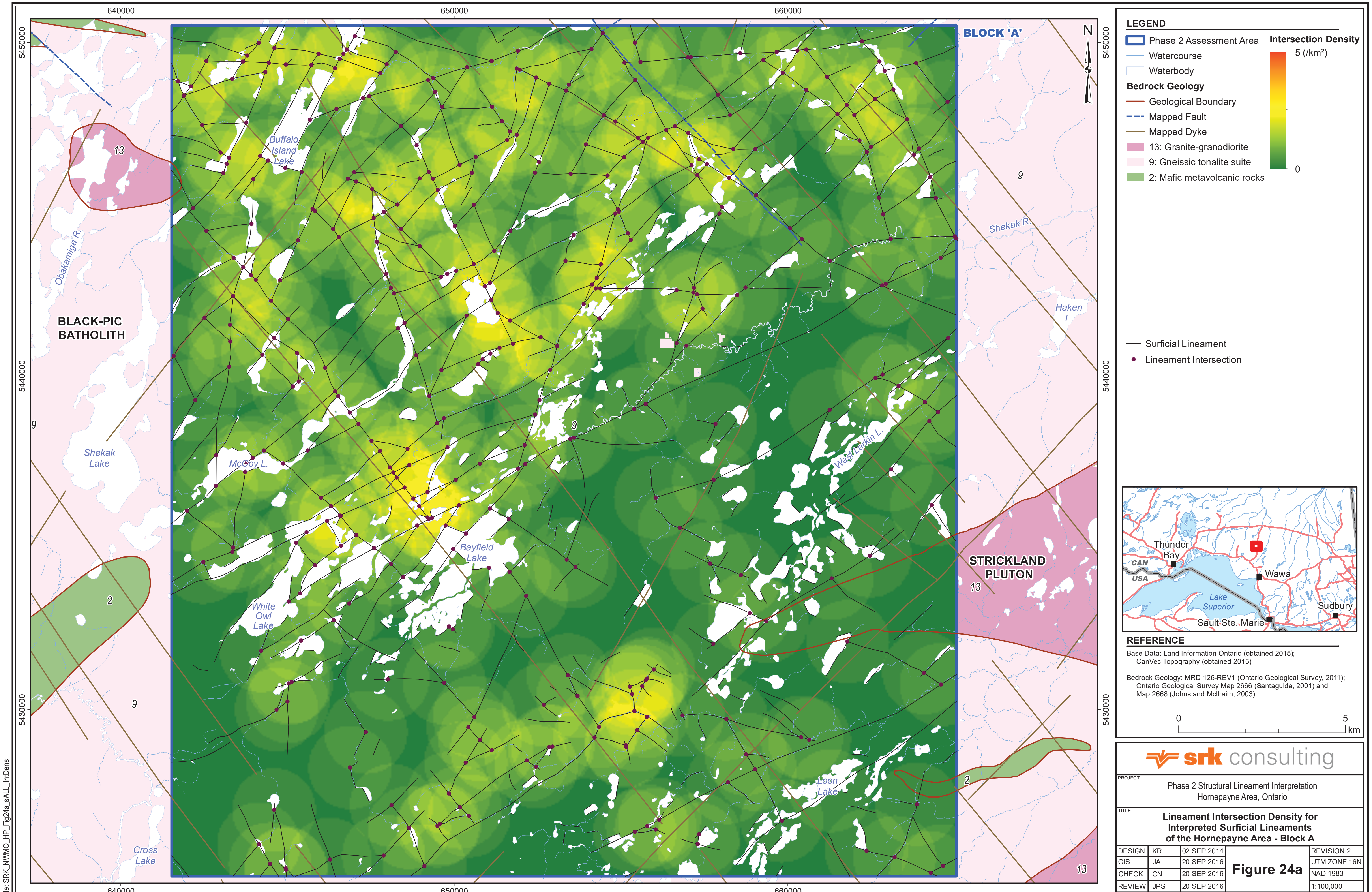
TITLE

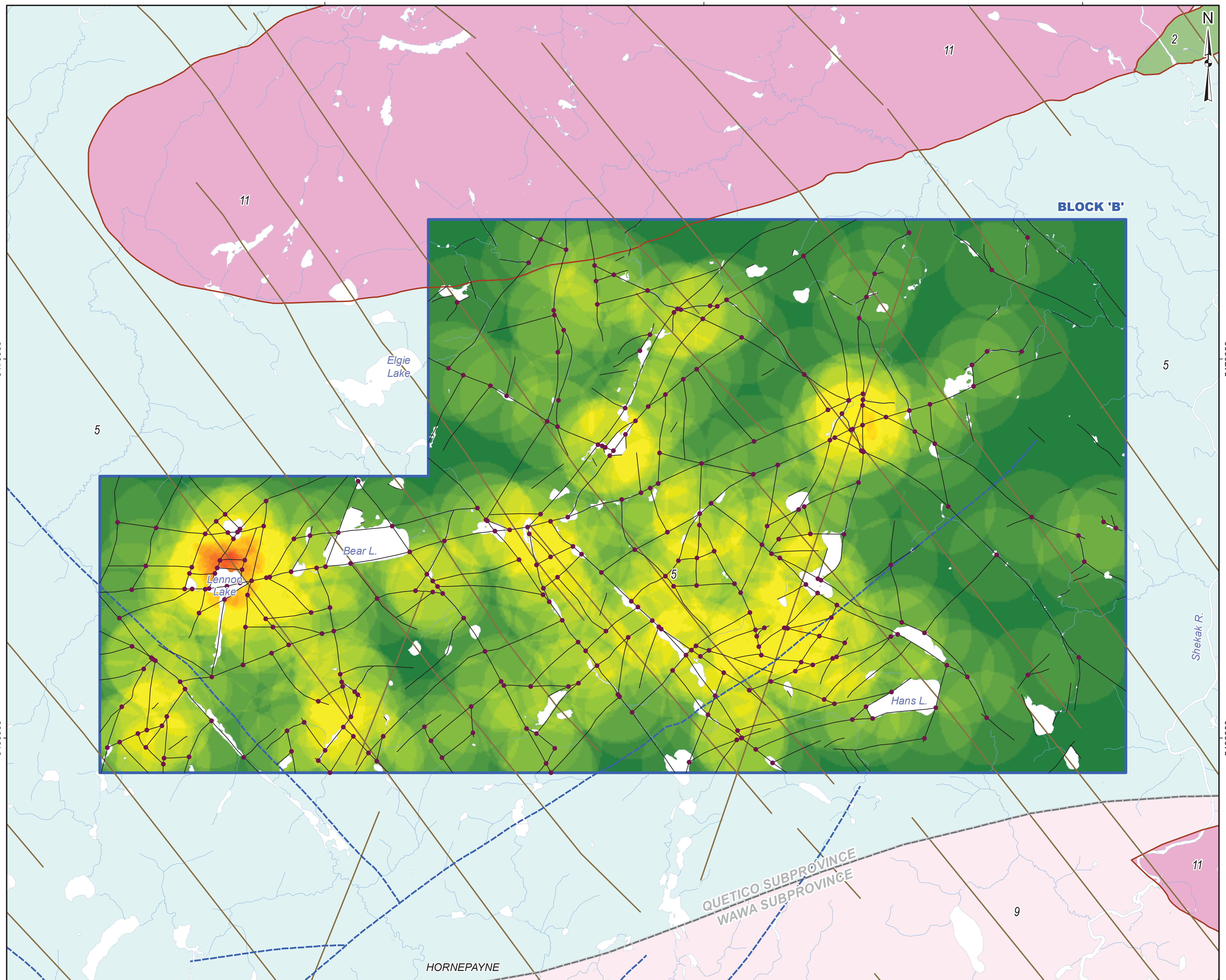
Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 23b**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig23b_mALL_IntDens


LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
10: Foliated tonalite suite
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Intersection Density
5 (/km²)
0
Surficial Lineament
Lineament Intersection
BLOCK 'B'
BLOCK 'A'
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
HORNEPAYNE
Nagagami Lake
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Dowsley Lake
Bruce Lake
Shekak R.
Linbarr Lake
Government Lakes
Armitage L.
Buffalo Island Lake
Obakamiga Lake
Granitehill Lake
Shekak Lake
Tocheri Lake
McCoy L.
Bayfield Lake
White Owl Lake
West Larkin L.
Loon Lake
Cross Lake
Mountain Lake
Shekak River
Lascelles Lake
Kabinakagamisis Lake
Kabinakagami Lake
Thunder Bay
Wawa
Sudbury
Sault Ste. Marie
Lake Superior
CAN
USA
N
630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Intersection Density for Interpreted Surficial Lineaments of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 24
REVISION 2
UTM ZONE 16N
NAD 1983
1:200,000
File: SRK_NWMO_HP_Fig24_sALL_IntDens


BLOCK 'A'
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
Buffalo Island Lake
McCoy L.
Shekak Lake
Bayfield Lake
White Owl Lake
West Larkin L.
Loon Lake
Cross Lake
Shekak R.
Haken L.
Obakamiga R.
640000
650000
660000
5450000
5440000
5430000
N
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks
Intersection Density
5 (/km²)
0
Surficial Lineament
Lineament Intersection
Thunder Bay
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
CAN
USA
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Intersection Density for Interpreted Surficial Lineaments of the Hornepayne Area - Block A
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 24a
REVISION 2
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig24a_sALL_IntDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- 11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
- 9: Gneissic tonalite suite
- 5: Metasedimentary rocks
- 2: Mafic metavolcanic rocks

Intersection Density

5 (/km²)

0

- Surficial Lineament
- Lineament Intersection

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

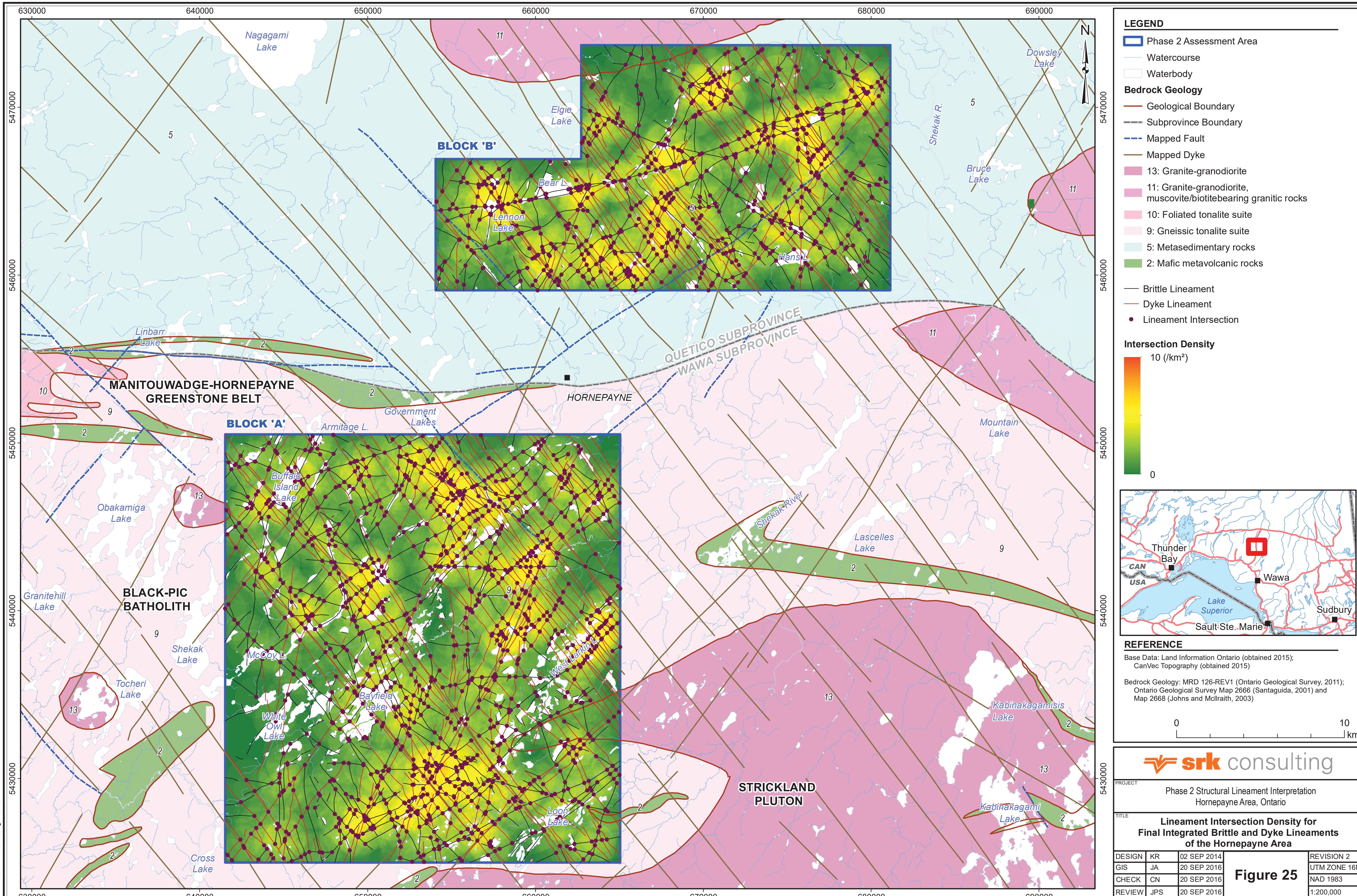
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

