



NUCLEAR WASTE MANAGEMENT ORGANIZATION SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 1 Geoscientific Desktop Preliminary Assessment,  
Processing and Interpretation of Borehole Geophysical  
Log and 2D Seismic Data

MUNICIPALITIES OF ARRAN-ELDERSLIE, BROCKTON AND SOUTH BRUCE,  
TOWNSHIP OF HURON-KINLOSS AND TOWN OF SAUGEEN SHORES,  
ONTARIO



**APM-REP-06144-0110**

**JUNE 2014**

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# **Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Municipalities of Arran-Elderslie, Brockton and South  
Bruce, Township of Huron-Kinloss and  
Town of Saugeen Shores

Revision: 0 (Final)

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Document ID: SedSites\_2DSeismic\_BHGeophys\_R0  
NWMO Report Number: APM-REP-06144-0110

June, 2014

Title:	Phase 1 Geoscientific Desktop Preliminary Assessment Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data, Municipalities of Arran-Elderslie, Brockton and South Bruce, Township of Huron-Kinloss and Town of Saugeen Shores	
Client:	Nuclear Waste Management Organization	
Document ID:	SedSites_2DSeismic_BHGeophys_R0	
Revision Number:	0	Date: June, 2014
Prepared by:	Sean Sterling and David Schieck	
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## EXECUTIVE SUMMARY

In Fall 2012, the municipalities of Arran-Elderslie, Brockton and South Bruce, the Township of Huron-Kinloss and the Town of Saugeen Shores (the Communities) individually expressed interest in continuing to learn more about the Nuclear Waste Management Organization nine-step site selection process (NWMO, 2010), and requested that a preliminary assessment be conducted to assess potential suitability of each of the Communities for safely hosting a deep geological repository (Step 3). This request followed successful completion of initial screenings conducted during Step 2 of the site selection process.

The preliminary assessment is a multidisciplinary study integrating both technical and community well-being studies, including geoscientific suitability, engineering, transportation, environment and safety, as well as social, economic and cultural considerations. The findings of the overall preliminary assessments are reported in integrated reports (NWMO, 2014a; 2014b; 2014c; 2014d; 2014e). The objective of the geoscientific desktop preliminary assessment is to determine whether the Communities contain general areas that have the potential to meet NWMO's geoscientific site evaluation factors.

This report presents the findings of an interpretation study looking at historical borehole geophysical well log data and historical 2D seismic data. The assessment focused on the Communities and their immediate periphery, referred to as the Area of the Five Communities. This study was completed as part of the Phase 1 Geoscientific Desktop Preliminary Assessment for the municipalities of Arran-Elderslie, Brockton and South Bruce, the Township of Huron-Kinloss and the Town of Saugeen Shores (Geofirma Engineering Ltd., 2014).

The main information sources relied on in this study include:

- the petroleum wells subsurface database from the MNR Oil, Gas and Salt Resources Library (OGSRL) current as of June 2013;
- historical 2D seismic data purchased from a seismic data brokerage company;
- the OGS bedrock depth (drift thickness) data (Gao et al., 2006);
- ground surface elevation data defined by a topographic model created from Shuttle Radar Topographic Mission (SRTM) data (NASA, 2006);
- Additional information sources included several files on drainage features, watersheds, lake depths, aggregate pits, and roads obtained from Land Information Ontario (LIO); and,
- Additional stratigraphic information was provided by the site characterization activities undertaken at the Bruce nuclear site (NWMO, 2011; Intera Engineering Ltd., 2011).

The study addresses the following four main objectives:

- Assessing key bedrock formation top elevations across the Area of the Five Communities based on the reinterpretation of available borehole geophysical data.
- Interpreting available 2D seismic data and evaluating their usefulness for the purpose of identifying geological structures in the Precambrian basement and Paleozoic bedrock within the Area of the Five Communities.

- Providing a better understanding of the three-dimensional geometry (depth, thickness and extent) of key Paleozoic sedimentary packages and the top of the Precambrian basement, based on the borehole geophysical data assessment and the interpretation of 2D seismic data.
- Interpreting potential geological structures such as: pinnacle reefs, potential faults, salt dissolution features, and karst, within the Area of the Five Communities.

To meet the study objectives outlined above, the scope of work involved the completion of two complimentary desktop studies, including a borehole geophysics data interpretation and a 2D seismic data interpretation, based on available data for the Area of the Five Communities.

A total of 334 boreholes from the OGSRL exist within the Area of the Five Communities and its surrounding region, 111 of which contain useful gamma and neutron borehole geophysical logs. These borehole geophysical logs were studied to select formations which could be easily and consistently identified based on the geophysical signals. Eight formations were identified and termed "key formation tops". A dataset of these eight key formation tops for each of the 111 boreholes was created. These key formation tops included:

- Bass Islands Formation;
- Salina Group G-Unit;
- Salina Group F-Unit;
- Cabot Head Formation;
- Queenston Formation;
- Cobourg Formation - Collingwood Member;
- Coboconk Formation; and,
- Precambrian.

In addition to these 111 boreholes, top depths of these same key formation tops were added to the database from the remaining 223 boreholes within the Area of the Five Communities and its surrounding region that did not contain useful geophysical logs, which together comprise the total of 334 boreholes mentioned above.

The updated formation top dataset discussed above was used to create geological cross-section figures to assist with the interpretation of regional geology and 2D seismic data. The amount of historical 2D seismic data within the Communities is limited. A total of approximately 53 km of historical 2D seismic data, originally acquired as part of four lines during 1976 and 1977, were purchased, re-processed and interpreted as part of this study. The quality of this historical data was sufficient for use in this study but considered to be of lower quality compared to current 2D seismic standards.

The results of the study provide a foundation for developing an integrated interpretation of the subsurface geological and stratigraphic framework in the Area of the Five Communities.

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## 1 INTRODUCTION

In Fall 2012, the municipalities of Arran-Elderslie, Brockton and South Bruce, the Township of Huron-Kinloss and the Town of Saugeen Shores (the Communities) individually expressed interest in continuing to learn more about the Nuclear Waste Management Organization nine-step site selection process (NWMO, 2010), and requested that a preliminary assessment be conducted to assess potential suitability of the Communities for safely hosting a deep geological repository (Step 3). This request followed the successful completion of initial screenings of the Communities conducted during Step 2 of the site selection process by AECOM Canada Ltd. (2012a; 2012b; 2012c; 2012d; 2012e).

This report presents the results of borehole geophysical data and two dimensional (2D) seismic data interpretation, focusing on each of the Communities. The assessment focused on the Communities and their immediate periphery, referred to as the Area of the Five Communities (Figure 1). This study was completed as part of the Phase 1 Geoscientific Desktop Preliminary Assessment study for the municipalities of Arran-Elderslie, Brockton and South Bruce, Township of Huron-Kinloss and Town of Saugeen Shores, Southern Ontario (Geofirma Engineering Ltd., 2014).

### 1.1 Area of the Five Communities

The preliminary assessment focused on the area within the boundaries of the Communities (Municipalities of Arran-Elderslie, Brockton and South Bruce, Township of Huron-Kinloss and Town of Saugeen Shores). Areas beyond the municipal boundaries of the five communities were not considered. For the purpose of the assessment, geoscientific information was collected and interpreted for the Communities and surrounding areas, referred to in this report as the Area of the Five Communities.

### 1.2 Study Objectives

The objective of the geoscientific desktop preliminary assessment (Geofirma Engineering Ltd., 2014) is to determine whether the Communities contain general areas that have the potential to satisfy NWMO's geoscientific site evaluation factors based on available geoscientific information. To help fulfill this goal, the borehole geophysical and 2D seismic data interpretation objectives included:

- Assessing key bedrock formation top elevations across the Area of the Five Communities based on the reinterpretation of available borehole geophysical data. This assessment will provide an updated borehole dataset that will be used for:
  - a) construction of strike-parallel and perpendicular cross-sections through the Communities;
  - b) constraining the 2D seismic data interpretation; and
  - c) gravity stripping procedures as part of the geophysical data interpretation study (PGW, 2014).
- Interpreting available 2D seismic data and evaluating their usefulness for the purpose of identifying geological structures in the Precambrian basement and Paleozoic bedrock within the Area of the Five Communities.
- Providing a better understanding of the three dimensional geometry (depth, thickness and extent) of key Paleozoic sedimentary packages and the top of the Precambrian basement, based on the borehole geophysical data assessment and the interpretation of 2D seismic data.

- Interpreting potential geological structures such as: pinnacle reefs, potential faults, salt dissolution features, and karst, within the Area of the Five Communities.

### 1.3 Qualifications of the Team

The team responsible for the borehole geophysics and 2D seismic data review, processing and interpretation investigation component of the Phase 1 Geoscientific Desktop Preliminary Assessment consisted of qualified experts from Geofirma Engineering Ltd. and Seismic Solutions Inc.

The following is a brief description of the qualifications and roles of key project team members.

**Sean Sterling, M.Sc., P.Eng, P.Geo.** is a senior hydrogeologist/geoscientist with Geofirma Engineering Ltd. and is a registered professional engineer and geoscientist in Ontario. He has 19 years of specialized experience and expertise in characterization and investigation of fractured bedrock sites. He managed all field work and data collection activities for the Deep Geological Repository (DGR) project at the Bruce nuclear site from 2005 through 2012, including the acquisition and interpretation of approximately 20 km of 2D surface seismic data and the acquisition and interpretation of borehole geophysical data from eight deep boreholes (DGR-1 to DGR-8). He was responsible for picking bedrock formation tops in the DGR wells and obtained interpretative assistance from provincial sedimentary geologists Terry Carter and Derek Armstrong. For the current study Mr. Sterling was responsible for the interpretation of borehole geophysical data, project management and report preparation.

**David Schieck, M.Sc., P.Geoph.** is the president of Seismic Solutions Inc. and a professional geophysicist in Alberta and professional geoscientist in Ontario. In 1988 Mr. Schieck founded and managed a full-service seismic company operating in Ontario (Geophysical Applications) where he acquired, processed and interpreted 2D seismic data collected north of Goderich for numerous oil and gas exploration companies. He has also designed, acquired, processed and interpreted 3D seismic data for more than 35 projects within southwestern Ontario ranging from 4 km<sup>2</sup> to 35 km<sup>2</sup> for gas storage and exploration development. For a number of these projects he was the lead contractor responsible for the management of surveying, seismic data acquisition, processing and final interpretation. He was recently involved in the peer review and final reporting of the 20 linear km of 2D seismic data acquired at the Bruce nuclear site as part of the DGR site characterization work at the Bruce nuclear site completed by Geofirma for NWMO in 2010. For the current study Mr. Schieck was responsible for data review, selection, purchase, processing, interpretation and reporting on historical 2D seismic data.

**Kenneth Raven, M.Sc., P.Eng. P.Geo.** is President of Geofirma Engineering Ltd. He has over 35 years of experience in site characterization for the purpose of radioactive waste management for a variety of clients including Atomic Energy of Canada Ltd., Ontario Hydro, Ontario Power Generation and NWMO. He recently served as principal geoscientist and project manager for the DGR site characterization program at the Bruce nuclear site from 2005 to 2012. He currently manages Geofirma geoscience consulting services to NWMO under the Adaptive Phased Management Program including the Phase 1 geoscientific preliminary assessment for sedimentary sites, southwestern Ontario. Mr. Raven completed review of this report.

## 1.4 Report Organization

This report is organized into nine sections and four appendices.

- Section 1 of this report includes an introduction, lists the study objectives and scope of work for the borehole geophysical well log and 2D seismic data interpretation, and describes the qualifications of the geophysical interpretation team.
- Section 2 provides an overview of the geological setting and includes a brief overview of the bedrock and Quaternary geology in the Area of the Five Communities.
- Section 3 summarizes the data sources available and data limitations for both the borehole geophysical well log study as well as the 2D seismic study.
- Section 4 documents the methodology used for the borehole geophysical well log and 2D seismic data interpretation studies.
- Section 5 documents the findings of the two studies. This includes a description of the results from borehole geophysical well log interpretation, a discussion of the resulting geologic cross-sections and their important relevant features, and seismic reinterpretations for each 2D seismic line studied including any geologically important features (e.g., faults, salt layers, reef structure, seismic character, etc.) that were identified.
- Section 6 provides a discussion of the integrated results from both studies with respect to each community.
- Section 7 provides a summary of the report findings.
- Section 8 lists the report references, and Section 9 includes a report signoff page.
- Appendix A includes a summary of all OGSRL boreholes used in this study.
- Appendix B includes a summary of 2D seismic collection and processing parameters.
- Appendix C includes a summary of formation tops picked as part of this study based on analysis of borehole geophysical logs.
- Appendix D includes a compilation of processed 2D seismic data figures used during interpretation of the 2D seismic data.

## 2 SUMMARY OF PHYSICAL GEOGRAPHY AND GEOLOGY

### 2.1 Physical Geography

A detailed discussion of the physical geography of the Area of the Five Communities including physiography, topography, surface water/wetlands and built-up areas is provided in a separate Terrain and Remote Sensing Study Report (JDMA, 2014) and the following is a summary of that information.

The Area of the Five Communities is found within a set of landforms and landform complexes that resulted from the advance and retreat of the glaciers during the Late Wisconsinan glaciation. These landforms provide a map of the glacial and postglacial events that were largely responsible for producing the detailed topography of the area. The physiography of the Area of the Five Communities is classified into a set of ten physiographic units based on the presence of distinct landforms such as valleys, drumlins fields, escarpments and till plains (JDMA, 2014). The dominant physiographic units within the Communities are the Arran drumlin field (Municipality of Arran Elderslie), the Horseshoe moraines (municipalities of Brockton and South Bruce, Township of Huron-Kinloss), the Huron fringe (Town of Saugeen Shores), the Huron slope (Town of Saugeen Shores and Township of Huron-Kinloss), Saugeen clay plain (municipalities of Arran Elderslie and Brockton), and Teeswater drumlin field (Municipality of South Bruce). These physiographic units are in part reflected in the surficial geology of the area (Figure 5).

The large-scale topography in the Area of the Five Communities is controlled by bedrock topography whereas the detailed topography is often controlled by surficial landforms. The elevation gradient from east to west (Lake Huron) is from 400 to 176 m, with this elevation drop occurring over an approximate 70 km lateral distance. The elevation minimum is defined by the surface of Lake Huron, with a chart datum of 176 m (Figure 3). The highest points in the Area of the Five Communities with elevations of 400 m are located in the southeast corner of the area. Steep slopes which are rare in the Area of the Five Communities are associated with drumlins, river valleys, spillways, moraines, and raised shore bluffs.

Apart from Lake Huron, the Area of the Five Communities contains no large lakes (Figure 1). For example, the largest lake in the area is Arran Lake, which is located in the northern part of the Municipality of Arran-Elderslie, with an area of 3.9 km<sup>2</sup>. Water bodies cover 38.7 km<sup>2</sup> or 0.8 % of the land within Area of the Five Communities. Wetlands cover 671.8 km<sup>2</sup> or 14.3 % of the land within the Area of the Five Communities.

Built-up areas are found in the villages and towns of the Communities. The largest of these built-up areas are associated with settlements of Walkerton, Port Elgin, Southampton, Mildmay, Formosa, Lucknow, Point Clark, Paisley, Chesley, Tara and Teeswater (Figure 1).

### 2.2 Bedrock Geology

The bedrock geology of southern Ontario and the Area of the Five Communities is described in detail in Geofirma Engineering Ltd. (2014) and the following is a summary of that information.

### 2.2.1 Geological Setting

The bedrock geology of southern Ontario consists of a thick Paleozoic sequence of sedimentary rocks ranging in age from Cambrian to Mississippian deposited between approximately 540 million and 323 million years ago (Johnson et al., 1992). This sedimentary sequence rests unconformably on an erosional surface of the Precambrian crystalline basement of the Grenville Province, the south-eastern most subdivision of the Canadian Shield. The Grenville Province comprises 2,690 million to 990 million year old metamorphic rocks deformed during orogenic events 1,210 million to 970 million years ago (Percival and Easton, 2007; White et al., 2000). The Grenville Province is considered to have been relatively tectonically stable for the past 970 million years (Williams et al., 1992).

Southern Ontario is underlain by two paleo-depositional centres referred to as the Michigan Basin and the Appalachian Basin. The Appalachian Basin is an elongate foreland basin that parallels the Appalachian orogen and comprises primarily siliciclastic sediments. The Michigan Basin is a broadly circular carbonate-dominated, evaporite-bearing intracratonic basin. These basins are separated by the northeast-trending Algonquin and Findlay arches which, along with the intervening east-southeast-trending Chatham Sag structural depression, define a regional basement high beneath southern Ontario and extending further southwestward into the northeastern United States.

The Paleozoic succession underlying the Area of the Five Communities was deposited within the Michigan Basin. Within the Michigan Basin the thickness of Paleozoic rocks range from a maximum of about 4,800 m at the centre of the basin to approximately to 450 m at the northeast corner of the Area of the Five Communities (OGSRL, 2013). The Paleozoic strata dip gently (3.5 to 12 m/km) to the west or southwest throughout the Ontario portion of the Michigan Basin (Armstrong and Carter, 2010).

Figure 2 shows the bedrock geological map for southern Ontario, and Figure 3 shows a vertically exaggerated cross-section constructed through the Area of the Five Communities. The location of the cross-section is shown on Figure 2. The geological cross-section (Figure 3) shows the west-southwesterly dip of the Paleozoic sedimentary formations from the Niagara Escarpment in the east to below Lake Huron in the west. The large vertical exaggeration of 50 times used in Figure 3 results in apparent moderate formation dips when, in reality, the sedimentary formations within the Area of the Five Communities are flat lying with dips of 1° or less. These moderate west-southwesterly dips result in outcrop or subcrop exposure of increasingly older sedimentary formations from west to east across southern Ontario, as shown on Figure 2.

### 2.2.2 Geological and Tectonic History

The structural and tectonic history of southern Ontario includes both Precambrian and Phanerozoic events. These events are described below and summarized in Table 1.

As mentioned above, the Paleozoic sedimentary sequence of southern Ontario lies unconformably on the Precambrian crystalline basement of the Grenville Province of the Canadian Shield. The Grenville Province is a complex orogenic belt that truncates several older geologic provinces. Basement rocks in southern Ontario have all been affected by an approximately 1,210 to 970 million year old orogenic event, the Grenville Orogeny. The Grenville Orogeny is generally interpreted to have involved northwest-directed thrusting and imbrication of the entire crust, presumably as a result of collision with another continental landmass originally located somewhere to the southeast. Older tectonic events

including the approximately 2,700 million year old Kenoran Orogeny and the approximately 2,000-1,700 million year old Trans-Hudson/Penokean Orogen, built the proto-North American craton upon which Grenville deformation was imprinted (Easton, 1992). Post-Grenville extension associated with the initial opening of the Iapetus Ocean began approximately 970 million years ago (Thomas, 2006).

**Table 1 Timetable of Major Tectonic Events in Southern Ontario**

<i>Million Years Before Present</i>	<i>Tectonic Activity</i>	<i>Reference</i>
1,210 – 1,180	Regional metamorphism in Central Metasedimentary Belt Boundary Zone (proto-Grenville)	Easton (1992), Lumbers et al. (1990), Hanmer and McEachern (1992)
1,109 – 1,087	Magmatism and formation of Midcontinent Rift	Van Schmus (1992)
1,030 – 970	Main phase of Grenville Orogeny	Carr et al. (2000), White et al. (2000)
970 – 530	Rifting and opening of the Iapetus Ocean	Thomas (2006)
530 – 320	Subsidence of Michigan Basin and uplift of Frontenac and Algonquin Arches (episodic)	Howell and van der Pluijm (1999), Sanford et al. (1985), Kesler and Carrigan (2002)
470 – 440	Taconic Orogeny <ul style="list-style-type: none"> <li>E-W to NW-SE compression, uplift in foreland (Frontenac and Algonquin Arches)</li> </ul>	Quinlan and Beaumont (1984), Sloss (1982), McWilliams et al. (2007)
410 – 320	Caledonian/Acadian Orogeny <ul style="list-style-type: none"> <li>E-W to NW-SE compression, uplift (Frontenac and Algonquin Arches)</li> </ul>	Gross et al. (1992), Marshak and Tabor (1989), Sutter et al. (1985), Kesler and Carrigan (2002)
300 – 250	Alleghenian Orogeny <ul style="list-style-type: none"> <li>E-W to NW-SE compression</li> </ul>	Gross et al. (1992), Engelder and Geiser (1980)
200 – 50	<ul style="list-style-type: none"> <li>Opening of the Atlantic Ocean</li> <li>St. Lawrence rift system created</li> <li>Reactivation of Ottawa-Bonnechère Graben</li> <li>NE-SW extension</li> <li>Uplift</li> </ul>	Kumarapeli (1976, 1985)
Pre-50 – Present	<ul style="list-style-type: none"> <li>NE-SW compression (from ridge push)</li> <li>Post-glacial uplift</li> </ul>	Barnett (1992)

The deposition of the sedimentary rocks within the Michigan and Appalachian basins was largely dependent on two tectonic influences (Johnston et al., 1992). These were: the orogenic activity at the eastern margin of North America, which provided clastic input to both the Appalachian and Michigan basins, and the resultant tectonic forces that controlled the positioning of the basins and arches separating the basins. The Algonquin Arch acted as a major structural control on depositional patterns, rising and falling with respect to the Michigan and Appalachian basins in response to epirogenic movements and horizontal tectonic forces during the course of several distinct Paleozoic orogenic episodes (Howell and van der Pluijm, 1999).

Coincident with sediment deposition, the bedrock of southern Ontario was subject to a complex history of Paleozoic tectonism that included the Taconic (Ordovician), Caledonian/Acadian (Devonian) and Alleghenian (Carboniferous) orogenies (Howell and van der Pluijm, 1999). Subsequent events include the Mesozoic initiation of far field stresses associated with the opening of the Atlantic Ocean (Jurassic), compression from global-scale plate reorganization and ridge push (late Cretaceous-Eocene), and finally post-glacial uplift (Quaternary).

### 2.2.3 Precambrian Geology

The geology of the Precambrian crystalline basement of the Grenville Province in southern Ontario has been well characterized by surface mapping north of the Paleozoic/Precambrian basement boundary, regional geophysical data (aeromagnetism and gravity), regional seismic reflection surveys and geochemical, geochronological and petrographic analyses of rock samples recovered from boreholes (O'Hara and Hinze, 1980; Green et al., 1988; Carr et al., 2000; Carter and Easton, 1990; Easton and Carter, 1995; Carter et al., 1996).

The Precambrian basement in southern Ontario has been grouped into two lithologic belts – the Central Gneiss Belt, located between the Grenville Front Tectonic Zone and the Central Metasedimentary Belt Boundary Zone, and the Central Metasedimentary Belt located southeast of the Central Metasedimentary Belt Boundary Zone. The Grenville Front Tectonic Zone and the Central Metasedimentary Belt Boundary Zone are major sub parallel shear zones several kilometres or more in width, characterized by strongly deformed rocks with northeast-trending, moderately to shallowly southeast-dipping tectonic layering and southeast plunging mineral lineations (Easton and Carter, 1995). Similar subparallel zones of intense deformation on a smaller scale form boundaries between lithotectonic terranes within both the Central Gneiss Belt and Central Metasedimentary Belt (Easton and Carter, 1995).

Major tectonic zones in southern Ontario are defined by extrapolation of the exposed basement structural boundaries beneath the Paleozoic cover. This process is aided by field mapping, borehole stratigraphic correlation, interpretation of seismic, aeromagnetic and gravity surveys (e.g., Boyce and Morris, 2002; Wallach et al., 1998), and by geochemical, geochronological and petrographic analyses of samples recovered from drill cuttings and core (Carter and Easton, 1990; Carter et al., 1996).

Based on aeromagnetic data and borehole samples, the Precambrian basement below the sedimentary rock cover has been subdivided into several lithotectonic domains and boundary zones similar in scale and form to those found where the Precambrian bedrock of the Grenville Province is exposed (Carter and Easton, 1990). Much of southern Ontario, including the Area of the Five Communities, is underlain by Precambrian crystalline basement of the Central Gneiss Belt and consists mainly of quartzofeldspathic gneissic rocks which have generally been metamorphosed to upper amphibolite facies, and locally to granulite facies. Most of these gneisses are believed to be plutonic in origin, with subordinate amounts of metasedimentary gneiss.

The Huron Domain is a lithotectonic domain within the Central Gneiss Belt, and underlies most of the Area of the Five Communities. The Huron Domain acted as single crustal block during the Paleozoic. It is defined by Carter and Easton (1990), Easton and Carter (1995) and Carter et al. (1996) based on lithologic data from boreholes and published aeromagnetic maps.



## 2.2.4 Paleozoic Stratigraphy

Table 2 illustrates the Paleozoic bedrock stratigraphy for the Area of the Five Communities as presented by Geofirma Engineering Ltd. (2014). The Paleozoic stratigraphic nomenclature has evolved over time and a recent compilation by Armstrong and Carter (2010) provides the current standard for usage. Two key stratigraphic designations have recently been revised. Firstly, strata traditionally referred to as Middle Ordovician, i.e., Black River and Trenton groups (from Armstrong and Carter, 2006), are now considered part of the Upper Ordovician. Secondly, the formal term Middle Silurian (from Armstrong and Carter, 2006) has been abandoned so all strata have been re-assigned to either the Lower or Upper Silurian.

In addition, the stratigraphic nomenclature in Table 2 and Figure 3 adopts the subsurface nomenclature of Armstrong and Carter (2010), while geological mapping as shown in Figures 2 and 4 uses an outcrop nomenclature. This distinction primarily applies to the Trenton and Black River groups, where the Bobcaygeon Formation (outcrop) is equivalent to the Coboconk and Kirkfield formations (subsurface), and the Verulam and Lindsay formations (outcrop) are approximately equivalent to the Sherman Fall and Cobourg formations (subsurface), respectively.

The Paleozoic stratigraphy includes shale, carbonate and evaporite units formed predominantly from marine sediments that were deposited when this portion of eastern North America was located at tropical latitudes and intermittently covered by shallow seas (Johnson et al., 1992; Armstrong and Carter, 2010).

### 2.2.4.1 Cambrian

The Cambrian bedrock geology in southern Ontario is dominated by white to grey quartzose sandstone with regional lithological variations that include fine to medium crystalline dolostone, sandy dolostone, and argillaceous dolostone to fine to coarse quartzose sandstone (Hamblin, 1999). Cambrian sedimentary rocks unconformably overlie the Precambrian basement. These sedimentary rocks are generally characterized as a succession of clastic and carbonate rocks resulting from transgressive Cambrian seas that flooded across the broad platform of the Algonquin Arch and into the subsiding Michigan and Appalachian basins (Hamblin, 1999). The Cambrian units are largely absent over the Algonquin Arch as the result of a pre-Ordovician regional-scale unconformity (Bailey Geological Services Ltd. and Cochrane, 1984a). The Cambrian unit is interpreted to pinch out eastwards, near the western boundaries of the municipalities of Arran-Elderslie, Brockton and South Bruce (Bailey Geological Services Ltd. and Cochrane, 1984a), and thus is expected to be absent beneath the eastern and central parts of the Area of the Five Communities. There are no surface exposures of the Cambrian unit in southern Ontario.

### 2.2.4.2 Upper Ordovician

Unconformably overlying the Cambrian unit is a thick sequence of Upper Ordovician sedimentary units with a distinctly bimodal composition: a carbonate-rich lower unit and a shale-rich upper unit. The lower unit was deposited during a major marine transgression (Coniglio et al., 1990) prior to the westward inundation of the carbonate platform by the upper shale-dominated sediments (Hamblin, 1999). The Upper Ordovician carbonates subcrop in the northeastern part of southern Ontario around the Lake Ontario and Lake Simcoe regions, and the Upper Ordovician shales subcrop east of the

**Table 2 Stratigraphy of the Area of the Five Communities (after Armstrong and Carter, 2010)**

Standard Reference	Area of the Five Communities	
Devonian	Dundee	
	Detroit R. Lucas Amherstburg	
Lower	Bois Blanc	
Silurian <sup>b</sup>	Bass Islands	
	Salina G Unit F Unit E Unit D Unit C Unit B Unit A2 Unit A1 Unit <sup>c</sup> A0 Unit	
	Guelph	
	Amabel-Lockport Goat Island Gasport Lions Head	
Lower	Clinton Fossil Hill	
	Cataract Cabot Head Manitoulin	
	Upper	Queenston Georgian Bay Blue Mountain
	Trenton Collingwood Cobourg <sup>1</sup> Sherman Fall <sup>2</sup> Kirkfield <sup>3</sup>	
Upper	Black River Coboconk <sup>3</sup> Gull River Shadow Lake	
	Cambrian	
Precambrian	Precambrian	

Notes:

a - Strata traditionally referred to as Middle Ordovician (i.e., Black River and Trenton groups; Armstrong and Carter, 2006) are now considered part of the Upper Ordovician.

b - The formal term Middle Silurian (e.g., Armstrong and Carter, 2006) has been abandoned so all strata have been re-assigned to either the Lower or Upper Silurian.

c - A-0 Unit (Salina Formation) is recognized based on site characterization activities at the Bruce nuclear site (Intera, 2011)

Surface Nomenclature Equivalent (approx.):

