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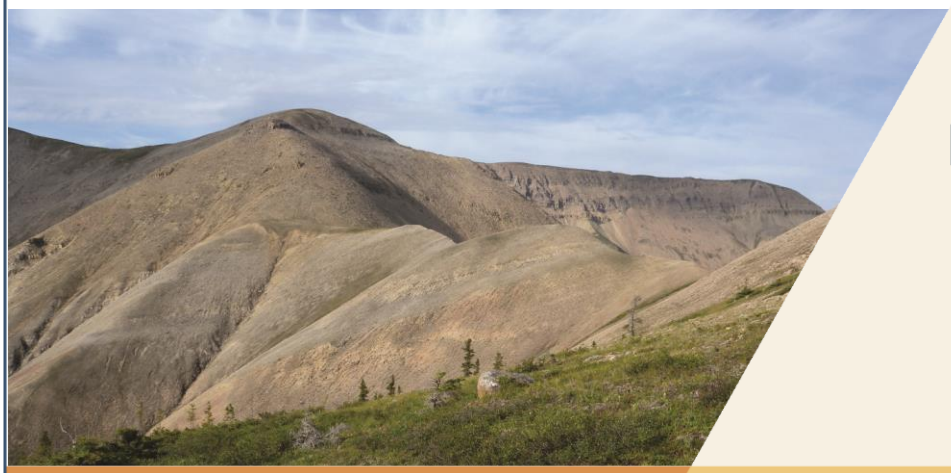
CANADIAN GEOSCIENCE MAP 100

GEOLOGY

NORMAN WELLS (SOUTHEAST)

Northwest Territories



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Cover Illustration

View looking southwest at a minor thrust fault placing brown-weathering dolostone of the middle member of the Franklin Mountain Formation over light grey-weathering upper member on the northeast side of Discovery Ridge, Norman Range, Northwest Territories.

ABSTRACT

The southeast quadrant of Norman Wells map area (NTS 96-E) covers parts of the Franklin Mountains and Mackenzie Plain, Northwest Territories. The area varies from low-lying forested plain to alpine mountainous terrain along the Norman Range, with bedrock exposures concentrated along the mountain ridges, and stream or lake outcrops. The geological interpretation in poorly exposed portions of the Mackenzie Plain has been enhanced by examination of public-domain seismic-reflection lines, archived with the National Energy Board. Cordilleran deformation from the southwest has triggered uplift of Cambrian and younger strata along reverse or thrust faults in the Franklin Mountains. The variation in trend of significant faults is believed to be due to the reactivation of older normal faults. To the southwest of the Norman Range, the Mackenzie Plain is dominated by folded Devonian and Cretaceous siliciclastic strata that have largely been planed off by glacial activity. The presence of the Saline River Formation, an evaporitic unit, in the hanging wall of larger faults suggests its

involvement as a local detachment surface. An unconformity at the base of Upper Cretaceous strata cuts more deeply into underlying Lower Cretaceous and Devonian strata to the northeast, a reflection of uplift along the Keele Arch before deposition of the Slater River Formation. This map area includes the Norman Wells oilfield, a field that has been active for many decades, producing oil from the Kee Scarp Member of the Ramparts Formation, a limestone reef encased in shale.

RÉSUME

Le quadrant sud-est de la région cartographique de Norman Wells (SNRC 96-E) couvre des parties des monts Franklin et de la plaine du Mackenzie (Territoires du Nord-Ouest). La région passe d'une basse plaine boisée à un terrain montagneux alpin le long du chaînon Norman, avec des affleurements rocheux qui sont concentrés le long des crêtes montagneuses, ainsi que des ruisseaux ou des lacs. L'interprétation géologique dans les portions pauvres en affleurements de la plaine du Mackenzie a été améliorée par l'examen de profils de sismique-réflexion du domaine public, archivés par l'Office national de l'énergie. La déformation cordillérienne en provenance du sud-ouest a déclenché le soulèvement des strates du Cambrien et de temps plus récents le long de failles inverses ou de failles de chevauchement dans les monts Franklin. La variation dans la direction des failles d'importance serait causée par la réactivation de failles anciennes. Au sud-ouest du chaînon Norman, le sous-sol de la plaine du Mackenzie est constitué en prédominance de strates silicoclastiques du Dévonien et du Crétacé qui ont été en grande partie arasées par l'action des glaciers. La présence de la Formation de Saline River, une unité évaporitique, dans le toit de grandes failles donne à penser qu'elle a agi comme surface locale de décollement. Une discordance à la base de la succession du Crétacé supérieur s'enfonce plus profondément dans les strates du Crétacé inférieur et du Dévonien au nord-est, ce qui témoigne du soulèvement s'étant produit le long de l'arche de Keele avant le dépôt de la Formation de Slater River. Cette région cartographique englobe le champ pétrolifère de Norman Wells, actif depuis plusieurs dizaines d'années, où le pétrole est extrait du Membre de Kee Scarp de la Formation de Ramparts, à partir d'un récif calcaire encaissé dans du shale.