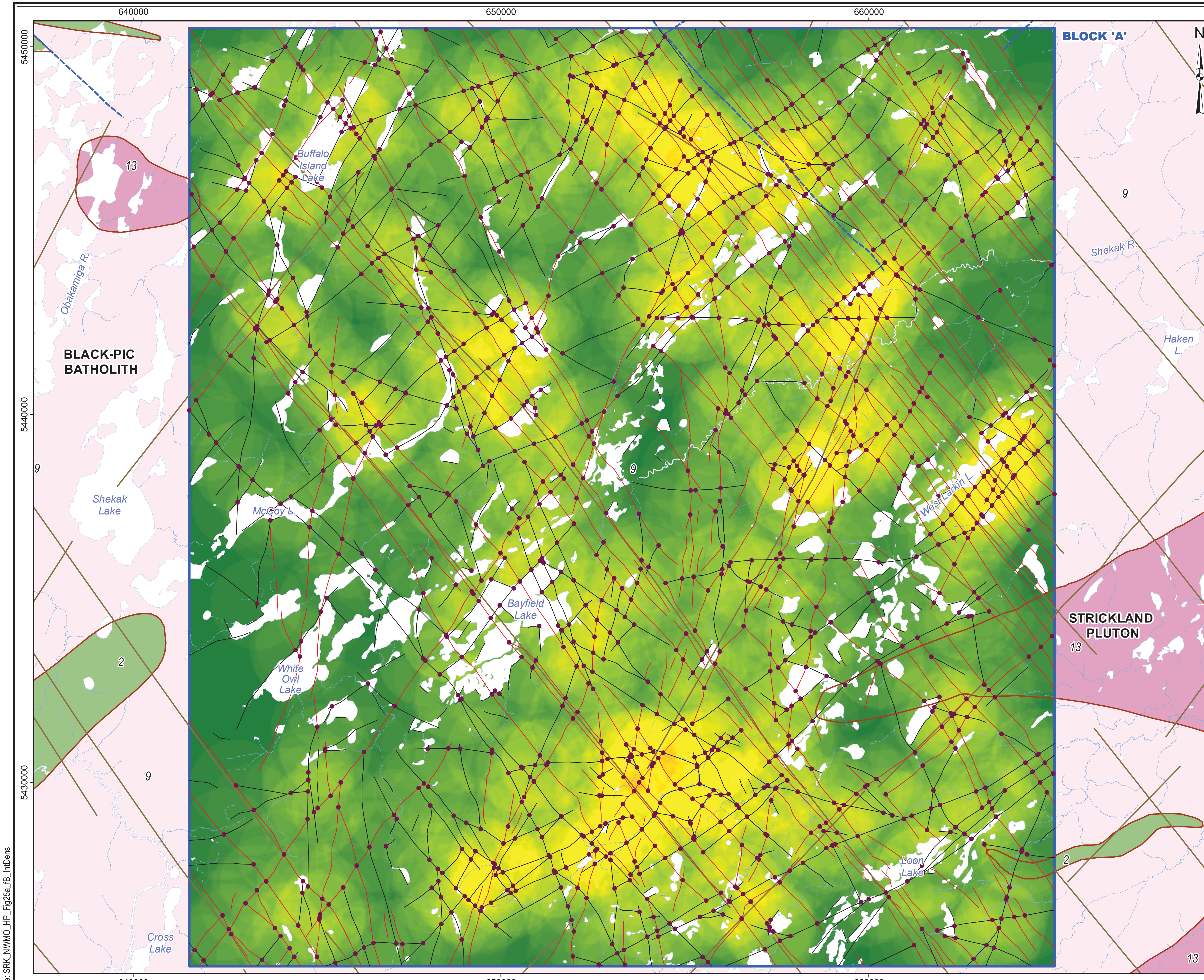
Lineament Intersection Density for Interpreted Surficial Lineaments of the Hornepayne Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 24b**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig24b_sALL_IntDens



File: SRK_NWMO_HP_Fig25_fB_IntDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

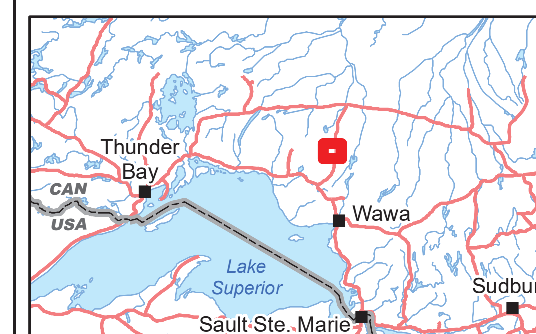
- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 9: Gneissic tonalite suite
- 2: Mafic metavolcanic rocks