1 - Lindsay Fm; 2 - Verulam Fm; 3 - Bobcaygeon Fm

~~~~~ Unconformity

## Niagara Escarpment between Owen Sound and Niagara Falls (Figure 2).

The lower carbonate unit of the Upper Ordovician succession is a thick sequence of predominantly limestone formations (carbonate and argillaceous carbonate sedimentary rocks), which include, from bottom to top: the Shadow Lake, Gull River and Coboconk formations of the Black River Group; and the Kirkfield, Sherman Fall, and Cobourg (including the Collingwood Member) formations of the Trenton Group (Table 2). These rocks range in character from coarse-grained bioclastic carbonates to carbonate mudstone with interbedded calcareous and non-calcareous shales. The Shadow Lake Formation, at the base of the Black River Group, is characterized by poorly sorted, red and green sandy shales, argillaceous and arkosic sandstones, minor sandy argillaceous dolostones and rare basal arkosic conglomerate. The lower part of the overlying Gull River Formation consists mainly of light grey to dark brown limestones and the upper part of the formation is very fine grained with thin shale beds and partings. The Coboconk Formation, at the top of the Black River Group, is composed of light grey-tan to brown-grey, medium to very thick bedded, fine to medium grained bioclastic limestones (Armstrong and Carter, 2010).

The Kirkfield Formation, at the base of the Trenton Group, is characterized by fossiliferous limestones with shaley partings and locally significant thin shale interbeds. The overlying Sherman Fall Formation ranges in lithology from dark grey argillaceous limestones interbedded with calcareous shales, found lower in the formation, to grey to tan bioclastic, fossiliferous limestones that characterize the upper portions of the formation. The overlying Cobourg Formation is described regionally as a grey, fine-grained limestone to argillaceous limestone with coarse-grained fossiliferous beds and a nodular texture. The Cobourg Formation is also subdivided to include an upper Collingwood Member that consists of dark grey to black, calcareous shales with increased organic content and distinctive fossiliferous limestone interbeds (Hamblin, 2003; Armstrong and Carter, 2010).

The upper unit of the Upper Ordovician succession is characterized by a thick sequence of predominantly shale sedimentary rocks, which comprise from base to top: the Blue Mountain, Georgian Bay and Queenston formations. The Blue Mountain Formation is characterized by uniform soft and laminated grey non-calcareous shale with minor siltstone and minor impure carbonate (Johnson et al., 1992; Hamblin, 1999). In the lower part of the Blue Mountain Formation there is downward gradation from grey to greenish-grey shales to a very dark grey to black shale (Armstrong and Carter, 2010). This lower part of the Blue Mountain Formation was historically named the Rouge River Member (Russell and Telford, 1983). The overlying Georgian Bay Formation is composed of blue-grey shale with intermittent centimetre-scale siltstone and limestone interbeds. The Queenston Formation is characterized by maroon, with lesser green, shale and siltstone with varying amounts of carbonate. The top of the Queenston Formation is marked by a regional erosional unconformity (Table 2; Armstrong and Carter, 2010).

### 2.2.4.3 Lower Silurian

The Lower Silurian units, including the Cataract and Clinton groups and the Amabel-Lockport and Guelph formations, unconformably overlie the Upper Ordovician shales (Table 2). A major marine transgression at the top of the Clinton Group marks the transition to deposition of the extensive carbonate-dominated Amabel and Guelph formations. These Lower Silurian units form the cap-rock of the Niagara Escarpment in outcrop. The Lower to Upper Silurian boundary occurs within the Guelph Formation (Table 2; Brunton and Dodge, 2008).

The Cataract Group unconformably overlies the Upper Ordovician Queenston Formation and includes a lower unit of grey argillaceous dolostone and minor grey-green shale, and an upper clastic unit which consists of grey to green to maroon noncalcareous shales with minor sandstone and carbonate interbeds. The Clinton Group is composed of thin- to medium-bedded, very fine- to coarse-grained fossiliferous dolostone.

The Amabel-Lockport Formation includes a lower unit of light grey to grey-brown, finely crystalline, thin- to medium-bedded, sparingly fossiliferous dolostone with minor chert nodules. It also includes an upper unit of blue-grey, fine- to coarse-grained, thick bedded to massive dolostone, which locally contains minor dolomitic limestone.

The Guelph Formation lithology varies from reefal to inter-reefal dolostones and dolo-mudstones (Armstrong and Goodman, 1990). Reefal facies represent pinnacle, patch and barrier reefs and their distribution defines the key aspects of the paleogeography during deposition. The widespread inter-reefal dolostones are typically sucrosic, dark brown to black dolo-mudstones with pebble-size fragments lithologically similar to the underlying Goat Island unit (Armstrong and Carter, 2006). Within the Area of the Five Communities, the Guelph Formation is characterized by facies deposited between the basinward pinnacle reef belt found along the eastern shore of Lake Huron, the patch reefs found in the central parts of the Area of the Five Communities, and the basin margin reef complex typically located in the eastern part of the Area of Five Communities (Johnson et al., 1992).

#### 2.2.4.4 Upper Silurian

The Upper Silurian units include the evaporite and evaporite-related sedimentary rocks of the Salina Group, and overlying dolostones and minor evaporites of the Bass Islands Formation (Table 2). The Upper Silurian units subcrop in a northwest trending belt that extends from south of Niagara Falls to west of Owen Sound (Figure 4). The Salina Group is characterized by repeated, cyclical deposition of carbonate, evaporite and argillaceous sedimentary rocks, comprising Units A through G. Parts of the Silurian salt beds (i.e., B, D, E and F Unit salts) have been dissolved resulting in the collapse structure within the overlying uppermost Silurian and Devonian strata (Sanford, 1993; 1976).

A change to less-restricted depositional conditions was responsible for deposition of the Bass Islands Formation, which is a microcrystalline, commonly bituminous dolostone containing evaporite mineral clasts. The contact with the overlying Devonian carbonates marks a major unconformity characterized by subaerial exposure (Uyeno et al., 1982).

#### 2.2.4.5 Lower and Middle Devonian

The Lower and Middle Devonian units unconformably overlie the Upper Silurian Bass Islands Formation and are dominated by carbonate sedimentary rocks of the Bois Blanc Formation, the Detroit River Group consisting of the Amherstburg and Lucas formations. The Bois Blanc Formation consists of cherty, fossiliferous limestones and argillaceous dolostones that unconformably overlie Silurian strata. The Lucas Formation is fine-crystalline, fossiliferous dolostone and limestone. The Amherstburg Formation is a bituminous bioclastic fossiliferous limestone and dolostone (Table 2). The Dundee Formation, which does not subcrop within the Communities, comprises sparsely fossiliferous limestones and minor dolostones that unconformably overly the Detroit River Group.

The Detroit River Group rocks represent the subcropping bedrock within western and central parts of the municipalities of Brockton and South Bruce and all of the Township of Huron-Kinloss (Figure 4). Devonian rocks are not present beneath the Municipality of Arran-Elderslie (Figure 4). The Devonian carbonates are found southwest of the Municipality and crop out along the shoreline of Lake Huron and north shoreline of Lake Erie.

### 2.2.5 Faulting of the Paleozoic Strata

Figures 2 and 4 show basement-seated faults that displace the Paleozoic strata in southern Ontario and the Area of the Five Communities, respectively. These faults were compiled from several sources by the Ontario Geological Survey (Armstrong and Carter, 2010) and given relative ages based on the youngest geological unit that is offset: i) Shadow Lake/Precambrian, ii) Trenton Group and iii) Rochester Formation (Silurian-aged). These faults are interpreted based on vertical displacements of key unit-top surfaces in the Paleozoic strata, based on earlier compilation and assessment work completed by Brigham (1971) and Bailey Geological Services Ltd. and Cochrane (1984a; 1984b). Vertical displacement of unit top surfaces was identified based primarily on hand contouring and interpretation of formation top data in the Petroleum Wells Subsurface Database (OGSRL, 2013). Where these data are numerous, such as in the southwestern corner of southern Ontario, the faults are identified with a high degree of confidence, and are often named (e.g., Dawn Fault and Electric Fault). In areas where oil and gas exploration wells are widely spaced, such as in the Area of the Five Communities, faults are identified with a low degree of confidence.

As will be discussed further below, this study included an assessment of historic 2D seismic data, including seismic line 725937 in the Municipality of South Bruce. This seismic line also crosses a mapped subsurface fault previously identified as being of Trenton Group age (Figure 4). The re-interpretation of this seismic line identified a potential fault that extends upwards from the Precambrian basement into the base of the Silurian Cabot Head Formation. The coincidence between this interpreted seismic anomaly and the mapped subsurface fault provides a certain amount of confidence in the existence of a fault in the area crossed by the seismic line. However, as discussed below, given the poor quality and limited lateral resolution of the seismic data at this location, the confidence in the exact location and nature of this fault, including its upward continuation into the Silurian succession, is very low.

## 2.3 **Quaternary Geology**

Information on Quaternary geology in the Area of the Five Communities is described in detail in the Terrain and Remote Sensing Study Report (JDMA, 2014) and a summary of that information is provided here.

Quaternary glaciations have played a major role in shaping and creating the landscape of southern Ontario (Barnett, 1992). Glacial landforms and associated sediments within the Area of the Five Communities were deposited by the Huron and Georgian Bay lobes of the Laurentide Ice Sheet during the Late Wisconsinan 23,000 to 10,000 years ago. Exposures of older deposits are rare as they are mostly buried beneath the Late Wisconsinan sediments and can only be seen in such places as riverbank exposures, lake bluffs or man-made exposures in quarries and pits (Barnett, 1992). The surficial deposits of the Area of the Five Communities have been mapped at the scale of 1:50,000 by Cowan (1977), Cowan et al. (1986), Cowan and Pinch (1986), Feenstra (1994), Karrow (1993),

Sharpe and Broster (1977), Sharpe and Edwards (1979) and Sharpe and Jamieson (1982). The overburden can exceed 100 m in this area with values in the range of 30 to 60 m (Karrow, 1989).

Overburden thickness in the Area of the Five Communities ranges from zero up to about 104 m. The thickest overburden in the area appears to be associated with buried bedrock valleys. One of the regional buried valleys extends from Wellesley, through Milverton to Wingham. Another extends from Drayton to Mount Forest. There appears to be a complex of valleys east and west of Walkerton in the Area of the Five Communities. Overburden thickness exceeds 60 m within these structures. Table 3 lists the statistics on overburden thickness within each of the Communities and within the Area of the Five Communities based on the data release of Gao et al. (2006) that involved quality assurance checking to remove erroneous water well information from the MOE Water Well Information System.

**Table 3 Summary of Overburden Thickness within the Communities**

| Community                       | Overburden Thickness (m) |     |      |
|---------------------------------|--------------------------|-----|------|
|                                 | Min                      | Max | Mean |
| Municipality of Arran-Elderslie | 0                        | 89  | 37   |
| Municipality of Brockton        | 0                        | 104 | 33   |
| Municipality of South Bruce     | 0                        | 73  | 20   |
| Township of Huron-Kinloss       | 9                        | 91  | 39   |
| Town of Saugeen Shores          | 2                        | 86  | 50   |
| Area of the Five Communities    | 0                        | 104 | 30   |

Figure 5 shows the surficial Quaternary geology of the Area of the Five Communities. Glacial deposits composed of till are exposed at the surface over 45.6 % of the Area of the Five Communities, and are found as drumlinized and undrumlinized till plains, bevelled till plains and till moraines. The Elma Till is the most abundant till in the Area of the Five Communities, mapped over 23 % of the area. The St. Joseph and Dunkeld/Rannoch tills are the next most common till formations mapped in the Area of the Five Communities, covering 20 % and 1 % of the area, respectively.

Glaciofluvial deposits primarily of sand or sand and gravel are exposed over 21.2 % of the Area of the Five Communities. These deposits are associated with kame moraines, spillways and eskers. Glaciolacustrine deposits of primarily clay, silt and sand are exposed over 23.7 % of the Area of the Five Communities, with about 58% of these deposits mapped as foreshore to basinal deposits and the remaining 42 % as littoral to foreshore deposits. The largest glaciolacustrine deposit mapped in the Area of the Five Communities is represented by the Saugeen clay plain. Fluvial deposits are represented by the modern and abandoned floodplains of the major rivers and creeks in the Area of the Five Communities. These deposits are primarily composed of silt, sand and gravel. Lacustrine deposits of sand and gravel consisting of beaches, bars and spits have been mapped along the shores of Lake Huron and Georgian Bay, covering only 0.2 % of the Area of the Five Communities. Organic deposits of peat and muck have been mapped over 4.4 % of the Area of the Five Communities, with many of the deposits located within spillways, within topographic lows within till plains or on rocky plains of the Bruce Peninsula.

## **2.4 Land Use**

Land use within the Area of the Five Communities consists mostly of agricultural lands, wetlands, forested areas, and developed/built-up areas with residential, commercial and industrial land uses. Wetlands and forested areas represent 14.3 % and 25.2 % respectively of the Area of the Five Communities.

### 3 DATA SOURCES AND LIMITATIONS

Two main tasks were undertaken during this study including an assessment of borehole geophysical data and 2D seismic data interpretation. The data sources used for each of these tasks and the respective limitations to each data source are described below.

#### 3.1 Source Data for Borehole Geophysics Study

Borehole data used for the borehole geophysics component of this assessment were obtained from the Oil, Gas and Salt Resources Library (OGSRL, 2013), which includes the eight boreholes drilled and tested as part of the site characterization work completed at the Bruce nuclear site (Intera Engineering Ltd., 2011). The OGSRL contains a database with information on depths to the top of each bedrock formation intersected as well as borehole geophysical data when these are available. All boreholes in the OGSRL database have data pertaining to the bedrock formation tops provided in the MNR Form 7 submission, and several of the boreholes also have updated formation tops provided by an MNR geologist.

Borehole data was obtained from the OGSRL database for the Area of the Five Communities and its surrounding region. This was done to provide a regional context to the assessment, which is needed for subsequent tasks such as creating cross-sections through the Communities (Geofirma Engineering Ltd, 2014). In total, data from 334 boreholes were obtained from the OGSRL database for the Area of the Five Communities and its surrounding region.

Quality assurance checks (Section 4.1.1) identified 73 of these OGSRL boreholes as not being of sufficient quality for use in this assessment, leaving 261 remaining boreholes with reliable data. A variety of borehole geophysical logs are available for boreholes in the Area of the Five Communities and surrounding region, including gamma ray, neutron, sonic, and density. The most useful of these geophysical logs for the purpose of this study were: gamma ray (GR) and neutron logs (NL) for interpretation of formation tops; and sonic logs for correlation and interpretation of 2D seismic data. Of the 261 quality-checked boreholes (Section 4.1.1) available, 115 have gamma ray and/or neutron logs; however four of these geophysical logs appeared to contain errors in borehole depths, therefore only 111 were considered to have useable data for the purpose of this study. Within the Area of the Five Communities there are a total of 60 boreholes with reliable data, 37 of which also have borehole geophysical data available.

Figure 4 shows the location of the OGSRL boreholes in the Area of the Five Communities. Appendix A lists the characteristics of the boreholes obtained for the Area of the Five Communities and its surrounding region, including: MNR license number, well name, operator name, purpose, UTM coordinates, total depth, deepest formation intersected, date of drilling, and an indication of additional data available such as geophysical logs on record, and rock core in archive.

Borehole data within each of the Communities include:

- No boreholes in the Municipality of Arran-Elderslie;
- Six boreholes, two with geophysical data, in the Municipality of Brockton;
- Four boreholes, one with geophysical data, in the Municipality of South Bruce;



- Three boreholes, two with geophysical data, in the Town of Saugeen Shores; and,
- Seven boreholes, six with geophysical data, in the Township of Huron-Kinloss.

For the construction of the geological cross-sections, the following additional data sources were also used: the Ontario Ministry of Northern Development and Mines (MNDM) Miscellaneous Release Data 207 titled *Bedrock Topography and Overburden Thickness Mapping, Southern Ontario* (Gao et al., 2006); and the Provincial Digital Elevation Model (DEM) accessed through Land Information Ontario (LIO, 2013). Gao et al (2006) compiled data from approximately 253,000 data points (including outcrop mapping, oil and gas well records, geotechnical drill records and 180,000 domestic water wells records) to establish the depth to the top of the bedrock surface. The ground surface elevation data used in this study (provincial DEM) has a resolution of 10m, and was smoothed to produce a dataset with a resolution of 500 m to match other formation top surfaces. This dataset is considered to be sufficient for the purpose for which it was used in this study.

### 3.2 Source Data for 2D Seismic Study

Figure 4 shows all of the known 2D seismic data that were potentially available for purchase within the Area of the Five Communities. In addition, Figure 4 also indicates the portions of 2D seismic data that were acquired for this assessment. Most of the available 2D seismic data are located outside of the Communities and in the southern portion of the Area of the Five Communities.

Sigma Explorations Inc., a seismic data brokerage company based in Calgary, was retained to provide a list of available seismic lines within the Area of the Five Communities. Portions of the available lines were reviewed for quality, location and data acquisition parameters. Based on this assessment, data from four seismic lines were purchased in the Area of the Five Communities, which include two lines in the Township of Huron-Kinloss, and the other two in the municipalities of Brockton and South Bruce, respectively. The two lines within the Township of Huron-Kinloss that were selected for use in this study were chosen because they are the longest lines available and provided a good regional assessment of the applicability of 2D seismic as a tool for future investigations. The lines in the municipalities of Brockton and South Bruce represent the only seismic lines that were available for those communities. Table 4 summarizes the acquisition parameters of the seismic data associated with these four seismic lines, originally collected in the field during the mid to late 1970's.

Lines A003900020 (17.8 km) and A002800018 (23.5 km), located within the Township of Huron-Kinloss (Figure 4), were both collected by Shell Canada, which also currently owns the rights to the data. Line 725937 is approximately 7.3 km long and located within the Municipality of South Bruce (Figure 4), while Line 825938 is approximately 4.5 km long and located primarily within the Municipality of Brockton with a short length extending west of the municipal boundary. Both of these lines were collected by Pacific Petroleum; however Suncor Energy now owns the rights to these data. The orientation of Line 825938 is rotated by approximately 30 degrees north at the western boundary of the Municipality of Brockton as a result of following local roads to acquire the seismic data.

**Table 4 Summary of 2D Seismic Data Acquired for Study**

| <i>Line</i>             | <i>725937</i>     | <i>825938</i>     | <i>A003900020</i> | <i>A002800018</i> |
|-------------------------|-------------------|-------------------|-------------------|-------------------|
| Beginning of Line (BOL) | 0                 | 15                | 400               | 400               |
| End of Line (EOL)       | 245               | 163               | 1290              | 1575              |
| Source Spacing (Sx)     | 30 m              | 30 m              | 20 m              | 20 m              |
| Receiver Spacing (Rx)   | 30 m              | 30 m              | 20 m              | 20 m              |
| Length (L)              | 7.35 km           | 4.47 km           | 17.82 km          | 23.52 km          |
| Owner at Acquisition    | Pacific Petroleum | Pacific Petroleum | Shell Canada      | Shell Canada      |
| Current Data Owner      | Suncor Energy     | Suncor Energy     | Shell Canada      | Shell Canada      |
| Date Acquired           | 1977              | 1977              | 1976              | 1976              |
| Instrument              | DFS III           | DFS III           | DFS IV            | DFS IV            |
| Charge                  | unknown           | unknown           | 0.2 kg            | 0.2 kg            |
| Depth                   | unknown           | unknown           | 10 m              | 10 m              |
| Number of Traces (NTR)  | 24                | 24                | 48                | 48                |
| Fold                    | 12                | 12                | 24                | 24                |
| Far offset              | 360 m             | 360 m             | 500 m             | 500 m             |
| Field filter            | 12-248 Hz         | 12-248 Hz         | 0-124 Hz          | 0-124 Hz          |

The portion of the lines purchased for this assessment are defined in Table 4 by the beginning of line (BOL) and end of line (EOL) station numbers, where the station number represents the position of the receivers along the seismic array. Source spacing (Sx) and receiver spacing (Rx) are the lateral increments in the data position expressed in units of meters. Source spacing is defined as the incremental spacing between shot points while receiver spacing is the incremental spacing between receivers. The subsurface lateral sampling of the final processed wiggle trace is approximately half of the receiver interval spacing, therefore a 20 m receiver spacing interval results in a 10 m common midpoint (CMP) sampling interval, whereas a 30 m receiver spacing interval results in a 15 m CMP sampling interval. The number of traces (NTR) used by the acquisition system is equal to the number of receivers recorded for each source station. Fold is essentially the number of times the same common reflection point (CRP) in the subsurface is sampled. The CRP is half way between the source point and seismic receiver point. Fold is calculated simply as the receiver spacing multiplied by the number of channels divided by the source receiver spacing.

Field filters were used to minimize unwanted noise that would saturate the amplifiers in the instruments; modern instruments have broader dynamic range and do not require field filters. All these data were acquired using dynamite as the vibration source (charge), however the size of the charge and depth were not known for Lines 725937 and 825938. More specific detail regarding the recording and processing parameters used for these lines are included in Appendix B.

### 3.3 Data Limitations

The main limitation associated with the borehole geophysical data is their sparse spatial distribution in the Area of the Five Communities and surrounding region. It is common for any two boreholes within Area of the Five Communities to be 5 to 10 km apart on average (Figure 4). Furthermore, very few boreholes extend through the entire sequence of Paleozoic bedrock; therefore vertical control is limited on some of the deeper bedrock formations. In addition, the number of boreholes within the Area of the Five Communities and surrounding region that contain usable geophysical data for determining formation contacts is approximately 33 % (111 out of 334), as discussed in Section 3.1. Formation tops at boreholes without useable geophysics data were taken as the values listed in the OGSRL database.

Another limitation associated with the borehole geophysical data is that their quality is variable, owing to the historical nature of the collected data. Some geophysical logs were acquired in the 1970's, and as a result formation contacts are in some cases difficult to distinguish as sharp signal contrasts, especially in comparison to more recently acquired borehole geophysical data (e.g., Intera Engineering Ltd., 2011). This is primarily due to the logging parameters used in the study, particularly logging speed. It is common for contractors in the oil and gas industry to use logging speeds of 18 m per minute (m/min) or greater, while the high resolution datasets for the Bruce DGR boreholes were completed using logging speeds of approximately 3 m/min. In order to mitigate against this limitation a workflow was devised in which the geophysical interpretation was limited to those formations tops whose geophysical character or transitional pattern was most discernible and distinct (Section 4.1.2).

Limitations of the 2D seismic include data availability and data quality issues. The data quality issues can be attributed to near surface conditions and/or data collection methods. The main limitation of the 2D seismic interpretation was the limited availability of suitable data. Very few suitable seismic data are available within the Communities and not all Communities contain 2D seismic data (i.e. none within the Town of Saugeen Shores or the Municipality of Arran-Elderslie). As discussed in Section 3.2, only four lines were obtained for this assessment, two in the Township of Huron-Kinloss, and the other two in the municipalities of Brockton and South Bruce.

Data quality issues were mainly attributable to the limitations in equipment technology when these data were collected in the late 1970's. The data within the municipalities of Brockton and South Bruce were shot with only 24 channel seismographs and sparse 30 m station spacing, therefore the data quality is below optimal. The lines within the Township of Huron-Kinloss were acquired with 48 channel seismographs and 20 m station spacing, providing better lateral sampling and more fold multiplicity, and hence more reliable results, compared to the shorter lines mentioned above. For comparison, data typical of modern seismic acquisition is usually collected with 480 channel seismographs using 10 m station spacing. Finally, the overburden heterogeneity and thickness within these municipalities had a detrimental effect on data quality. This limitation would still be valid today using modern equipment and collection methods and is a well known limitation of seismic methods for

areas within southwestern Ontario north of Lambton County.

Station spacing is essentially representative of the lateral sampling interval. For example, 30 m station spacing results in a common reflection point (CRP) spacing of 15 m, compared to a seismic survey with 20 m station spacing which results in a CRP of 10 m. For comparison, modern parameters typically include spacings of 10 m resulting in a CRP of 5 m, essentially 300 % greater than the 15 m CRP acquired on lines 725937 and 825938. In simple terms a 30 m wide geologic feature would have only one sample trace at 15 m spacing whereas with 5 m spacing it would have 5 samples or subsurface traces. A feature such as a reef within the Silurian would typically be 200 - 300 m across and be very difficult to see with the 15 m sampling interval of the older acquisition parameters. Modern systems thus enable higher frequency recording hence better vertical resolution, higher fold or subsurface fold multiplicity thus gives much higher confidence in the final results; and finally broader dynamic range provides the ability to separate meaningful signal from background noise.

The Area of the Five Communities is known to be a difficult area to collect high quality seismic data due to the thickness and inhomogeneity of the overburden material. Seismic signals emanated from the source pulse are attenuated through the overburden and reflected and refracted at the overburden-bedrock interface; reflected and transmitted through acoustic boundaries within the bedrock and then returned back up through the overburden to the recording receivers. Although refraction statistical models attempt to remove the affects of this overburden layer by calculating its characteristics and replacing with a standardized layer, the seismic signal-to-noise ratio is reduced dramatically by the often thick and irregular overburden layer typical of the Area of the Five Communities. Modern recording systems with broader dynamic signal recording range have enabled seismic methods to improve the signal-to-noise ratio typical of this area.

An addtional limitation of the historical 2D seismic data acquired for this study is that most of the lines do not lie close to high quality borehole data (i.e. sonic logs) that can provide geological constraints to the seismic data interpretation. This makes it more difficult to calibrate 2D seismic interpretation by matching 2D seismic markers with the tops of formations known from geological logs.

## 4 METHODOLOGY

### 4.1 Workflow for Borehole Geophysical Data Interpretation

The borehole geophysical data interpretation included four distinct tasks: acquisition and quality check of borehole geophysical data; selection of key formation tops to consider for the reinterpretation of geophysical data; generation of an updated dataset of key formation tops; and creation of geological cross-sections through the Communities. The following sections describe each of these tasks in detail.

#### 4.1.1 Quality Check of OGSRL Borehole Data

As discussed in Section 3.1, a total of 334 boreholes had geological data available from the OGSRL database for the Area of the Five Communities and its surrounding region, 261 of which were considered to be of sufficient quality for use in this assessment. The rationale for discarding the data from the remaining 73 boreholes included a variety of reasons, such as:

- The borehole did not intersect any of the key formation tops;
- The OGSRL borehole data did not have a ground surface elevation;
- The total vertical depth associated with the borehole was not reliable; and,
- The geophysical logs were unreliable due to depth issues or poor quality data.

#### 4.1.2 Selection of Key Formation Tops

The selection of key formation tops for reinterpretation in the borehole geophysical data assessment took into consideration the following: historical formation tops from the OGSRL database to assess stratigraphic variations throughout the Area of the Five Communities and surrounding region; formation tops interpreted by Armstrong and Carter (2010); and formation tops interpreted from geophysical data in eight boreholes drilled at the Bruce nuclear site (Intera Engineering Ltd., 2011; Sterling, 2011). As a result, eight key formations tops were defined (Table 5) based on:

- Ability to interpret the formation top using borehole geophysical data and to consistently identify these same formation tops in boreholes throughout the Area of the Five Communities and surrounding region;
- Geological significance of the Paleozoic formation packages defined by these key formation tops for the overall objective of the geoscientific desktop preliminary assessment; and,
- Grouping of Paleozoic formations to provide a reasonable dataset for use in gravity stripping as discussed in the geophysics interpretation report (PGW, 2014).

As shown in Table 5, a rationale for identifying the key formation tops was established to ensure that they were interpreted consistently at every borehole. Table 5 also lists the stratigraphic packages defined by the key formation tops that formed the basis for creating the 2D cross-sections through each of the Communities (Section 4.1.4). The rationale for identifying the top depth of each key formation was selected to remain consistent with the approach taken by Armstrong and Carter (2010), and Intera Engineering Ltd. (2011) at the Bruce nuclear site, which involved discussions with geologists of the Ministry of Natural Resources (MNR) and the Ontario Geological Survey (OGS).

This rationale is premised on selecting an easily identifiable inflection point of the appropriate geophysical curves for each individual key formation top. Differences between the historical formation top depths in the OGSRL and the depths identified during the reinterpretation of geophysical logs may be the result of geophysical logging acquisition parameters (e.g. cable stretch, tool speed, frequency of data collection) that result in depth offsets, but no attempt to reconcile such potential depth differences was attempted during this work.

When the reinterpretation of a key formation top overlapped or created a conflict with the historic under/overlying formation top pick, the conflicting formation top was also reinterpreted (although the confidence of such reinterpretation was lower). As discussed in Section 5.1.1, conflicts arose with the Cobourg (Lower Member) and Gull River formation tops as a consequence of the reinterpretation of the overlying Cobourg (Collingwood Member) and the Coboconk formations. Such conflicts had no impact on the resulting cross-sections included herein, as the Cobourg (Lower Member) and Gull River formations were not defined as key formation tops for this study.

**Table 5 Summary of Key Formation Tops and Rationale for Identification Based on Geophysical Logs**

| <i>Formation Top</i>  | <i>Rationale</i>                                                                                                                                    | <i>Confidence</i>                       | <i>Stratigraphic Package</i> |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------|
| Bass Islands          | increase in neutron log associated with higher permeability "aquifer"                                                                               | Low to Medium                           | Silurian                     |
| Salina (G-Unit)       | last gamma spike (large) ~9m above F-shale and start of drop in NL (last NL trough before higher GR plateau of F-shale); upper gamma peak if double | Medium to High                          |                              |
| Salina (F-Unit)       | Sharp increase in gamma ray above Cabot Head                                                                                                        | High                                    |                              |
| Cabot Head            | sharp gamma increase above Queenston and sharp decrease in NL                                                                                       | High                                    |                              |
| Queenston             | top of gamma plateau and sharp decrease in NL                                                                                                       | High                                    | Upper Ordovician Shales      |
| Cobourg (Collingwood) | base of sharp, significant gamma plateau                                                                                                            | High                                    | Upper Ordovician Limestones  |
| Coboconk              | base of gamma plateau (Kirkfield) and approximately 6m above largest gamma peak in Coboconk                                                         | Medium                                  |                              |
| Precambrian           | Increase and spiky gamma ray                                                                                                                        | Low to Medium based on limited log data | n/a                          |

Table 5 lists the general level of confidence (low, medium, high) to consistently pick the same key formation top throughout all boreholes in the Area of the Five Communities and surrounding region. Figure 6 shows examples of gamma ray and neutron logs for the eight key formation tops, demonstrating the rationale. Generally, the highest level of confidence was assigned to those key formation tops with obvious and consistent changes in gamma ray or neutron logs, such as the Salina Group F-Unit, the Cabot Head Formation, Queenston Formation, and the Collingwood Member of the Cobourg Formation (Figure 6). The Salina G unit could also be picked with a high degree of confidence in some cases; however, this formation top was not always as clearly distinguishable in all borehole logs. Although the top of the Bass Islands Formation and Precambrian basement are

distinguishable in the majority of borehole geophysical logs, their gamma ray or neutron log signatures were less consistent between boreholes and were therefore attributed a lower confidence.

#### 4.1.3 Updated Database for Key Formation Tops

An updated database for the key formation tops listed in Table 5 was compiled for the boreholes used as part of this assessment. This updated database includes:

- Key formation top depths reinterpreted as part of this study using borehole geophysical logs; and
- Historical key formation top depths from the OGSRL database for those wells where no geophysical data was available for reinterpretation. In these cases the MNR picks from the OGSRL database, as opposed to the Form 7 picks, were used when available as they include quality control checks completed by the MNR.

Generally, the steps followed to create this database included:

- a) Tabulate top depths for key formations in all boreholes within the Area of the Five Communities and surrounding region as listed in the OGSRL database (Section 3.1);
- b) Reinterpret key formation top depths in boreholes with useable gamma ray or neutron geophysical log data;
- c) Update the OGSRL top depths of key formations with the reinterpreted formation top depths; and,
- d) Remove borehole entries flagged to contain unreliable data as discussed in Section 5.1.1. (Quality Checks).

The one exception to step (c) above involved the reinterpreted top depths for the Cobourg Formation - Collingwood Member. The rationale used as part of this study, which is consistent with that used by Intera Engineering Ltd. (2011) at the Bruce Nuclear Site, identified the large, sharp decrease in gamma signal which corresponds to the top of the Cobourg Formation being called the Cobourg Formation – Collingwood Member. Most historical OGSRL formation top entries do not follow this rationale and instead identify this same large, sharp gamma decrease as simply the top of the Cobourg Formation while sometimes identifying the Collingwood “Formation” above the Cobourg and associating it with the top of the Rouge River Member of the Blue Mountain Formation. This discrepancy is addressed by interpreting the historical Cobourg Formation top depths in the OGSRL database to correlate with the newly picked Cobourg Formation – Collingwood Member top depths identified from boreholes with useful geophysics logs as part of this study. Therefore, the updated database for key formation tops more consistently identifies the Cobourg Formation - Collingwood Member.

The depth of the key formation tops included in the updated database are expressed in units of metres below ground surface (mBGS). The updated key formation tops dataset was used to create the geological cross-sections shown and discussed later in this report (Section 4.1.4), as well as for gravity stripping (PGW, 2014).

#### 4.1.4 Creation of Cross-Sections

Six stratigraphic cross-sections were created to better illustrate the depths and thicknesses of the Paleozoic stratigraphic packages defined by the key formation tops (Table 5) within the Communities

(Figures 8, 9 and 10). It was necessary to use borehole data from outside of the Area of the Five Communities to complete some of the cross-sections due to a lack of data within this area. Note that Figure 7, which shows the location of the cross-sections, encompasses a slightly larger area than the Area of the Five Communities.

The orientation and location of each cross-section was selected to maximize subsurface coverage both parallel and perpendicular to the regional northwesterly strike of formations across the Area of the Five Communities. In creating the cross-sections, an effort was made to use the highest confidence data available including boreholes with available geophysical data and those referenced by Armstrong and Carter (2010), as control points. In this manner, a high degree of confidence could be assigned to large portions of the cross-sections. However, due to the limited availability of geophysical data, and to the generally low density of boreholes across the area, additional boreholes without accompanying geophysical data were also used in constructing the cross-sections. In these latter cases, there was complete reliance on the historical interpretations in determining the key formation tops, which are obtained from the OGSRL database (aside from the top of Cobourg Formation - Collingwood Member as discussed above in Section 4.1.3). Solid and dashed lines are utilized to indicate where confidence was higher (solid) versus lower (dashed) in extending key formation top surfaces across the cross-sections (Figures 8, 9 and 10). Solid lines were used when there were borehole data to define both ends of the straight line; conversely, dashed lines were used when the formation top surface was only defined at one end and the data needed to be extrapolated to define the other end. The cross-sections created also present gamma ray log data where they exist, as well as the ground surface and top of bedrock surfaces.

## 4.2 Workflow for 2D Seismic Data Interpretation

### 4.2.1 2D Seismic Data Processing

Standard 2D seismic data processing has been applied, including elevation statistics, refraction statics, amplitude balancing, pre-stack noise reduction, deconvolution, move out correction, residual statics, post-stack spectral whitening and post stack time migration. In addition, an additional processing step called crooked line binning was applied to the subsurface data for this line to ensure correct locations of the subsurface common reflection points. This workflow is consistent with typical data processing routinely used for oil and gas exploration in this area. Appendix B presents the details of the recording and processing parameters for the 2D seismic lines used as part of this assessment.

These 2D seismic data were provided as shot gathers in digital form, including survey information and observer notes detailing the location of each shot gathers and corresponding channels. The data processing steps used as part of the 2D seismic interpretation included:

- *Elevation Statistics:* Lines 725937 and 825938 did not have elevation information therefore the georeferenced coordinates were imported into a mapping program and the approximate elevation for each station was selected from the ground surface elevations. These elevations are defined within the seismic processing software as Topo 9 Canada elevation data which is made up of 90 meter cell resolution derived from Canada Digital Elevation Data (CDED) 250k data. In Topo North America 10 this data was updated to be mostly derived from CDED 50k data.



- *Refraction Statics:* The shot gathers were analyzed for the first seismic-signal arrival time using a refraction program to estimate the thickness of the drift layer or shallow low velocity layer. The variable velocity and thicknesses of the weathered bedrock (or overburden layer) were calculated for each source and receiver point. A time was calculated to replace the time delays resulting from these variations with a replacement elevation (340m) and velocity (4800 m/s) to correct for the calculated time delays for each source and receiver point. This replacement elevation is approximately the highest elevation within the area of interest and this replacement velocity is the highest rock velocity calculated with the refraction analysis. This is known as a weathering static correction. In addition, the effects of variable elevations were similarly corrected to provide a floating surface in time enabling accurate comparison of the subsequent seismic section to reflect true stratigraphy in time.
- *Amplitude Balancing:* A spherical divergence correction was applied to the amplitudes as well as a low frequency envelope to attempt to scale the data to highlight the reflection events
- *Pre-Stack Noise Reduction:* A signal velocity filter is used to remove the effects of the ground roll, a low frequency filter of 4-20 Hz and a low velocity filter of 300-2000 m/s was used.
- *Deconvolution:* A deconvolution filter was used along with spectral whitening to enhance the high frequency reflections events that correspond to velocity/density stratigraphy within the geology. A spiking deconvolution process with 3 % pre-whitening and a 40 ms operator length was used.

After the above data processing was completed, these 2D seismic data were stacked into common reflection point cross-sections. During this stacking process, the following data processing steps were followed:

- *Residual Statics:* Not all of the time delays can be captured with the refraction statics so a process of analyzing common shot gathers and common receiver gathers is used to assess additional time delays that occur for all recorded traces that are common to a source or receiver point.
- *Move Out Correction:* Hyperbolic reflection events depicted in the shot gathers were corrected for velocity and stacked into sections using a normal move out method. A number of iterative steps of residual static correction and velocity analysis were completed prior to arriving at the final reflection sections.
- *Post-stack Spectral Whitening:* The frequency spectrum was balanced to optimize the sections for geologic interpretation. This process is also known as post-stack noise reduction.
- *Post-stack Time Migration:* These final reflection sections were then processed using migration methods which correct the dips relative to lateral location and helps to filter random noise. 100 % of the stacking velocity, max dip of 25 degrees and frequency range of 10-115 Hz were the parameters set for the FX migration algorithm.

Appendix D includes the 2D seismic processed data that were used in this study. Final processed 2D seismic sections are shown in Figure D.1 (Line 725937), Figure D.2 (Line 825938), Figure D.3 (Line A002800018) and Figure D.4 (Line A002800020). The tops of these figures show the ground elevation as well as the results of the refraction interpretation of the overburden thickness and velocities. These results were used to correct for near surface time delays within the processing of the final time sections below.

These final processed data sets were then loaded into Winpics 5.9.0 workstation geo-referenced to the well, culture and land database in NAD83 UTM zone 17N, meters.

#### 4.2.2 Creation of Synthetic Seismograms

Seismic reflection data are initially only available in the time domain. In order that the geology encountered in a borehole can be tied to the seismic data, a 1D synthetic seismogram is generated. This is important in identifying the origin of seismic reflections seen on the seismic data. Density and velocity data are routinely measured down the borehole using wireline logging tools. These logs provide data with a sampling interval much smaller than the vertical resolution of the seismic data. Sonic logs, also referred to as acoustic impedance logs, are measures of the signal velocity versus distance between source and receiver (travel time) within the bedrock formations encountered in a borehole. These acoustic impedance logs were combined with the velocity data to generate a reflection coefficient series in time. This series is convolved with a seismic wavelet to produce the synthetic seismogram. The input seismic wavelet is chosen to match as closely as possible to that produced during the original seismic acquisition, paying particular attention to phase and frequency content. The spectral band width of the data processing was identified by analyzing the processed sections using a Fourier transform around the window of interest and determined to be 0 phase 20-70 Hz.

Two sonic logs in digital LAS format were obtained from the OGSR library. These were chosen as they were the closest sonic logs to the seismic lines. Borehole T004910 is located near the western end of seismic Line 825938 and borehole T007544 is located approximately 6km from the south end of seismic Line A002800020. Sonic and pseudo-density logs were used to generate an acoustic impedance reflectivity sequence and their corresponding reflection coefficients. Pseudo-density was calculated following the empirical formula as outlined by Gardner et al. (1974) which multiplies signal velocity (in units of m/s) to the power of 1.4 by an empirical constant value of 0.31. These reflection coefficients were convolved using an Ormsby wavelet with 10/20-70/80 Hz corners (wavelet #1) and a Klauder wavelet sweep length 10-70 Hz with 0.5 s tapers (wavelet #2) to generate a synthetic seismogram that can be tied to the seismic sections. The details of the exact wavelets are shown at the bottom of Figures 11 and 12 as wavelets in time with their amplitude spectrum details. The depths to bedrock formations are well known within these boreholes, therefore the seismic section depicted in time can be correlated to a synthetic seismogram that was created by converting formation depths in a borehole log to travel time.

Figures 11 and 12 depict the resulting synthetic seismograms, sonic velocity, pseudo-density, and acoustic impedance with the known geologic tops from OGSR boreholes T004910 and T007544, respectively, to show the resulting seismic markers on the seismic sections.

In cases where high quality sonic data is not available close to a seismic line for use in the interpretation, a synthetic seismogram can be created by patching together data from wells further away. For example, seismic Line 725937 does not have any nearby sonic log data and the closest borehole is F012077, located approximately 1 km south of this seismic line, which terminates within the Cobourg Formation. A synthetic sonic log for this well was created using the sonic log from a nearby borehole (T007544) and stretching or squeezing the combined sonic profile as required to fit the known geology within borehole F012077. As such, the deeper sonic data from borehole T007544 was reprocessed and adjusted by thickness in order to tie with the seismic as shown in Figure 13. Figure 13 shows the synthetic seismogram inserted within the line adjacent to borehole F012077 and the interpreted reflection coefficient data and picks superimposed on top of these data at this location to demonstrate the process of interpreting formation contacts in the 2D seismic data.

These synthetic seismograms were created to assist with the interpretation of seismic markers. Synthetic seismograms from OGSRL sonic logs are tied to the processed lines to identify the reflection markers on the 2D seismic sections. Details of the horizons picked are discussed below as part of the interpretation of each seismic line and are based on seismic markers identified on the synthetic seismograms.

#### 4.2.3 Interpretation of Synthetic Seismograms

Final digital files of the processed 2D seismic lines were loaded into a database of the surface culture and well tops for interpretation. Figure 11 through 13 depict key markers used in the geologic borehole study, where present on the log, as well as key seismic markers known to have good reflectivity. Key markers identified, using the synthetic seismograms, are the Salina Group G-Unit, B-Unit, A2-Carbonate Unit, and A1-Carbonate Unit (lower-upper Silurian), the Fossil Hill Formation (base of Lion's Head, lower Silurian), the Cabot Head/Queenston Formation (base of Silurian), the Cobourg Formation - Collingwood Member (top of Trenton, upper Ordovician), Coboconk and the top of the Precambrian basement. Table 6 summarizes these seismic markers with a brief description of their quality and their appearance in the seismograms as either a peak or a trough. The Cabot Head, Manitoulin, and Queenston formations are all difficult to distinguish from each other, and although the true seismic reflector is likely the hard carbonate Manitoulin Formation, this seismic marker is termed the Cabot Head/Queenston reflector for the purpose of this report to remain consistent with the key formation tops identified using borehole geophysical logs. Similarly, the Shadow Lake Formation is thin and difficult to distinguish from the Precambrian; therefore these are both grouped together. These picks are based on corresponding amplitude peaks or troughs on the associated synthetic seismograms which are presented as a function of two-way travel time based on the sonic velocities measured in the nearby well.

**Table 6 Summary of 2D Seismic Markers**

| <b><i>Seismic Marker</i></b> | <b><i>Peak/Trough (normal polarity plots)</i></b> | <b><i>Quality</i></b>                                                            | <b><i>Geologic Time</i></b> |
|------------------------------|---------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------|
| Bass Islands/G-unit          | Trough                                            | Low reflection coefficient                                                       | Top Silurian                |
| B-unit                       | Trough                                            | Good when thick enough and/or present                                            | Upper Silurian              |
| A2-Carb                      | Peak                                              | Excellent marker, strong reflection coefficient                                  | Upper Silurian              |
| A1-Carb                      | Peak                                              | Excellent Carbonate seismic marker as a package with the A2 carbonate/salt above | Upper Silurian              |
| Fossil Hill                  | Peak                                              | Good marker                                                                      | Lower Silurian              |
| Cabot Head/Queenston         | Peak                                              | Good marker                                                                      | Base Silurian               |
| Cobourg                      | Peak                                              | Excellent reflector                                                              | Upper Ordovician            |
| Coboconk                     | Trough                                            | Very weak reflector                                                              | Upper Ordovician            |
| Shadow Lake/Precambrian      | Trough                                            | Very weak reflector                                                              | Precambrian                 |

Vertical resolvability of the individual geologic packages is very limited by the frequency of the recorded data and thickness of each package. Using a dominant frequency of 40 Hz based on the amplitude spectrum depicted in Section 4.2.2 above and an average velocity of 3500 m/s the minimum resolvable layer is roughly 22 m which is basically  $\frac{1}{4}$  wavelength converted to depth using 3500 m/s velocity. For example, within borehole T007544 the Cabot Head Formation is 24 meters thick and the Manitoulin Formation (underlain by the Queenston Formation) is identified to be only 13 m thick, thus a total thickness of 37 m. A dominant frequency of 40 Hz means a wavelength of 0.025 seconds which at a velocity of 3500 m/s results in a peak to trough thickness of 43.75 m. The seismic wavelet interpreted as reflecting the Cabot Head Formation is positioned just below the trough and very close to the seismic wavelet interpreted as reflecting the Queenston Formation (seismic-peak) within the same wavelet hence it is difficult to separate these two formations on the seismic section. The strong seismic reflection is due to the hard carbonate Manitoulin Formation sandwiched between them, while the Cabot Head and Queenston Formations can be approximated as the upper limb and lower limb, respectively for the seismic reflection peak. The seismic markers picked as part of this study and summarized in Table 6 are the common peak/trough events typically identified on seismic sections within southwestern Ontario.

## 5 RESULTS

### 5.1 Reinterpretation of Borehole Geophysical Data

Appendix C lists the top depths of key formations identified in Table 5 reinterpreted based on the review of historical borehole geophysical data from 111 boreholes that contained useable gamma ray and/or neutron logs within the Area of the Five Communities and surrounding region. Appendix C summarizes: the borehole geophysical data acquired; depths of logging; reinterpreted key formation top picks based on gamma and/or neutron logs; the MNR key formation top pick; the difference in depth if the reinterpreted top was different from the MNR top; and a note as to which geophysical logs were used to identify the top depth of the key formation.

Table 7 summarizes the number of picks and percentage of picks changed for each key formation top pick, as well as the total dataset. In total, there were 502 picks recorded in the OGSRL database for the eight key formation tops in boreholes where geophysical data existed. Of these 502 key formation top picks, 349 were not changed, 86 were changed less than 5 m, 26 were changed between 5-10 m, and 41 were changed greater 10 m. This represents approximately 69 % formation picks unchanged, 17 % with changes less than 5 m, 5 % with changes between 5-10 m, and 8 % with changes greater than 10 m.

**Table 7 Summary of Changes to Key Formation Top Depths Based on Borehole Geophysical Well Logs**

| <i>Formation</i>      | <i>Total # with OGSRL picks</i> | <i>Unchanged from OGSRL</i> |          | <i>Changed +/- 0 to 5m</i> |          | <i>Changed +/- 5 to 10m</i> |          | <i>Changed &gt; +/- 10m</i> |          |
|-----------------------|---------------------------------|-----------------------------|----------|----------------------------|----------|-----------------------------|----------|-----------------------------|----------|
|                       |                                 | <i>#</i>                    | <i>%</i> | <i>#</i>                   | <i>%</i> | <i>#</i>                    | <i>%</i> | <i>#</i>                    | <i>%</i> |
| Bass Islands          | 95                              | 73                          | 77       | 11                         | 12       | 6                           | 6        | 5                           | 5        |
| Salina (G-Unit)       | 94                              | 62                          | 66       | 16                         | 17       | 10                          | 11       | 6                           | 6        |
| Salina (F-Unit)       | 82                              | 64                          | 78       | 11                         | 13       | 5                           | 6        | 2                           | 2        |
| Cabot Head            | 87                              | 60                          | 69       | 22                         | 26       | 3                           | 4        | 2                           | 2        |
| Queenston             | 44                              | 30                          | 69       | 13                         | 30       | 0                           | 0        | 1                           | 2        |
| Cobourg (Collingwood) | 33                              | 10                          | 30       | 2                          | 6        | 0                           | 0        | 21                          | 64       |
| Coboconk              | 36                              | 25                          | 69       | 5                          | 14       | 2                           | 6        | 4                           | 11       |
| Precambrian           | 31                              | 25                          | 81       | 6                          | 19       | 0                           | 0        | 0                           | 0        |
| <b>Total</b>          | 502                             | 349                         | 69       | 86                         | 17       | 26                          | 5        | 41                          | 8        |

As shown on Table 7, most of the key formation tops reinterpreted from borehole geophysical data were unchanged from the OGSRL (MNR) picks. The high percentage of unchanged tops for the Salina F-Unit, Cabot Head, Queenston and Coboconk formations is due to the fact that these tops can be picked from geophysical data with a medium to high level of confidence as they show distinct log signatures (Section 4.1.2). The high percentage of unchanged tops for the Bass Islands Formation and the Precambrian basement is related to the fact that these contacts were harder to identify on borehole geophysical data (i.e. data were not clear or the change in the signal at the formation top

was not obvious) and therefore the Geofirma pick simply defaulted back to the MNR pick. There were also several instances where the geophysical logs did not extend to the bottom of the borehole and the MNR had formation top pick entries above or below the geophysical logs signals. In both of these cases, a confident reinterpretation of formation tops was not possible and therefore the default formation top pick reverted to the MNR pick.

The reinterpreted key formation top that changed most frequently compared to the MNR pick was the Cobourg Formation (Collingwood Member). Typical corrections to the MNR top for the Collingwood Member of the Cobourg Formation involved lowering the pick to the large drop in gamma signal at the bottom of the elevated gamma plateau associated with the Upper Ordovician shales (Figure 6). This correction is the result of historically picking the top of the Collingwood Member within the Blue Mountain Formation (Table 2). In this assessment the Cobourg Formation (Collingwood Member) top was reinterpreted based on methods employed during site characterization work performed at the Bruce nuclear site (Sterling and Melaney, 2011; Sterling, 2011).

## 5.2 Geological Cross-Sections

In order to visualize the results of the borehole geophysical data interpretation, and to better understand the subsurface geometry of the Paleozoic formations beneath the Area of the Five Communities, six geological cross-sections have been constructed (Figures 7 through 10). Figure 7 shows the location of the six geological cross-sections, Figure 8 shows cross-sections A-A' and B-B', Figure 9 shows cross-sections C-C' and D-D', and Figure 10 shows cross-sections E-E' and F-F'.

There are several qualitative comments that can be made based upon visual inspection of the constructed cross-sections, and in relation to the general distribution of the Paleozoic formation packages that were defined during the borehole geophysics assessment. The Upper Ordovician shale and limestone packages exhibit relatively uniform, about 200 m each, thicknesses regardless of the orientation of the cross-sections, thus highlighting the lateral uniformity of both packages beneath the entire Area of the Five Communities. The Silurian formation package shows some variability in total thickness (Figures 8 to 10). There are several factors to consider in assessing this variability, including:

- The understanding that the top of the Bass Islands Formation is a regional unconformity (Armstrong and Carter, 2010);
- Salt dissolution throughout the Salina Group (not shown), which would have induced collapse of the overlying formations resulting in localized reduced thickness of the entire Silurian formation package; and
- The existence of several types of reef facies (e.g., pinnacle, barrier) in the Guelph Formation across the Area of the Five Communities.

The inflections in the dips of key formation tops observed in the cross-sections are an artefact of the irregular distribution of the boreholes used to construct the sections, rather than actual variability in the dip of the layering. This is because none of the cross-section lines are uniformly parallel or perpendicular to the strike of the layering. The dip inflections are also magnified by the 25X vertical exaggeration employed in the construction of the cross-sections. In reality, the Paleozoic formations are reported to dip uniformly to the southwest at between  $0.23^\circ$  and  $1^\circ$  which is equivalent to 4 to 17

m/km (Watts et al., 2009) in the Area of the Five Communities. Similarly, regional dips within southwestern Ontario are reported by Armstrong and Carter (2010) to be approximately 3 to 6 m/km southwestwards along the crest of the Algonquin Arch and 3.5 to 12 m/km down the flanks of the Algonquin Arch westwards into the Michigan Basin.

It was not possible to interpret any basement-seated fault structures in the Paleozoic sequence based on the constructed cross-sections. This is mainly due to the sparse distribution of available boreholes, the limited number of key formation tops reinterpreted during the borehole geophysics assessment, and the understanding that the key formation packages exhibited relatively uniform thicknesses, as mentioned above.

Some of the wells used for the cross-sections are known to penetrate pinnacle reefs. However, due to the sparse borehole distribution and the limited number of key formation tops reinterpreted, it was not possible to distinguish different reefal facies in the Guelph Formation. The top of the Guelph Formation was deemed not to be a clear, high confidence pick on borehole geophysical data and so no detail for this unit has been added. The same can be said with regard to salt beds within the Salina Group, which were not clearly discernible from borehole geophysical data

There is an increased degree of uncertainty in the subsurface distribution of the key formation packages with increased distance away from control boreholes with available geophysical data, and due to the generally low density of boreholes penetrating the entire Paleozoic succession. As mentioned above, this is acknowledged by the use of solid and dashed lines in the constructed cross-sections (Figures 8 to 10).

Section A-A' (Figure 8) is approximately 98 km long, intersecting nine boreholes, and transects the municipalities of South Bruce, Brockton and Arran-Elderslie (Figure 7) and is roughly oriented to show a strike-perpendicular section through the Paleozoic sequence, however portions of this cross-section appear more strike-parallel. The orientation of the cross-section is such that the nine boreholes used to construct Figure 8 leave an 83 km long portion in the middle of the section without borehole data below the Upper Silurian formations, and therefore lower confidence in the formation contact depths within this area. Conversely, higher confidence is associated with the formation contact depths within the initial 10 km at the southern portion of the cross-section, where borehole geophysical data is available for a couple of wells, one of them transecting almost the entire Paleozoic sequence (borehole T004767). Higher confidence is also associated with the formation contact depths within the final 5 km at the northern portion of the cross-section, where a number of borehole logs (four of which are shown on this figure) contain data that extend to the bottom of the Paleozoic sequence. The key formation top picks from the boreholes that intersect the entire Paleozoic sequence highlight the relatively uniform, approximately 200 m, thicknesses of the Upper Ordovician shale and limestone formations and provide justification for projecting these formation packages beneath the entire section.

Section B-B' (Figure 8) is approximately 93 km long, intersecting fourteen boreholes, and transects the Township of Huron-Kinloss, Town of Saugeen Shores and Municipality of Arran-Elderslie (Figure 7), and is roughly oriented to show a strike-perpendicular section through the Paleozoic sequence. Section B-B' also is crossed by the easternmost edge of Seismic Line A002800018. A high degree of confidence is associated with the interpreted key formation top depths in this cross-section because of the large number of boreholes that were used to construct this figure, eight of which include borehole geophysical data (southern half), and seven of which extend to the bottom of the Paleozoic sequence

(spaced throughout section). Although there is a small portion (approximately 28 km) in the northern half of this section without well control, the characteristically uniform thickness of the Upper Ordovician shale and limestone formation packages is evident in this section, thus providing a high degree of confidence and justification in extrapolating this geometrical attribute to areas with sparser well control. Three of the boreholes on this section intersect known pinnacle reefs within the lower half of the Silurian formation package, as indicated in the figure.

Section C-C' (Figure 9) is approximately 82 km long, intersecting seven boreholes, and extends mostly southeasterly while transecting the Township of Huron-Kinloss and the Municipality of South Bruce (Figure 7). This section is roughly oriented to show a strike-parallel section through the Paleozoic sequence with a slight trend to strike-perpendicular. The varying orientation of the cross-section between control boreholes results in variations of the dip of the formation packages between sub-horizontal and shallowly dipping. A high degree of confidence is associated with the interpreted key formation top depths in this cross-section because the seven boreholes that were used to construct this figure provide reasonable coverage, four of which include borehole geophysical data (middle of section), and four of which extend to the bottom of the Paleozoic sequence (southeast half). The characteristically uniform thicknesses of the Upper Ordovician shale and limestone packages is evident in this section, again providing a high degree of confidence and justification in extrapolating this geometrical attribute to areas with sparser well control. Two of the boreholes (T003535 and F012078) intersect known pinnacle reefs within the Silurian formation package.

Section D-D' (Figure 9) is approximately 98 km long, intersecting four boreholes, and extends east-north-easterly while transecting the Township of Huron-Kinloss and the Municipality of South Bruce (Figure 7). This section is roughly oriented to show a strike-perpendicular section through the Paleozoic sequence. Section D-D runs subparallel to, and immediately south of, both Seismic Line 725937 and the mapped subsurface fault in the Municipality of South Bruce. The orientation of the cross-section is such that the four boreholes used to construct figure leave a 62 km long portion in the middle of the section without any data control. In addition, only two boreholes in the southwest have geophysical data available and only one borehole at the northeast end extends through the entire Paleozoic sequence, therefore lower confidence is associated with the deep Ordovician formation contact depths within this area. Conversely, higher confidence is assigned to the Devonian and Silurian formation packages beneath the Township of Huron-Kinloss, where boreholes with geophysical data are available. Based on the results of other sections where the deep formations are constrained with geophysical data, the interpreted continuity of the Upper Ordovician shale and limestone packages in this section is, though of lower confidence, well justified. One of the boreholes near the southwest end intersects a known pinnacle reef within the Silurian formation package.

Section E-E' (Figure 10) is approximately 85 km long, intersecting six boreholes, and transects the Municipalities of Brockton and South Bruce (Figure 7). This section is roughly oriented in an east-west direction with an oblique angle to strike (roughly strike-perpendicular). The orientation of the cross-section is such that the boreholes used to construct figure leave a 60 km long portion in the middle of the section without any data control and therefore lower confidence in the formation contact depths within this area. Conversely, higher confidence is associated with the formation contact depths within the initial 25 km within the west portion of the cross-section beneath the western part of the Municipality of Brockton, where borehole geophysical data are available for three boreholes that transect the entire Paleozoic sequence. These high confidence picks, along with a borehole



extending through the entire Paleozoic sequence at the east end of the section line, show a relatively uniform thickness of Upper Ordovician shale and limestone packages, which provides the justification for extending these units with a similar thickness beneath the entire cross-section length. One of the boreholes near the western boundary of the Municipality of Brockton intersects a known pinnacle reef within the Silurian formation package. Section E-E' crosses the mapped subsurface fault located along the western margin of the Municipality of Brockton. As mentioned in Section 2.2.4.6, there is a low degree of confidence in the nature of this fault structure, and therefore it has not been included on Section E-E'.

Section F-F' (Figure 10) is approximately 61 km long, intersecting five boreholes, and extends eastwards while transecting the Town of Saugeen Shores and the Municipality of Arran-Elderslie (Figure 7). The section is also oriented at an oblique angle to strike (close to strike-perpendicular). There is a high degree of confidence in formation contact picks within the western half of the cross-section where four of the five boreholes are located, all of which extend through the entire Paleozoic sequence and three of which have geophysical data available. Although there is a large portion (approximately 40 km) in the eastern half of this section without well control, these high confidence picks along with a borehole extending through the entire Paleozoic sequence at the east end of the section line show a relatively uniform thickness of Upper Ordovician shale and limestone packages that provides the justification for extending these units with a similar thickness beneath the entire cross-section length. In this cross-section, two boreholes within the Town of Saugeen Shores intersect known pinnacle reef structures.

### 5.3 Interpretation of 2D Seismic Data

Figures 14 to 17 show the interpreted 2D seismic sections for each of the four seismic lines reinterpreted as part of this study. On these figures, the y-axis represents travel time of seismic signal expressed in units of milliseconds (ms), while the x-axis represents the horizontal station spacing along the seismic line and is determined by multiplying the source point number by the station spacing to calculate the shot position. The following sections provide a detailed description of the interpretation of each 2D seismic line, including limitations derived from the data. In general, low quality seismic data (fair to poor quality) and minimal amounts of corresponding deep borehole data make interpretation difficult. The interpretation has been approached from a regional perspective and only those seismic anomalies that are interpreted with high confidence as potential faults are included in this report. Other seismic anomalies could be interpreted but due to the low confidence associated with their existence as faults these anomalies were not reported. For example, seismic anomalies were interpreted with lower confidence due to the fact that they could be attributed to a thickening of overburden or changes in overburden type (e.g. gravel does not transmit a seismic signal as well as sand or clay) which degrades the seismic signal-to-noise ratio, ultimately resulting in a poorer quality signal and a decrease in confidence in any interpretations for these zones. In total, two seismic anomalies were interpreted with higher confidence and retained in this report.