ABOUT THE MAP

General Information

Authors: K.M. Fallas and R.B. MacNaughton

Geological compilation by K.M. Fallas, and R.B. MacNaughton, 2011–2012

Geological field observations by K.M. Fallas, K. Montgomery, R. Lemiski (Northwest Territories Geoscience Office), R.B. MacNaughton, T. Proks, and J. Powell (University of Ottawa), 2009-2012, D.G. Cook, C.W. Thayer, J.D. Aitken, M.E. Ayling, H.R. Balkwill, and C.J. Yorath, 1968-1973, and J. Davison (University of Calgary), 2008

Seismic data interpretation by B.C. MacLean, 2010–2012. Stratigraphic sections measured by E.C. Turner (Laurentian University), 2010, R.W. Macqueen, W.S. MacKenzie, A.E.H. Pedder, and T. Uyeno, 1968-1971, and D.W. Morrow, 1980

Geomatics by K.M. Fallas, S.D. Orzeck, and N. Raska

Cartography by S.D. Orzeck and R. Kung

Scientific editing by E. Inglis

Joint initiative of the Geological Survey of Canada and the Northwest Territories Geoscience Office, conducted under the auspices of the Mackenzie Delta and Corridor Project as part of Natural Resources Canada's Geomapping for Energy and Minerals (GEM) program.

Logistical support provided by the Polar Continental Shelf Program as part of its mandate to promote scientific research in the Canadian North, PCSP 02509, 01310, 00411, and 00912.

Map projection Universal Tranverse Mercator, zone 9.
North America Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications.
Elevations are in feet above mean sea level

Some geographic names on this map are not official.

Mean magnetic declination 2013, 23°21'E, decreasing 31' annually. Readings vary from 23°31'E in the NW corner of the map to 23°11'E in the SE corner of the map.

The Geological Survey of Canada welcomes corrections or additional information from users.

Data may include additional features not portrayed on this map.
See documentation accompanying the data.
Additional references are included in the map information document.

This publication is available for free download through
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Map Viewing Files

The published map is distributed as a Portable Document File (PDF), and may contain a subset of the overall geological data for legibility reasons at the publication scale.

The spatial geological data is provided in two file formats, SHP and XML, that may be imported into Geographic Information System (GIS) software for the purposes of viewing, querying, and analysis.

ABOUT THE GEOLOGY

Descriptive Notes

The authors have updated and revised map unit terminology from the Operation Norman map (Aitken and Cook, 1976). In general, terminology for Cambrian units is that of Dixon and Stasiuk (1998), Silurian and Devonian usage follows that of Morrow (1991), and Cretaceous to Paleocene formation names are those of Dixon (1999). Cambrian to Ordovician units have recently undergone revision to their terminology, as outlined below.

Previous work by the Geological Survey of Canada in the Norman Wells map area (Aitken et al., 1973) subdivided the Cambro-Ordovician Franklin Mountain Formation into three informal units. In ascending order they are: Cyclic member, Rhythmic member, and Cherty member (Norford and Macqueen, 1975). On the present maps, these older unit names correspond, in ascending order, to informal lower, middle, and upper members of the Franklin Mountain Formation. These members correspond to the units 1, 2, and 3 of the Franklin Mountain Formation described by Turner (2011).

For detailed information on surficial deposits, here shown as “Quaternary sediment”, *see* Duk-Rodkin (2002).