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

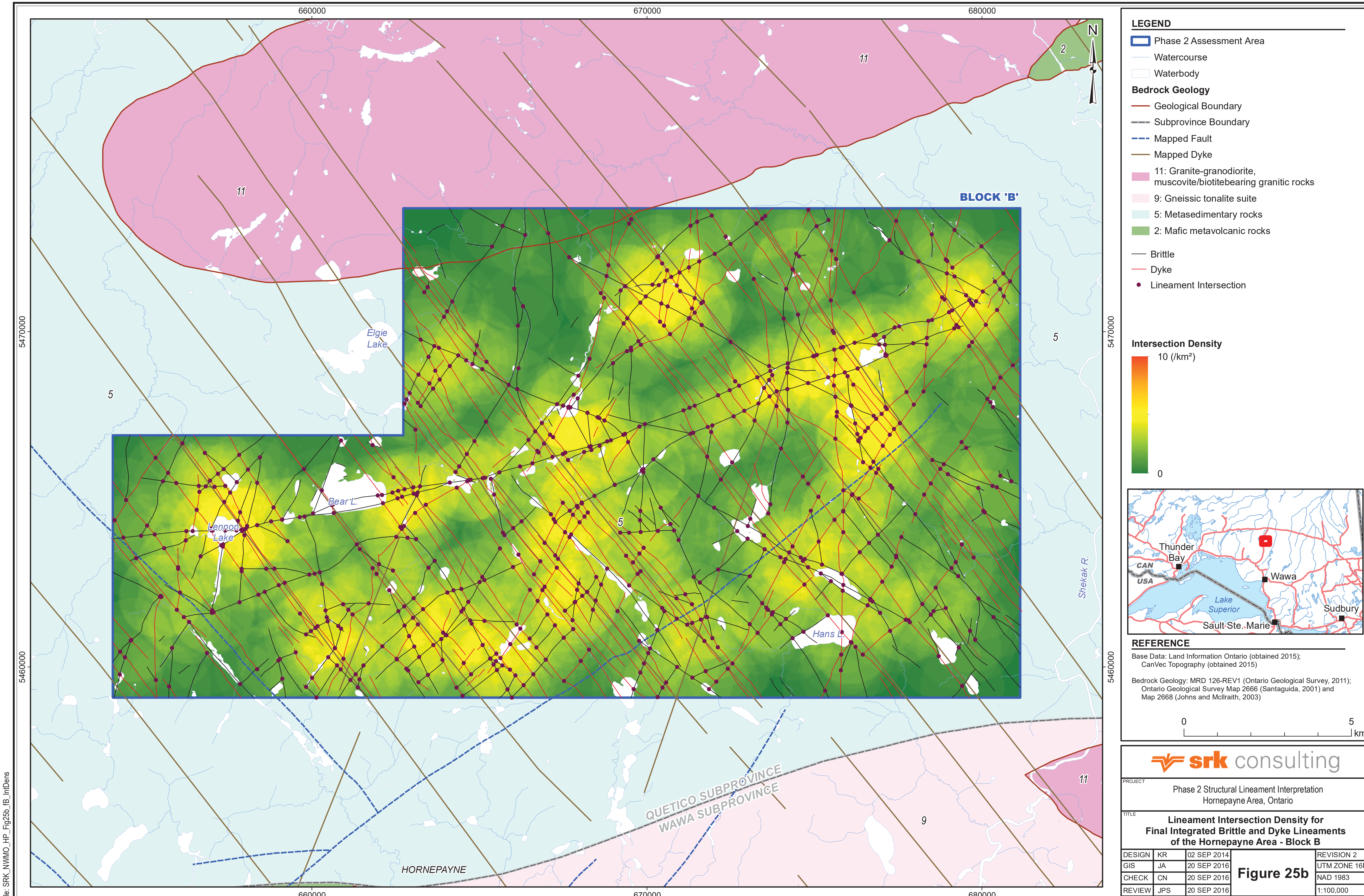
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

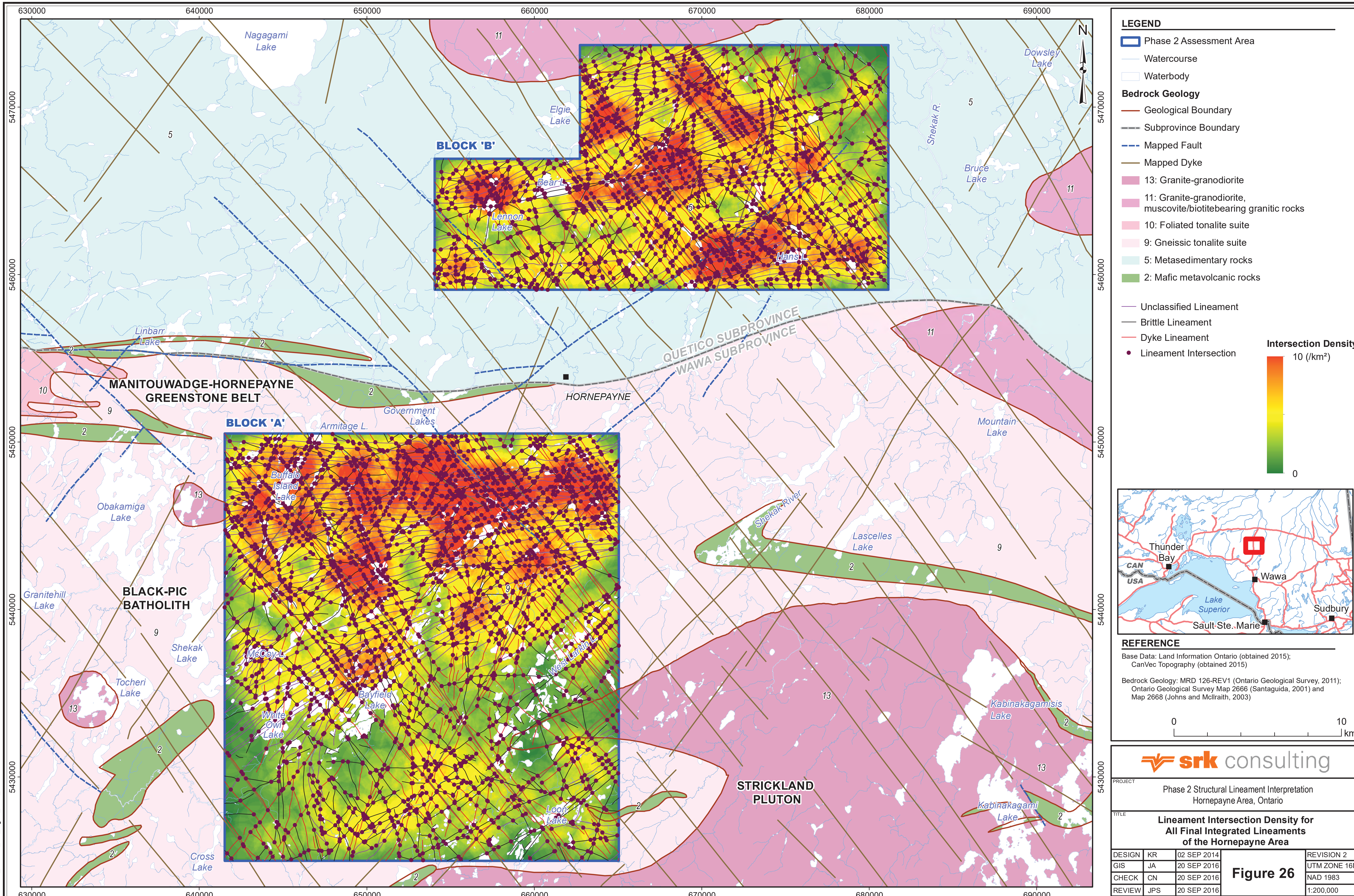
Lineament Intersection Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 25a**	REVISION 2
GIS	JA	20 SEP 2016		UTM ZONE 16N
CHECK	CN	20 SEP 2016		NAD 1983
REVIEW	JPS	20 SEP 2016		1:100,000