OGSRL (2013) includes a map of all seismic lines reported in this area and deep borehole data, which does not identify any known Silurian reef pools within the Area of the Five Communities, although four small pinnacle gas reefs are shown to be still active south of the Township of Huron-Kinloss. No reef type features have been interpreted along any of the four seismic lines interpreted as part of this study.

### 5.3.1 Seismic Line 725937

Figure 14 shows the 2D seismic section and interpretation of Line 725937 located in the northwestern edge of the Municipality of South Bruce. The east end of this line is situated approximately 1 km from borehole F012077 (Dominion) that only extends to the Cobourg Formation. As discussed in Section 4.2.2, a synthetic seismogram was constructed using sonic data from borehole T007544 as there were no other closer sonic data available. Therefore, interpretation for seismic Line 725937 is based on the identification of key formation tops from this constructed synthetic seismogram as well as extending the interpretation from nearby seismic Line 825938 (Section 5.3.2).

The 2D seismic data quality along this line is very poor due to the limited number of channels and sparse station spacing. In addition, it is sub-parallel to and crossed by a mapped subsurface fault that is interpreted to extend from the Precambrian basement upwards to within the Trenton Group. The existence of a fault transecting the seismic line may cause data quality issues due to out of plane reflections distorting the seismic data for all markers below the top of the Trenton Group.

A seismic anomaly was identified between stations 5700 and 6300 (approximately 1.5km from the western end of this seismic line) as an offset in the two-way travel-times to the reflection markers. In this case, this travel-time offset is observed on deeper reflectors, where the shallower reflectors tend to be near horizontal and continuous. In this position, a near vertical reverse fault is interpreted to extend upwards from the Precambrian basement into the base of the Silurian Cabot Head Formation. The coincidence between this interpreted seismic anomaly and the mapped subsurface fault provides a certain amount of confidence in the existence of a fault in the area crossed by the seismic line. However, given the poor quality and limited lateral resolution of the seismic data at this location, the confidence in the exact location and nature of this fault, including its upward continuation into the Silurian succession, is very low.

The closest and only significant well tie for this seismic data is a nearby well located approximately 1 km to the south at the eastern end (F012077). As discussed in Section 4.2.2, a synthetic sonic log for this well was created using the sonic logs from borehole T007544. The resulting synthetic seismogram is shown in Figure 13 with the associated horizon picks from borehole F012077 which correspond to the stratigraphic horizons identified on the seismic cross-section. The geologic log for this borehole (F012077) indicates that the Salina B-Unit does not exist at this location, however the western portion of the seismic data (up to 1500 m) shows a seismic marker that is consistent with the Salina B-Unit, therefore, this unit is interpreted to pinch out at about the 1500 m point. Due to the low confidence in these data there is a possibility that this is not the Salina B formation. Above is the trough identified as the top of the Salina Group or Salina G (base of the Bass Island Formation) within borehole F012077 elevation 126.5 m and a time of 145 ms dipping decreasing to 135ms in the middle of the line and ending at 150 ms in the West. A reliable seismic event, due to the high reflectivity contrast between the carbonate and underlying anhydrite is the A2 Carbonate interpreted at 195 ms on the Eastern end of the line and dipping to 230 ms at the Western end, the elevation of this seismic marker within the borehole F012077 is 29.5 m. The Cabot Head/Queenston seismic marker is another prominent pick on this seismic section interpreted to be at 245 ms at the eastern end of this line, indicated to be at an elevation of -146 m within the borehole F012077, dipping to the western end of the line at 275 ms. The Cobourg Formation, a prominent seismic marker, has been identified at 350 ms on the west end of the line moving up to 325 ms at the east end of the line. At the east end of the Line 725937 borehole F012077 is offset 1 km to the south and indicates a Cobourg elevation of -377

m The apparent dip of the Ordovician geology along this line is 3.4 ms or 6 m/km

### 5.3.2 Seismic Line 825938

Figure 15 shows the 2D seismic section and interpretation of Line 825938 located on the western side of the Municipality of Brockton, ending within 1 km of the western end of the synthetic sonic log obtained from the OGSR library (Borehole T004910). This seismic line crosses a mapped subsurface fault that is interpreted to extend upwards from the Precambrian basement into the overlying Shadow Lake Formation.

The closest and only significant well tie for this seismic data is a nearby well located approximately 150 m south of the line (T004854). This borehole was drilled through the entire Paleozoic sequence and completed near the top of Precambrian bedrock. Borehole T004910 has Salina B thickness of ~25 m, a time of 150 ms on the western end of the section, whereas this unit has thinned to only 17 m at borehole T004854 and ends at a time of 10 ms on the Eastern end of the line. Elevation of the Salina B is at 34.5 m in the Amoco well (T004910) and decreases to 3 m at the Pacific well (T004854), Above this the Salina G has been identified at a time of 115 ms in the west offset from borehole T004910 where it has an elevation of 117.5 m increasing in elevation at borehole T004854 to an elevation of 104 m and ending at a time of 105 ms at the eastern end of this line.

The Cabot Head/Queenston seismic marker is interpreted to be the peak at 220 ms at the western end of the line, at an elevation of -200 m in borehole T004910 increasing to elevation of -171 m in the Pacific well (T004854) and ending at a time of 190 ms at the eastern end of the line. The interpreted top of the Cobourg Formation based on this 2D seismic data has the most confidence of all picks, whereas the deeper Precambrian horizon is picked with little to no confidence due to the limited maximum offset of the recording system and low fold. The Cobourg at the west end of the line is interpreted at a seismic travel time of 355 ms and decreases in depth to the east end of the line where it is interpreted at a travel time of 335 ms. At this end of the line the Cobourg elevation from the T004854 well is approximately 388 m, which corresponds to approximately 11 m deeper than the eastern end of the 725397 line situated to the north.

No faults were interpreted based on this 2D seismic data even though the seismic line is crossed by the surface trace of a mapped subsurface fault. It is likely that the quality and resolution of the seismic data at this location are too poor to distinguish any clear fault structure in the re-processed section. Therefore, no additional comment can be made regarding the true nature of this mapped subsurface structure.

Regional dip on the Cobourg is approximately 4.5 ms or 8 m/km based in the seismic interpretation of this line..

### 5.3.3 Seismic Line A002800018

Figure 16 shows the 2D seismic section and interpretation of Line A002800018 located at the northern end of the Township of Huron-Kinloss trending from northwest to the southeast with a total line length of 12.5 km. Midway along this line, at approximately shot position 16000 m location, is the north end of line A002800020 (Section 5.3.4). The interpretation of the seismic markers within Line A002800018 is an extension of Line A002800020 as no nearby sonic logs were available. The re-processing of this

line using modern processing methods results in relatively good quality data relative to the limitations in the collection methods used in the 1970's, with the exception of the first and last 800 m within which the fold is lower, resulting in the appearance of washed-out reflectors.

A seismic anomaly was identified between stations 12200 and 12400 as an offset in the two way travel-times within the Ordovician and Precambrian seismic markers interpreted on the section. A near vertical reverse fault is interpreted to extend from the Precambrian basement up to the base of the Silurian succession at approximately 4.25 km from the northwest end of the line. This fault is evidenced by a seismic travel time offset at the Cobourg Formation contact of approximately 8 ms (or the equivalent of approximately 15 m vertical distance). The confidence in the position of this fault is moderately high due to the distinct offset in seismic signal at this location, however the data is historic and of lower quality than modern data would be. It should also be noted that no mapped subsurface fault was previously identified at this location.

The Salina G pick starts at 125 ms at the southeast end of the line dropping to 150 ms in the northwest. The Salina B is interpreted to be present at a constant thickness throughout the length of this line indicating there is no salt dissolution or thinning in this area. The fault is interpreted to terminate below the Cabot Head/Queenston marker which is at a time of 275 ms at the southeast end of the line dropping to 300 ms at the fault edge. The Queenston drops to 325 ms where it remains relatively flat to the northwest end of the line. The Cobourg Formation marker occurs at a seismic travel time of approximately 390 ms in the southeast and decreases to about 425 ms in the northwest, a difference of about 35 ms which equates to approximately 65 m vertically. This regional variation corresponds to an apparent dip of 5m/km for the Ordovician geology sequence.

#### 5.3.4 Seismic Line A002800020

Figure 17 shows the 2D seismic section and interpretation of Line A002800020 located in the central portion of the Township of Huron-Kinloss trending from northeast to southwest with a total length of approximately 12.5 km. The south end of this line is situated approximately 6.5 km from borehole T007544 (BP-1) which also contains a sonic log. Interpretation for this seismic line is based on the identification of key formation tops from this nearby borehole. The north end of this line lies midway along seismic Line A002800018 (Section 5.3.3) and at which point interpretation was extended onto that line.

The north end of this line, from source station 14800 m north to source station 20000 m, is of good quality. Seismic markers tend to be coherent and data is consistently higher frequency, such that subtle amplitude variations are observed.

There is a nearby OGSRL borehole located to the east of station 8700 m (F012066) drilled in 1956 to a total depth of approximately 566 mBGS and terminated within Cabot Head Formation.

The Salina G seismic marker was identified at 160 ms at the south end of this line by extending the synthetic seismogram of borehole T007544 that indicated an elevation of -45 m. This seismic marker was extended along the seismic section and interpreted to be at a time of 135 ms at the north end of the line. Similarly the Salina B, at an elevation of -147 m at borehole T007544 was identified at a time of 220 ms at the south end of the line and the trough was interpreted to the north to end at a time of 180 ms at the north end. The Cabot Head/Queenston seismic marker, at an elevation of -410 m at

borehole T007544, was interpreted to be the strong peak at 340 ms in the south decreasing in time to 280 ms at the north end of this line. The Cobourg formation is interpreted at a seismic travel time of approximately 400 ms in the north and drops to 450 ms in the south representing a difference in depth of approximately 100 m, corresponding to a regional apparent dip along line of approximately 8 m/km.

No faults were interpreted based on this 2D seismic data. Seismic anomalies within this section include those found between source station 12400 m to 13200 m, near station 9600 m, and between stations 10200 m to 10800 m. These anomalies are thought to be a result of thickening or material changes in the overburden which degrades the seismic signal-to-noise ratio, ultimately resulting in a poor quality signal and lower confidence in any interpretations for these zones.

## 6 DISCUSSION OF RESULTS FOR INDIVIDUAL COMMUNITIES

The following sections summarize the results of the borehole geophysical data interpretation for each of the five Communities, as well as the results from the interpretation of 2D seismic data, where applicable. Table 8 lists the OGSRL wells available within each of the five Communities, including the date drilled, an indication if there were borehole geophysical data available, their total depth (TD), and the depth of the key formation tops. Table 9 lists the thicknesses of the stratigraphic packages defined by top depth for key formation tops in the wells within the five Communities as summarized in Table 8.

### 6.1 Town of Saugeen Shores

There are three boreholes recorded in the OGSRL database (T001720, T001720A and T001892) located within the Town of Saugeen Shores (Table 8). All three boreholes, drilled between 1964 and 1965, are located near the southwestern boundary of the Town (Figure 7). Well T001720 was abandoned at a total depth of approximately 315 mBGS within the Manitoulin Formation due to technical issues during drilling and replaced with a nearby well (T001720A) that was drilled down to 718.8 mBGS within the Precambrian basement. Wells T001720A and T001892, both drilled down to the Precambrian basement, have borehole geophysical data available. None of the wells in the Town of Saugeen Shores were used as a reference well by Armstrong and Carter (2010). There are no 2D seismic data available for the Town of Saugeen Shores (see Section 3.2).

In the Town of Saugeen Shores, the top of the bedrock surface underlying the overburden comprises primarily Silurian formations, with only a very small portion of the Town underlain by Devonian formations at surface (Figure 7). As part of this assessment, the two wells with available geophysical data were used to reinterpret key formation tops. Table 8 lists the depth at which the different key formation tops are found in the southern portion of the Town, where the wells were drilled. The total thickness of the Paleozoic sequence in the two deep wells ranges from approximately 656 m (T001720A) to 724 m (T001892). There is no well control on the depth of the key formation tops in the northern half of the Town of Saugeen Shores.

Cross-sections B-B' (Figure 8) and F-F' (Figure 10) show cross-sections through the Paleozoic stratigraphic succession beneath the southeastern corner of the Town of Saugeen Shores (Figure 7). Both of these cross-sections are constructed roughly strike-perpendicular, although parts of section F-F' trend more strike-parallel. As discussed in Section 5.2, the relatively uniform thicknesses of the Upper Ordovician shale and limestone packages are evident beneath the Town of Saugeen Shores.

The boreholes in the Town of Saugeen Shores were drilled through two known pinnacle reefs (Figure 7) in the Silurian Guelph Formation. It is not possible to identify these pinnacle reefs from the cross-sections as the reefs do not express themselves in the key formation tops shown. Similarly, the salt beds within the Salina Group were not clearly discernible from borehole geophysical data and have not been interpreted in the cross-sections. Also, given the lack of borehole control across the remainder of the Town and the absence of available 2D seismic data, it is not possible to infer the possible presence of additional pinnacle reefs or other geological and structural features (e.g., faults, karst, salt horizons).

**Table 8 Summary of Bedrock Formation Top Depths within the Communities (in mBGS)**

| Standard Reference    |                 | Geological Unit                   | Municipality of Brockton |         |         |              |              | Municipality of South Bruce |              |         |              |              |
|-----------------------|-----------------|-----------------------------------|--------------------------|---------|---------|--------------|--------------|-----------------------------|--------------|---------|--------------|--------------|
|                       |                 |                                   | OGSRL Well ID            | F012088 | F012089 | F012090      | F012093      | T002730                     | T004854      | F012062 | F012068      | F012077      |
|                       |                 | <b>Borehole Geophysics Data</b>   | No                       | No      | No      | No           | Yes          | Yes                         | No           | No      | No           | Yes          |
|                       |                 | <b>Date Drilled</b>               | 1948                     | 1948    | 1948    | 1948         | 1969         | 1979                        | 1942         | 1941    | 1941         | 1978         |
|                       |                 | <b>Total Depth (mBGS)</b>         | 75.29                    | 26.52   | 64.01   | 35.05        | 428.56       | 892.8                       | 869.6        | 322.79  | 726.6        | 881.5        |
| Devonian              | Middle          | Lucas / Amherstburg Formation     |                          |         |         |              | 36.6         | 76.5                        | 9.5          | 24.1    | 29.0         | 19.8         |
|                       | Lower           | Bois Blanc Formation              |                          |         |         |              | 134.4        | 117.7                       | 82.0         | 45.4    | 59.1         | 100.9        |
| Silurian              | Upper           | Bass Islands*                     | 5.2                      | 1.5     |         | 3.7          | 160.3        | 150.6                       | 136.6        | 92.7    | 117.7        | <b>130.8</b> |
|                       |                 | Salina G Unit*                    | 21.6                     | 9.1     |         | 20.4         | <b>189.1</b> | 189.6                       | 177.1        | 133.2   | 156.7        | 172.5        |
|                       |                 | Salina F Unit*                    |                          |         |         |              | <b>197.1</b> | 196.9                       |              |         |              | 181.4        |
|                       |                 | Salina E Unit                     | 50.6                     |         |         |              | 231.7        | 240.2                       | 217.3        | 171.0   | 192.0        | 225.6        |
|                       |                 | Salina C Unit                     | 78.9                     |         |         |              | 263.4        | 270.1                       | 248.4        | 207.9   | 225.3        | 254.8        |
|                       |                 | Salina B Unit                     |                          |         |         |              | 282.6        | 285.9                       |              |         |              | 268.2        |
|                       |                 | Salina A-2 Unit                   |                          |         |         |              | 306.3        | 312.1                       | 282.9        | 242.9   | 253.6        | 295.4        |
|                       | Salina A-1 Unit |                                   |                          |         |         | 334.1        | 340.8        | 316.7                       | 274.9        | 284.1   | 320.4        |              |
|                       | Lower           | Guelph Formation                  |                          |         |         |              | 379.5        | 391.4                       | 359.7        | 317.0   | 329.8        | 365.5        |
|                       |                 | Reynales / Fossil Hill Formation  |                          |         |         |              | 424.9        | 427.0                       | 393.2        |         |              |              |
| Cabot Head Formation* |                 |                                   |                          |         |         | <b>427.1</b> | 435.3        | 402.7                       |              |         | 406.7        |              |
| Ordovician            | Upper           | Manitoulin Formation              |                          |         |         |              | 453.3        | 419.4                       |              |         |              | 425.5        |
|                       |                 | Queenston Formation*              |                          |         |         |              |              | 462.1                       | 428.9        |         | 428.9        | 434.1        |
|                       |                 | Georgian Bay / Blue Mtn Formation |                          |         |         |              |              | 542.0                       | 504.8        |         | 525.2        | 515.7        |
|                       |                 | Collingwood Member*               |                          |         |         |              |              | <b>678.8</b>                | <u>657.5</u> |         | <u>659.9</u> | <b>658.1</b> |
|                       |                 | Cobourg Formation                 |                          |         |         |              |              | <b>692.8</b>                |              |         |              | <b>673.4</b> |
|                       |                 | Sherman Fall Formation            |                          |         |         |              |              | 721.2                       | 700.4        |         |              | 705.9        |
|                       |                 | Kirkfield Formation               |                          |         |         |              |              | 773.6                       | 748.6        |         |              | 760.5        |
|                       |                 | Coboconk Formation*               |                          |         |         |              |              | 807.1                       | 789.7        |         |              | 795.9        |
| Precambrian           |                 | Gull River Formation              |                          |         |         |              | 830.9        | 802.5                       |              |         | 816.3        |              |
|                       |                 | Shadow Lake Formation             |                          |         |         |              |              | 882.7                       | 861.1        |         |              | 870.8        |
|                       |                 | Precambrian*                      |                          |         |         |              | 888.5        | 867.8                       |              |         | 874.5        |              |

Notes:

\* and shading indicate Key Formations

**bold and italicized** indicates entry that has been updated as part of this study based on borehole geophysical data repick as per Appendix C

underlined indicates updated entry based on replacing depth to Collingwood Member with depth to Cobourg Formation as discussed in Section 4.1.3

**Table 8 Summary of Bedrock Formation Top Depths within the Communities (in mBGS) (Continued)**

| Standard Reference       |                 | Geological Unit                   | Township of Huron-Kinloss |              |              |              |              |              | Town of Saugeen Shores |              |              |              |
|--------------------------|-----------------|-----------------------------------|---------------------------|--------------|--------------|--------------|--------------|--------------|------------------------|--------------|--------------|--------------|
| OGSRL Well ID            |                 |                                   | F012061                   | F012063      | F012066      | F012078      | T002663      | T003535      | T003553                | T001720      | T001720A     | T001892      |
| Borehole Geophysics Data |                 |                                   | No                        | Yes          | Yes          | Yes          | Yes          | Yes          | Yes                    | No           | Yes          | Yes          |
| Date Drilled             |                 |                                   | 1956                      | 1959         | 1956         | 1955         | 1969         | 1973         | 1978                   | 1964         | 1964         | 1965         |
| Total Depth (mBGS)       |                 |                                   | 1020.6                    | 568.1        | 566.3        | 506.9        | 607.8        | 582.5        | 509.6                  | 315.1        | 718.8        | 769.6        |
| Devonian                 | Middle          | Lucas / Amherstburg Formation     | 47.2                      | 26.8         | 26.2         | 39.0         | 49.4         | 64.3         | 65.5                   |              |              |              |
|                          | Lower           | Bois Blanc Formation              | 139.6                     | 138.4        |              | 106.4        | 153.0        | 164.3        | 175.9                  |              |              |              |
| Silurian                 | Upper           | Bass Islands*                     | 199.9                     | <b>198.4</b> | 182.3        | 162.2        | 214.3        | 183.2        | 208.5                  |              | 57.6         | 44.5         |
|                          |                 | Salina G Unit*                    | 250.8                     | <b>241.9</b> | <b>222.4</b> | <b>201.4</b> | 267.6        | <b>232.3</b> | 247.5                  |              | 61.3         | <b>71.1</b>  |
|                          |                 | Salina F Unit*                    |                           | <b>250.4</b> | <b>230.4</b> | 208.2        | 277.1        | <b>241.0</b> | 255.1                  |              |              | <b>81.1</b>  |
|                          |                 | Salina E Unit                     | 305.7                     | 285.9        | 258.5        | 254.5        | 311.2        | 276.8        | 291.1                  | 60.7         | 68.0         | 119.5        |
|                          |                 | Salina C Unit                     | 319.4                     | 314.6        | 296.6        | 276.5        | 352.7        | 307.5        | 326.1                  | 84.7         | 83.3         | 151.5        |
|                          |                 | Salina B Unit                     | 369.7                     | 342.0        | 316.4        |              | 368.5        | 314.9        | 344.4                  |              |              |              |
|                          |                 | Salina A-2 Unit                   | 421.5                     | 414.2        | 353.9        | 299.9        | 450.2        | 370.0        | 388.0                  | 114.3        | 113.4        | 177.4        |
|                          | Salina A-1 Unit | 477.9                             | 506.6                     | 380.4        | 317.3        | 518.8        | 400.8        | 424.6        | 136.6                  | 137.8        | 204.6        |              |
|                          | Lower           | Guelph Formation                  | 516.0                     | 522.4        | 426.1        | 331.6        | 566.6        | 418.8        | 471.5                  | 140.2        | 140.9        | 210.0        |
|                          |                 | Reynales / Fossil Hill Formation  | 540.7                     | 548.6        | 557.2        |              |              | 565.1        |                        | 264.0        | 269.5        | 314.3        |
| Cabot Head Formation*    |                 | 550.4                             | 560.8                     | 561.8        |              | <b>600.1</b> | <b>576.8</b> |              | 281.0                  | <b>283.4</b> | <b>330.1</b> |              |
| Ordovician               | Upper           | Manitoulin Formation              | 570.9                     |              |              |              |              |              |                        | 290.8        | 290.2        | 337.4        |
|                          |                 | Queenston Formation*              | 580.0                     |              |              |              |              |              |                        |              | <b>310.4</b> | <b>359.1</b> |
|                          |                 | Georgian Bay / Blue Mtn Formation | 657.7                     |              |              |              |              |              |                        |              | 361.5        | 416.7        |
|                          |                 | Collingwood Member*               | <u>804.1</u>              |              |              |              |              |              |                        |              | <b>521.4</b> | <b>570.1</b> |
|                          |                 | Cobourg Formation                 |                           |              |              |              |              |              |                        |              | <b>534.9</b> | <b>582.6</b> |
|                          |                 | Sherman Fall Formation            | 840.6                     |              |              |              |              |              |                        |              | 565.8        | 612.4        |
|                          |                 | Kirkfield Formation               | 890.9                     |              |              |              |              |              |                        |              |              |              |
|                          |                 | Coboconk Formation*               |                           |              |              |              |              |              |                        |              | 640.1        | 688.6        |
| Precambrian              |                 | Gull River Formation              | 932.1                     |              |              |              |              |              |                        |              |              | 697.1        |
|                          |                 | Shadow Lake Formation             | 1009.8                    |              |              |              |              |              |                        |              | 709.9        | 756.8        |
|                          |                 | Precambrian*                      | 1016.5                    |              |              |              |              |              |                        |              | <b>713.4</b> | 768.1        |

Notes:

\* and shading indicate Key Formations

**bold and italicized** indicates entry that has been updated as part of this study based on borehole geophysical data repick as per Appendix C

underlined indicates updated entry based on replacing depth to Collingwood Member with depth to Cobourg Formation as discussed in Section 4.1.3



**Table 9 Summary of Bedrock Formation Group Thicknesses within the Communities (in m) from OGSRL Data**

| <i>Bedrock Group</i>     | <i>Statistic</i> | <i>Brockton</i> | <i>South Bruce</i> | <i>Huron-Kinloss</i> | <i>Saugeen Shores</i> |
|--------------------------|------------------|-----------------|--------------------|----------------------|-----------------------|
| Overburden               | Min              | 1.5             | 9.5                | 26.2                 | 44.5                  |
|                          | Max              | 76.5            | 29.0               | 65.5                 | 68.0                  |
|                          | Avg              | 24.7            | 20.6               | 45.5                 | 57.7                  |
|                          | N                | 5               | 4                  | 7                    | 3                     |
| Paleozoic                | Min              | 812.0           | 854.7              | 969.3                | 655.7                 |
|                          | Max              | 812.0           | 858.3              | 969.3                | 723.6                 |
|                          | Avg              | 812.0           | 856.5              | 696.3                | 689.7                 |
|                          | N                | 1               | 2                  | 1                    | 2                     |
| Devonian                 | Min              | 74.1            | 68.6               | 118.9                | NA                    |
|                          | Max              | 123.7           | 127.1              | 171.6                | NA                    |
|                          | Avg              | 98.9            | 98.9               | 147.2                | NA                    |
|                          | N                | 2               | 4                  | 7                    | 0                     |
| Silurian                 | Min              | 311.5           | 292.3              | 380.1                | 242.4                 |
|                          | Max              | 311.5           | 311.2              | 380.1                | 314.6                 |
|                          | Avg              | 311.5           | 302.3              | 380.1                | 278.5                 |
|                          | N                | 1               | 3                  | 1                    | 2                     |
| Ordovician and Cambrian  | Min              | 426.4           | 438.9              | 436.5                | 403.0                 |
|                          | Max              | 426.4           | 440.4              | 436.5                | 409.0                 |
|                          | Avg              | 426.4           | 439.7              | 436.5                | 406.0                 |
|                          | N                | 1               | 2                  | 1                    | 2                     |
| Ordovician Shale         | Min              | 216.7           | 224.0              | 224.1                | 211.0                 |
|                          | Max              | 216.7           | 231.0              | 224.1                | 211.0                 |
|                          | Avg              | 216.7           | 227.9              | 224.1                | 211.0                 |
|                          | N                | 1               | 3                  | 1                    | 2                     |
| Trenton Group Limestones | Min              | 128.3           | 132.2              | NA                   | 118.5                 |
|                          | Max              | 128.3           | 137.8              | NA                   | 118.7                 |
|                          | Avg              | 128.3           | 135.0              | NA                   | 118.6                 |
|                          | N                | 1               | 2                  | 0                    | 2                     |

Notes:

thicknesses calculated using data from Table 8

NA = not applicable

N = number of boreholes in the community with thickness data (i.e. OGSRL contains depth information for both top and bottom of formation groups)

## 6.2 Municipality of Arran-Elderslie

Although there are no boreholes located within the Municipality of Arran-Elderslie that are recorded in the OGSRL database, there are a number of closely spaced boreholes located north, west and east of the Municipality (Figure 7). These nearby boreholes provide the control points for the geological cross-sections and allow for interpretation of the subsurface distribution of the key formation packages. Similarly, there are no 2D seismic data available for the Municipality of Arran-Elderslie (Section 3.2). Therefore, there are no data to show evidence of anomalous features such as salt horizons, karst, reefs or faults.

In the Municipality of Arran-Elderslie, the top of the bedrock surface underlying the overburden is comprised entirely of Silurian-age formations. The Municipality of Arran-Elderslie is the furthest up-dip of the five communities and therefore encompasses an area with the thinnest Paleozoic sequence and where Ordovician bedrock formations are shallowest. It is also the only one of the five communities where the Guelph Formation, which is the top formation within the Lower Silurian group of formations, subcrops (Figure 7). There is no well control on the depth of the key formation tops within the Municipality of Arran-Elderslie.

There are three cross-section lines (Figure 7) that show an interpretation of the depths and thicknesses for the Paleozoic bedrock formations beneath the Municipality of Arran-Elderslie including A-A' (Figure 8) oriented roughly strike-parallel and running north-south through the eastern half of the community, B-B' (Figure 8) oriented roughly strike-perpendicular and running southwest-northeast in the western corner of the community, and F-F' (Figure 10) oriented strike-perpendicular and running approximately east-west in the central portion of the community.

As there are no boreholes to provide information within the Municipality of Arran-Elderslie, the interpreted formation top depths used to create cross-sections show a relatively uniform apparent dip of approximately 5 to 6 m/km and relatively uniform thicknesses of the Upper Ordovician shale and limestone packages are beneath the Municipality of Arran-Elderslie.