The names Norman Range Thrust, Kelly Lake Fault, Oscar Lake syncline, Medzih Lake syncline, Twenty Five Mile Lake syncline, and Loon Creek anticline have been introduced to facilitate discussion of these structural features. Cordilleran deformation in this map area has generated two types of faults: thrust faults which are interpreted to be detached within the Cambrian Saline River Formation, and reverse faults which are interpreted to be inverted normal faults with steep dips at depth, in Proterozoic strata. Seismic-reflection data are the basis for interpreting the Norman Range Thrust as a thrust fault. The north-trending fault north of Kelly Lake is an example of an inverted normal fault, supported by the presence of Mount Cap Formation in the hanging wall.

Due to the high density of petroleum wells in the Norman Wells oil field, a subset of wells was selected to be shown in this map representation for legibility reasons. The full list of wells in the public record is provided in the data of this publication. Coverage of public-domain seismic-reflection data used to augment the map compilation and constrain stratigraphic relationships is shown in Figure 1. Surface and subsurface stratigraphic relationships within this map area are shown schematically in Figure 2.

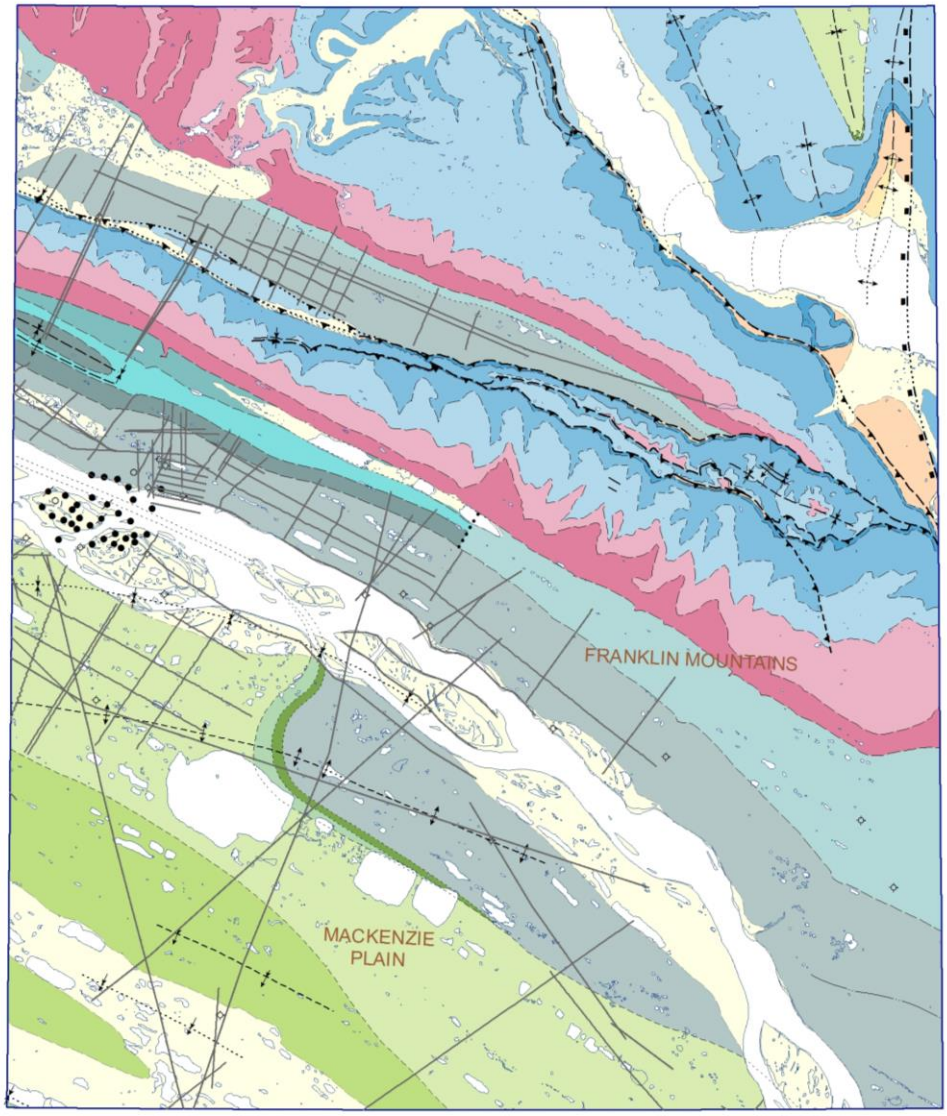

Figure 1. Southeast Norman Wells map area (NTS 96-E/SE) showing seismic lines on record with the National Energy Board that were used to augment the bedrock geology interpretation. Line names are provided in the data files.