File: SRK_NWMO_HP_Fig25a_fB_IntDens



660000
670000
680000
5470000
5460000
N
11
2
5
9
BLOCK 'B'
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Shekak R.
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
HORNEPAYNE
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Brittle
Dyke
Lineament Intersection
Intersection Density
10 (/km²)
0
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Intersection Density for Final Integrated Brittle and Dyke Lineaments of the Hornepayne Area - Block B
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 25b
REVISION 2
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig25b_fB_IntDens


LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
10: Foliated tonalite suite
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Unclassified Lineament
Brittle Lineament
Dyke Lineament
Lineament Intersection
Intersection Density
10 (/km²)
0
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sault Ste. Marie
Sudbury
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
10
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Intersection Density for All Final Integrated Lineaments of the Hornepayne Area
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 26
REVISION 2
UTM ZONE 16N
NAD 1983
1:200,000
BLOCK 'B'
BLOCK 'A'
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
HORNEPAYNE
MANITOUWADGE-HORNEPAYNE GREENSTONE BELT
BLACK-PIC BATHOLITH
STRICKLAND PLUTON
Nagagami Lake
Elgie Lake
Dowsley Lake
Bruce Lake
Bear L.
Lennon Lake
Hans L.
Shekak R.
Linbarr Lake
Government Lakes
Armitage L.
Mountain Lake
Buffalo Island Lake
Obakamiga Lake
Shekak River
Lascelles Lake
Granitehill Lake
Shekak Lake
McCoy L.
West Larkin L.
Tocheri Lake
Bayfield Lake
White Owl Lake
Kabinakagamisis Lake
Kabinakagami Lake
Loon Lake
Cross Lake
N
630000
640000
650000
660000
670000
680000
690000
5470000
5460000
5450000
5440000
5430000
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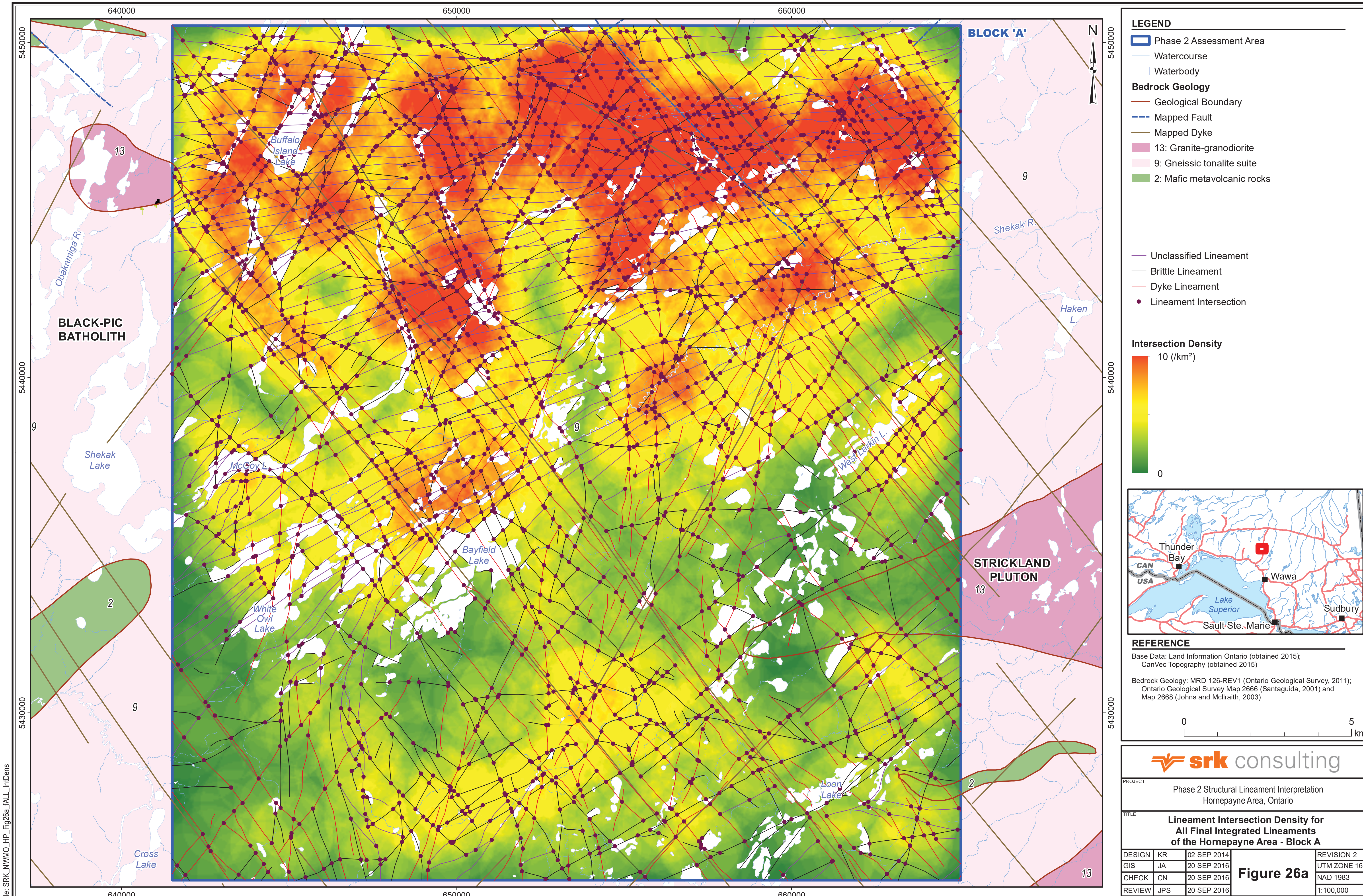
BLOCK 'A'
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Mapped Fault
Mapped Dyke
13: Granite-granodiorite
9: Gneissic tonalite suite
2: Mafic metavolcanic rocks
Unclassified Lineament
Brittle Lineament
Dyke Lineament
Lineament Intersection
Intersection Density
10 (/km²)
0
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Intersection Density for
All Final Integrated Lineaments
of the Hornepayne Area - Block A
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 26a
REVISION 2
UTM ZONE 16N
NAD 1983
1:100,000
640000
650000
660000
5450000
5440000
5430000
BLACK-PIC
BATHOLITH
STRICKLAND
PLUTON
Buffalo
Island
Lake
Obakamiga R.
Shekak
Lake
McCoy L.
Bayfield
Lake
White
Owl
Lake
West Larkin L.
Shekak R.
Haken
L.
Loon
Lake
Cross
Lake
Thunder
Bay
Wawa
Lake
Superior
Sudbury
Sault Ste. Marie
CAN
USA
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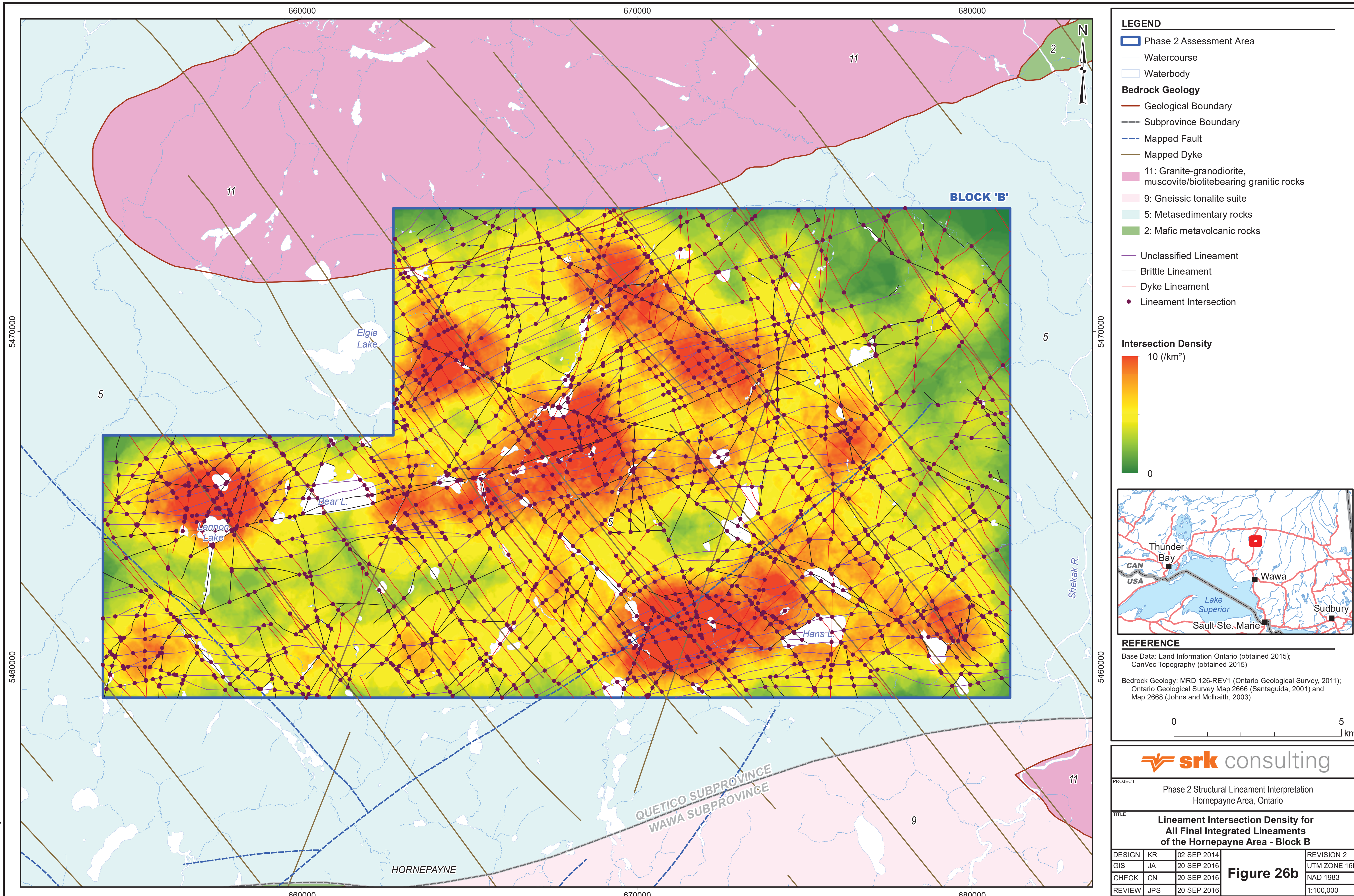
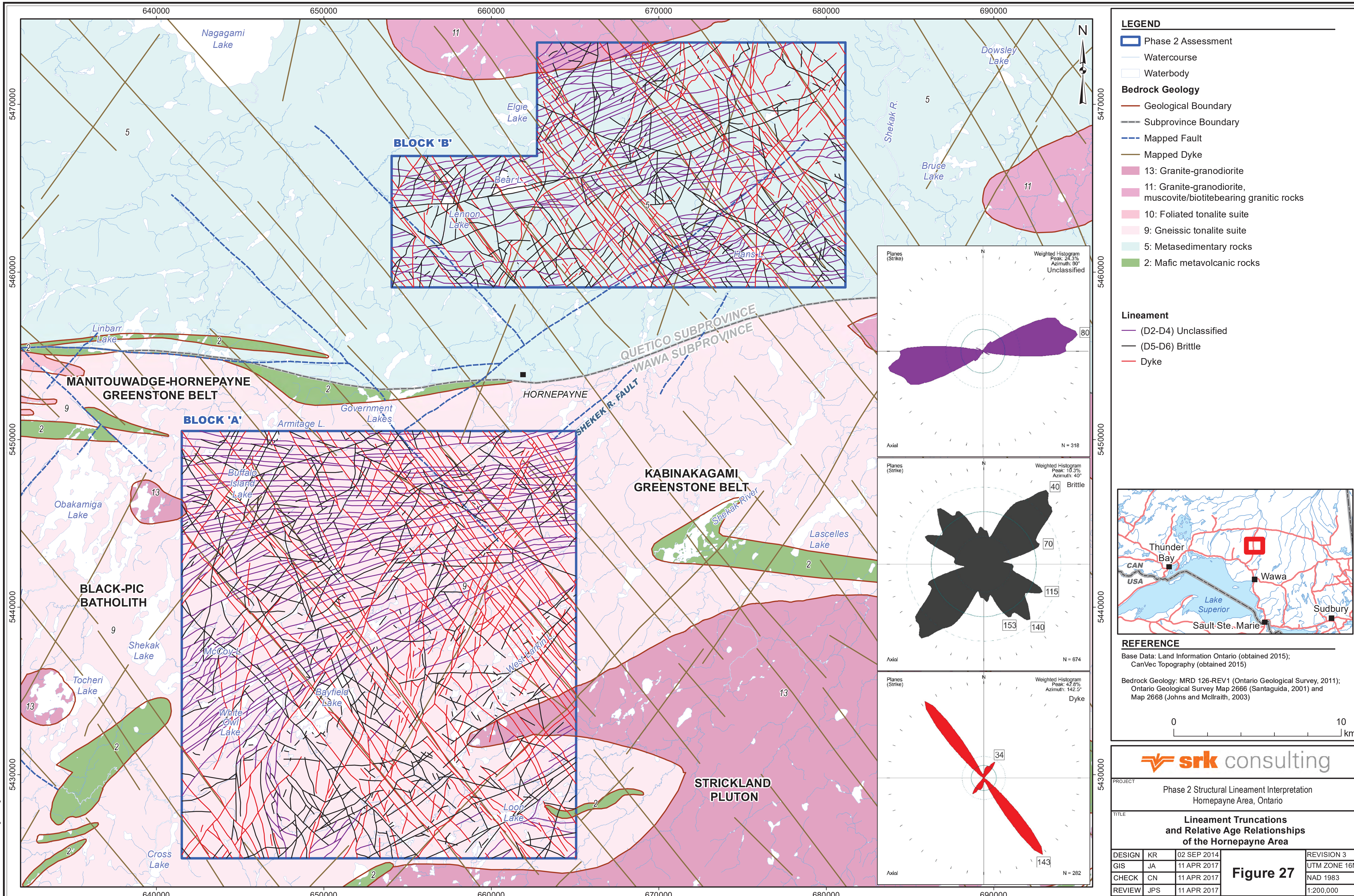