## 6.3 Municipality of Brockton

There are six boreholes recorded in the OGSRL database (F012088, F012089, F012090, F012093, T002730 and T004854) located within the Municipality of Brockton (Table 8). Four boreholes (F-series) were drilled in 1948 near the Town of Walkerton (Figure 7). All four of these boreholes were completed at shallow depths less than 80 mBGS and none have borehole geophysical data available. Two boreholes (T002730 and T004854) were drilled between 1969 and 1979 near the southwestern boundary of the Municipality (Figure 7). Both boreholes have borehole geophysical data available and were drilled to depths of approximately 428 mBGS into the Cabot Head Formation and 893 mBGS into the Precambrian basement, respectively. One of these two boreholes (T004854) is also a reference well used by Armstrong and Carter (2010). Aside from a few additional isolated boreholes in the near vicinity, but outside of the Municipality, deep borehole data is sparse.

One acquired seismic line (825938; Figure 15), approximately 4.5 km in length was available within the Municipality of Brockton for this study. It transects the western boundary of the community and passes within 150 m of borehole T004854 within the Municipality of Brockton and extends close to T004910 (identified pinnacle reef) approximately 2.5 km outside of the community. Both of these boreholes were drilled in 1979 while the 2D seismic data was acquired in 1977. Although there is a

mapped subsurface fault whose surface trace crosses the seismic line, no faults were interpreted with high confidence based on these 2D seismic data.

In the Municipality of Brockton the top of the bedrock surface underlying the overburden comprises Silurian and Devonian formations (Figure 7). As part of this assessment, the two wells with available geophysical data were used to reinterpret key formation tops. Table 8 lists the depth at which the eight key formation tops are found in the southwestern portion of the Municipality, where the wells were drilled. There is no well control on the depth of the key formation tops within the Municipality of Brockton aside from these two boreholes. The total thickness of the Paleozoic sequence in the only well that intersects the Precambrian basement (T004854) is approximately 812 m.

There are two cross-section lines (Figure 7) that show an interpretation of the depths and thicknesses for the Paleozoic bedrock formations beneath the Municipality of Brockton including A-A' (Figure 8) generally running north-south (roughly strike-perpendicular in the south and trending slightly more strike-parallel moving north) through the eastern half of the Municipality, and E-E' (Figure 10) running approximately east-west roughly strike-perpendicular in the central portion of the Municipality. The mapped subsurface fault that crosses the section is not shown because its true position, or its existence, cannot be constrained with any degree of confidence.

As discussed, there is minimal deep geologic data from boreholes within the Municipality of Brockton and therefore a more regional interpretation using deep bedrock data from other boreholes outside of the Municipality was completed. As discussed in Section 5.2, the interpreted formation top depths used to create cross-sections show a relatively uniform apparent dip of approximately 7.5 m/km and relatively uniform thicknesses of the Upper Ordovician shale and limestone packages beneath the Municipality of Brockton.

No known pinnacle reefs were identified based on the limited borehole data or 2D seismic within the Municipality of Brockton, however borehole T004910 identifies a pinnacle reef approximately 2.5 km west of the municipal boundary. Given the lack of borehole control and the absence of available 2D seismic data across the majority of the Municipality, it is not possible to infer the possible presence of additional pinnacle reefs or other geological and structural features (e.g., faults, karst, or salt beds).

#### **6.4 Municipality of South Bruce**

There are four boreholes recorded in the OGSRL database (F012062, F012068, F012077 and T004881) located within the Municipality of South Bruce (Table 8). Boreholes F012062 and T004881 were drilled into the Precambrian basement to total depths of 881.5 mBGS and 869.6 mBGS, respectively. Boreholes F012068 and F012077 was reported in the OGSRL to be completed to total depths of approximately 323 mBGS in the Guelph Formation, and 726 mBGS in the Cobourg Formation, respectively. The three F-series boreholes were drilled in 1941 to 1942 in the western and central portion of the Municipality near the contact boundary between the Amherstburg and Lucas Formations (Figure 7). None of these three boreholes have borehole geophysical data available. Borehole T004881 was drilled in 1979 near F012062, which has borehole geophysical data available through the OGSRL, and was used as a reference well by Armstrong and Carter (2010). Aside from a few additional isolated boreholes in the near vicinity but outside of the Municipality deep borehole data is sparse.

One acquired seismic line (725937), approximately 7.4 km in length was available within the Municipality of South Bruce for this study and fell on the western boundary of the Municipality in the northwestern corner. It starts approximately 1 km away from borehole F012077 within the Municipality of South Bruce and extends to the municipal boundary with the Township of Huron-Kinloss. This borehole was drilled in 1941 while the 2D seismic data was acquired in 1977.

In the Municipality of South Bruce the top of the bedrock surface underlying the overburden comprises Silurian and Devonian formations (Figure 7). As part of this assessment, the wells with available geophysical data were used to reinterpret key formation tops. Table 8 lists the depth at which the different key formation tops are found in the western portion of the Municipality, where the wells were drilled. There is no well control on the depth of the key formation tops within the Municipality of South Bruce aside from these two boreholes. The total thickness of the Paleozoic sequence in the two wells that intersect the Precambrian basement (T004881 and F012062) is approximately 855 m and 858 m, respectively.

There are three cross-section lines (Figure 7) that show an interpretation of the depths and thicknesses for the Paleozoic bedrock formations beneath the Municipality of South Bruce including A-A' (Figure 8) running northwest and turning northeast roughly strike-perpendicular through the central part of the Municipality, D-D' (Figure 9) running slightly southwest to northeast roughly strike-perpendicular through the northern portion of the Municipality, and E-E' (Figure 10) running east-west roughly strike-perpendicular (trending slightly strike-parallel) and just clipping the extreme northeast corner of the Municipality.

As discussed, there is minimal deep geologic data from boreholes within the Municipality of South Bruce and therefore a more regional interpretation using deep bedrock data from other boreholes outside of the Municipality was completed. As discussed in Section 5.2, the interpreted formation top depths used to create cross-sections show a relatively uniform apparent dip of approximately 8 to 10 m/km and relatively uniform thicknesses of the Upper Ordovician shale and limestone packages beneath the Municipality of South Bruce.

As discussed in Section 5.3.1, seismic Line 725937 identifies one fault based on a seismic signal offset in the section data, as well as the eastern boundary of the Salina Group B-salt or where the Salina Group B-anhydrite thins. The fault was interpreted to originate in the Precambrian basement and extend up through to the Silurian Cabot Head Formation. The coincidence between this interpreted seismic anomaly and a mapped subsurface fault in the Municipality of South Bruce provides a certain amount of confidence in the existence of a fault in the area crossed by the seismic line. However, given the poor quality and limited lateral resolution of the seismic data at this location, the confidence in the exact location and nature of this fault, including its interpreted upward continuation into the Silurian succession, is very low. There are no other data showing evidence of anomalous features such as salt beds, karst, reefs or additional fault structures.

## 6.5 Township of Huron-Kinloss

There are seven boreholes recorded in the OGSRL database (F012061, F012063, F012066, F012078, T002663, T003535, and T003553) located within the Township of Huron Kinloss (Table 8). The only borehole within the Township that was drilled into the Precambrian basement was F012061 to a total depth of 1020.6 mBGS, however since there was no reported depth for the top of the

Coboconk Formation this borehole could not be used to determine a thickness of the Trenton Group Limestones (Table 9). Boreholes F012078 and T003553 were reported in the OGSRL to have been completed within the Guelph Formation to total depths of approximately 507 mBGS and 510 mBGS, respectively. The remaining four boreholes were all drilled to depths ranging from approximately 566 to 608 mBGS and completed within the Cabot Head Formation.

Five of the boreholes are situated along the southern municipal boundary and were drilled between 1956 and 1978, while the remaining two boreholes (F012078 and T003535) are situated in the central and northern portion of the Township and drilled in 1955 and 1973, respectively (Figure 7). Six of these boreholes (T003535, F012078, T002663, F012066, F012063, and T003553) have borehole geophysical data. None of these wells are considered to be reference wells by Armstrong and Carter (2010). The density of borehole data is higher close to the shore of Lake Huron and further south in closer proximity to known hydrocarbon pools hence the very slight increase in borehole data (seven boreholes) within the Township of Huron-Kinloss compared to the other communities.

Portions of two acquired seismic lines (A002800018 and A002800020) exist within this community. The southern 15 km portion of Line A002800018 (23.5 km total) running southwest to northeast through the centre of the Township and the entire 18 km of Line A002800020 running northwest to southeast along the northern border and orthogonal to Line A002800018 fall within the Township of Huron-Kinloss. The seismic lines do not intersect any boreholes; however two boreholes, that are identified to be situated at pinnacle reefs, exist within 2 to 3 km of the lines. These boreholes were drilled in 1955 and 1956 while the 2D seismic data was acquired in 1976.

In the Township of Huron-Kinloss the top of the bedrock surface underlying the overburden comprises the Lucas Formation of the Devonian Group (Figure 7). As part of this assessment, the six wells with available geophysical data were used to reinterpret key formation tops. Table 8 lists the depth at which the different key formation tops are found in the Township where the wells were drilled. The total thickness of the Paleozoic sequence in the only well that intersects the Precambrian basement (F012061) is approximately 969 m.

There are three cross-section lines (Figure 7), all oriented roughly strike-perpendicular, that show an interpretation of the depths and thicknesses for the Paleozoic bedrock formations beneath the Township of Huron-Kinloss including B-B' (Figure 8) generally running southwest to northeast through the central part of the Municipality, C-C' (Figure 9) running approximately east-west and turning slightly to the southeast crossing through the centre of the entire Municipality, and D-D' (Figure 10) running slightly southwest to northeast and along dip in the south-central portion of the Municipality.

As discussed, there is minimal deep geologic data from boreholes within the Township of Huron-Kinloss and therefore a more regional interpretation using deep bedrock data from other boreholes outside of the Municipality was completed. As discussed in Section 5.2, the interpreted formation top depths used to create cross-sections show a relatively uniform apparent dip of approximately 7.5 m/km and relatively uniform thicknesses of the Upper Ordovician shale and limestone packages beneath the Township of Huron-Kinloss.

As discussed in Sections 5.4.3 and 5.4.4, interpretation of seismic line A002800018 identified one potential fault with relatively high confidence based offsets observed in the two-way travel-time along an interpreted seismic marker. This fault is interpreted to originate in the Precambrian basement and

extend up through the entire Paleozoic bedrock sequence to the base of the Silurian. Data quality was reasonable, however these lines were acquired when technology for data acquisition and processing was limited resulting in some uncertainty in the interpretations made of these lines. The existence of a mapped subsurface fault that extends into the eastern part of the Township cannot be confirmed as there is no seismic or well control in that area (Figure 7).

The boreholes in the Township of Huron-Kinloss were drilled through three known pinnacle reefs (Figure 7) of the Silurian Guelph Formation. Similar to the Town of Saugeen Shores, as described in Section 6.1, the Township of Huron-Kinloss is situated in the same pinnacle reef belt along the eastern shore of Lake Huron. It is not possible to identify these pinnacle reefs from the cross-sections as the reefs do not express themselves in the key formation tops shown. Similarly, the salt beds within the Salina Group were not clearly discernible from borehole geophysical data and have not been interpreted in the cross-sections. Also, given the lack of borehole control across the remainder of the Township it is not possible to infer the possible presence of additional pinnacle reefs or other geological and structural features (e.g., faults, karst, or salt beds).

## 7 SUMMARY

This report presents the findings of an interpretation study looking at historical borehole geophysical well log data and historical 2D seismic data for the municipalities of Arran-Elderslie, Brockton and South Bruce, the Township of Huron-Kinloss and the Town of Saugeen Shores. The assessment focused on the five Communities and their immediate periphery, referred to as the “Area of the Five Communities”. This study was completed as part of the desktop geoscientific preliminary assessment of the Communities (Geofirma Engineering Ltd., 2014).

The main data sources used in this study include the OGSRL borehole database (OGSRL, 2013) for bedrock formation contact depths, overburden thickness mapping from the MNM Miscellaneous Release Data 207 (Gao et al., 2006); the Provincial Digital Elevation Model (DEM) accessed through Land Information Ontario (LIO, 2013), the stratigraphic information from site characterization activities at the Bruce nuclear site (NWMO, 2011; Intera Engineering Ltd., 2011), and existing 2D seismic data inventories from the OGSRL (OGSRL, 2013) and from Sigma Exploration Inc. (2013), a seismic data broker.

A total of 334 boreholes from the OGSRL exist within the Area of the Five Communities and its surrounding region, 111 of which contain useful gamma and neutron borehole geophysical logs. These borehole geophysical logs were studied to re-evaluate the depths to the top of key formations which could be easily and consistently identified based on the geophysical signals. These re-evaluated picks were merged with the existing OGSRL data for these 334 boreholes to produce an updated database for the Area of the Five Communities. The majority of these boreholes are located south of the Communities due to the increase in oil and gas exploration further south. The updated formation top dataset was used to create geological cross-sections to assist with the interpretation of regional subsurface geology and 2D seismic data. In addition, these surfaces were used as part of a separate airborne geophysical study (PGW, 2014) that looked at gravity stripping to interpret gravity data.

The amount of historical 2D seismic data within the Area of the Five Communities is limited. A total of approximately 53 km of historical 2D seismic data, originally acquired as part of four lines during 1976 and 1977, were purchased, re-processed and interpreted as part of this study. These seismic data are primarily located within the Communities. The quality of this historical data was sufficient for use in this study but considered to be of lower quality compared to current 2D seismic standards. These data were useful for understanding general subsurface geometry and for comparison to borehole data, but less useful for interpreting reefs or geologic structure. These data also provide some insight into the applicability of seismic techniques to image geology between known boreholes. However, the re-processing and interpretation of the historical 2D seismic data allowed for the identification of several key formation tops also identified as part of the borehole geophysical study.

Regionally, the Ordovician shale and limestone packages exhibit relatively uniform thicknesses (approximately 200 m each, ranging from 195 to 228 m). In contrast, the Silurian succession shows some variability in total thickness within the Area of the Five Communities (approximately 278 to 380 m). This may be attributed to several factors, including: the top of the Bass Islands Formation is a regional unconformity; salt dissolution throughout the Salina Group resulting in collapse of overlying formations; and the known existence of reef facies in the Guelph Formation across the Area of the

Five Communities. The Paleozoic strata are reported to dip at approximately 3.5 to 12 m/km to the west or southwest throughout the Ontario portion of the Michigan Basin (Armstrong and Carter, 2010) which is consistent with dips of approximately 5 to 10 m/km within the Area of the Five Communities as evidenced on six regional geologic cross-sections that were constructed using the updated database.

The Town of Saugeen Shores contains three boreholes recorded in the OGSRL database, two of which extend through the entire Paleozoic bedrock sequence and into Precambrian bedrock. Two boreholes have borehole geophysical data available. All three wells were located along the southern boundary of the Town and therefore there is no well control on the depth of formation tops in the northern half of the Town. There are no 2D seismic data available for the Town of Saugeen Shores.

In the Town of Saugeen Shores the top of the bedrock surface underlying the overburden comprises primarily Silurian formations, with only a very small portion of the Town underlain by Devonian formations at surface. The total thickness of the Paleozoic sequence in the two deep wells ranges from approximately 658 to 724 m. The depth to the top of the Queenston Formation ranges from 310 to 360 mBGS in the two OGSRL boreholes that extend to this depth, both of which are located at the southern boundary. Aside from two boreholes in the Town of Saugeen Shores that were drilled through pinnacle reefs within the Guelph Formation (Silurian formation package), given the lack of borehole control across the remainder of the Town and the absence of available 2D seismic data, it is not possible to infer the presence of additional pinnacle reefs or other geological and structural features (e.g., faults, karst or salt beds).

Although there are no boreholes located within the Municipality of Arran-Elderslie that are recorded in the OGSRL database, there are a large number of closely spaced boreholes located north and a couple boreholes located east of the Municipality. These nearby boreholes provide the control points for the geological cross-sections which allow for interpretation of the subsurface distribution of the key formation packages. There are no 2D seismic data available for the Municipality of Arran-Elderslie.

In the Municipality of Arran-Elderslie the top of the bedrock surface underlying the overburden comprises entirely of Silurian-age formations. The Municipality of Arran-Elderslie is situated the furthest up-dip of the five communities and therefore encompasses an area with the thinnest Paleozoic sequence and where Ordovician bedrock formations are shallowest. It is also the only one of the five communities where the Guelph Formation, which is the top formation within the Lower Silurian group of formations, subcrops. The total thickness of the Paleozoic sequence within this Municipality, based on nearby boreholes just outside the municipal boundaries, is estimated to range from approximately 515 m (borehole F012117) to 656 m (borehole T001720A). The depth to the top of the Queenston Formation using these same reference points ranges from 310 to 380 mBGS. Given the lack of borehole control and 2D seismic data within the Municipality of Arran-Elderslie, there are no data to show evidence of anomalous features such as salt horizons, karst, reefs or faults.

The Municipality of Brockton contains six boreholes recorded in the OGSRL database, one of which extends through the entire Paleozoic bedrock sequence and into Precambrian bedrock. Two boreholes have borehole geophysical data available. Aside from a few additional isolated boreholes in the near vicinity, but outside of the Municipality, deep borehole data is sparse. One acquired seismic line (825938), approximately 4.5 km in length was available within this Municipality for this study and fell on the western boundary. Although a mapped subsurface fault crosses the seismic line,



no faults were interpreted with any degree of confidence based on the 2D seismic data.

In the Municipality of Brockton the top of the bedrock surface underlying the overburden comprises Silurian and Devonian formations. The total thickness of the Paleozoic sequence in the only well that intersects the Precambrian basement is approximately 889 m. The depth to the top of the Queenston Formation using the only borehole data within the Municipality that extends to this formation is 461 mBGS. No known pinnacle reefs were identified based on the limited borehole data or 2D seismic within the Municipality of Brockton. Given the lack of borehole control and the absence of available 2D seismic data across the majority of the Municipality, it is not possible to infer the presence of additional pinnacle reefs or other geological and structural features (e.g., faults, karst or salt beds).

The Municipality of South Bruce contains four boreholes recorded in the OGSRL database, two of which extend through the entire Paleozoic bedrock sequence and into Precambrian bedrock. One borehole has borehole geophysical data available. Aside from a few additional isolated boreholes in the near vicinity, but outside of the Municipality, deep borehole data is sparse. One acquired seismic line (725937), approximately 7.4 km in length was available within this Municipality for this study and fell on the western boundary in the northwestern corner. One seismic anomaly was interpreted as a fault, albeit with low confidence. The fault was interpreted to originate in the Precambrian basement and extend up through the entire Paleozoic bedrock sequences to the base of the Silurian formations. The seismic line along which the fault was interpreted is also crossed by a mapped subsurface fault that was previously interpreted to extend upwards from the Precambrian basement and into the Trenton Group. The relatively poor quality of the 2D seismic data does not provide any further insight into the true nature of this mapped subsurface fault structure.

In the Municipality of South Bruce the top of the bedrock surface underlying the overburden comprises Silurian and Devonian formations. The total thickness of the Paleozoic sequence in the two wells that intersect the Precambrian basement ranges from approximately 875 m and 868 m. The depth to the top of the Queenston Formation using data from boreholes within the Municipality that extend to this formation ranges from 428 to 434 mBGS. No known pinnacle reefs were identified based on the limited borehole data or 2D seismic within the Municipality of South Bruce. Given the lack of borehole control and the absence of available 2D seismic data across the majority of the Municipality, it is not possible to infer the presence of additional pinnacle reefs or other geological and structural features (e.g., faults, karst or salt beds).

The Township of Huron-Kinloss contains seven boreholes recorded in the OGSRL database, only one of which extends through the entire Paleozoic bedrock sequence and into Precambrian bedrock. Six boreholes have borehole geophysical data available. Five of these boreholes were located along the southern Township boundary. The density of borehole data is higher close to the shore of Lake Huron and further south in closer proximity to known hydrocarbon reservoirs, hence the very slight increase in borehole data (seven boreholes) within the Township of Huron-Kinloss compared to the other communities.

Portions of two acquired seismic lines (A002800018 and A002800020) exist within the Township of Huron-Kinloss. The southern 15 km portion of Line A002800018 running southwest to northeast through the centre of the Township and the entire 18 km of Line A002800020 running northwest to southeast along the northern border and orthogonal to Line A002800018 fell within the Township of Huron-Kinloss. One fault (line A00280018) was interpreted with relatively high confidence from this

seismic data. The fault was interpreted to originate in the Precambrian basement and extend upwards into the base of the Silurian Cabot Head Formation.

In the Township of Huron-Kinloss the top of the bedrock surface underlying the overburden comprises the Lucas Formation of the Devonian group. The total thickness of the Paleozoic sequence in the only well that intersects the Precambrian basement is approximately 1016 m. The depth to the top of the Queenston Formation using data from the only boreholes within the Township that extend to this formation is 580 mBGS.

The boreholes in the Township of Huron-Kinloss were drilled through three known pinnacle reefs of the Guelph Formation, within the Silurian formation package. Similar to the Town of Saugeen Shores the Township of Huron-Kinloss is situated in the same pinnacle reef belt along the eastern shore of Lake Huron. Also, given the lack of borehole control across the remainder of the Township it is not possible to infer the presence of additional pinnacle reefs or other geological and structural features (e.g., faults, karst or salt beds).

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## 9 REPORT SIGNATURE PAGE

Respectfully submitted,

Geofirma Engineering Ltd.

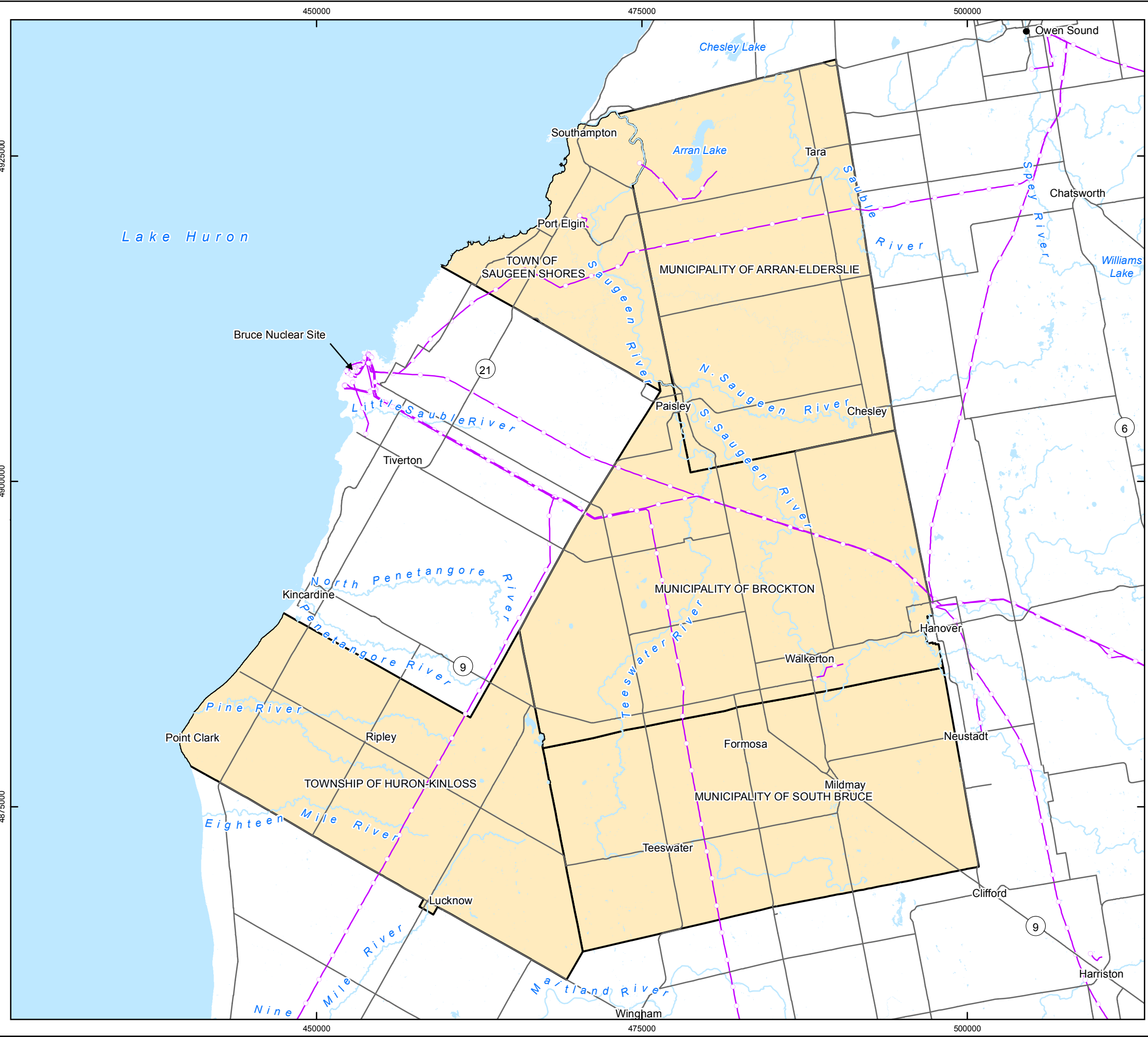
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Sean Sterling, P.Eng., P.Geo.  
Senior Geoscientist

A handwritten signature in black ink that reads "David Schieck". The signature is written in a cursive, flowing style.

David Schieck, P.Geoph.  
Senior Geophysicist

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**LEGEND**

- The Communities
- Highway/Major Road
- Utility Line
- Waterbody
- Watercourse

**INDEX MAP**

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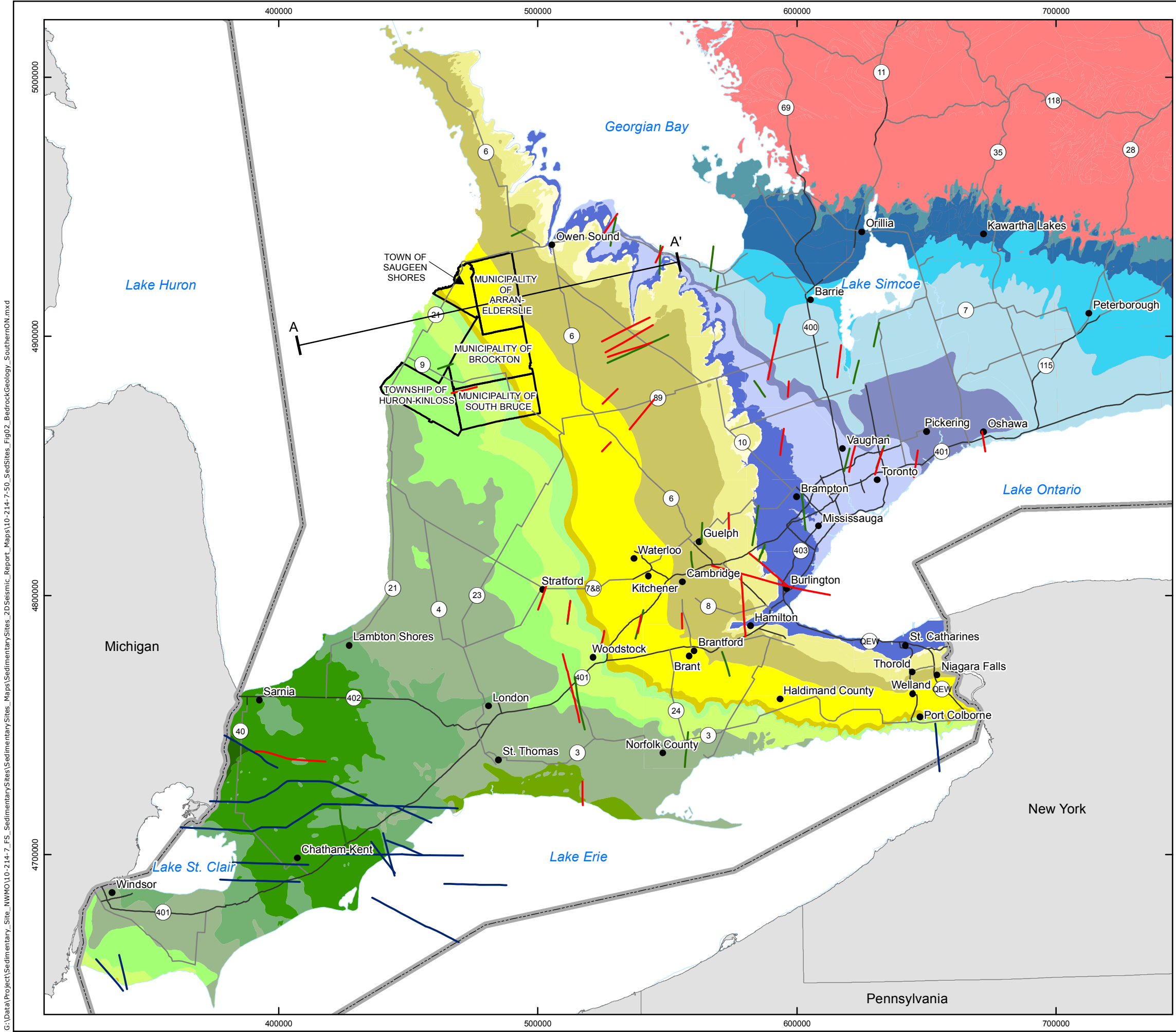
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Produced by Geofirma Engineering Ltd under license from Ontario Ministry of Natural Resources, ©Queens Printer 2011

PROJECT No. 10-214-7.50  
Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data

TITLE **The Area of the Five Communities**

|                 |                                                             |  |
|-----------------|-------------------------------------------------------------|--|
| <b>FIGURE 1</b> | DESIGN: NMP<br>CAD/GIS: NMP/ADG<br>CHECK: KGR/SNS<br>REV: 0 |  |
|                 | DATE: 8/21/2014                                             |  |



**LEGEND**

- The Communities
- Expressway
- Highway
- Canada - USA Boundary

**Mapped Subsurface Faults**

- Rochester (Silurian)
- Trenton (Ordovician)
- Shadow Lake/Precambrian
- Waterbody
- Regional Cross-Section

|                        |                                   |
|------------------------|-----------------------------------|
| <b>Bedrock Geology</b> |                                   |
| <b>Upper Devonian</b>  | <b>Lower Silurian</b>             |
| Port Lambton Group     | Amabel                            |
| Kettle Point           | Lockport                          |
| <b>Middle Devonian</b> | Clinton-Cataract Group            |
| Hamilton Group         | <b>Upper Ordovician</b>           |
| Marcellus              | Queenston                         |
| Dundee                 | Georgian Bay                      |
| Lucas                  | Blue Mountain                     |
| Amherstburg            | Lindsay (Cobourg)                 |
| Onondaga               | Verulam (Sherman Fall)            |
| <b>Lower Devonian</b>  | Bobcaygeon (Coboconk & Kirkfield) |
| Bois Blanc             | Gull River                        |
| Oriskany               | Shadow Lake                       |
| <b>Upper Silurian</b>  | <b>Cambrian</b>                   |
| Bass Islands           | Cambrian                          |
| Bertie                 | <b>Precambrian</b>                |
| Salina                 | Precambrian                       |
| Guelph                 |                                   |

(Cobourg) = Subsurface Nomenclature



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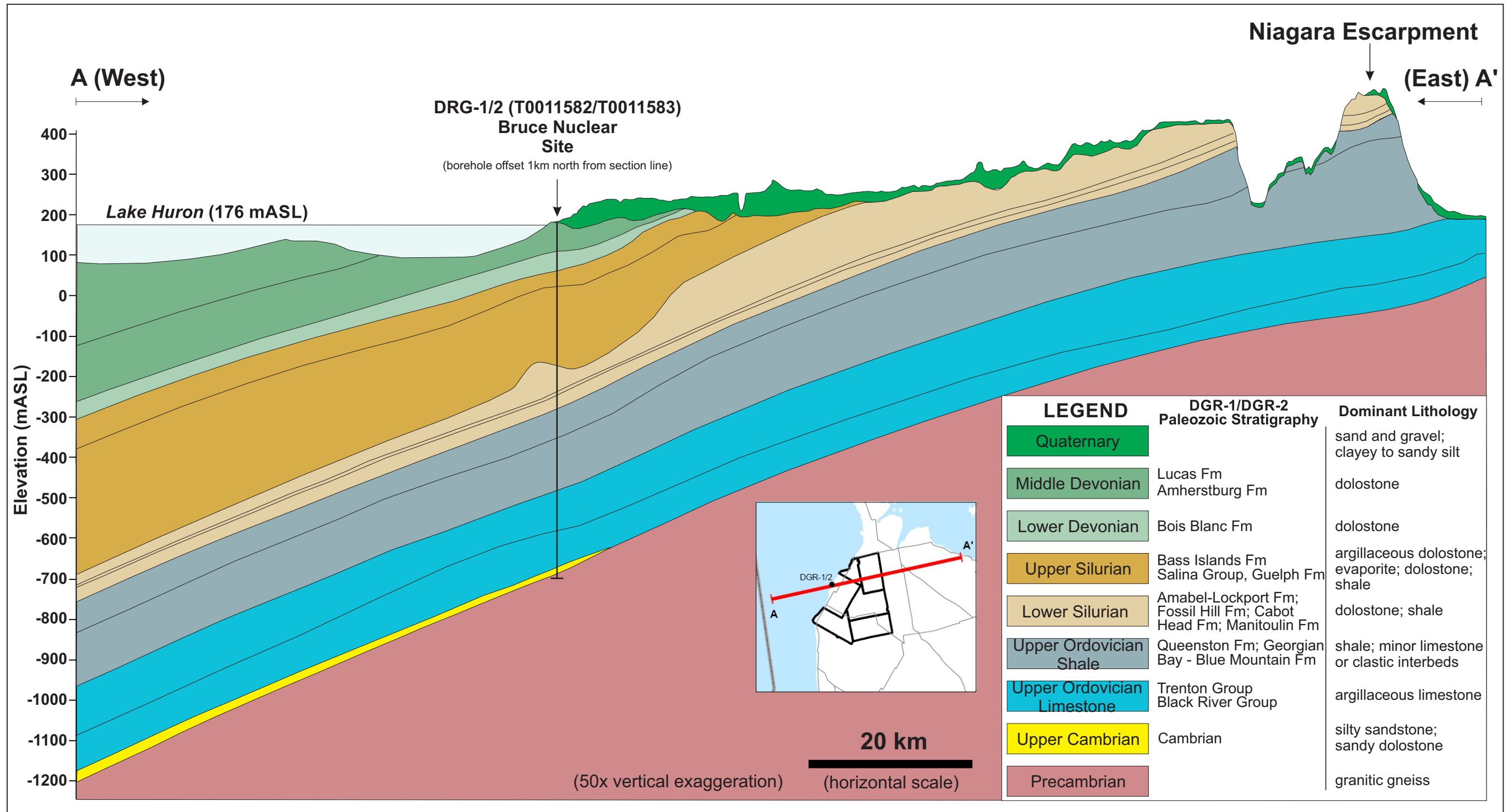
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Basemap Layers: LIO, MNR, ESRI  
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Produced by Geofirma Engineering Ltd under license from Ontario Ministry of Natural Resources, ©Queens Printer 2011

PROJECT No. 10-214-7.50  
Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data

TITLE **Bedrock Geology of Southern Ontario**

|                 |                                                             |  |
|-----------------|-------------------------------------------------------------|--|
| <b>FIGURE 2</b> | DESIGN: NMP<br>CAD/GIS: NMP/ADG<br>CHECK: KGR/SNS<br>REV: 0 |  |
|                 | DATE: 8/21/2014                                             |  |

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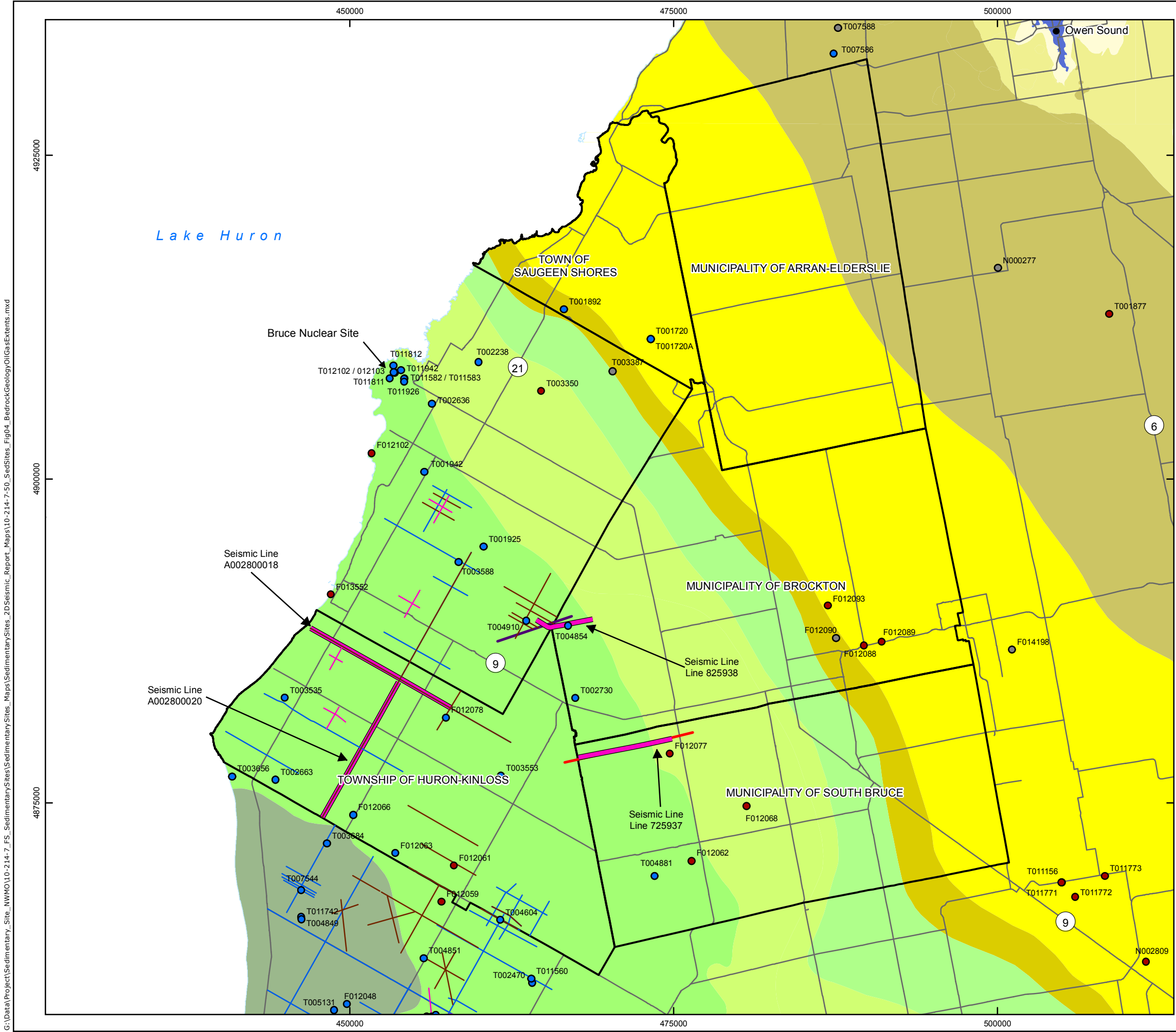
Data Source: NWMO, 2011

**FIGURE 3 - Regional Geological Cross-Section of the Eastern Flank of the Michigan Basin**

PROJECT No: 10-214-7.50  
**Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Prepared by: NMP/ADG  
 Reviewed by: KGR/SNS  
 Date: 23/06/2014



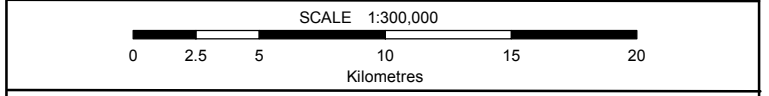


**LEGEND**

|                                               |                          |
|-----------------------------------------------|--------------------------|
| The Communities                               | Seismic Lines            |
| Highway/Major Road                            | 1975 - 1985              |
| Waterbody                                     | 1985 - 1995              |
| <b>Mapped Subsurface Faults</b>               | Acquired 2D Seismic Data |
| Shadow Lake/Precambrian                       |                          |
| Trenton (Ordovician)                          |                          |
| OGSRL Wells                                   |                          |
| OGSRL Wells with Geophysics Log Used in Study |                          |
| OGSRL Wells Not Used in Study                 |                          |

**Bedrock Geology**

|                        |                         |
|------------------------|-------------------------|
| <b>Middle Devonian</b> | <b>Lower Silurian</b>   |
| Dundee                 | Amabel                  |
| Lucas                  | Clinton-Cataract Group  |
| Amherstburg            | <b>Upper Ordovician</b> |
| <b>Lower Devonian</b>  | Queenston               |
| Bois Blanc             |                         |
| <b>Upper Silurian</b>  |                         |
| Bass Islands           |                         |
| Salina                 |                         |
| Guelph                 |                         |



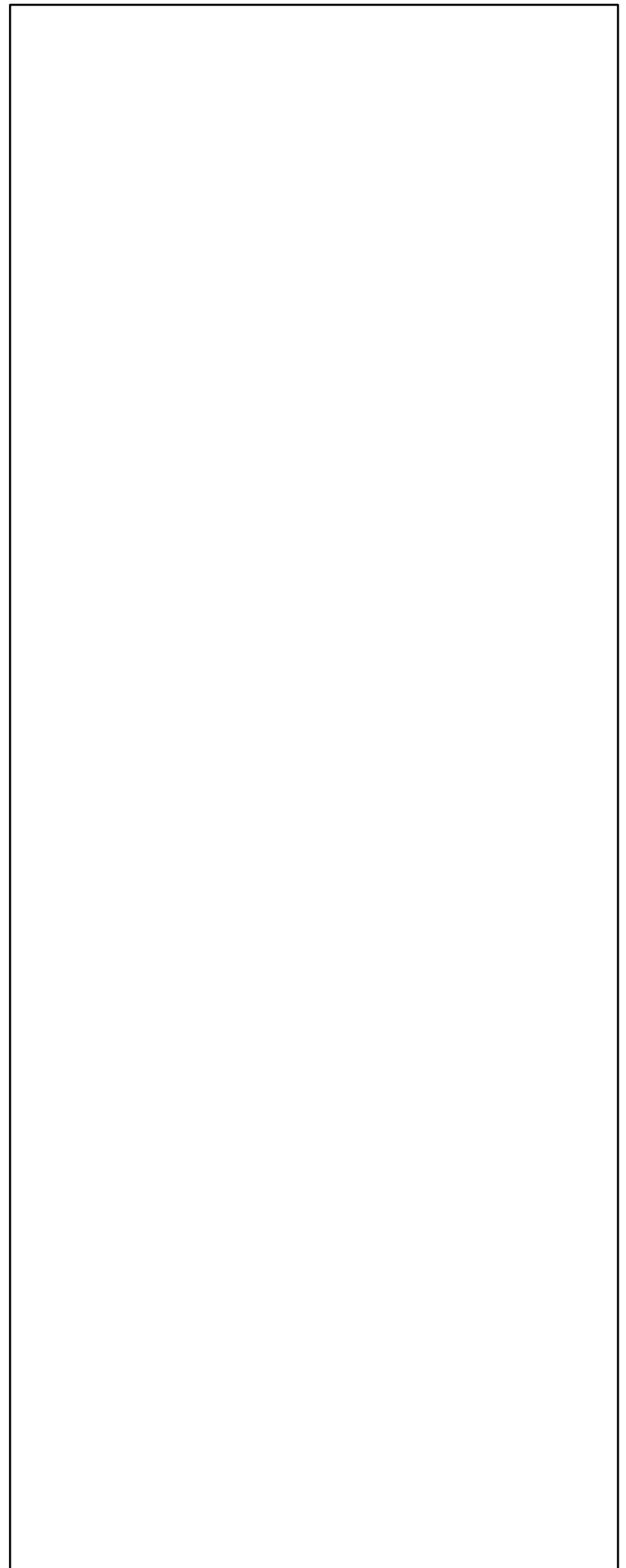
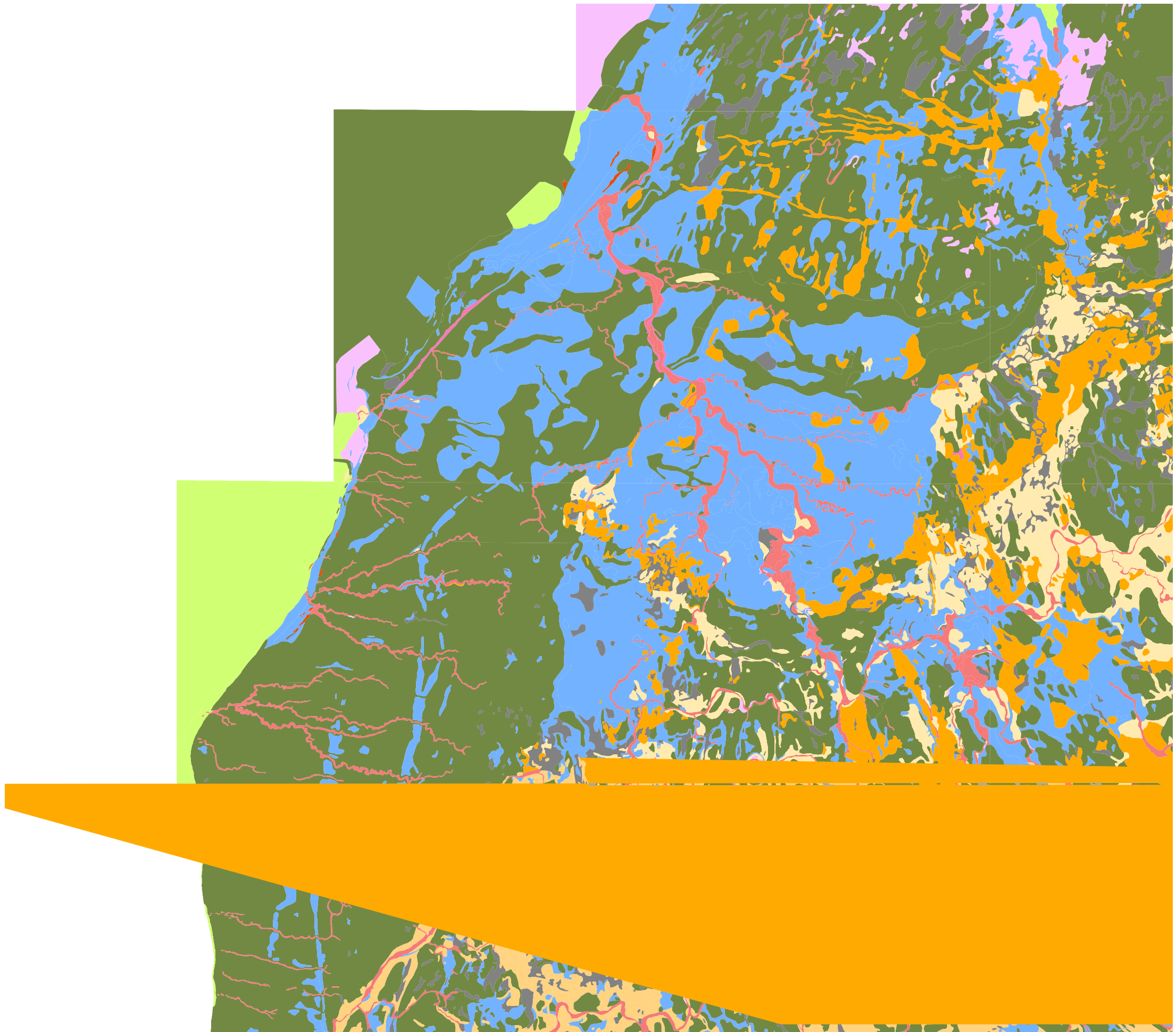
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 SOURCE:  
 Basemap Layers: LIO, MNR, ESRI  
 Fault Mapping: MRD 276 Regional structure and isopach maps of potential hydrocarbon-bearing strata for southern Ontario, OGS, 2011  
 Geology: MRD219 Paleozoic Geology of Southern Ontario, OGS, 2007  
 Oil and Gas Wells: OGSRL, 2013  
 2D Seismic: Sigma Explorations Inc., April 2013  
 Produced by Geofirma Engineering Ltd under license from Ontario Ministry of Natural Resources, ©Queens Printer 2011

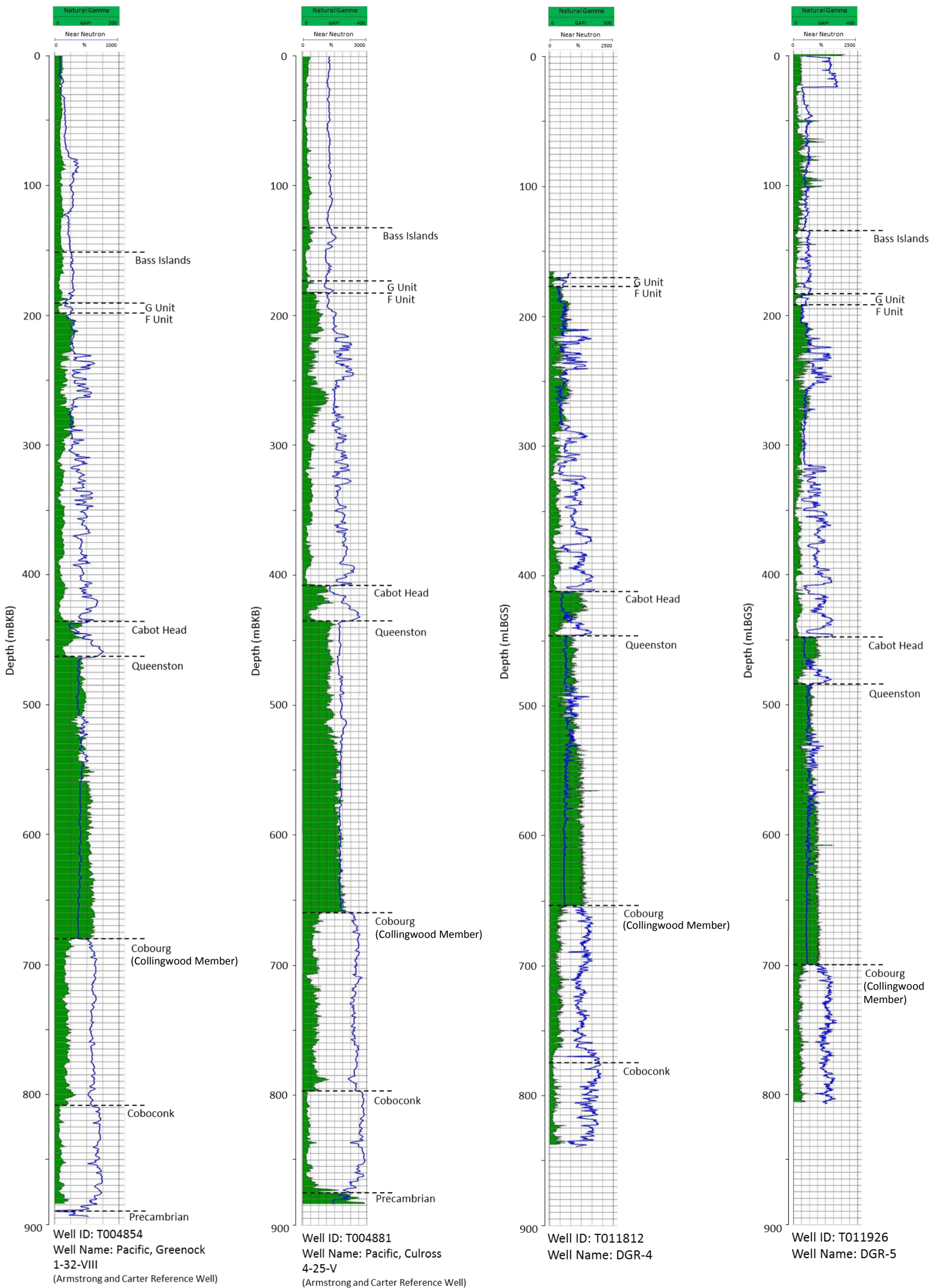
PROJECT No. 10-214-7.50  
 Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data

TITLE **Bedrock Geology, Oil and Gas Wells and Existing 2D Seismic Data of the Area of the Five Communities**

|                 |                                                             |  |
|-----------------|-------------------------------------------------------------|--|
| <b>FIGURE 4</b> | DESIGN: NMP<br>CAD/GIS: NMP/ADG<br>CHECK: KGR/SNS<br>REV: 0 |  |
|                 | DATE: 8/21/2014                                             |  |

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**FIGURE 6 - Geophysical Signatures of Key Formation Tops**

PROJECT No: 10-214-7-50

**Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

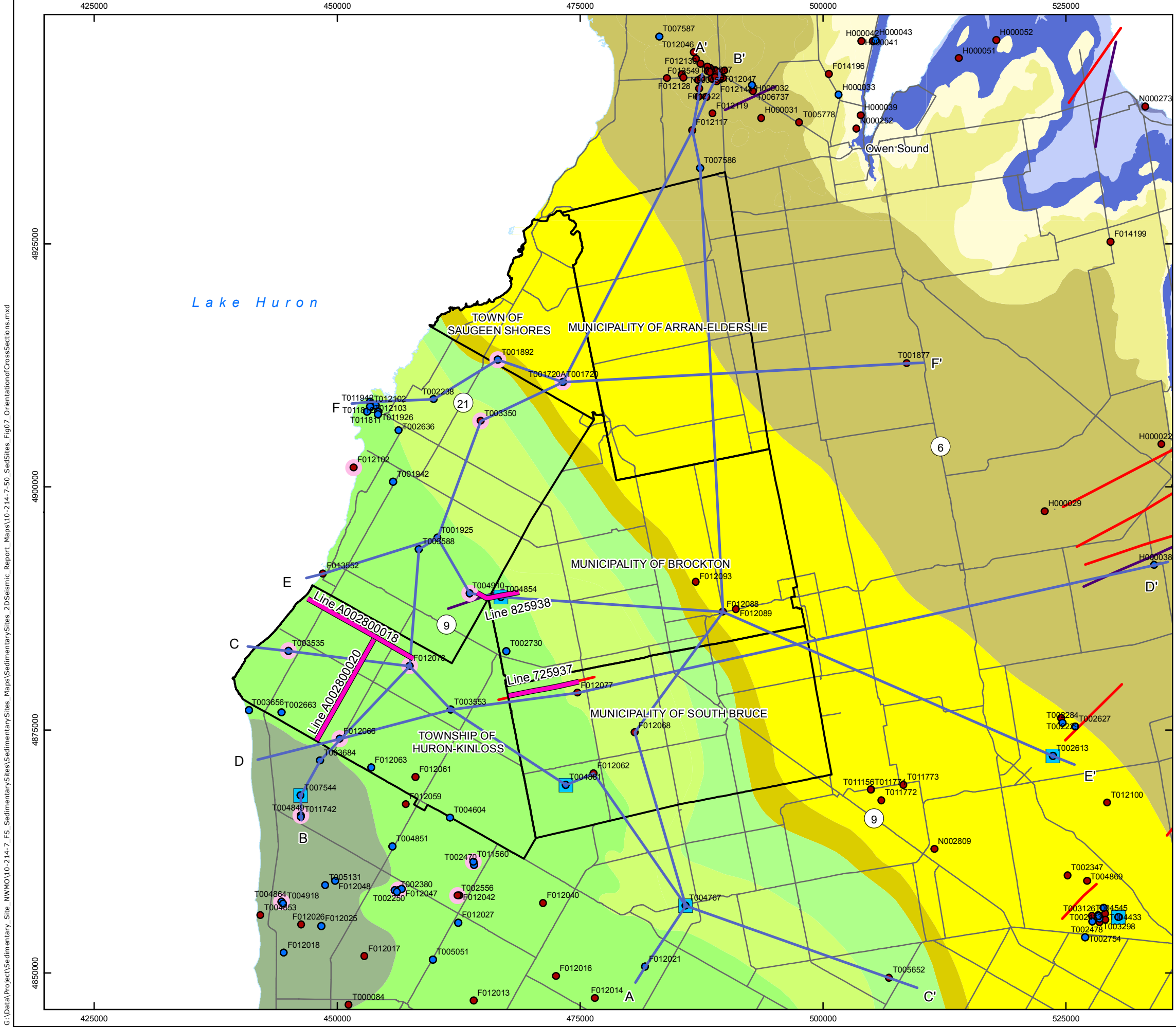
Prepared by: SNG

Reviewed by: SNS

Date: 25-Jun-14







**LEGEND**

- The Communities
- Highway/Major Road
- OGSRL Well Used in Study
- OGSRL with Geophysics Log
- Armstrong & Carter Reference Well
- Pinnacle Reef
- Geological Cross-Section
- Acquired 2D Seismic Data

**Bedrock Geology**

**Middle Devonian**

- Dundee
- Lucas
- Amherstburg

**Lower Devonian**

- Bois Blanc

**Upper Silurian**

- Bass Islands
- Salina
- Guelph

**Lower Silurian**

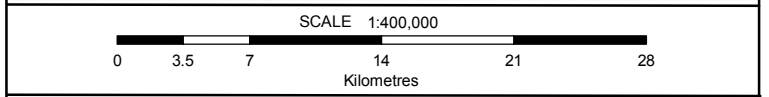
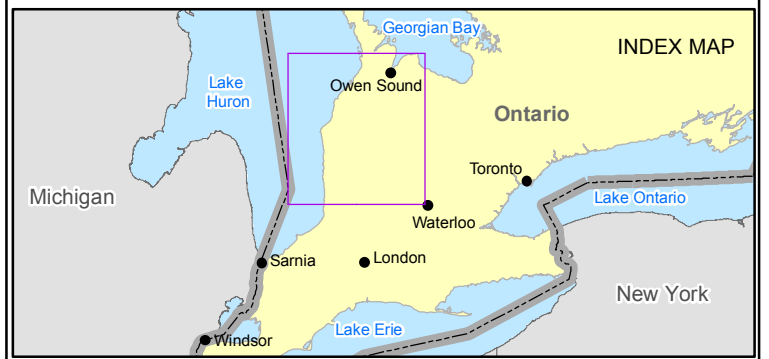
- Amabel
- Clinton-Cataract Group

**Upper Ordovician**

- Queenston
- Georgian Bay
- Blue Mountain

**Mapped Subsurface Faults**

- Shadow Lake/Precambrian
- Trenton (Ordovician)



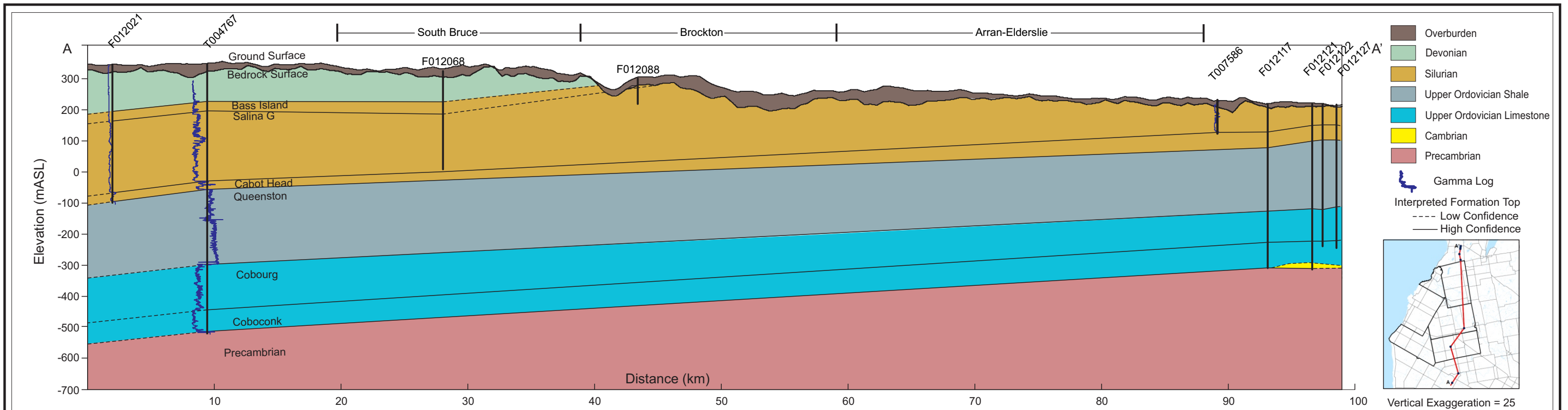
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 Fault Mapping and Pinnacle Reefs: MRD 276 Regional structure and isopach maps of potential hydrocarbon-bearing strata for southern Ontario, OGS, 2011  
 Oil and Gas Wells: OGSRL, 2013  
 Seismic Lines: OGSRL, 2013  
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 Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data

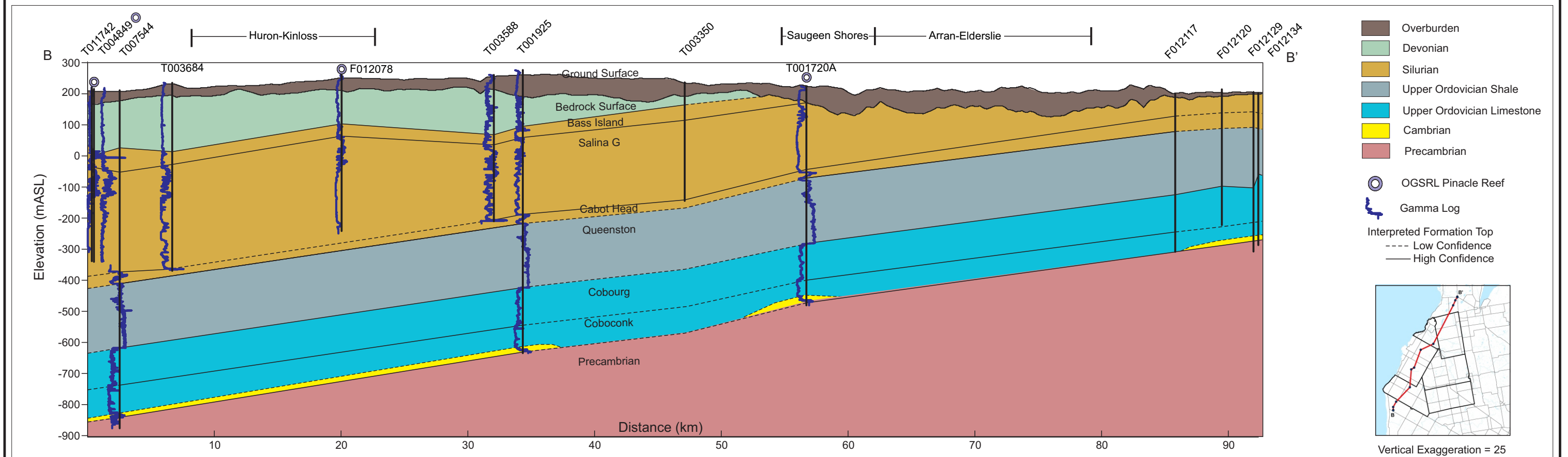
TITLE **Orientation of Geological Cross-Sections through the Communities**

|                 |                                                             |  |
|-----------------|-------------------------------------------------------------|--|
| <b>FIGURE 7</b> | DESIGN: NMP<br>CAD/GIS: NMP/ADG<br>CHECK: KGR/SNS<br>REV: 0 |  |
|                 | DATE: 8/21/2014                                             |  |

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**(a) Cross-Section A-A'**



**(b) Cross-Section B-B'**

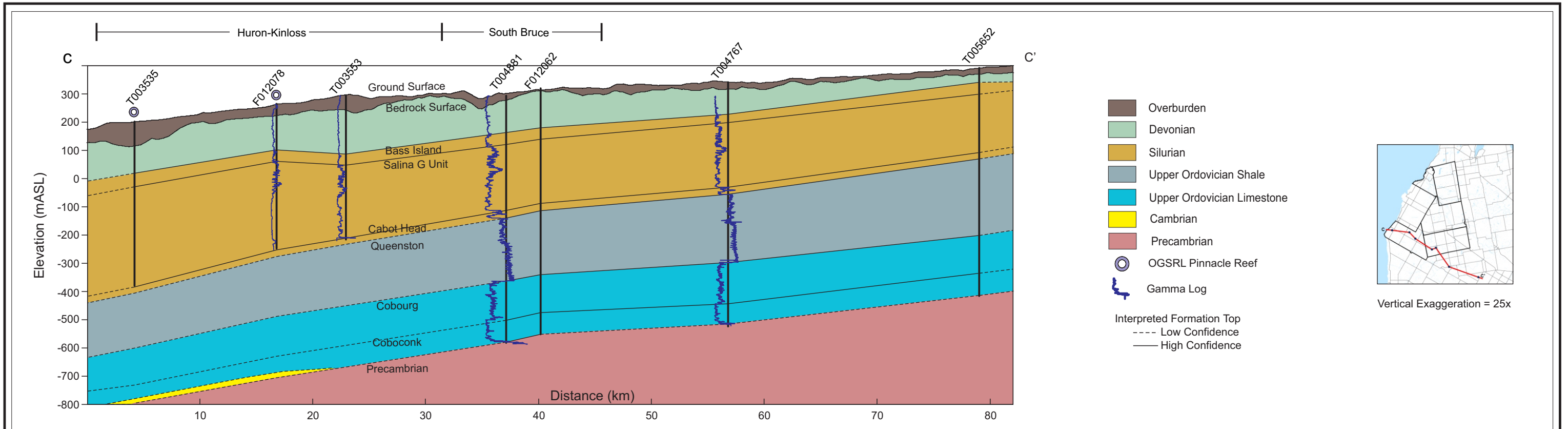
Data Source: OGSRL, 2013

**FIGURE 8 - Geological Cross-Sections (a) A-A' and (b) B-B'**

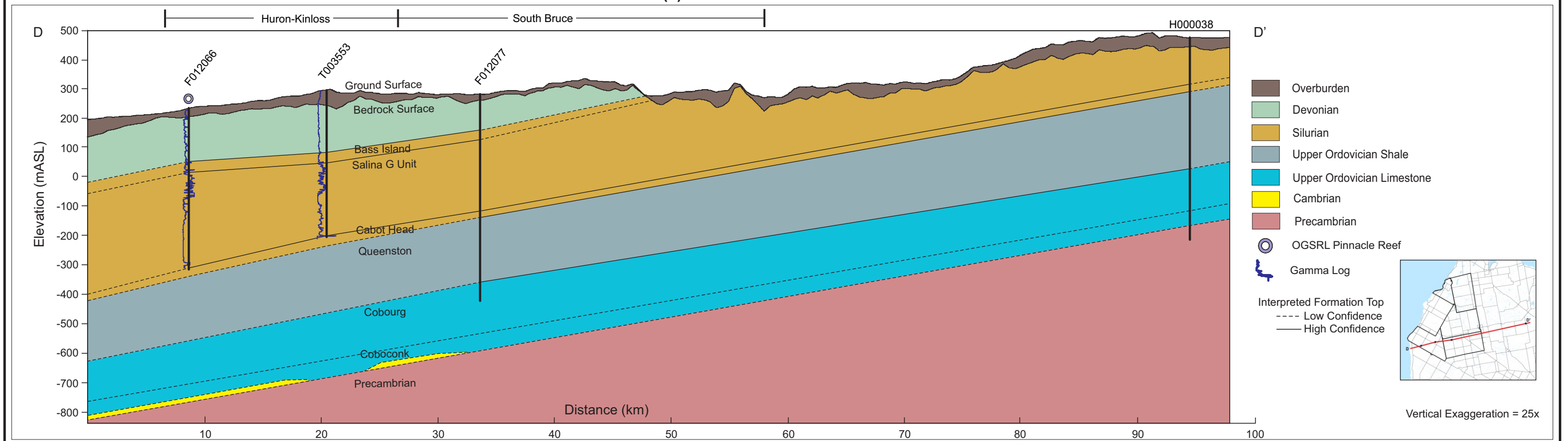
PROJECT No: 10-214-7.50  
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 Reviewed by: KGR/SNS  
 Date: 23/06/2014





(a) Cross-Section C-C'



(b) Cross-Section D-D'

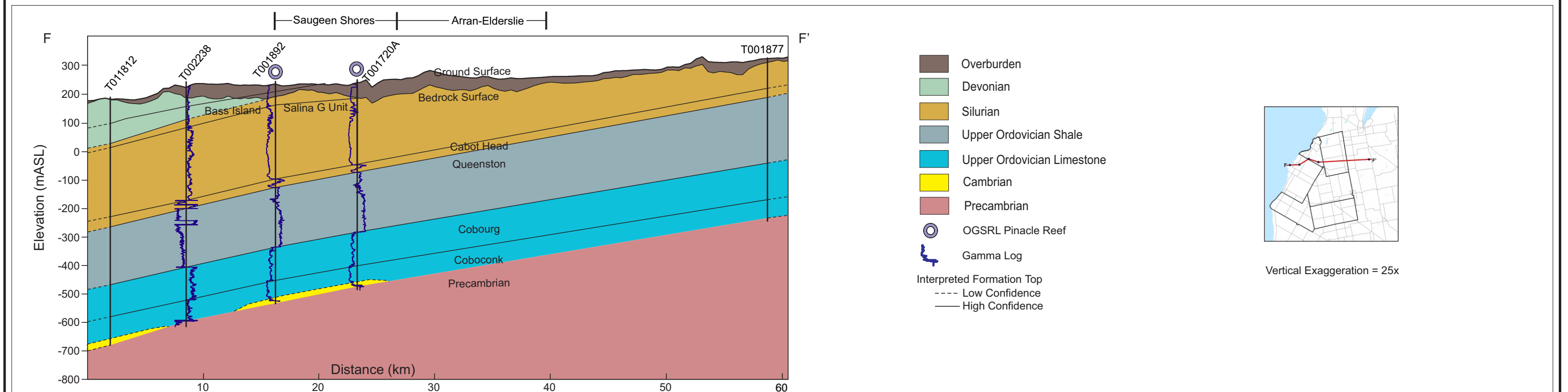
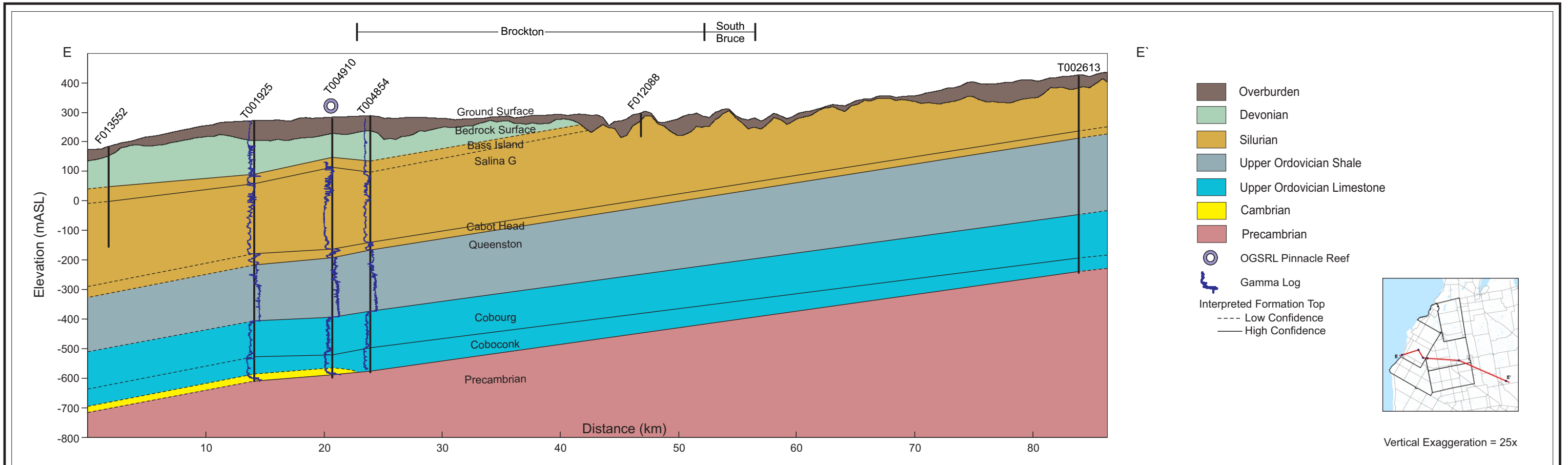
Data Source: OGSRL, 2013

**FIGURE 9 - Geological Cross-Sections (a) C-C' and (b) D-D'**  
 PROJECT No: 10-214-7.50  
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 Date: 23/06/2014



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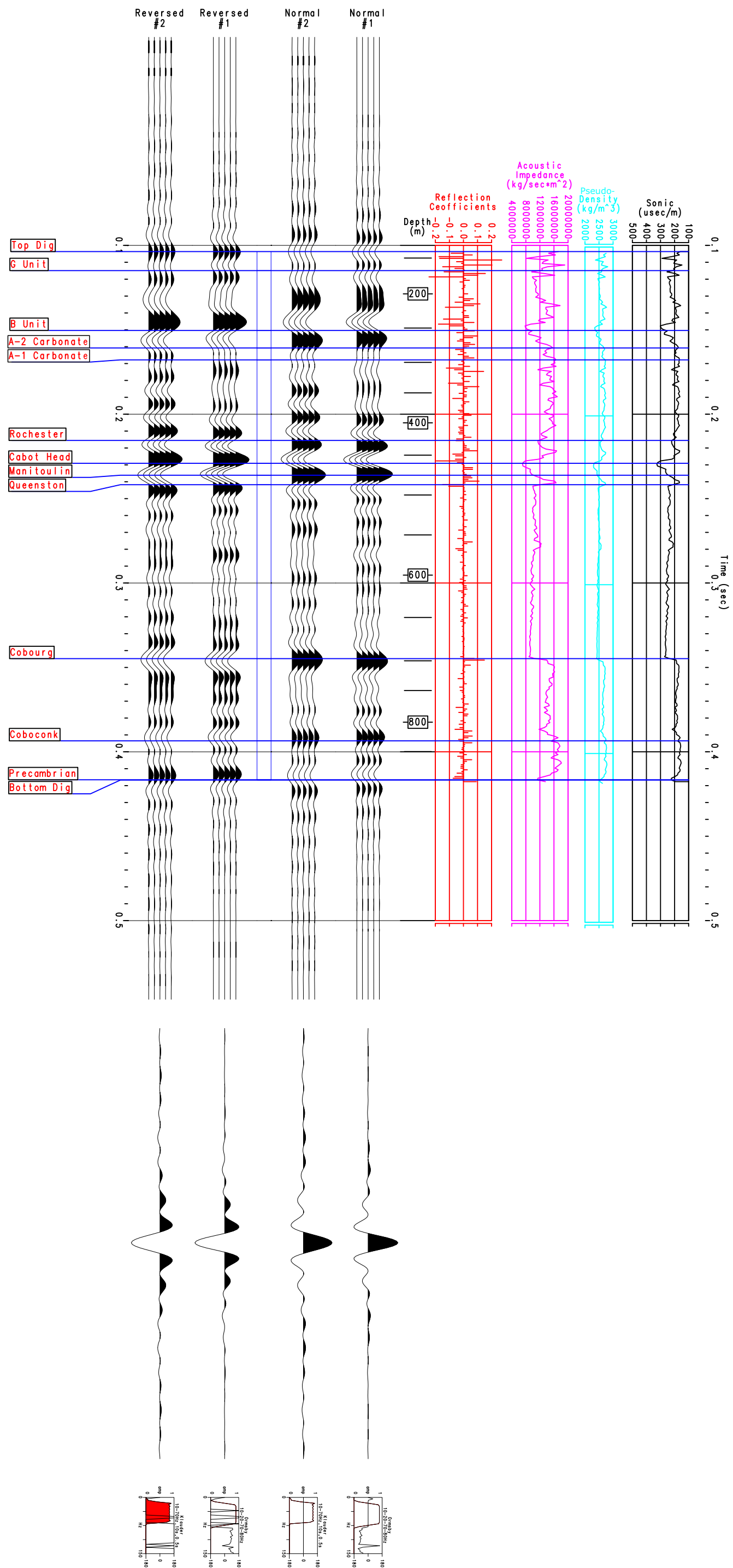
Data Source: OGSRL, 2013

**FIGURE 10 - Geological Cross-Sections (a) E-E' and (b) F-F'**

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Prepared by: NMP/ADG  
 Reviewed by: KGR/SNS  
 Date: 23/06/2014





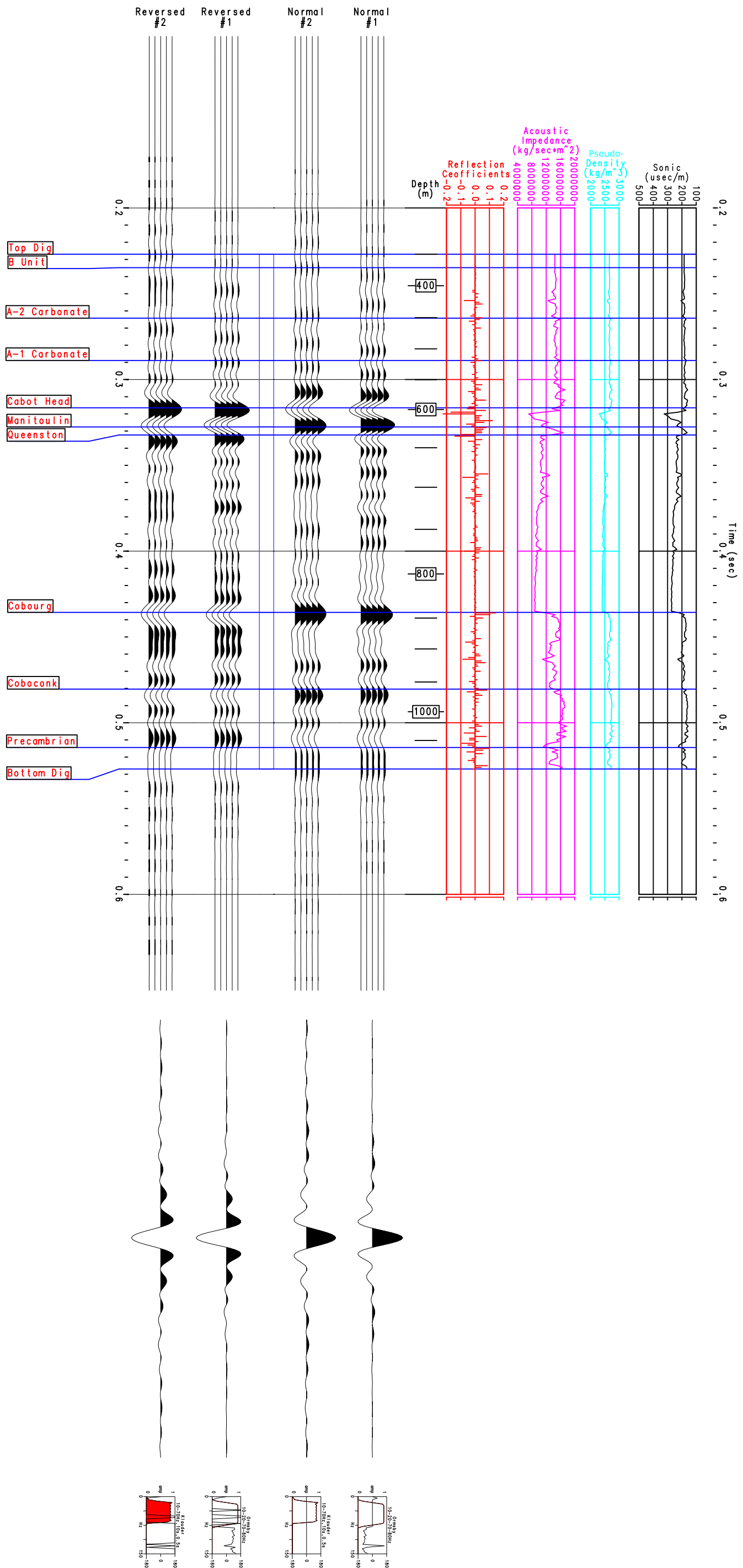
Source: Borehole Geophysical Logs: OGSRL, 2013

**Figure 11 - Synthetic Seismogram for OGSRL Borehole T004910**

PROJECT No: 10-214-7.50  
**Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Prepared by: NMP/ADG  
 Reviewed by: KGR/SNS  
 Date: 23/06/2014





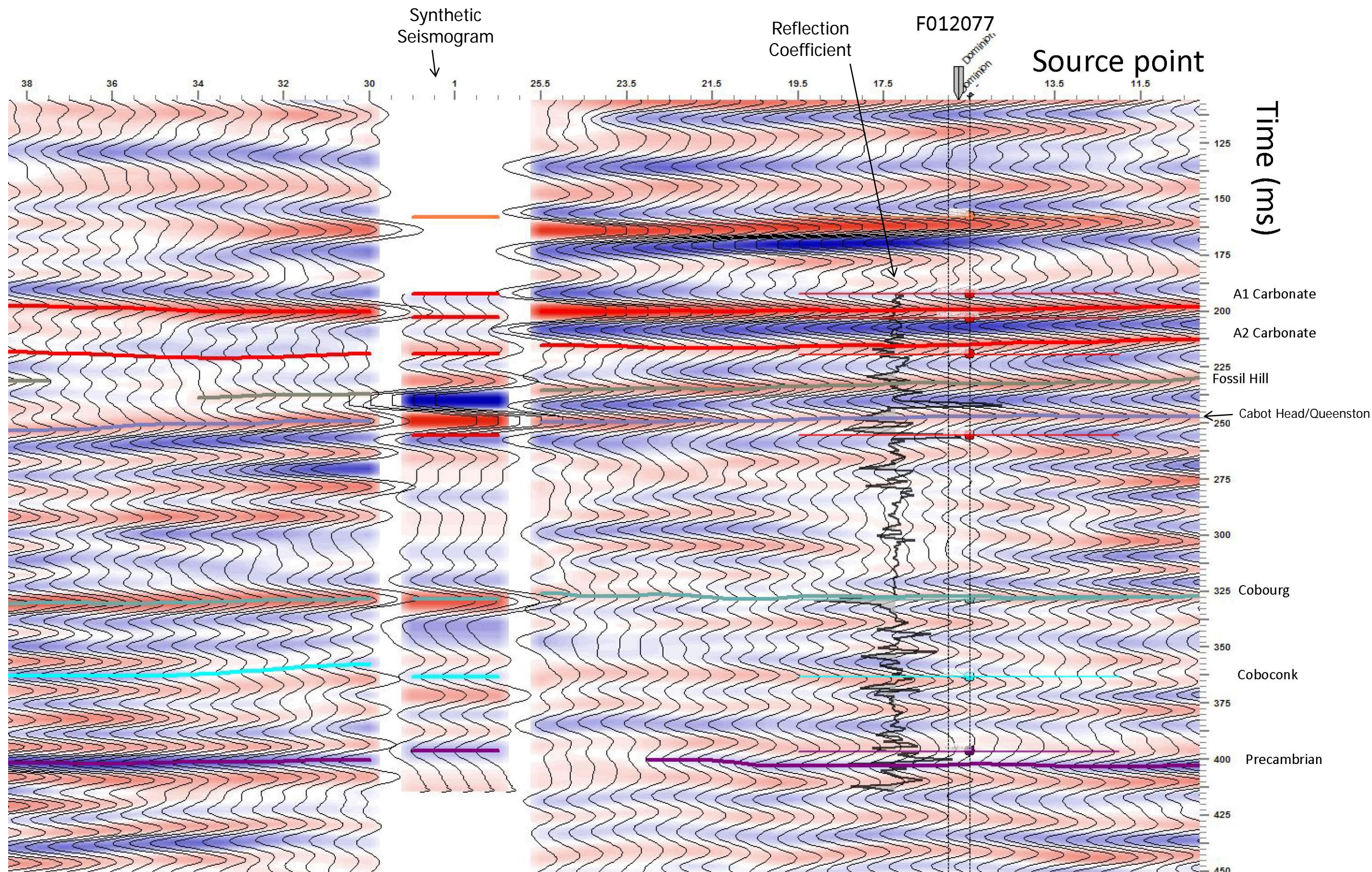
Source: Borehole Geophysical Logs: OGSRL, 2013

**Figure 12 - Synthetic Seismogram for OGSRL Borehole T007544**

PROJECT No: 10-214-7.50  
**Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Prepared by: NMP/ADG  
 Reviewed by: KGR/SNS  
 Date: 23/06/2014



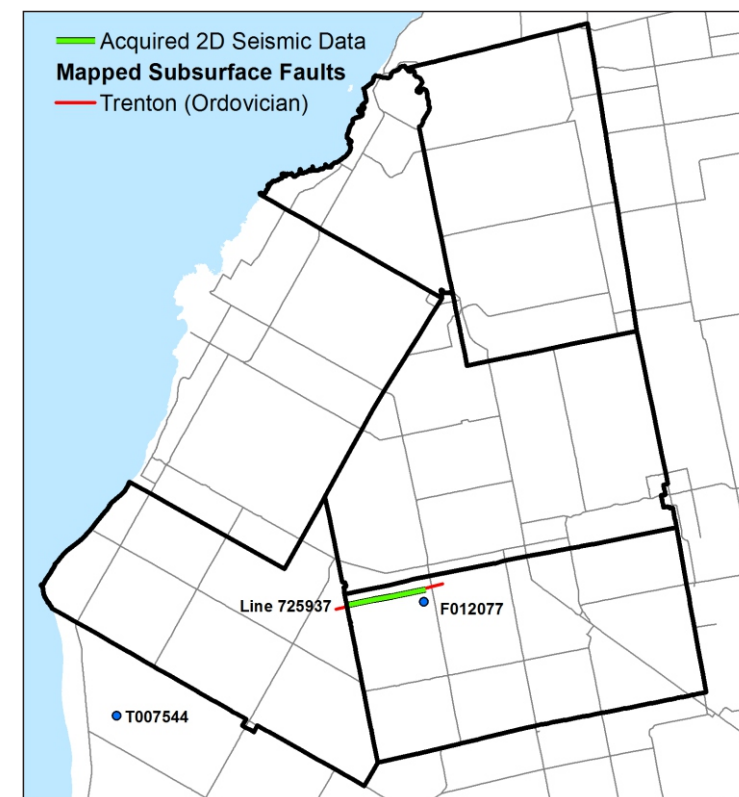
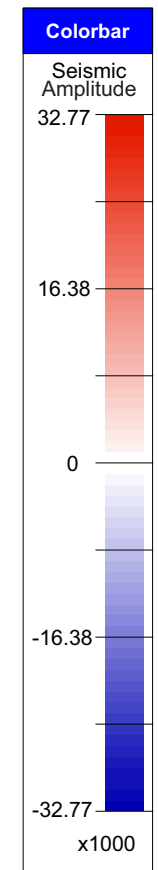
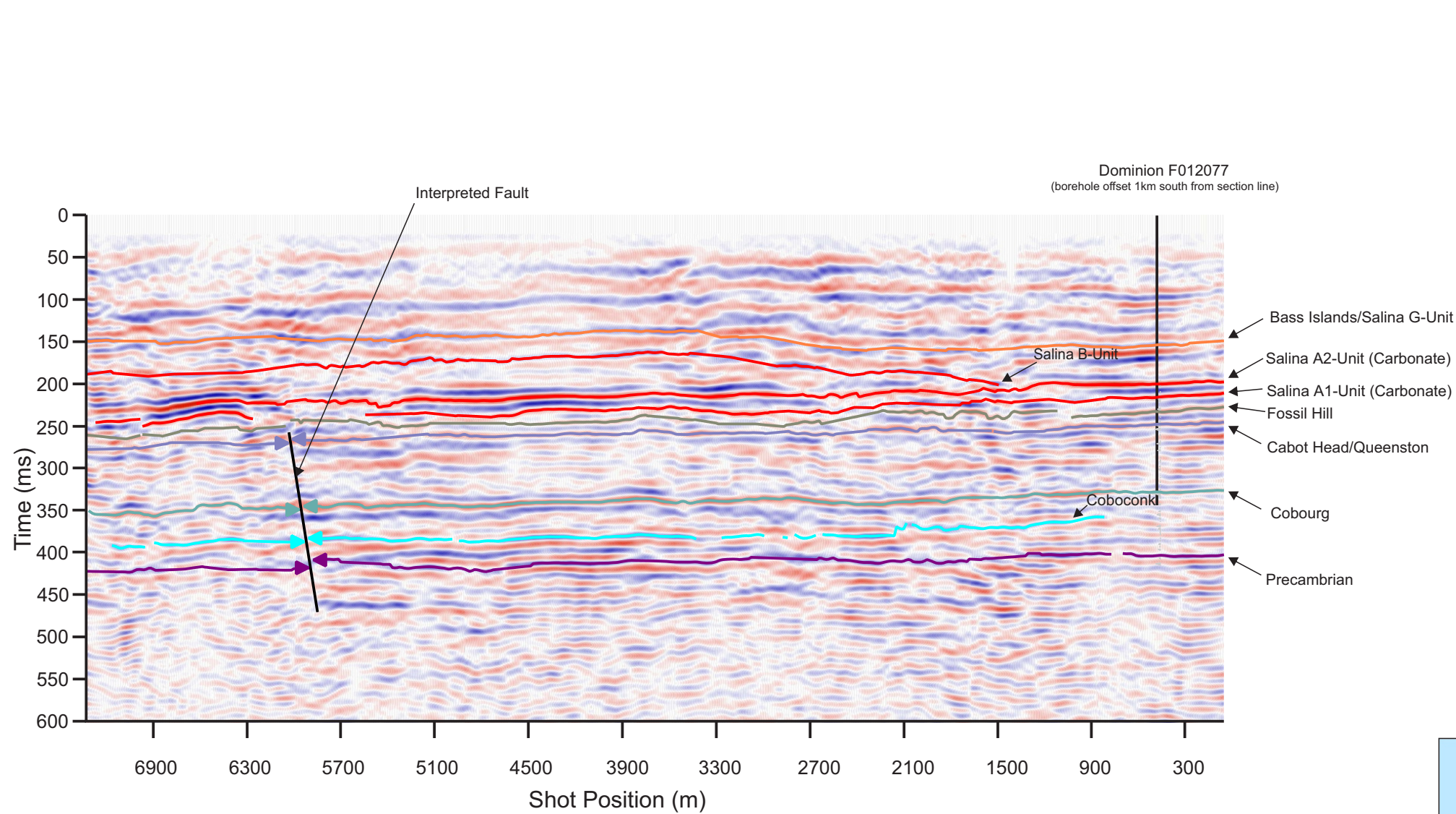


**Figure 13 – Combined Synthetic Seismogram for OGSRL Boreholes F012077 and T007544**

PROJECT No: 10-214-7.50  
**Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Prepared by: ADG/NMP  
 Reviewed by: DS  
 Date: 23-June-14

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**Figure 14 - 2D Seismic Interpretation of Line 725937 in the Municipality of South Bruce**

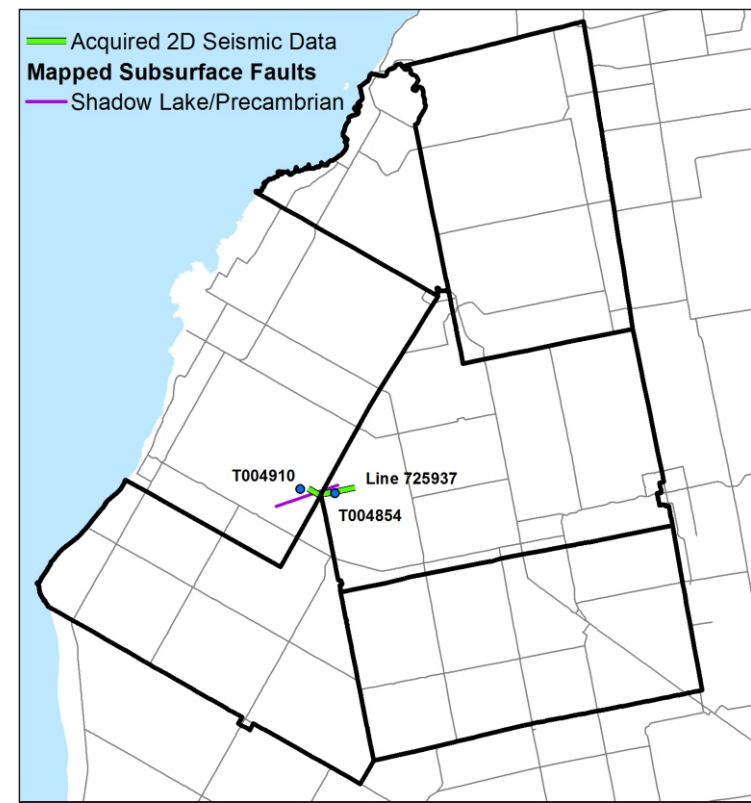
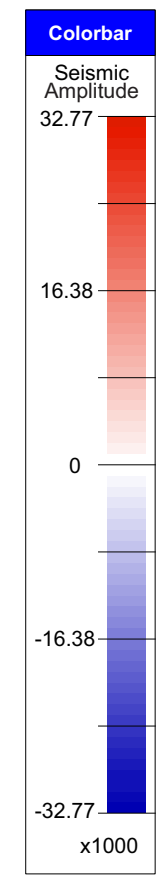
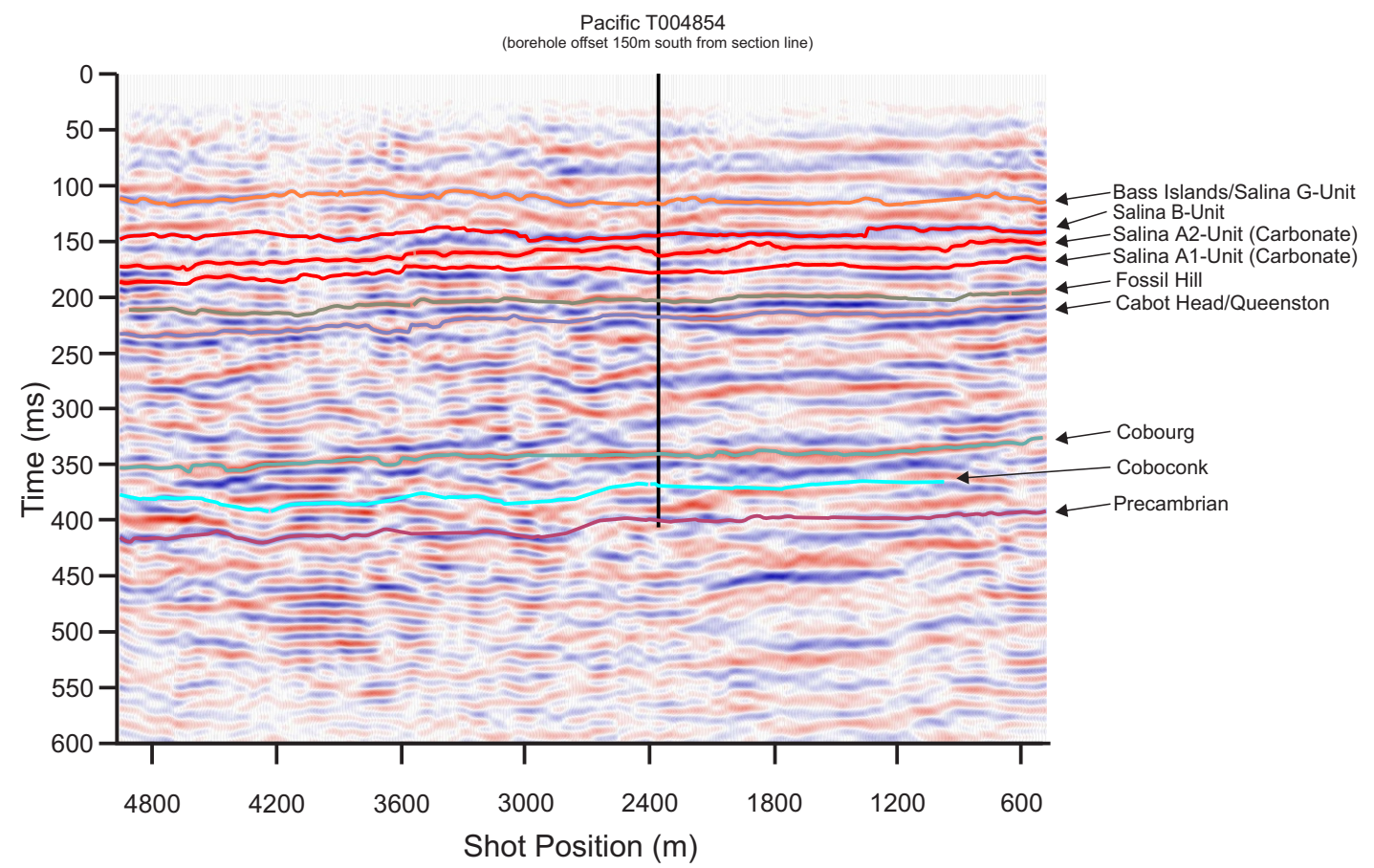
PROJECT No: 10-214-7.50  
**Phase 1 Geoscientific Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Prepared by: NMP/ADG  
 Reviewed by: SNS  
 Date: 23/06/2014



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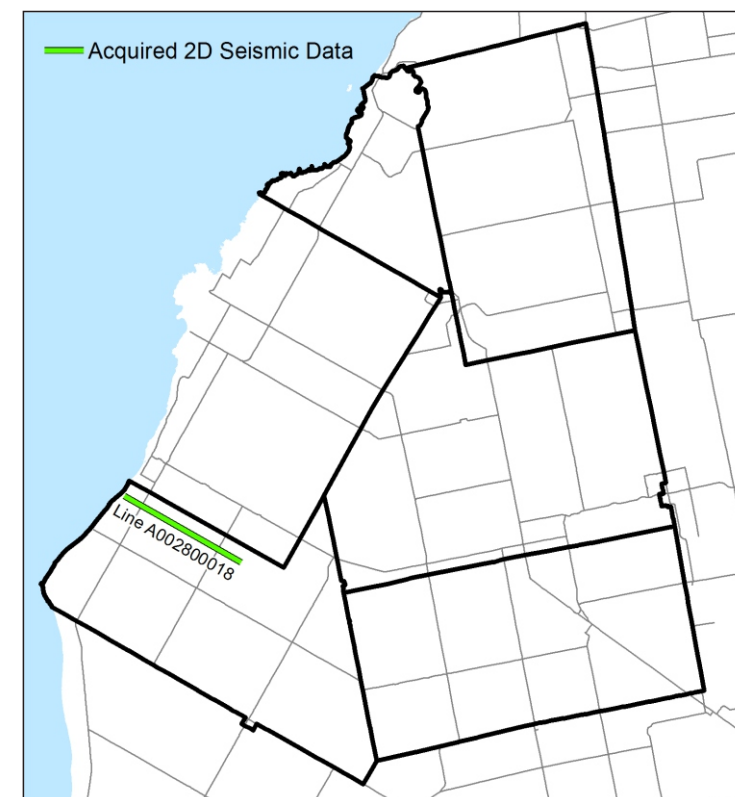
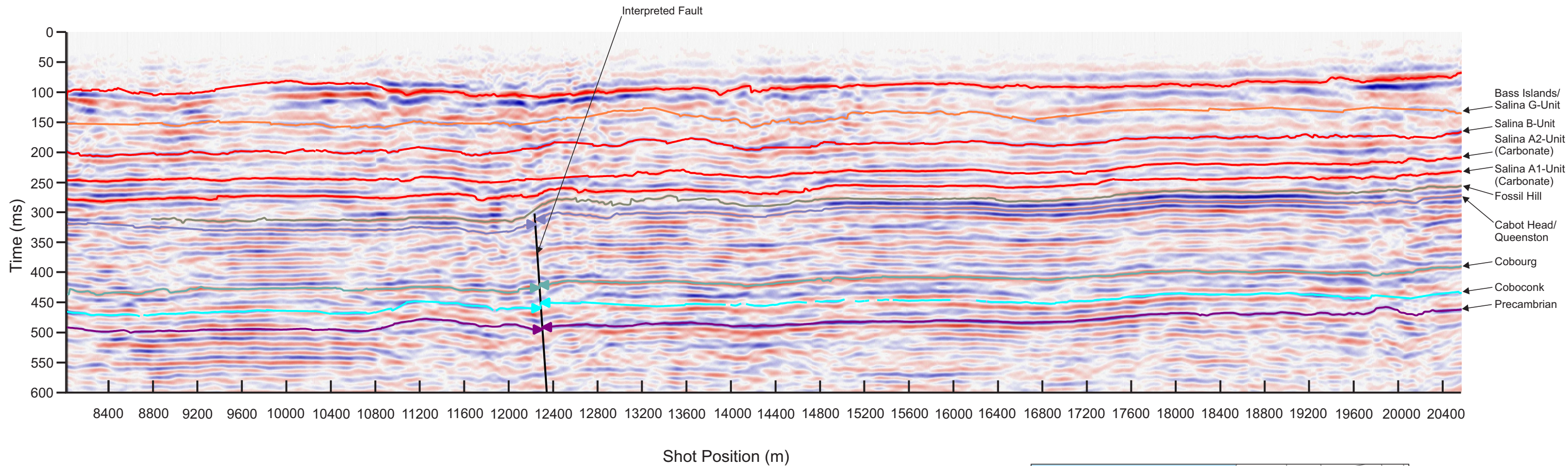
**Figure 15 - 2D Seismic Interpretation of Line 825938 in the Municipality of Brockton**

PROJECT No: 10-214-7.50  
**Phase 1 Geoscientific Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Prepared by: NMP/ADG  
 Reviewed by: SNS  
 Date: 23/06/2014



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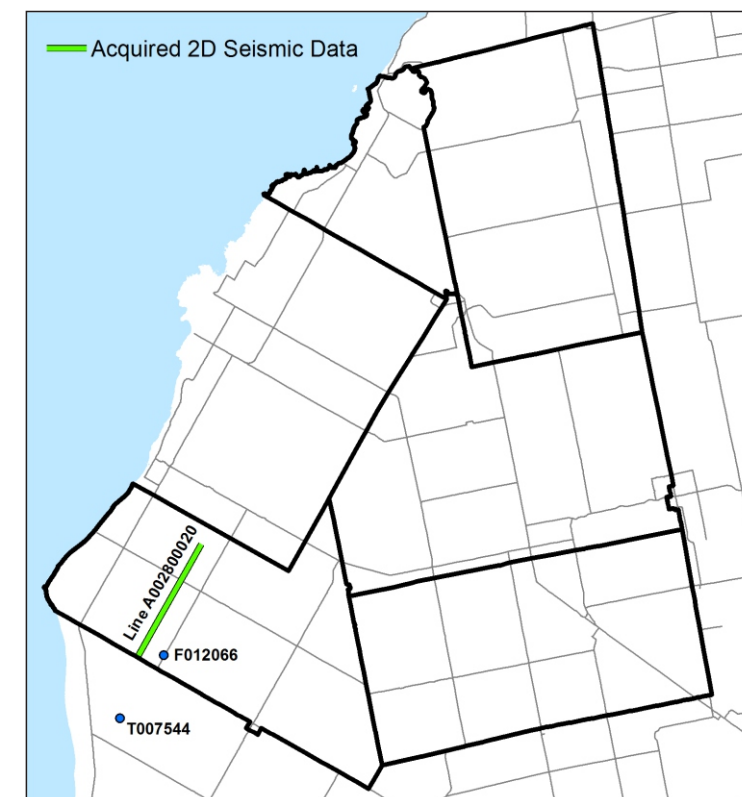
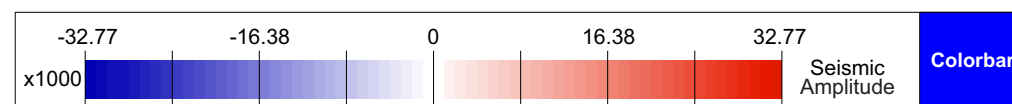
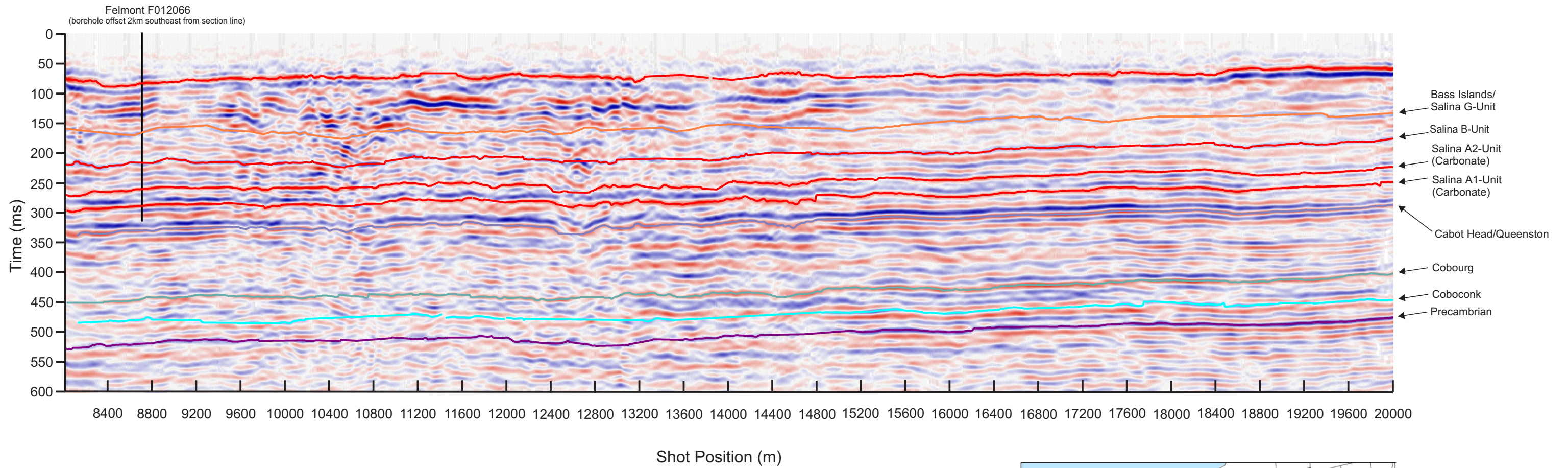


**Figure 16 - 2D Seismic Interpretation of Line A002800018 in the Township of Huron-Kinloss**

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**Phase 1 Geoscientific Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Prepared by: NMP/ADG  
 Reviewed by: SNS  
 Date: 23/06/2014





**Figure 17 - 2D Seismic Interpretation of Line A002800020 in the Township of Huron-Kinloss**

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**Phase 1 Geoscientific Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data**

Prepared by: NMP/ADG  
 Reviewed by: SNS  
 Date: 23/06/2014



## **APPENDIX A**

### **Summary of OGSRL Wells in the Area of the Five Communities**

| COUNT | LICENSE NUMBER | NAME                                                    | OPERATOR                 | UTM NAD83 EASTING | UTM NAD83 NORTHING | PURPOSE         | WELL MODE      | GROUND ELEVATION (m) | TVD     | TOTAL DEPTH FORMATION | POOL | TD_DATE | Geophysics | Armstrong/Carter Reference | Used in BR Surface | Rock Core Available | Oil/Gas Pool | Pin Reef |