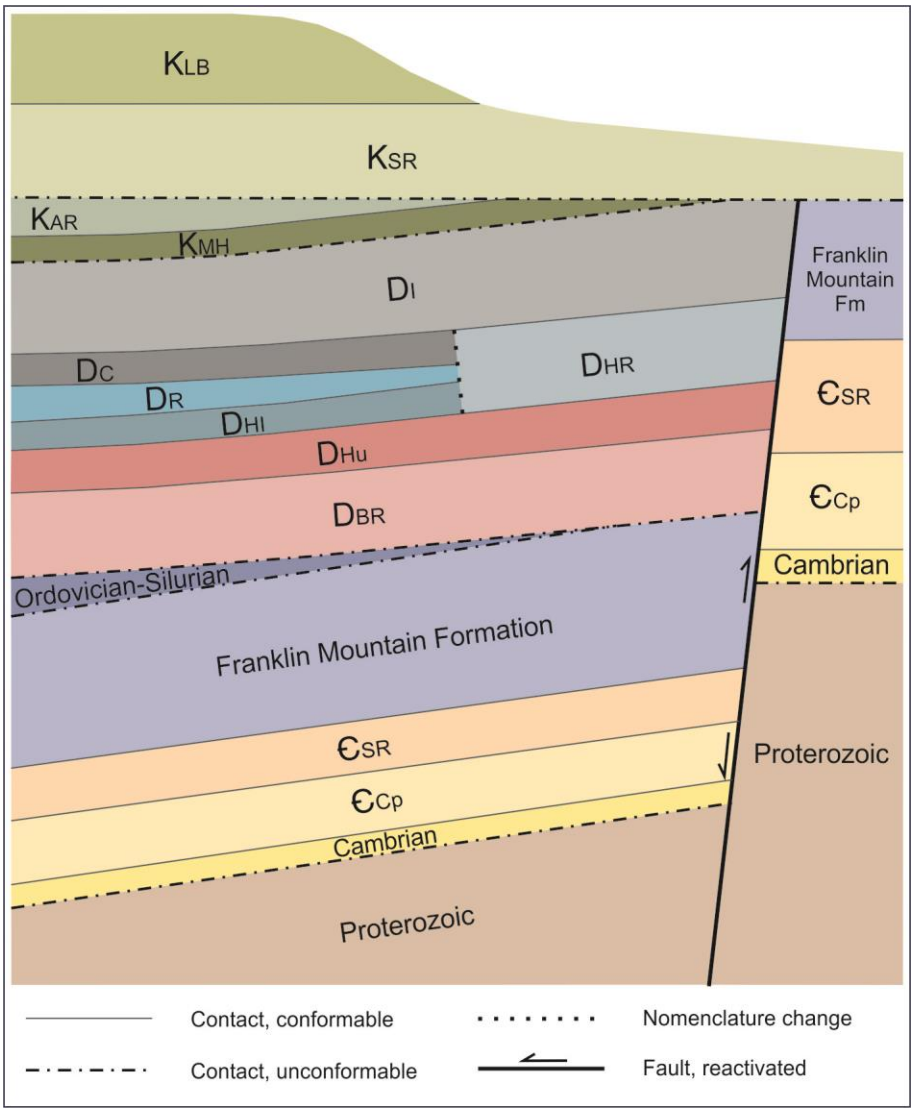

Figure 2. Schematic stratigraphic relationship diagram for southeast Norman Wells map area (NTS 96-E/SE). Subsurface units are constrained by well and seismic data. Differential preservation of units beneath erosional unconformities reflects tectonic activity adjacent to the Keele Arch from the Paleozoic to the Cretaceous. The reactivated fault shown is postulated to exist beneath the Kelly Lake Fault.