660000
670000
680000
5470000
5460000
11
2
5
9
BLOCK 'B'
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Shekak R.
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
HORNEPAYNE
N
LEGEND
Phase 2 Assessment Area
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Unclassified Lineament
Brittle Lineament
Dyke Lineament
Lineament Intersection
Intersection Density
10 (/km²)
0
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0
5
km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Intersection Density for All Final Integrated Lineaments of the Hornepayne Area - Block B
DESIGN KR 02 SEP 2014
GIS JA 20 SEP 2016
CHECK CN 20 SEP 2016
REVIEW JPS 20 SEP 2016
Figure 26b
REVISION 2
UTM ZONE 16N
NAD 1983
1:100,000
File: SRK_NWMO_HP_Fig26b_fALL_IntDens



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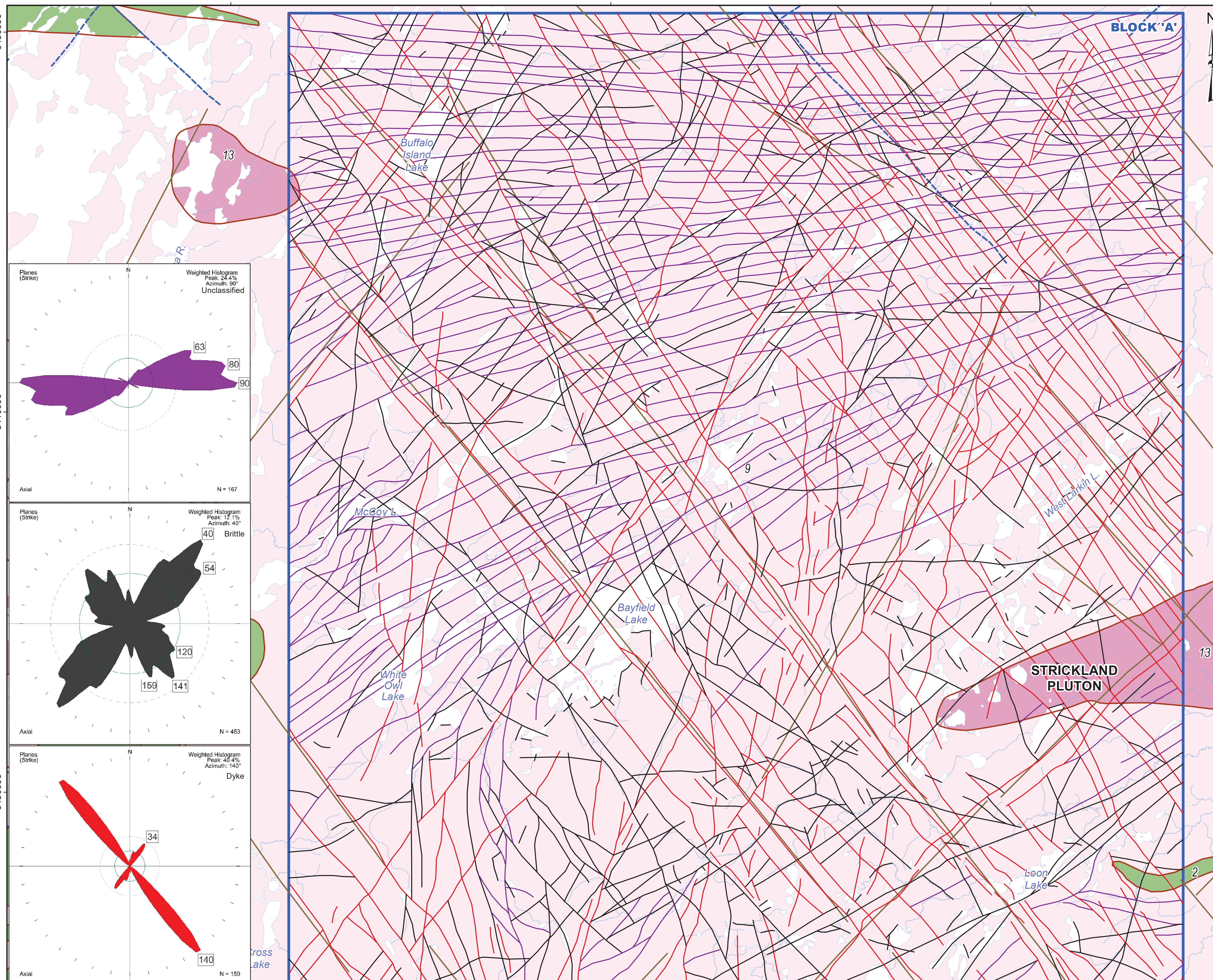