|-------|----------------|---------------------------------------------------------|--------------------------|-------------------|--------------------|-----------------|----------------|----------------------|---------|-----------------------|------|---------|------------|----------------------------|--------------------|---------------------|--------------|----------|
| 1     | F011876        | Bluewater Oil & Gas - Martin No. 1                      | Prenalta Minerals Inc.   | 447190            | 4814135            | Oil and Gas     | Abandoned Well | 248.1                | 606.25  | Cabot Head            | N/A  | Jul-57  |            |                            | ✓                  |                     |              |          |
| 2     | F011877        | Imperial 497 - McKinley No. 1                           | Imperial Oil Ltd         | 448134            | 4814180            | Oil and Gas     | Abandoned Well | 273.71               | 623.01  | Cabot Head            | N/A  | Jan-55  |            |                            | ✓                  |                     |              |          |
| 3     | F011878        | Imperial 516 - W. Aikenhead No. 1                       | Imperial Oil Ltd         | 457744            | 4814798            | Oil and Gas     | Abandoned Well | 268.83               | 527     | Cabot Head            | N/A  | May-55  |            |                            | ✓                  |                     |              |          |
| 4     | F011880        | Pan Western Oils No. 2 - L. Barker No. 1                | Pan Western Oils Ltd     | 481094            | 4815330            | Oil and Gas     | Abandoned Well | 345.64               | 958.6   | Precambrian           | N/A  | Sep-54  |            |                            | ✓                  |                     |              |          |
| 5     | F011881        | Pan - Western                                           | Pan Western Oils Ltd     | 481548            | 4816847            | Oil and Gas     | Abandoned Well | 345.03               | 439.52  | Cabot Head            | N/A  | Dec-55  |            |                            | ✓                  |                     |              |          |
| 6     | F011882        | Pan - Western Logan 25-2 Panwestern #6                  | Pan Western Oils Ltd     | 480174            | 4816956            | Oil and Gas     | Abandoned Well | 344.12               | 449.28  | Cabot Head            | N/A  | Nov-55  | ✓          |                            | ✓                  |                     |              |          |
| 7     | F011886        | Pan - Western                                           | Pan Western Oils Ltd     | 479989            | 4818246            | Oil and Gas     | Abandoned Well | 343.51               | 523.65  | Queenston             | N/A  | Nov-54  |            |                            | ✓                  |                     |              |          |
| 8     | F011888        | Pan-Western Oil No. 1 - J. Shea No. 1                   | Unknown                  | 477415            | 4818522            | Oil and Gas     | Abandoned Well | 338.63               | 496.82  | Queenston             | N/A  | Jul-54  |            |                            | ✓                  |                     |              |          |
| 9     | F011890        | Pan-Western Oils No. 7 - J. Delaney No. 1               | Unknown                  | 478077            | 4819180            | Oil and Gas     | Abandoned Well | 338.63               | 454.76  | Cabot Head            | N/A  | Dec-55  |            |                            | ✓                  |                     |              |          |
| 10    | F011891        | Imperial 672 et al - Mustard No. 1                      | Imperial Oil Ltd         | 453906            | 4819543            | Oil and Gas     | Abandoned Well | 258.17               | 578.82  | Cabot Head            | N/A  | Sep-58  |            |                            | ✓                  |                     |              |          |
| 11    | F011893        | Imperial Oil No. 451 - Imperial - Sun - G. Wilson No. 1 | Imperial Oil Ltd         | 453927            | 4820690            | Oil and Gas     | Abandoned Well | 245.67               | 1065.58 | Precambrian           | N/A  | Aug-54  |            |                            | ✓                  |                     |              |          |
| 12    | F011894        | Pan-Western Oils - Nolan No. 1                          | Pan Western Oils Ltd     | 471523            | 4821046            | Oil and Gas     | Abandoned Well | 317.6                | 482.8   | Cabot Head            | N/A  | Sep-55  | ✓          |                            | ✓                  |                     |              |          |
| 13    | F011895        | Pan - Western                                           | Pan Western Oils Ltd     | 491261            | 4821075            | Oil and Gas     | Abandoned Well | 360.27               | 411.48  | Cabot Head            | N/A  | Aug-55  |            |                            | ✓                  |                     |              |          |
| 14    | F011904        | Imperial 523 - Weston No. 1                             | Imperial Oil Ltd         | 445417            | 4823418            | Oil and Gas     | Abandoned Well | 221.6                | 611.12  | Cabot Head            | N/A  | Aug-55  |            |                            | ✓                  |                     |              |          |
| 15    | F011909        | Imperial 471 - G. Turner No. 1                          | Imperial Oil Ltd         | 460308            | 4824404            | Oil and Gas     | Abandoned Well | 288.65               | 551.69  | Cabot Head            | N/A  | Oct-54  |            |                            | ✓                  |                     |              |          |
| 16    | F011928        | Imperial 397 - I. McCullagh No. 1                       | Imperial Oil Ltd         | 449486            | 4826945            | Oil and Gas     | Abandoned Well | 280.72               | 643.13  | Cabot Head            | N/A  | Aug-53  |            |                            | ✓                  |                     |              |          |
| 17    | F011941        | Imperial 368 - Huron Lorne Murch                        | Imperial Oil Ltd         | 449938            | 4827429            | Oil and Gas     | Abandoned Well | 276.15               | 629.11  | Cabot Head            | N/A  | Mar-53  |            |                            | ✓                  |                     |              |          |
| 18    | F011951        | B. Gibbings                                             | Unknown                  | 458580            | 4822533            | Solution Mining | Unknown        | 280.35               | 391.67  | N/A                   | N/A  | N/A     |            |                            | note 1             |                     |              |          |
| 19    | F011953        | Imperial 400 - A. Gloor No. 1                           | Imperial Oil Ltd         | 459781            | 4828116            | Oil and Gas     | Abandoned Well | 284.99               | 548.03  | Cabot Head            | N/A  | Sep-53  |            |                            | ✓                  |                     |              |          |
| 20    | F011962        | Bluewater Oil & Gas - D. Murray No. 1                   | Prenalta Minerals Inc.   | 478539            | 4828801            | Oil and Gas     | Abandoned Well | 338.94               | 438.3   | Rochester             | N/A  | Jun-56  |            |                            | ✓                  |                     |              |          |
| 21    | F011965        | Imperial 658 - J. Wain No. 1                            | Imperial Oil Ltd         | 443873            | 4829976            | Oil and Gas     | Abandoned Well | 205.13               | 619.35  | Cabot Head            | N/A  | Jun-58  | ✓          |                            | ✓                  |                     |              |          |
| 22    | F011968        | Forest & Daley - J. Mann                                | Unknown                  | 461193            | 4830801            | Oil and Gas     | Unknown        | 297.48               | 60.35   | Dundee                | N/A  | Sep-38  |            |                            | note 1             |                     |              |          |
| 23    | F011969        | Nationwide Minerals No. 2 - L. Quipp No. 1              | Nationwide Minerals Ltd. | 495901            | 4830644            | Oil and Gas     | Abandoned Well | 357.84               | 883.92  | Precambrian           | N/A  | May-54  |            |                            | ✓                  |                     |              |          |
| 24    | F011970        | Huron & Bruce Oil Co.                                   | Unknown                  | 457824            | 4830925            | Oil and Gas     | Unknown        | 299.62               | 1076.25 | Precambrian           | N/A  | May-39  |            |                            | ✓                  |                     |              |          |
| 25    | F011973        | Imperial 511 - J.E. Murch No. 1                         | Imperial Oil Ltd         | 457284            | 4833589            | Oil and Gas     | Abandoned Well | 284.07               | 563.88  | Cabot Head            | N/A  | Apr-55  |            |                            | ✓                  |                     |              |          |
| 26    | F011974        | Imperial (533)                                          | Imperial Oil Ltd         | 446767            | 4833840            | Oil and Gas     | Abandoned Well | 254.51               | 1128.98 | Precambrian           | N/A  | Nov-55  |            |                            | ✓                  |                     |              |          |
| 27    | F011975        | Imperial 380 - Farquhar No. 1                           | Imperial Oil Ltd         | 457688            | 4834080            | Oil and Gas     | Abandoned Well | 292.3                | 567.23  | Cabot Head            | N/A  | May-53  |            |                            | ✓                  |                     |              |          |
| 28    | F011976        | Imperial 396 - Farquhar No. 2                           | Imperial Oil Ltd         | 458300            | 4834132            | Oil and Gas     | Abandoned Well | 295.96               | 563.88  | Cabot Head            | N/A  | Aug-53  |            |                            | ✓                  |                     |              |          |
| 29    | F011977        | Imperial 409 - Wm. Blacker No. 1                        | Imperial Oil Ltd         | 457695            | 4834694            | Oil and Gas     | Abandoned Well | 288.04               | 562.36  | Cabot Head            | N/A  | Oct-53  |            |                            | ✓                  |                     |              |          |
| 30    | F011978        | Imperial 573 - J.L. Taylor No. 1                        | Imperial Oil Ltd         | 469037            | 4835202            | Oil and Gas     | Abandoned Well | 323.09               | 518.16  | Cabot Head            | N/A  | Sep-56  | ✓          |                            | ✓                  |                     |              | ✓        |
| 31    | F011981        | Silver Creek Oil No. 1 - B. Allen No. 2                 | Unknown                  | 469781            | 4836310            | Oil and Gas     | Abandoned Well | 324.31               | 504.44  | Cabot Head            | N/A  | Feb-50  |            |                            | ✓                  |                     |              |          |
| 32    | F011982        | Huron Dome Oil Co. - H.S. Allen No. 1                   | Unknown                  | 470317            | 4837011            | Oil and Gas     | Abandoned Well | 327.36               | 551.99  | Queenston             | N/A  | Aug-41  |            |                            | ✓                  |                     |              |          |
| 33    | F011983        | Bluewater Oil & Gas - G. Knight No. 1                   | Prenalta Minerals Inc.   | 482654            | 4831106            | Oil and Gas     | Abandoned Well | 349.91               | 430.99  | Cabot Head            | N/A  | Sep-57  |            |                            | ✓                  |                     |              |          |
| 34    | F011984        | Imperial 464 - E. Spuran No. 1                          | Imperial Oil Ltd         | 490433            | 4837045            | Oil and Gas     | Abandoned Well | 359.36               | 451.41  | Queenston             | N/A  | Aug-54  |            |                            | ✓                  |                     |              |          |
| 35    | F011985        | Imperial 583 - P. Fischer No. 1                         | Imperial Oil Ltd         | 451442            | 4837291            | Oil and Gas     | Abandoned Well | 284.68               | 610.21  | Rochester             | N/A  | Nov-56  | ✓          |                            | ✓                  |                     |              |          |
| 36    | F011986        | Imperial 369 - E. Jamieson No. 1                        | Imperial Oil Ltd         | 460163            | 4838578            | Oil and Gas     | Abandoned Well | 294.44               | 549.55  | Cabot Head            | N/A  | Mar-53  |            |                            | ✓                  |                     |              |          |
| 37    | F011987        | Imperial 679 - G. Ginn No. 1                            | Imperial Oil Ltd         | 449252            | 4839547            | Oil and Gas     | Abandoned Well | 244.45               | 611.73  | Cabot Head            | N/A  | Oct-58  | ✓          |                            | ✓                  |                     |              |          |
| 38    | F011988        | Imperial 378 - H. Hill No. 1                            | Imperial Oil Ltd         | 452698            | 4841323            | Oil and Gas     | Abandoned Well | 288.65               | 624.84  | Cabot Head            | N/A  | May-53  |            |                            | ✓                  |                     |              |          |
| 39    | F011989        | Imperial 557 - J. Yungblut No. 1                        | Imperial Oil Ltd         | 457162            | 4841796            | Oil and Gas     | Abandoned Well | 293.52               | 570.28  | Cabot Head            | N/A  | Jun-56  | ✓          |                            | ✓                  |                     |              |          |
| 40    | F011993        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 441627            | 4842978            | Stratigraphic   | Abandoned Well | 206.04               | 569.37  | A-2 Salt              | N/A  | Apr-57  |            |                            | note 1             |                     |              |          |
| 41    | F011995        | Sifto Salt (1960) Ltd.                                  | Sifto Canada Inc.        | 444463            | 4843044            | Solution Mining | Abandoned Well | 218.2                | 485.55  | B Salt                | N/A  | Nov-60  |            |                            | note 1             |                     |              |          |
| 42    | F011997        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 441539            | 4843226            | Stratigraphic   | Abandoned Well | 178                  | 537.06  | A-2 Salt              | N/A  | Sep-56  |            |                            | note 1             |                     |              |          |
| 43    | F011998        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 441607            | 4843225            | Stratigraphic   | Abandoned Well | 178.49               | 256.64  | Drift                 | N/A  | Jul-56  |            |                            | note 1             |                     |              |          |
| 44    | F011999        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 440984            | 4843601            | Stratigraphic   | Abandoned Well | 179.59               | 543.46  | A-2 Salt              | N/A  | Sep-56  |            |                            | ✓                  |                     |              |          |
| 45    | F012000        | Dominion Rock Salt Co. - D.D.H. No. 6                   | Dominion Rock Salt Co.   | 441566            | 4843658            | Stratigraphic   | Abandoned Well | 181.51               | 540.41  | A-1 Carbonate         | N/A  | Jun-56  |            |                            | note 1             |                     |              |          |
| 46    | F012001        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 440717            | 4843850            | Stratigraphic   | Abandoned Well | 179.16               | 548.94  | A-2 Salt              | N/A  | Sep-56  |            |                            | ✓                  |                     |              |          |
| 47    | F012002        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 441233            | 4843938            | Stratigraphic   | Abandoned Well | 178.77               | 542.85  | A-2 Salt              | N/A  | Jun-56  |            |                            | ✓                  |                     |              |          |
| 48    | F012003        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 441680            | 4843996            | Stratigraphic   | Abandoned Well | 177.7                | 344.73  | E Unit                | N/A  | Jun-57  |            |                            | ✓                  |                     |              |          |
| 49    | F012004        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 442240            | 4844053            | Stratigraphic   | Abandoned Well | 180.75               | 586.74  | Guelph                | N/A  | Jan-57  |            |                            | ✓                  |                     |              |          |
| 50    | F012005        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 442240            | 4844084            | Stratigraphic   | Abandoned Well | 178.16               | 585.06  | Guelph                | N/A  | May-55  |            |                            | ✓                  |                     |              |          |
| 51    | F012006        | Dominion Rock Salt Co.                                  | Dominion Rock Salt Co.   | 441659            | 4844089            | Stratigraphic   | Abandoned Well | 178.16               | 233.78  | G Unit                | N/A  | Oct-55  |            |                            | ✓                  |                     |              |          |
| 52    | F012008        | Imperial 390 - K. Webster No. 1                         | Imperial Oil Ltd         | 466347            | 4844141            | Oil and Gas     | Abandoned Well | 344.12               | 542.54  | Cabot Head            | N/A  | Jul-53  |            |                            | ✓                  |                     |              |          |

| COUNT | LICENSE NUMBER | NAME                                                      | OPERATOR                      | UTM NAD83 EASTING | UTM NAD83 NORTHING | PURPOSE       | WELL MODE      | GROUND ELEVATION (m) | TVD     | TOTAL DEPTH FORMATION | POOL           | TD_DATE | Geophysics | Armstrong/Carter Reference | Used in BR Surface | Rock Core Available | Oil/Gas Pool | Pin Reef |
|-------|----------------|-----------------------------------------------------------|-------------------------------|-------------------|--------------------|---------------|----------------|----------------------|---------|-----------------------|----------------|---------|------------|----------------------------|--------------------|---------------------|--------------|----------|
| 53    | F012009        | Dominion Rock Salt Co.                                    | Dominion Rock Salt Co.        | 440967            | 4844218            | Stratigraphic | Abandoned Well | 179.1                | 545.9   | A-2 Salt              | N/A            | Nov-56  |            |                            | ✓                  |                     |              |          |
| 54    | F012010        | Imperial 412 - R. McCabe No. 1                            | Imperial Oil Ltd              | 448188            | 4844164            | Oil and Gas   | Abandoned Well | 252.37               | 618.74  | Cabot Head            | N/A            | Oct-53  |            |                            | ✓                  |                     |              |          |
| 55    | F012011        | Imperial 445 - H. Walter No. 1                            | Imperial Oil Ltd              | 448755            | 4844857            | Oil and Gas   | Abandoned Well | 267.31               | 633.98  | Cabot Head            | N/A            | Jun-54  |            |                            | ✓                  |                     |              |          |
| 56    | F012013        | Imperial 562 - E.A. Toll No. 1                            | Imperial Oil Ltd              | 464073            | 4847133            | Oil and Gas   | Abandoned Well | 323.1                | 533.4   | Cabot Head            | N/A            | Jul-56  |            |                            | ✓                  |                     |              |          |
| 57    | F012014        | Bluewater Oil & Gas - W. Marks No. 1                      | Prenalta Minerals Inc.        | 476524            | 4847389            | Oil and Gas   | Abandoned Well | 336.8                | 441.35  | Cabot Head            | N/A            | Aug-57  |            |                            | ✓                  |                     |              |          |
| 58    | F012015        | Imperial 643 - Buchanan No. 1                             | Imperial Oil Ltd              | 498939            | 4829467            | Oil and Gas   | Abandoned Well | 360.27               | 346.25  | Cabot Head            | N/A            | Nov-57  | ✓          |                            | ✓                  |                     |              |          |
| 59    | F012016        | Imperial 389 - Procter No. 1                              | Imperial Oil Ltd              | 472541            | 4849662            | Oil and Gas   | Abandoned Well | 337.41               | 469.7   | Cabot Head            | N/A            | Jun-53  |            |                            | ✓                  |                     |              |          |
| 60    | F012017        | Imperial 385 - B. Ruddock No. 1                           | Imperial Oil Ltd              | 452831            | 4851698            | Oil and Gas   | Abandoned Well | 265.8                | 590.4   | Cabot Head            | N/A            | Jun-53  |            |                            | ✓                  |                     |              |          |
| 61    | F012018        | Imperial Oil No. 563 - W.W. Hill No. 1                    | Imperial Oil Ltd              | 444530            | 4852040            | Oil and Gas   | Abandoned Well | 218.54               | 1111    | Cambrian              | N/A            | Sep-56  | ✓          |                            | ✓                  |                     |              |          |
| 62    | F012021        | Felmont Oil Corporation No. 11 - Campbell No. 1           | Unknown                       | 481723            | 4850624            | Oil and Gas   | Abandoned Well | 336.8                | 435.86  | Queenston             | N/A            | Sep-55  | ✓          |                            | ✓                  |                     |              |          |
| 63    | F012022        | Imperial 594 - Horn No. 1                                 | Imperial Oil Ltd              | 497118            | 4830456            | Oil and Gas   | Abandoned Well | 358.44               | 348.08  | Cabot Head            | N/A            | Jan-57  | ✓          |                            | ✓                  |                     |              |          |
| 64    | F012025        | Imperial Oil No. 600 - Black No. 1                        | Imperial Oil Ltd              | 448372            | 4854801            | Oil and Gas   | Abandoned Well | 238.96               | 1083.87 | Precambrian           | N/A            | May-57  | ✓          |                            | ✓                  |                     |              |          |
| 65    | F012026        | Imperial 526 - G. Feagan No. 1                            | Imperial Oil Ltd              | 446305            | 4854953            | Oil and Gas   | Abandoned Well | 226.47               | 622.1   | Cabot Head            | N/A            | Aug-55  |            |                            | ✓                  |                     |              |          |
| 66    | F012027        | Felmont Oil Corp. - R. Thompson No. 1                     | Felmont Oil Corporation       | 462480            | 4855139            | Oil and Gas   | Abandoned Well | 328.88               | 551.69  | Cabot Head            | N/A            | Nov-55  | ✓          |                            | ✓                  |                     |              |          |
| 67    | F012040        | Imperial Oil No. 469 - J.L. Currie No. 1                  | Imperial Oil Ltd              | 471212            | 4857171            | Oil and Gas   | Abandoned Well | 323.1                | 975.06  | Precambrian           | N/A            | Nov-54  |            |                            | ✓                  |                     |              |          |
| 68    | F012042        | Felmont Oil Corporation - G. Webster No. 1                | Felmont Oil Corporation       | 462578            | 4857930            | Oil and Gas   | Abandoned Well | 319.43               | 542.54  | Cabot Head            | N/A            | Feb-56  |            |                            | ✓                  |                     |              |          |
| 69    | F012047        | Felmont MacTavish No. 1                                   | Felmont Oil Corporation       | 456657            | 4858617            | Oil and Gas   | Abandoned Well | 297.18               | 577.6   | Cabot Head            | Dungannon Pool | Aug-58  | ✓          |                            | ✓                  |                     | ✓            |          |
| 70    | F012048        | Felmont Oil No. 13 - M. Berger No. 1                      | Felmont Oil Corporation       | 449791            | 4859452            | Oil and Gas   | Abandoned Well | 245.67               | 601.98  | Cabot Head            | N/A            | Oct-55  | ✓          |                            | ✓                  |                     |              |          |
| 71    | F012059        | Bluewater - G. Walden No. 1                               | Prenalta Minerals Inc.        | 457070            | 4867346            | Oil and Gas   | Abandoned Well | 291.08               | 556.87  | Cabot Head            | N/A            | Sep-57  |            |                            | ✓                  |                     |              |          |
| 72    | F012061        | Lake St Clair Gasfields                                   | Lake St. Clair Gasfields Ltd. | 458057            | 4870139            | Natural Gas   | Abandoned Well | 295.96               | 1021.38 | Precambrian           | N/A            | Mar-56  |            |                            | ✓                  |                     |              |          |
| 73    | F012062        | Dominion Gas - McKenzie No. 1                             | Domestic Natural Gas Co.      | 476382            | 4870517            | Natural Gas   | Abandoned Well | 316.7                | 870.2   | Precambrian           | N/A            | Apr-42  |            |                            | ✓                  |                     |              |          |
| 74    | F012063        | Felmont Oil                                               | Felmont Oil Corporation       | 453515            | 4871111            | Natural Gas   | Abandoned Well | 260.3                | 568.76  | Cabot Head            | N/A            | Jan-59  | ✓          |                            | ✓                  |                     |              |          |
| 75    | F012066        | Felmont Oil                                               | Felmont Oil Corporation       | 450276            | 4874071            | Natural Gas   | Abandoned Well | 235.61               | 566.93  | Cabot Head            | N/A            | Apr-56  | ✓          |                            | ✓                  |                     |              | ✓        |
| 76    | F012068        | Dominion Gas - Armstrong No. 1                            | Unknown                       | 480626            | 4874752            | Natural Gas   | Abandoned Well | 318.2                | 323.09  | Guelph                | N/A            | Nov-41  |            |                            | ✓                  |                     |              |          |
| 77    | F012077        | Dominion Gas - Smyth No.1                                 | Dominion Natural Gas Co.      | 474716            | 4878798            | Natural Gas   | Abandoned Well | 282.9                | 726.6   | Cobourg               | N/A            | Sep-41  |            |                            | ✓                  |                     |              |          |
| 78    | F012078        | Imperial Oil                                              | Imperial Oil Ltd              | 457447            | 4881565            | Oil and Gas   | Abandoned Well | 264.87               | 507.49  | Guelph                | N/A            | Nov-55  | ✓          |                            | ✓                  | ✓                   |              | ✓        |
| 79    | F012088        | Imperial 161 S.T. No. 5                                   | Imperial Oil Ltd              | 489695            | 4887137            | Stratigraphic | Abandoned Well | 294.4                | 75.59   | C Unit                | N/A            | Jun-48  |            |                            | ✓                  |                     |              |          |
| 80    | F012089        | Imperial (166) S.T. No. 6                                 | Imperial Oil Ltd              | 491066            | 4887416            | Stratigraphic | Abandoned Well | 285.3                | 26.82   | G Unit                | N/A            | Jun-48  |            |                            | ✓                  |                     |              |          |
| 81    | F012090        | Imperial 167 S.T. No. 7                                   | Imperial Oil Ltd              | 487527            | 4887709            | Stratigraphic | Unknown        | 289.99               | 64.01   | N/A                   | N/A            | Jul-48  |            |                            | note 1             |                     |              |          |
| 82    | F012093        | Imperial (172) S.T. No. 8                                 | Imperial Oil Ltd              | 486917            | 4890231            | Stratigraphic | Abandoned Well | 274                  | 35.05   | G Unit                | N/A            | Jul-48  |            |                            | ✓                  |                     |              |          |
| 83    | F012102        | Union Gas Co. -Kincardine No.1 -J.J. Sem                  | Union Gas Limited             | 451704            | 4901991            | Natural Gas   | Abandoned Well | 184.1                | 890.9   | Cambrian              | N/A            | Sep-41  |            |                            | ✓                  |                     |              | ✓        |
| 84    | F012117        | D. Carmichael No. 1 - H. R. Matches No. 1                 | Carmichael, D. H.             | 486555            | 4936704            | Natural Gas   | Abandoned Well | 212.18               | 525.5   | Precambrian           | N/A            | Jul-58  |            |                            | ✓                  |                     |              |          |
| 85    | F012119        | Imperial Oil Co. - M.S. Rourke No.1                       | Imperial Oil Ltd              | 488651            | 4938416            | Natural Gas   | Unknown        | 216.7                | 511.5   | Trenton Group         | N/A            | May-01  |            |                            | ✓                  |                     |              |          |
| 86    | F012120        | NottABWa Oil & Gas Co.- Hillis No.1                       | Nottawa Oil & Gas Co. Ltd.    | 488015            | 4940108            | Natural Gas   | Abandoned Well | 226.2                | 449.9   | Trenton Group         | N/A            | Oct-35  |            |                            | ✓                  |                     |              |          |
| 87    | F012121        | NottABWa Gas & Oil Company - P. Doubt No. 1               | Nottawa Oil & Gas Co. Ltd.    | 487193            | 4940162            | Natural Gas   | Abandoned Well | 212.8                | 526.7   | Precambrian           | N/A            | Nov-35  |            |                            | ✓                  |                     |              |          |
| 88    | F012122        | NottABWa Oil & Gas Co.- P. Doubt No.2                     | Nottawa Oil & Gas Co. Ltd.    | 487263            | 4940998            | Natural Gas   | Abandoned Well | 212.8                | 452     | Trenton Group         | N/A            | Feb-36  |            |                            | ✓                  |                     |              |          |
| 89    | F012123        | NottABWa Oil & Gas Co. - L. Kinch No. 1                   | Nottawa Oil & Gas Co. Ltd.    | 489404            | 4941596            | Natural Gas   | Unknown        | 218.8                | 439.52  | Drift                 | N/A            | Jan-35  |            |                            | note 1             |                     |              |          |
| 90    | F012124        | NottABWa Oil & Gas Co. No.8 - R. Kinch No. 1              | Nottawa Oil & Gas Co. Ltd.    | 487159            | 4941859            | Natural Gas   | Abandoned Well | 207.85               | 436.5   | Trenton Group         | N/A            | Aug-35  |            |                            | ✓                  |                     |              |          |
| 91    | F012125        | NottABWa Oil & Gas Co. - Cupsky No.1                      | Nottawa Oil & Gas Co. Ltd.    | 489272            | 4941935            | Natural Gas   | Unknown        | 218.5                | 453.2   | Trenton Group         | Hepworth Pool  | Jun-35  |            |                            | ✓                  |                     | ✓            |          |
| 92    | F012126        | NottABWa Oil & Gas Co. - C.W. Sinclair No 1               | Nottawa Oil & Gas Co. Ltd.    | 488556            | 4941983            | Natural Gas   | Unknown        | 215.2                | 438.9   | Trenton Group         | Hepworth Pool  | Nov-35  |            |                            | ✓                  |                     | ✓            |          |
| 93    | F012127        | NottABWa Oil & Gas Co.- T. Ruth No. 1                     | Nottawa Oil & Gas Co. Ltd.    | 487490            | 4942059            | Natural Gas   | Unknown        | 210.9                | 455.7   | Trenton Group         | N/A            | Nov-36  |            |                            | ✓                  |                     |              |          |
| 94    | F012128        | Mckillop No. 2 -Hughes No.2                               | Mckillop, W.                  | 485637            | 4942112            | N/A           | Unknown        | 200.92               | 457.2   | Cobourg               | N/A            | Mar-19  |            |                            | ✓                  |                     |              |          |
| 95    | F012129        | NottABWa Oil & Gas Co.-Binns No.1                         | Nottawa Oil & Gas Co. Ltd.    | 489343            | 4942154            | Natural Gas   | Unknown        | 217.9                | 525.8   | Trenton Group         | Hepworth Pool  | Nov-35  |            |                            | ✓                  |                     | ✓            |          |
| 96    | F012130        | NottABWa Oil & Gas Co.- B. Kocker Estate No. 3            | Nottawa Oil & Gas Co. Ltd.    | 487391            | 4943556            | Natural Gas   | Unknown        | 210                  | 457.2   | Black River Group     | Hepworth Pool  | Jul-36  |            |                            | ✓                  |                     | ✓            |          |
| 97    | F012131        | Mckillop No. 1 - H. Anderson                              | Mckillop, W.                  | 485468            | 4942464            | Natural Gas   | Unknown        | 192.3                | 460.2   | Trenton Group         | N/A            | Apr-19  |            |                            | ✓                  |                     |              |          |
| 98    | F012132        | Grey & Bruce Oil & Gas Company No. 7 - W. S. Driffle      | Grey and Bruce Oil & Gas Co.  | 489146            | 4942656            | Natural Gas   | Unknown        | 215.5                | 430.99  | N/A                   | N/A            | Dec-00  |            |                            | note 1             |                     |              |          |
| 99    | F012133        | Grey-Bruce Oil & Gas Co. - W. Driffle No. 2               | Grey and Bruce Oil & Gas Co.  | 488982            | 4942768            | Natural Gas   | Unknown        | 215.2                | 429.5   | Trenton Group         | Hepworth Pool  | Jan-01  |            |                            | ✓                  |                     | ✓            |          |
| 100   | F012134        | Grey & Bruce Oil and Gas Company No. 2 - W. Driffle No. 1 | Grey and Bruce Oil & Gas Co.  | 489314            | 4942528            | Natural Gas   | Unknown        | 215.8                | 502.92  | Precambrian           | N/A            | Dec-05  |            |                            | ✓                  |                     |              |          |
| 101   | F012135        | Grey-Bruce Oil & Gas Co. - Hepworth No. 3                 | Grey and Bruce Oil & Gas Co.  | 488930            | 4942849            | Natural Gas   | Unknown        | 214                  | 458.7   | Trenton Group         | Hepworth Pool  | Dec-01  |            |                            | ✓                  |                     | ✓            |          |