Acknowledgments

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Author Contact

Questions, suggestions, and comments regarding the geological information contained in the data sets should be addressed to:

K.M. Fallas
Geological Survey of Canada
3303-33rd Street N.W.
Calgary, Alberta
T2L 2A7

Karen.Fallas@NRCan-RNCan.gc.ca

Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 9
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 127°00’00” W
Eastern longitude: 126°00’00” W
Northern latitude: 65°30’00” N
Southern latitude: 65°00’00” N

Data Model Information

Surface bedrock data are organized into feature classes and themes consistent with logical groupings of geological features. All field observation point data are related through the Station_ID property of the Station theme. These feature attribute names and definitions are identical in the shapefiles and the XML files.

Consult PDFs in Data folder for complete description of the feature classes, feature attributes, and attribute domains.

The Bedrock Data Model and the Bedrock Domains documents are intended to describe all bedrock features which may be compiled at the 1:50 000 scale. Therefore, some of the feature classes and feature attributes described in these documents may not be present.

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ACCORD DE LICENCE

ACCORD DE LICENCE D'UTILISATION SANS RESTRICTION DE DONNÉES NUMÉRIQUES DE GÉOGRATIS

CE DOCUMENT constitue une entente légale entre vous (ci-après le " Détenteur de licence ") et SA MAJESTÉ LA REINE DU CHEF DU CANADA (ci-après le " Canada "), représentée par le Ministre des Ressources naturelles du Canada. **EN ATTEIGNANT, TÉLÉCHARGEANT, IMPRIMANT OU UTILISANT LES DONNÉES, L'INFORMATION OU LE MATÉRIEL FOURNIS OU ACCESSIBLES SELON CETTE ENTENTE, VOUS VOUS ENGAGEZ À RESPECTER LES MODALITÉS DE CET ACCORD.** SI VOUS ÊTES EN DÉSACCORD AVEC CES MODALITÉS, VOUS DEVEZ IMMÉDIATEMENT ÉLIMINER TOUTE COPIE DE CES DONNÉES, INFORMATION, MATÉRIEL ET PRODUITS DÉRIVÉS.

I. **ATTENDU QUE** le Canada détient les droits de propriété sur les données (les " Données ") accessibles aux termes des modalités de cet Accord;

II. **ATTENDU QUE** le Détenteur de licence désire obtenir certains droits sur les Données, sous réserve des modalités énoncées ci-après;

III. **ATTENDU QUE** le Canada déclare avoir la pleine autorité pour accorder les droits demandés par le Détenteur de licence, sous réserve des modalités énoncées ci-après;

IV. **ET ATTENDU QUE** les parties veulent en venir à une entente d'utilisation à partir de ce qui suit.

V. **À CES CAUSES**, en considérant les conventions contenues dans cet Accord, les parties conviennent de ce qui suit :

1.0 DÉFINITIONS

1. Données du Canada signifie toute Donnée dont le Canada détient le droit de propriété.

2. Données signifie toute donnée numérique, métadonnée ou documentation visée par les modalités de cet Accord.

3. Produits dérivés signifie tout produit, système, sous-système, appareil, composant, matériel ou logiciel qui comprend ou utilise toute partie des Données.

4. Droits de propriété intellectuelle signifie tout droit de propriété intellectuelle reconnu par la loi, y compris tout droit de propriété intellectuelle protégé par une législation telle que celle qui régit, sans être limitée à, les droits d'auteur et les brevets.

2.0 CESSION D'UNE LICENCE

1. 2.1 Sous réserve des modalités du présent Accord, le Canada octroie au Détenteur de licence une licence non exclusive, sans frais ni redevances exigibles, et le droit d'exercer tous les Droits de propriété intellectuelle sur les Données. Ceci comprend le droit d'utiliser, incorporer, accorder des licences d'utilisation (avec droit subséquent d'accorder des licences d'utilisation), modifier, améliorer, développer et distribuer les Données; et de fabriquer ou distribuer des Produits dérivés.

2. Les Droits de propriété intellectuelle découlant de toute modification, amélioration, développement ou traduction des Données, ou de la fabrication de Produits dérivés, effectués par ou pour le Détenteur de licence seront détenus par le Détenteur de licence ou tout substitut identifié par le Détenteur de licence.