LEGEND

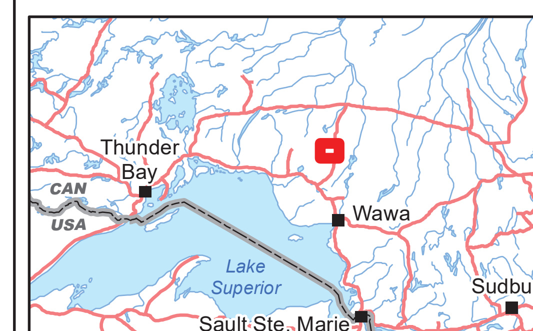
- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 9: Gneissic tonalite suite
- 2: Mafic metavolcanic rocks

Lineament

- (D2-D4) Unclassified
- (D5-D6) Brittle
- Dyke



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario

TITLE

Lineament Truncations and Relative Age Relationships of the Hornepayne Area - Block A

DESIGN	KR	02 SEP 2014	Figure 27a	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:100,000

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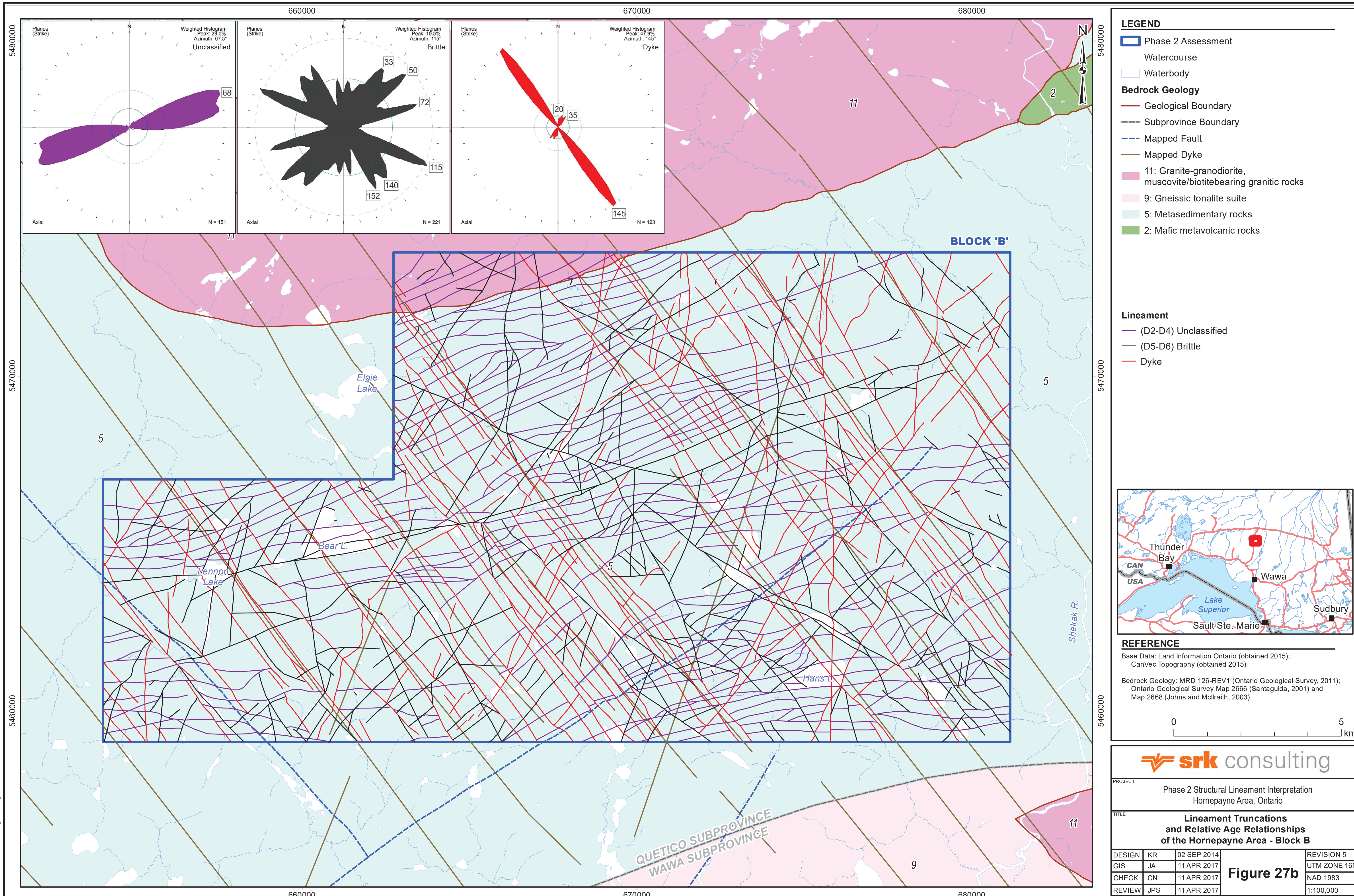

Unclassified
Brittle
Dyke
BLOCK 'B'
Elgie Lake
Bear L.
Lennon Lake
Hans L.
Shekak R.
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
LEGEND
Phase 2 Assessment
Watercourse
Waterbody
Bedrock Geology
Geological Boundary
Subprovince Boundary
Mapped Fault
Mapped Dyke
11: Granite-granodiorite, muscovite/biotitebearing granitic rocks
9: Gneissic tonalite suite
5: Metasedimentary rocks
2: Mafic metavolcanic rocks
Lineament
(D2-D4) Unclassified
(D5-D6) Brittle
Dyke
Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie
REFERENCE
Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2666 (Santaguida, 2001) and Map 2668 (Johns and McIlraith, 2003)
0 5 km
srk consulting
PROJECT
Phase 2 Structural Lineament Interpretation
Hornepayne Area, Ontario
TITLE
Lineament Truncations and Relative Age Relationships of the Hornepayne Area - Block B
DESIGN KR 02 SEP 2014
GIS JA 11 APR 2017
CHECK CN 11 APR 2017
REVIEW JPS 11 APR 2017
Figure 27b
REVISION 5
UTM ZONE 16N
NAD 1983
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