| 102   | F012136        | Northern Gas - Kemp No. 1                                 | Northern Gas & Gasoline C.    | 488408            | 4943116            | Natural Gas   | Unknown        | 214                  | 442     | Trenton Group         | Hepworth Pool  | Sep-19  |            |                            | ✓                  |                     | ✓            |          |
| 103   | F012138        | Grey-Bruce Oil & Gas Co. - Hepworth No. 4                 | Grey and Bruce Oil & Gas Co.  | 489314            | 4943512            | Natural Gas   | Unknown        | 219.5                | 433.1   | Trenton Group         | Hepworth Pool  | Dec-01  |            |                            | note 5             |                     | ✓            |          |
| 104   | F012139        | Imperial Oil Co. -A. Schnurr No. 1                        | Imperial Oil Ltd              | 486945            | 4944066            | Natural Gas   | Abandoned Well | 212.8                | 448.4   | Trenton Group         | N/A            | Jan-02  |            |                            | ✓                  |                     |              |          |

| COUNT | LICENSE NUMBER | NAME                                                      | OPERATOR                          | UTM NAD83 EASTING | UTM NAD83 NORTHING | PURPOSE         | WELL MODE      | GROUND ELEVATION (m) | TVD    | TOTAL DEPTH FORMATION | POOL          | TD_DATE | Geophysics | Armstrong/Carter Reference | Used in BR Surface | Rock Core Available | Oil/Gas Pool | Pin Reef |
|-------|----------------|-----------------------------------------------------------|-----------------------------------|-------------------|--------------------|-----------------|----------------|----------------------|--------|-----------------------|---------------|---------|------------|----------------------------|--------------------|---------------------|--------------|----------|
| 105   | F012141        | Imperial Oil No.536 - Taylor et al No. 1                  | Imperial Oil Ltd                  | 484603            | 4950304            | Natural Gas     | Abandoned Well | 208.5                | 501.4  | Precambrian           | N/A           | Oct-55  | ✓          |                            | ✓                  |                     |              |          |
| 106   | F012142        | Warton Local Co. - G. Farrow No. 1                        | Warton Local Company              | 488214            | 4952580            | Natural Gas     | Unknown        | 198.7                | 396.2  | Trenton Group         | N/A           | Dec-01  |            |                            | ✓                  |                     |              |          |
| 107   | F012144        | NottABWa Oil & Gas Co.-J.Goetz No. 1                      | Nottawa Oil & Gas Co. Ltd.        | 489058            | 4941714            | Natural Gas     | Abandoned Well | 217.3                | 442    | Trenton Group         | N/A           | Aug-35  |            |                            | ✓                  |                     |              |          |
| 108   | F013429        | Unknown                                                   | Unknown                           | 477017            | 4816701            | Solution Mining | Unknown        | 0                    | 425.5  | N/A                   | N/A           | N/A     |            |                            | note 2             |                     |              |          |
| 109   | F013430        | Unknown                                                   | Unknown                           | 502431            | 4850628            | Location        | Abandoned Well | 0                    | 0      | N/A                   | N/A           | Jan-15  |            |                            | note 5             |                     |              |          |
| 110   | F013547        | Northern Gas & Gasoline - Doubt Farm                      | Northern Gas & Gasoline Co.       | 488833            | 4942880            | N/A             | Unknown        | 213.97               | 428.24 | N/A                   | N/A           | N/A     |            |                            | note 1             |                     |              |          |
| 111   | F013549        | W. McKillop No. 2 - J. Hughes                             | McKillop, W.                      | 483927            | 4942048            | Natural Gas     | Unknown        | 195.36               | 457.2  | Cobourg               | N/A           | Mar-19  |            |                            | ✓                  |                     |              |          |
| 112   | F013552        | Kincardine Salt                                           | Unknown                           | 448548            | 4891083            | Natural Gas     | Unknown        | 180.97               | 342.9  | N/A                   | N/A           | Jul-29  |            |                            | ✓                  |                     |              |          |
| 113   | F014090        | OGS 86-6                                                  | ON Geological Survey              | 491669            | 4948301            | Stratigraphic   | Abandoned Well | 0                    | 6      | Eramosa               | N/A           | Jan-86  |            |                            | note 5             | ✓                   |              |          |
| 114   | F014091        | OGS 86-10                                                 | ON Geological Survey              | 479271            | 4936988            | Stratigraphic   | Abandoned Well | 0                    | 6.5    | Eramosa               | N/A           | Jan-86  |            |                            | note 2             |                     |              |          |
| 115   | F014092        | OGS 86-1                                                  | ON Geological Survey              | 496600            | 4937299            | Stratigraphic   | Abandoned Well | 0                    | 3      | Eramosa               | N/A           | Jan-86  |            |                            | note 2             | ✓                   |              |          |
| 116   | F014095        | G. Bowles                                                 | ON Geological Survey              | 530395            | 4897466            | Stratigraphic   | Unknown        | 473.77               | 46.94  | Guelph                | N/A           | Jan-31  |            |                            | note 1             |                     |              |          |
| 117   | F014194        | Golder Assoc. BH 2 Proj. 783224                           | Golder Associates                 | 503190            | 4950731            | Stratigraphic   | Abandoned Well | 236                  | 5.9    | Gasport               | N/A           | N/A     |            |                            | note 1             | ✓                   |              |          |
| 118   | F014195        | Golder Assoc. ORIH 783224                                 | Golder Associates                 | 503234            | 4950731            | Stratigraphic   | Abandoned Well | 236                  | 6.1    | Gasport               | N/A           | N/A     |            |                            | note 1             | ✓                   |              |          |
| 119   | F014196        | Sutherland Quarry                                         | Gamsby and Mannerow Ltd           | 500601            | 4942498            | Stratigraphic   | Unknown        | 248                  | 21.7   | Cabot Head            | N/A           | Jun-86  |            |                            | ✓                  | ✓                   |              |          |
| 120   | F014197        | Golder Assoc. BH1 773163 St. Vincent                      | Golder Associates                 | 532458            | 4937549            | Stratigraphic   | Abandoned Well | 218                  | 7.6    | Gasport               | N/A           | N/A     |            |                            | note 1             | ✓                   |              |          |
| 121   | F014198        | Golder Assoc BH1 Proj. 773300                             | Golder Associates                 | 501136            | 4886813            | Stratigraphic   | Abandoned Well | 0                    | 14.1   | Gasport               | N/A           | N/A     |            |                            | note 2             | ✓                   |              |          |
| 122   | F014199        | Seeley & Arnill TW-1                                      | Seeley & Arnill Aggregates        | 529606            | 4925230            | Stratigraphic   | Unknown        | 426                  | 50.9   | Cabot Head            | N/A           | Mar-90  |            |                            | ✓                  | ✓                   |              |          |
| 123   | H000007        | NottABWa Oil & Gas Co. - W. Binns                         | Nottawa Oil & Gas Co. Ltd.        | 488838            | 4941736            | Natural Gas     | Unknown        | 217.9                | 527.3  | Black River Group     | N/A           | Oct-34  |            |                            | note 1             |                     |              |          |
| 124   | H000009        | Oliphant Well                                             | Unknown                           | 478698            | 4952518            | N/A             | Unknown        | 184.7                | 335.3  | Cobourg               | N/A           | Dec-08  |            |                            | note 5             |                     |              |          |
| 125   | H000022        | Canadian Oil Fields - Lever                               | Canadian Oil Fields Limited       | 534866            | 4904382            | Oil and Gas     | Unknown        | 425.2                | 570.9  | Cambrian              | N/A           | Jan-17  |            |                            | ✓                  |                     |              |          |
| 126   | H000029        | Arnora Sulphur Mining Corporation No.2 - J. O'Neill No. 1 | Arnora Sulphur Mining Corp        | 522830            | 4897482            | Oil and Gas     | Abandoned Well | 390.14               | 598.02 | Precambrian           | N/A           | Jan-56  |            |                            | ✓                  |                     |              |          |
| 127   | H000030        | West Kale - Harrison Well                                 | Unknown                           | 489715            | 4942058            | Oil and Gas     | Unknown        | 218.85               | 452.6  | Trenton Group         | N/A           | N/A     |            |                            | ✓                  |                     |              |          |
| 128   | H000031        | NottABWa Oil & Gas Co. - A.Barfoot No. 1                  | Nottawa Oil & Gas Co. Ltd.        | 493662            | 4937961            | Oil and Gas     | Unknown        | 221.75               | 492.9  | Cambrian              | N/A           | Mar-35  |            |                            | ✓                  |                     |              |          |
| 129   | H000032        | Imperial Oil No. 527 - W. Radbourne No. 1                 | Imperial Oil Ltd                  | 492711            | 4941352            | Oil and Gas     | Abandoned Well | 240.18               | 497.43 | Precambrian           | N/A           | Aug-55  | ✓          |                            | ✓                  |                     |              |          |
| 130   | H000033        | Ben Allen Cement Co. - Chambers & Dewus - McMillan No. 1  | Chambers & Dewus                  | 501617            | 4940342            | Oil and Gas     | Unknown        | 239.57               | 472.44 | Shadow Lake           | N/A           | Mar-58  | ✓          |                            | ✓                  |                     |              |          |
| 131   | H000034        | NottABWa Oil & Gas Co. - A. Cunningham No. 1              | Nottawa Oil & Gas Co. Ltd.        | 489832            | 4942819            | Oil and Gas     | Abandoned Well | 217.93               | 463.91 | Trenton Group         | N/A           | Jun-35  |            |                            | ✓                  |                     |              |          |
| 132   | H000035        | Thomas Smith No. 1                                        | Imperial Oil Ltd                  | 489249            | 4947328            | Oil and Gas     | Abandoned Well | 219.8                | 457.2  | Trenton Group         | N/A           | May-02  |            |                            | note 5             |                     |              |          |
| 133   | H000036        | NottABWa Oil & Gas Co. - D. Carson No. 1                  | Nottawa Oil & Gas Co. Ltd.        | 491274            | 4940382            | Oil and Gas     | Abandoned Well | 228.79               | 454.2  | Trenton Group         | N/A           | Mar-36  |            |                            | note 5             |                     |              |          |
| 134   | H000038        | Arnora Sulphur Mining Corporation No.1 - A.B. Whyte No. 1 | Arnora Sulphur Mining Corporation | 534100            | 4891959            | Oil and Gas     | Abandoned Well | 475.49               | 701.95 | Precambrian           | N/A           | Oct-55  | ✓          |                            | ✓                  |                     |              |          |
| 135   | H000039        | T. Catbush                                                | Unknown                           | 503895            | 4938239            | Oil and Gas     | Unknown        | 181.66               | 382.2  | Trenton Group         | N/A           | N/A     |            |                            | ✓                  |                     |              |          |
| 136   | H000040        | Morrison Well                                             | Unknown                           | 503988            | 4938212            | Oil and Gas     | Unknown        | 170.99               | 0      | Precambrian           | N/A           | N/A     |            |                            | note 3             |                     |              |          |
| 137   | H000041        | Wm L. Forrest - F. McNeil No. 2                           | Forrest, W. L.                    | 503962            | 4945893            | Oil and Gas     | Abandoned Well | 222.5                | 416.4  | Precambrian           | N/A           | Oct-39  |            |                            | ✓                  |                     |              |          |
| 138   | H000042        | Wm L. Forrest - E. Hind No. 1                             | Forrest, W. L.                    | 505163            | 4945894            | Oil and Gas     | Unknown        | 218.54               | 402.34 | Precambrian           | N/A           | Jul-39  |            |                            | ✓                  |                     |              |          |
| 139   | H000043        | Annan Petroleum No. 1 - D. Morris No. 1                   | Annan Petroleum                   | 505423            | 4945958            | Oil and Gas     | Unknown        | 217.3                | 368.2  | Black River Group     | N/A           | Jan-48  | ✓          |                            | ✓                  |                     |              |          |
| 140   | H000044        | Annan Petroleum No. 4 - F. Cavell No. 1                   | Annan Petroleum                   | 504458            | 4947117            | Oil and Gas     | Unknown        | 228.3                | 362.71 | Trenton Group         | N/A           | Aug-48  |            |                            | note 5             |                     |              |          |
| 141   | H000045        | Goodfellow Well                                           | Unknown                           | 504103            | 4948008            | Oil and Gas     | Unknown        | 224.03               | 367    | Kirkfield             | N/A           | Jan-24  |            |                            | note 5             |                     |              |          |
| 142   | H000046        | Doran Oil & Gas Company No. 3                             | Ben Doran Oil & Gas Company       | 529597            | 4943399            | Oil and Gas     | Unknown        | 181.4                | 260.3  | Trenton Group         | N/A           | Jun-19  |            |                            | note 5             |                     |              |          |
| 143   | H000047        | Doran Oil & Gas Company No. 4 - B. Doran                  | Ben Doran Oil & Gas Company       | 528228            | 4943962            | Oil and Gas     | Unknown        | 227.47               | 297.48 | Trenton Group         | N/A           | Jul-21  |            |                            | note 5             |                     |              |          |
| 144   | H000048        | Doran Oil & Gas Company No. 1 -B. Doran                   | Ben Doran Oil & Gas Company       | 529083            | 4944315            | Oil and Gas     | Abandoned Well | 197.5                | 260.9  | Trenton Group         | N/A           | Jan-18  |            |                            | note 5             |                     |              |          |
| 145   | H000049        | Penn-Ryan Oil & Gas Limited - G.H. Brown                  | Penn - Ryan Oil & Gas Co. Ltd.    | 526500            | 4944301            | Oil and Gas     | Unknown        | 347                  | 417.6  | Precambrian           | N/A           | Jan-30  |            |                            | note 5             |                     |              |          |
| 146   | H000050        | Pennsylvania Oil & Gas Company - G. Brown No. 1           | Pennsylvania Oil & Gas            | 525884            | 4945714            | Oil and Gas     | Unknown        | 326.1                | 317    | Cobourg               | N/A           | Jan-30  |            |                            | note 1             |                     |              |          |
| 147   | H000051        | Annan Petroleum No. 2 - S. Reilly No. 1                   | Annan Petroleum                   | 514003            | 4944104            | N/A             | Unknown        | 224.72               | 353.6  | Black River Group     | N/A           | May-48  |            |                            | ✓                  |                     |              |          |
| 148   | H000052        | Annan Petroleum No. 3 - J. B. Duggan No.                  | Annan Petroleum                   | 517854            | 4945971            | Oil and Gas     | Unknown        | 268.53               | 353.9  | Black River Group     | N/A           | Jul-48  |            |                            | ✓                  |                     |              |          |
| 149   | H000139        | Mitchell Oil Producing Syndicate - J. Challenger No. 1    | Mitchell Oil Producing Syndicate  | 483227            | 4815056            | Oil and Gas     | Abandoned Well | 351.43               | 971.7  | Precambrian           | N/A           | Jun-26  |            |                            | ✓                  |                     |              |          |
| 150   | H000167        | Ohio Oil Co. - G. Ernst No. 1                             | Ohio Oil Company                  | 523867            | 4834692            | Natural Gas     | Abandoned Well | 396.94               | 784.25 | Precambrian           | N/A           | Aug-00  |            |                            | ✓                  |                     |              |          |
| 151   | N000050        | NottABWa Oil and Gas Co. No. 6 - Goetz                    | Nottawa Oil & Gas Co. Ltd.        | 488835            | 4941754            | Natural Gas     | Unknown        | 217.32               | 435.86 | N/A                   | N/A           | Jan-35  |            |                            | note 1             |                     |              |          |
| 152   | N000053        | Grey & Bruce Oil & Gas                                    | Grey and Bruce Oil & Gas Co.      | 489200            | 4942460            | Natural Gas     | Unknown        | 217                  | 432.82 | Trenton Group         | Hepworth Pool | Dec-00  |            |                            | note 1             |                     | ✓            |          |
| 153   | N000055        | Northern Gas - Corbett No. 1                              | Northern Gas & Gasoline Co.       | 488374            | 4942708            | N/A             | Unknown        | 215.33               | 441.96 | Cobourg               | Hepworth Pool | Dec-19  |            |                            | ✓                  |                     | ✓            |          |
| 154   | N000252        | Walsh Well                                                | Unknown                           | 503458            | 4936873            | Oil and Gas     | Unknown        | 195.99               | 438.91 | Precambrian           | N/A           | N/A     |            |                            | ✓                  |                     |              |          |
| 155   | N000265        | J. McWilliams                                             | Unknown                           | 502595            | 4938142            | Oil and Gas     | Unknown        | 213.78               | 387.1  | Trenton Group         | N/A           | N/A     |            |                            | note 5             |                     |              |          |

| COUNT | LICENSE NUMBER | NAME                                                 | OPERATOR                           | UTM NAD83 EASTING | UTM NAD83 NORTHING | PURPOSE          | WELL MODE                   | GROUND ELEVATION (m) | TVD     | TOTAL DEPTH FORMATION      | POOL                    | TD_DATE | Geophysics | Armstrong/Carter Reference | Used in BR Surface | Rock Core Available | Oil/Gas Pool | Pin Reef |
|-------|----------------|------------------------------------------------------|------------------------------------|-------------------|--------------------|------------------|-----------------------------|----------------------|---------|----------------------------|-------------------------|---------|------------|----------------------------|--------------------|---------------------|--------------|----------|
| 156   | N000266        | S.S. Spencer                                         | Unknown                            | 489881            | 4938149            | Oil and Gas      | Unknown                     | 226.16               | 499.87  | Precambrian                | N/A                     | N/A     |            |                            | note 1             |                     |              |          |
| 157   | N000267        |                                                      | Unknown                            | 490709            | 4938524            | N/A              | Abandoned Well              | 221.89               | 243.84  | N/A                        | N/A                     | N/A     |            |                            | note 1             |                     |              |          |
| 158   | N000269        | NottABWa Gas Company No. 2                           | Nottawa Oil & Gas Co. Ltd.         | 490217            | 4940223            | Oil and Gas      | Unknown                     | 224.33               | 437.08  | Trenton Group              | N/A                     | Jan-35  |            |                            | note 1             |                     |              |          |
| 159   | N000270        | Shallow Lake Well                                    | Unknown                            | 492609            | 4940091            | N/A              | Unknown                     | 225.55               | 471.83  | N/A                        | N/A                     | N/A     |            |                            | note 1             |                     |              |          |
| 160   | N000271        | NottABWa Oil & Gas Company - A. Cunningham No. 3 (?) | Nottawa Oil & Gas Co. Ltd.         | 489918            | 4942835            | Oil and Gas      | Unknown                     | 218.54               | 438.3   | N/A                        | N/A                     | Jan-35  |            |                            | note 1             |                     |              |          |
| 161   | N000273        | OGS CLGD No. 17                                      | ON Geological Survey               | 533204            | 4939143            | Stratigraphic    | Abandoned Well              | 181.72               | 54.96   | Cobourg                    | N/A                     | Mar-82  |            |                            | ✓                  | ✓                   |              |          |
| 162   | N000274        | Robert Cherry                                        | Unknown                            | 532168            | 4939361            | Oil and Gas      | Unknown                     | 183.15               | 0       | N/A                        | N/A                     | N/A     |            |                            | note 1             |                     |              |          |
| 163   | N000275        | Doran Oil & Gas Company No. 2 - H. McCarkney         | Ben Doran Oil & Gas Company        | 529374            | 4943876            | Oil and Gas      | Unknown                     | 192.6                | 249.94  | Trenton Group              | N/A                     | Jan-19  |            |                            | note 5             |                     |              |          |
| 164   | N000276        | R.B. Harkness                                        | Unknown                            | 521380            | 4945676            | Oil and Gas      | Unknown                     | 304                  | 42.06   | Georgian Bay-Blue Mountain | N/A                     | N/A     |            |                            | note 1             |                     |              |          |
| 165   | N000277        | Desborough Well                                      | Unknown                            | 500033            | 4916285            | Oil and Gas      | Unknown                     | 274.32               | 298.7   | Georgian Bay-Blue Mountain | N/A                     | Jan-07  |            |                            | note 1             |                     |              |          |
| 166   | N000278        | Ormiston Well                                        | Unknown                            | 509098            | 4935774            | Oil and Gas      | Unknown                     | 216.71               | 426.72  | Black River Group          | N/A                     | Jan-24  |            |                            | note 5             |                     |              |          |
| 167   | N000554        | Goderich Salt Co. - No. 5 Brine Well                 | Goderich Salt Co.                  | 443941            | 4843133            | Solution Mining  | Abandoned Well              | 227                  | 353.57  | B Salt                     | N/A                     | Jan-35  |            |                            | note 5             |                     |              |          |
| 168   | N000556        | F.C. Rogers                                          | Unknown                            | 464074            | 4841823            | Oil and Gas      | No Well Found               | 329.2                | 370.33  | Guelph                     | N/A                     | N/A     |            |                            | note 1             |                     |              |          |
| 169   | N000559        | Seaforth Chemicals & Salt No. 2                      | Seaforth Chemicals & Salt Ltd.     | 467426            | 4822225            | Solution Mining  | No Well Found               | 309.37               | 350.52  | B Salt                     | N/A                     | Apr-48  |            |                            | ✓                  |                     |              |          |
| 170   | N002664        | Brussels - Henry No. 1                               | Brussels Oil Co. Ltd.              | 491272            | 4827672            | Oil and Gas      | Unknown                     | 0                    | 213.36  | N/A                        | N/A                     | Jan-14  |            |                            | note 2             |                     |              |          |
| 171   | N002809        | Brimblecombe and Manderson No. 1                     | Brimblecombe & Manderson           | 511481            | 4862737            | Natural Gas      | Suspended Well              | 383.2                | 277.37  | Queenston                  | N/A                     | Mar-31  |            |                            | ✓                  |                     |              |          |
| 172   | N004151        | Pounder & Harmon                                     | Unknown                            | 458889            | 4828664            | N/A              | Abandoned Well              | 0                    | 0       | N/A                        | N/A                     | N/A     |            |                            | note 5             |                     |              |          |
| 173   | T000084        | Canadian Hemisphere Petroleum No. 3 - Young No. 1    | Canadian Hemisphere Petroleum Ltd. | 451200            | 4846690            | Oil and Gas      | Abandoned Well              | 259.38               | 589.48  | Cabot Head                 | N/A                     | Apr-59  |            |                            | ✓                  |                     |              |          |
| 174   | T000085        | Canadian Hemisphere Petroleum - Wilson No. 1         | Canadian Hemisphere Petroleum Ltd. | 453206            | 4831213            | Oil and Gas      | Abandoned Well              | 267.61               | 590.7   | Cabot Head                 | N/A                     | Apr-59  |            |                            | ✓                  |                     |              |          |
| 175   | T000382        | British American - R. Dolmage No. 1                  | Unknown                            | 469936            | 4830429            | Oil and Gas      | Abandoned Well              | 325.53               | 507.8   | Cabot Head                 | N/A                     | Nov-59  |            |                            | ✓                  |                     |              |          |
| 176   | T000856        | United Reef No. 3 - S. Wilson No. 1                  | United Reef Petroleum Limited      | 460053            | 4818532            | Oil and Gas      | Abandoned Well              | 280.11               | 548.94  | Rochester                  | N/A                     | Sep-61  |            |                            | ✓                  |                     |              |          |
| 177   | T000857        | United Reef Petroleum No. 4 - John Kerr No. 1        | Brady Oil & Gas Limited            | 474075            | 4825241            | Oil and Gas      | Abandoned Well              | 324.92               | 481.28  | Rochester                  | N/A                     | Sep-61  |            |                            | ✓                  |                     |              |          |
| 178   | T001092        | United Reef No. 1 - G. H. Leiper No. 1               | Panhandle Drilling Company         | 466193            | 4835747            | Oil and Gas      | Abandoned Well              | 314.6                | 525.78  | Rochester                  | N/A                     | Jul-61  |            |                            | ✓                  |                     |              |          |
| 179   | T001182        | Imperial 801 - Turner No. 2                          | Imperial Oil Ltd                   | 459939            | 4824141            | Oil and Gas      | Abandoned Well              | 286.21               | 544.68  | Rochester                  | N/A                     | Feb-62  |            |                            | ✓                  |                     |              |          |
| 180   | T001720        | B.P. Exploration Triad                               | B.P. Exploration Canada Ltd.       | 473227            | 4910800            | Natural Gas      | Abandoned and Junked (Lost) | 239.88               | 315.47  | Manitoulin                 | N/A                     | Jul-64  |            |                            | ✓                  |                     |              | ✓        |
| 181   | T001720A       | BP Triad                                             | B.P. Exploration Canada Ltd.       | 473240            | 4910793            | Natural Gas      | Abandoned Well              | 239.88               | 722.38  | Precambrian                | N/A                     | Aug-64  | ✓          |                            | ✓                  | ✓                   |              | ✓        |
| 182   | T001877        | Silver City Petroleum                                | Silver City Petroleum Ltd.         | 508633            | 4912734            | Oil and Gas      | Abandoned Well              | 322.63               | 558.4   | Precambrian                | N/A                     | Sep-64  |            |                            | ✓                  |                     |              |          |
| 183   | T001892        | Home C.D.R.                                          | Home Oil Company Limited           | 466526            | 4913077            | Natural Gas      | Abandoned Well              | 235.31               | 770.5   | Precambrian                | N/A                     | Mar-65  | ✓          |                            | ✓                  |                     |              | ✓        |
| 184   | T001925        | BP Triad                                             | B.P. Resources Canada Limited      | 460322            | 4894759            | Natural Gas      | Abandoned Well              | 274.93               | 912.9   | Precambrian                | N/A                     | Apr-65  | ✓          |                            | ✓                  | ✓                   |              |          |
| 185   | T001942        | BP Home                                              | B.P. Resources Canada Limited      | 455764            | 4900536            | Natural Gas      | Abandoned Well              | 233.17               | 897.9   | Precambrian                | N/A                     | Feb-66  | ✓          |                            | ✓                  |                     |              |          |
| 186   | T002053        | GIBRALTAR SEVEN SEVENTY SEVEN                        | 839040 Ontario Inc.                | 456481            | 4823061            | Natural Gas      | Abandoned Well              | 269.14               | 554.13  | Irondequoit                | N/A                     | Apr-66  |            |                            | ✓                  |                     |              |          |
| 187   | T002229        | Creasing No.1                                        | Creasing Explorations Syndicate    | 524520            | 4876199            | Oil and Gas      | Abandoned Well              | 432.8                | 667.51  | Precambrian                | Egremont Pool           | Sep-66  |            |                            | ✓                  |                     | ✓            |          |
| 188   | T002235        | ALTAIR ET AL                                         | Northern Cross Energy Limited      | 456310            | 4858496            | Natural Gas      | Active Well                 | 285.3                | 560.83  | Goat Island                | Dungannon Pool          | Jan-67  |            |                            | ✓                  |                     | ✓            | ✓        |
| 189   | T002238        | Texaco No.4 Home C.D.R.                              | Texaco Exploration Co.             | 459943            | 4909022            | Natural Gas      | Abandoned Well              | 234.7                | 850.4   | Precambrian                | N/A                     | Jan-67  | ✓          |                            | ✓                  |                     |              |          |
| 190   | T002250        | Altair et al                                         | Altair Oil & Gas Company           | 455946            | 4858492            | Oil and Gas      | Abandoned Well              | 289.56               | 1053.08 | Precambrian                | N/A                     | Jun-67  | ✓          |                            | ✓                  |                     |              |          |
| 191   | T002284        | Creasing No.2                                        | McDougall, Ross (William)          | 524656            | 4875701            | Private Gas Well | Active Well                 | 438.61               | 672.08  | Precambrian                | Egremont Pool           | Oct-66  | ✓          |                            | ✓                  |                     | ✓            |          |
| 192   | T002347        | Kenartha No.1                                        | Kenartha Oil and Gas Company Ltd.  | 525183            | 4860023            | Oil and Gas      | Abandoned Well              | 427.3                | 718.72  | Precambrian                | N/A                     | Jul-67  |            |                            | ✓                  |                     |              |          |
| 193   | T002380        | MESA PETROLEUMS                                      | Northern Cross Energy Limited      | 456157            | 4858315            | Natural Gas      | Abandoned Well              | 290.47               | 577.6   | Cabot Head                 | Dungannon Pool          | Oct-67  | ✓          |                            | ✓                  |                     | ✓            |          |
| 194   | T002433        | Kenartha No.2                                        | Kenartha Oil and Gas Co.           | 529044            | 4856068            | Natural Gas      | Active Well                 | 442                  | 726.95  | Precambrian                | Arthur Pool             | Jan-68  |            |                            | ✓                  |                     | ✓            |          |