3.0 PROTECTION ET IDENTIFICATION DE LA SOURCE

1. L'utilisation des Données ne constitue en aucune façon une reconnaissance par le Canada d'un Produit dérivé. Le Détenteur doit identifier la source de données, de la façon suivante, lorsque toute partie des Données est redistribuée ou comprise dans un Produit dérivé :

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4.0 GARANTIE, EXCLUSION ET INDEMNISATION

1. Le Canada ne fait aucune représentation ou garantie, expresse ou tacite, découlant de la loi ou d'autres sources, en ce qui concerne entre autres l'exactitude, l'utilité, la nouveauté, la validité, l'étendue, l'intégralité ou l'actualité des Données et rejette expressément toute garantie implicite de qualité loyale et marchande ou l'à propos à une fin particulière des Données. Le Canada n'assure ni ne garantit la compatibilité du site qui contient les Données avec les versions antérieures, actuelles et futures de n'importe quel fureteur.

2. Le Canada ne peut être tenu responsable par le Détenteur de licence en ce qui a trait à toute réclamation, revendication ou action en justice, quelle qu'en soit la cause, concernant toute perte ou tout préjudice ou dommage ou frais, direct ou indirect, qui pourrait résulter de la possession ou de l'utilisation des Données par le Détenteur de licence.

3. Le Détenteur de licence tiendra le Canada et ses représentants, employés, agents et exécutants, indemnes et à couvert à l'égard de toute réclamation, revendication ou action en justice, quelle qu'en soit la cause, alléguant toute perte, tout frais, toute dépense, tout dommage ou toute blessure (y compris toute blessure mortelle) qui pourrait résulter de la possession ou de l'utilisation des Données par le Détenteur de licence.

4. Le Détenteur de licence devra accorder des licences d'utilisation à toute personne ou partie qui obtient les Données ou des Produits dérivés au moyen d'un accord de licence, et cet accord devra imposer à ces personnes ou parties les mêmes modalités que celles qui sont énoncées dans la section 4.0 de cet Accord.

5. L'obligation du Détenteur de licence d'indemniser le Canada selon cet Accord ne peut affecter ni empêcher le Canada d'exercer tout autre droit selon la loi.

5.0 DURÉE

1. Cet Accord entre en vigueur à partir de la date et de l'heure d'acceptation des modalités de l'Accord (Heure de l'Est) et restera en vigueur pour une période d'un (1) an, en vertu de la sous-section 5.2 et de la section 6.0 qui suivent.

2. À la fin du premier terme, cet Accord sera automatiquement renouvelé pour des termes successifs d'un (1) an, en vertu de la section 6.0 qui suit.

6.0 RÉSILIATION

1. 6.1 Nonobstant la section 5.0, cet Accord peut être résilié :

   i. automatiquement et sans préavis, si le Détenteur de licence manque à ses engagements ou obligations selon cet Accord;

   ii. par un préavis écrit de résiliation émis par le Détenteur de licence, en tout temps, et cette résiliation prendra effet trente (30) jours suivant la réception d'un tel préavis par le Canada; ou

   iii. par consentement mutuel des parties.

2. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, les obligations qui incombent au Détenteur de licence en vertu de la section 4.0 continueront de s'appliquer et les droits du Détenteur de licence en vertu de la section 2.0 cesseront immédiatement.

3. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, le Détenteur de licence devra immédiatement effacer ou détruire toutes les Données obtenues en vertu de cet Accord, ou à l'intérieur d'un délai raisonnable lorsque les Données sont nécessaires pour terminer la livraison de Produits dérivés commandés avant la résiliation de cet Accord.

7.0 GÉNÉRAL

1. **Lois d'application**
   Le présent Accord est régi et interprété en vertu des lois en vigueur dans la province de l'Ontario. Les parties acceptent de tomber sous la juridiction de la Cour supérieure de la Province de l'Ontario.

2. **Totalité de l'Accord**
   Le présent Accord constitue l'intégralité de l'entente conclue entre les parties relativement à l'objet du présent Accord. Toute modification à cet Accord ne peut être que par écrit, doit porter la signature de chaque partie et exprimer clairement l'intention de modifier cet Accord.

3. **Solution des litiges**
   Si un litige survient à propos de cet Accord, les parties tenteront de le résoudre par des négociations de bonne foi.