| 195   | T002470        | MESA ET AL TEESWATER                                 | Mesa Petroleum Limited             | 464082            | 4861103            | Oil and Gas      | Abandoned Well              | 314.55               | 526.69  | Cabot Head                 | N/A                     | May-68  | ✓          |                            | ✓                  |                     |              |          |
| 196   | T002478        | Kenartha No.3                                        | Kenartha Oil and Gas Co.           | 527739            | 4855270            | Natural Gas      | Active Well                 | 435.9                | 731.82  | Precambrian                | Arthur Pool             | May-68  | ✓          |                            | ✓                  |                     | ✓            |          |
| 197   | T002556        | MESA ET AL BELMORE NO.1                              | Northern Cross Energy Ltd.         | 462409            | 4857947            | Natural Gas      | Active Well                 | 320.04               | 543.5   | Reynales/Fossil Hill       | West Wawanosh 26-X Pool | Oct-68  | ✓          |                            | note 5             |                     | ✓            | ✓        |
| 198   | T002613        | Monray No.1                                          | Monray Enterprises Inc.            | 523662            | 4872322            | Oil and Gas      | Abandoned Well              | 422.45               | 677.57  | Precambrian                | N/A                     | Oct-68  | ✓          | ✓                          | ✓                  |                     |              |          |
| 199   | T002627        | Monray No.2                                          | Monray Enterprises Inc.            | 525962            | 4875340            | Oil and Gas      | Abandoned Well              | 449.58               | 679.7   | Precambrian                | Egremont Pool           | Nov-68  | ✓          |                            | ✓                  |                     | ✓            |          |
| 200   | T002636        | Texaco No.6 Bruce 8-E-IV                             | Texaco Exploration Co.             | 456347            | 4905796            | Natural Gas      | Abandoned Well              | 228.9                | 881.5   | Cambrian                   | N/A                     | Jan-69  | ✓          |                            | ✓                  |                     |              |          |
| 201   | T002663        | PINETREE MID-NORTHERN NO.1                           | Pinetree Capital Corp.             | 444274            | 4876779            | Natural Gas      | Abandoned Well              | 210.31               | 608.69  | Cabot Head                 | N/A                     | Apr-69  | ✓          |                            | ✓                  |                     |              |          |
| 202   | T002713        | Buxton Bozlan No.1                                   | Buxton Oil & Gas Limited           | 530430            | 4855695            | Natural Gas      | Abandoned Well              | 435.9                | 716.28  | Precambrian                | N/A                     | Jul-69  | ✓          | ✓                          | ✓                  |                     |              |          |



| COUNT | LICENSE NUMBER | NAME                        | OPERATOR                               | UTM NAD83 EASTING | UTM NAD83 NORTHING | PURPOSE                  | WELL MODE                   | GROUND ELEVATION (m) | TVD     | TOTAL DEPTH FORMATION | POOL                     | TD_DATE | Geophysics | Armstrong/Carter Reference Used in BR Surface | Rock Core Available | Oil/Gas Pool | Pin Reef |
|-------|----------------|-----------------------------|----------------------------------------|-------------------|--------------------|--------------------------|-----------------------------|----------------------|---------|-----------------------|--------------------------|---------|------------|-----------------------------------------------|---------------------|--------------|----------|
| 203   | T002730        | PINETREE ET AL NO.1         | Pinetree Capital Corp.                 | 467411            | 4883088            | Natural Gas              | Abandoned Well              | 277.1                | 429.46  | Cabot Head            | N/A                      | May-69  | ✓          |                                               |                     |              |          |
| 204   | T002731        | ZURICH ET AL GODERICH NO.1  | Talisman Energy Inc.                   | 449436            | 4827242            | Natural Gas              | Abandoned and Junked (Lost) | 277.98               | 77.11   | Dundee                | N/A                      | May-69  |            |                                               |                     |              |          |
| 205   | T002731A       | Zurich et al Goderich No.1A | Clearwood Resources Inc.               | 449438            | 4827137            | Natural Gas              | Abandoned Well              | 277.37               | 626.67  | Rochester             | Tipperary Pool           | Aug-69  | ✓          |                                               |                     | ✓            |          |
| 206   | T002754        | Buxton No.2                 | Buxton Oil & Gas Limited               | 526987            | 4853659            | Natural Gas              | Abandoned Well              | 434.9                | 743.41  | Precambrian           | N/A                      | Jul-69  | ✓          |                                               |                     |              |          |
| 207   | T002783        | MID-NORTHERN NO.1           | Mid-Northern Explorations Ltd.         | 481403            | 4843921            | Oil and Gas              | Abandoned Well              | 345.03               | 420.01  | Cabot Head            | N/A                      | Aug-69  | ✓          |                                               |                     |              |          |
| 208   | T002842        | Zurich et al Goderich No.2  | Tipperary Gas Corp.                    | 449607            | 4827352            | Natural Gas              | Active Well                 | 280.11               | 616.92  | Rochester             | Tipperary Pool           | Nov-69  | ✓          |                                               |                     | ✓            |          |
| 209   | T003126        | Kenartha No.4               | Kenartha Oil and Gas Co.               | 528369            | 4855816            | Natural Gas              | Abandoned Well              | 442.57               | 800.4   | Precambrian           | N/A                      | Feb-71  | ✓          |                                               |                     |              |          |
| 210   | T003298        | Kenartha No.5               | Kenartha Oil and Gas Co.               | 528470            | 4855205            | Natural Gas              | Abandoned Well              | 434.9                | 730.91  | Precambrian           | N/A                      | Oct-71  |            |                                               |                     |              |          |
| 211   | T003350        | Barr MacKinnon No. 1        | Barr, O.P.                             | 464779            | 4906776            | Natural Gas              | Abandoned Well              | 249                  | 393.8   | Cabot Head            | N/A                      | Mar-72  |            |                                               |                     |              | ✓        |
| 212   | T003387        | Barr Cormack No. 1          | Barr, O.P.                             | 470293            | 4908301            | Natural Gas              | Abandoned Well              | 247.5                | 335.89  | Cabot Head            | N/A                      | May-72  | ✓          |                                               |                     |              | ✓        |
| 213   | T003535        | FITZGERALD                  | Milton Resources Limited               | 444999            | 4883101            | Natural Gas Storage Well | Abandoned Well              | 203                  | 583.69  | Cabot Head            | N/A                      | Mar-73  | ✓          |                                               |                     |              | ✓        |
| 214   | T003553        | FITZGERALD                  | Milton Resources Limited               | 461680            | 4877090            | Natural Gas              | Abandoned Well              | 295.05               | 511.45  | Cabot Head            | N/A                      | Aug-73  | ✓          |                                               |                     |              |          |
| 215   | T003563        | DOMTAR GODERICH S.T.#1      | Domtar Chemicals Ltd.(Sifto Salt Div.) | 444609            | 4842965            | Stratigraphic            | Abandoned Well              | 228.6                | 498.35  | B Anhydrite           | N/A                      | Apr-73  |            |                                               |                     | ✓            |          |
| 216   | T003588        | FITZGERALD                  | Milton Resources Limited               | 458401            | 4893571            | Natural Gas              | Abandoned Well              | 268.83               | 481.89  | Cabot Head            | N/A                      | May-73  | ✓          |                                               |                     |              |          |
| 217   | T003607        | POUNDER & HARMON            | Pounder, Harmon & Hill Inc.            | 456630            | 4835278            | Oil and Gas              | Abandoned Well              | 278.6                | 540.72  | Goat Island           | N/A                      | Jul-73  | ✓          |                                               |                     |              |          |
| 218   | T003625        | THIMAC YOUNG CATHERINE NO.1 | J.B. McClusky Ltd.                     | 490215            | 4827080            | Oil and Gas              | Abandoned Well              | 358.44               | 401.73  | N/A                   | N/A                      | Aug-73  | ✓          |                                               |                     |              |          |
| 219   | T003632        | POUNDER & HARMON            | Pounder, Harmon & Hill Inc.            | 458882            | 4828485            | Oil and Gas              | Abandoned and Junked (Lost) | 288.04               | 92.05   | Lucas                 | N/A                      | Jul-73  |            |                                               |                     |              |          |
| 220   | T003632A       | Pounder & Harmon            | Pounder, Harmon & Hill Inc.            | 458884            | 4828488            | Oil and Gas              | Abandoned Well              | 288.04               | 536.45  | Goat Island           | N/A                      | Sep-73  | ✓          |                                               |                     |              |          |
| 221   | T003656        | JACKLIN                     | Baier, John E., Jacklin Farms Limited  | 440913            | 4877017            | Oil and Gas              | Abandoned Well              | 189.59               | 643.13  | Cabot Head            | N/A                      | Oct-73  | ✓          |                                               |                     |              |          |
| 222   | T003661        | THIMAC                      | J.B. McClusky Ltd.                     | 486101            | 4842408            | Oil and Gas              | Abandoned Well              | 349                  | 390.14  | Rochester             | N/A                      | Sep-73  | ✓          |                                               |                     |              |          |
| 223   | T003684        | THIMAC                      | J.B. McClusky Ltd.                     | 448246            | 4871846            | Oil and Gas              | Abandoned Well              | 241.1                | 612.34  | Cabot Head            | N/A                      | Mar-74  | ✓          |                                               |                     |              |          |
| 224   | T003785        | MOFFAT LAKE GODERICH #3     | Clearwood Resources Inc.               | 449583            | 4827632            | Oil and Gas              | Abandoned Well              | 279.2                | 624.84  | Gasport               | Tipperary Pool           | Mar-75  | ✓          |                                               |                     | ✓            |          |
| 225   | T003895        | Domtar No.9 Brine Well      | Sifto Canada Inc.                      | 444461            | 4842834            | Solution Mining          | Active Well                 | 228.6                | 495.3   | B Salt                | N/A                      | Apr-97  | ✓          |                                               |                     |              |          |
| 226   | T004315        | Kenartha No.6               | Kenartha Oil and Gas Co.               | 528883            | 4856669            | Oil and Gas              | Abandoned Well              | 440.7                | 773.58  | Precambrian           | N/A                      | Dec-77  | ✓          |                                               |                     |              |          |
| 227   | T004413        | Fitzgerald                  | Milton Resources Limited               | 459111            | 4817532            | Oil and Gas              | Abandoned Well              | 275.23               | 528.52  | Goat Island           | N/A                      | Jul-77  | ✓          |                                               |                     |              |          |
| 228   | T004433        | Kenartha No.7               | Kenartha Oil and Gas Co.               | 529087            | 4855430            | Natural Gas              | Abandoned Well              | 433.7                | 762     | Precambrian           | N/A                      | Aug-77  |            |                                               |                     |              |          |
| 229   | T004545        | Kenartha No.8               | Kenartha Oil and Gas Co.               | 527690            | 4855837            | Natural Gas              | Abandoned Well              | 438.3                | 730     | Precambrian           | N/A                      | Dec-77  |            |                                               |                     |              |          |
| 230   | T004604        | Shell                       | Shell Canada Products Limited          | 461636            | 4865951            | Oil and Gas              | Abandoned Well              | 307.24               | 528.52  | Gasport               | N/A                      | Feb-78  | ✓          |                                               |                     |              |          |
| 231   | T004730        | Pacific Elma 2-13-XI        | Petro-Canada Inc.                      | 496270            | 4833007            | Oil and Gas              | Abandoned Well              | 357.84               | 873.25  | Precambrian           | N/A                      | Aug-78  | ✓          |                                               |                     |              |          |
| 232   | T004767        | Pacific                     | Petro-Canada Inc.                      | 485863            | 4856905            | Oil and Gas              | Abandoned Well              | 342.3                | 865.94  | Precambrian           | N/A                      | Nov-78  | ✓          | ✓                                             | ✓                   |              |          |
| 233   | T004848        | Kenartha                    | Kenartha Oil and Gas Co.               | 528475            | 4855545            | Natural Gas              | Abandoned Well              | 435.9                | 739.14  | Precambrian           | N/A                      | Oct-78  | ✓          |                                               |                     |              |          |
| 234   | T004849        | FITZGERALD                  | Northern Cross Energy Ltd.             | 446265            | 4866188            | Natural Gas              | Active Well                 | 222                  | 567.54  | Goat Island           | Ashfield 5-IX WD Pool    | Feb-79  | ✓          |                                               |                     | ✓            | ✓        |
| 235   | T004851        | Total et al                 | Rigel Oil & Gas Ltd.                   | 455710            | 4862980            | Oil and Gas              | Abandoned Well              | 272.8                | 1037.23 | Precambrian           | N/A                      | Dec-78  | ✓          |                                               |                     |              |          |
| 236   | T004853        | BURT                        | Burt, Ross                             | 442104            | 4855920            | Oil and Gas              | Abandoned Well              | 201.8                | 573     | A-2 Carbonate         | N/A                      | Aug-79  |            |                                               |                     |              |          |
| 237   | T004854        | Pacific                     | Petro-Canada Inc.                      | 466865            | 4888669            | Natural Gas              | Abandoned Well              | 289.3                | 894     | Precambrian           | N/A                      | Feb-79  | ✓          | ✓                                             | ✓                   |              |          |
| 238   | T004855        | Fitzgerald                  | Milton Resources Limited               | 458926            | 4817079            | Oil and Gas              | Abandoned Well              | 272.8                | 544.4   | Cabot Head            | N/A                      | Feb-79  | ✓          |                                               |                     |              |          |
| 239   | T004864        | SHELL                       | Northern Cross Energy Limited          | 444283            | 4857305            | Natural Gas              | Active Well                 | 213.7                | 639     | Cabot Head            | Ashfield 7-1-III ED Pool | Mar-79  | ✓          |                                               |                     | ✓            | ✓        |
| 240   | T004869        | Kenartha                    | Kenartha Oil and Gas Co.               | 527186            | 4859433            | Oil and Gas              | Abandoned Well              | 431.8                | 726.6   | Precambrian           | N/A                      | Apr-79  |            |                                               |                     |              |          |
| 241   | T004881        | Pacific                     | Petro-Canada Inc.                      | 473530            | 4869343            | Natural Gas              | Abandoned Well              | 294.1                | 882.7   | Precambrian           | N/A                      | May-79  | ✓          | ✓                                             | ✓                   |              |          |
| 242   | T004910        | Amoco A-1                   | BP Canada Energy Co.                   | 463644            | 4889056            | Natural Gas              | Abandoned Well              | 282.2                | 909     | Precambrian           | N/A                      | Jul-79  | ✓          |                                               |                     | ✓            | ✓        |
| 243   | T004918        | SHELL                       | Northern Cross Energy Limited          | 444455            | 4857109            | Natural Gas              | Active Well                 | 213.3                | 626.4   | Cabot Head            | Ashfield 7-1-III ED Pool | May-79  | ✓          |                                               |                     | ✓            |          |
| 244   | T004985        | Petromark et al             | Petromark Minerals Limited             | 503007            | 4825710            | Oil and Gas              | Abandoned Well              | 363.6                | 875.1   | Precambrian           | N/A                      | Jul-79  | ✓          | ✓                                             | ✓                   |              |          |
| 245   | T005051        | SHELL                       | Shell Canada Products Limited          | 459873            | 4851356            | Oil and Gas              | Abandoned Well              | 305.9                | 594     | Cabot Head            | N/A                      | Aug-79  | ✓          |                                               |                     |              |          |
| 246   | T005124        | AMOCO                       | BP Canada Energy Co.                   | 466979            | 4825797            | Oil and Gas              | Abandoned Well              | 311.7                | 525     | Cabot Head            | N/A                      | Aug-79  | ✓          |                                               |                     |              |          |
| 247   | T005130        | Shell                       | Shell Canada Products Limited          | 451474            | 4818493            | Oil and Gas              | Abandoned Well              | 250.6                | 604     | Queenston             | N/A                      | Sep-79  | ✓          |                                               |                     |              |          |
| 248   | T005131        | FITZGERALD                  | Milton Resources Limited               | 448788            | 4859000            | Oil and Gas              | Abandoned Well              | 236.2                | 573.4   | Goat Island           | N/A                      | Nov-79  | ✓          |                                               |                     |              |          |
| 249   | T005166        | Shell                       | Clearwood Resources Inc.               | 448978            | 4826279            | Natural Gas              | Abandoned Well              | 272.8                | 644     | Cabot Head            | Tipperary South Pool     | Nov-79  | ✓          |                                               |                     | ✓            |          |

| COUNT | LICENSE NUMBER | NAME                                  | OPERATOR                                           | UTM NAD83 EASTING | UTM NAD83 NORTHING | PURPOSE          | WELL MODE                    | GROUND ELEVATION (m) | TVD    | TOTAL DEPTH FORMATION | POOL                        | TD_DATE | Geophysics | Armstrong/Carter Reference | Used in BR Surface | Rock Core Available | Oil/Gas Pool | Pin Reef |
|-------|----------------|---------------------------------------|----------------------------------------------------|-------------------|--------------------|------------------|------------------------------|----------------------|--------|-----------------------|-----------------------------|---------|------------|----------------------------|--------------------|---------------------|--------------|----------|
| 250   | T005177        | Kenartha Arthur 4-24-VII              | Kenartha Oil and Gas Co.                           | 528341            | 4855921            | Natural Gas      | Active Well                  | 438.3                | 883.9  | Precambrian           | Arthur Pool                 | Jan-80  | ✓          |                            | ✓                  |                     | ✓            |          |
| 251   | T005182        | FITZGERALD                            | Pounder, Harmon & Hill Inc.                        | 456649            | 4825121            | Oil and Gas      | Abandoned Well               | 271.9                | 545    | Goat Island           | N/A                         | Feb-80  | ✓          |                            | ✓                  |                     |              |          |
| 252   | T005326        | SHELL                                 | Shell Canada Products Limited                      | 452933            | 4831468            | Oil and Gas      | Abandoned Well               | 264.5                | 601    | Cabot Head            | N/A                         | Jun-80  | ✓          |                            | ✓                  |                     |              |          |
| 253   | T005397        | DOMTAR TEST HOLE #3                   | Domtar Chemicals Ltd.(Sifto Salt Div.)             | 442310            | 4844361            | Stratigraphic    | Unknown                      | 180                  | 259    | G Unit                | N/A                         | Aug-80  |            |                            | ✓                  | ✓                   |              |          |
| 254   | T005404        | SHELL                                 | Shell Canada Products Limited                      | 452248            | 4841009            | Oil and Gas      | Abandoned Well               | 292.5                | 625.5  | Cabot Head            | N/A                         | Sep-80  | ✓          |                            | ✓                  |                     |              |          |
| 255   | T005478        | DOMTAR FREEZE HOLE NO.'S 1 TO 34 INC. | Domtar Chemicals Ltd.(Sifto Salt Div.)             | 442310            | 4844361            | Stratigraphic    | Unknown                      | 180                  | 95     | Amherstburg           | N/A                         | Dec-80  |            |                            | ✓                  | ✓                   |              |          |
| 256   | T005554        | HURON 1                               | Talisman Energy Inc.                               | 449183            | 4815723            | Oil and Gas      | Abandoned Well               | 257.5                | 592    | Cabot Head            | N/A                         | Jan-82  | ✓          |                            | ✓                  |                     |              |          |
| 257   | T005555A       | Huron 2                               | Stanley Reef Resources Limited                     | 446264            | 4816101            | N/A              | Abandoned and Junked (Lost)  | 237.7                | 9      | Drift                 | N/A                         | Mar-82  |            |                            | note 1             |                     |              |          |
| 258   | T005652        | Pamperth                              | Burt, Ross                                         | 506804            | 4849490            | Oil and Gas      | Abandoned Well               | 391.3                | 809.3  | Precambrian           | N/A                         | Dec-81  |            |                            | ✓                  |                     |              |          |
| 259   | T005778        | Aurelian No. 1                        | Aurelian Small Business Developers Ltd.            | 497562            | 4937527            | N/A              | Abandoned Well               | 251.1                | 478.5  | Shadow Lake           | N/A                         | Apr-82  |            |                            | ✓                  |                     |              |          |
| 260   | T005779        | DOMTAR & CHEM.DDH #2                  | Domtar Chemicals Ltd.(Sifto Salt Div.)             | 441659            | 4844120            | Stratigraphic    | Abandoned Well               | 177.7                | 91.3   | Guelph                | N/A                         | Oct-81  |            |                            | note 1             |                     |              |          |
| 261   | T005884        | HURON 2 STANLEY 4-12-XII              | Talisman Energy Inc.                               | 446255            | 4816092            | Oil and Gas      | Abandoned Well               | 237.7                | 603.8  | Cabot Head            | N/A                         | Jun-82  |            |                            | ✓                  |                     |              |          |
| 262   | T005885        | Huron 3                               | Tribute Resources Inc.                             | 447664            | 4814373            | Natural Gas      | Abandoned Well               | 270                  | 615    | Cabot Head            | Stanley 4-7-XI Pool         | Aug-82  | ✓          |                            | ✓                  |                     | ✓            |          |
| 263   | T006251        | MILTON RESOURCE                       | Milton Resources Limited                           | 443500            | 4832167            | Oil and Gas      | Abandoned Well               | 211.5                | 623.8  | Cabot Head            | N/A                         | Jul-83  | ✓          |                            | ✓                  |                     |              |          |
| 264   | T006307        | HURON #4                              | Tribute Resources Inc.                             | 447698            | 4814467            | Natural Gas      | Suspended Well               | 262.49               | 576    | Guelph                | Stanley 4-7-XI Pool         | Aug-83  | ✓          |                            | ✓                  |                     | ✓            | ✓        |
| 265   | T006322        | HURON #5                              | PPC Oil & Gas Corp.                                | 449053            | 4815783            | Oil and Gas      | Abandoned Well               | 255.04               | 604    | Cabot Head            | N/A                         | Aug-83  | ✓          |                            | ✓                  |                     |              |          |
| 266   | T006341        | TIPPERARY #6                          | PPC Oil & Gas Corp.                                | 444686            | 4829334            | Oil and Gas      | Abandoned Well               | 214.55               | 632.8  | Queenston             | N/A                         | Sep-83  | ✓          |                            | ✓                  |                     |              |          |
| 267   | T006346        | Tipperary S #2                        | Tipperary Gas Corp.                                | 448905            | 4826391            | Natural Gas      | Active Well                  | 269.5                | 610    | Cabot Head            | Tipperary South Pool        | Sep-83  | ✓          |                            | ✓                  |                     | ✓            |          |
| 268   | T006364        | Tipperary No.4                        | Tipperary Resources Limited                        | 449452            | 4827488            | Oil and Gas      | Abandoned Well               | 278.55               | 1134   | Precambrian           | N/A                         | Oct-83  | ✓          | ✓                          | ✓                  |                     |              |          |
| 269   | T006737        | Forbes No. 1                          | J.E.English General Drilling & Well Servicing Ltd. | 492812            | 4940700            | N/A              | Abandoned Well               | 240                  | 451.5  | Gull River            | N/A                         | Aug-85  |            |                            | ✓                  |                     |              |          |
| 270   | T007104        | Florentine et al 1                    | PPC Oil & Gas Corp.                                | 447155            | 4819475            | Oil and Gas      | Abandoned Well               | 250                  | 613.5  | Cabot Head            | N/A                         | Mar-87  | ✓          |                            | ✓                  |                     |              |          |
| 271   | T007136        | Florentine et al 2                    | Paladin Petroleum Corporation                      | 448453            | 4818959            | Natural Gas      | Abandoned Well               | 270.3                | 614.2  | Grimsby               | N/A                         | Jun-87  |            |                            | ✓                  |                     |              |          |
| 272   | T007179        | Owenbrook et al 1                     | Paladin Petroleum Corporation                      | 450367            | 4824196            | Oil and Gas      | Abandoned Well               | 252.5                | 598    | Cabot Head            | N/A                         | Oct-87  | ✓          |                            | ✓                  |                     |              |          |
| 273   | T007307        | Orford Res et al 1                    | Talisman Energy Inc.                               | 448924            | 4813785            | Oil and Gas      | Abandoned Well               | 256.8                | 1114.7 | Precambrian           | N/A                         | Aug-88  | ✓          |                            | ✓                  |                     |              |          |
| 274   | T007412        | Orford Res et al #2                   | Clearwood Resources Inc.                           | 451441            | 4818271            | Natural Gas      | Abandoned Well               | 250.4                | 572    | Cabot Head            | N/A                         | Nov-88  | ✓          |                            | ✓                  |                     |              |          |
| 275   | T007544        | BP 1                                  | B.P. Resources Canada Limited                      | 446248            | 4868249            | Oil and Gas      | Abandoned Well               | 219.9                | 1100   | Precambrian           | N/A                         | Jan-90  | ✓          | ✓                          | ✓                  |                     |              |          |
| 276   | T007586        | OGS 90-2                              | Grey Sauble Conservation Authority                 | 487360            | 4932814            | Observation Well | Abandoned Well               | 226.9                | 106.4  | Cabot Head            | N/A                         | Mar-90  | ✓          |                            | ✓                  | ✓                   |              |          |
| 277   | T007587        | OGS 90-3                              | Grey Sauble Conservation Authority                 | 483154            | 4946326            | Observation Well | Abandoned Well               | 205.8                | 91.1   | Cabot Head            | N/A                         | Mar-90  | ✓          |                            | ✓                  | ✓                   |              |          |
| 278   | T007588        | OGS 90-2A                             | ON Geological Survey                               | 487702            | 4934816            | Observation Well | Unknown                      | 0                    | 0      | N/A                   | N/A                         | N/A     |            |                            | note 5             |                     |              |          |
| 279   | 008004+B49     | Sifto #10 Brine Well                  | Sifto Canada Inc.                                  | 444482            | 4842709            | Solution Mining  | Active Well                  | 233.1                | 498.6  | B Salt                | N/A                         | Jul-93  | ✓          |                            | note 1             |                     |              |          |
| 280   | T008250        | Paragon Bayfield #1                   | Clearwood Resources Inc.                           | 445367            | 4822581            | Oil and Gas      | Abandoned Well               | 217.9                | 612    | Cabot Head            | N/A                         | Apr-95  | ✓          |                            | ✓                  |                     |              |          |
| 281   | T008657        | Clearwood et al #12                   | Clearbeach Resources Inc.                          | 460213            | 4824266            | Natural Gas      | Active Well                  | 286.6                | 539    | Goat Island           | Tuckersmith 30-III-SHR Pool | Oct-98  | ✓          |                            | ✓                  |                     | ✓            | ✓        |
| 282   | T008752        | Bluewater Imperial Porter #1          | Tribute Resources Inc.                             | 447063            | 4822226            | Natural Gas      | Potential                    | 242.01               | 592.23 | Guelph                | Bayfield Pool               | Oct-56  |            |                            | note 1             | ✓                   | ✓            |          |
| 283   | T008753        | Bluewater Imperial Grainger #1        | Tribute Resources Inc.                             | 447186            | 4821949            | Natural Gas      | Potential                    | 246.89               | 580.95 | Guelph                | Bayfield Pool               | Feb-57  |            |                            | ✓                  |                     | ✓            |          |
| 284   | T008843        | Tribute et al #16                     | Clearwood Resources Inc.                           | 448233            | 4825295            | Natural Gas      | Abandoned Well               | 253.42               | 623    | Cabot Head            | N/A                         | May-99  | ✓          |                            | ✓                  |                     |              |          |
| 285   | T008915        | Domtar-Sifto Salt No. 8               | Sifto Canada Inc.                                  | 444578            | 4842945            | Solution Mining  | Abandoned Well               | 220.61               | 453.54 | B Salt                | N/A                         | Oct-64  |            |                            | ✓                  |                     |              |          |
| 286   | T009126        | Sifto #11                             | Sifto Canada Inc.                                  | 444083            | 4843330            | Solution Mining  | Active Well                  | 193.3                | 470    | A-2 Carbonate         | N/A                         | Feb-00  | ✓          |                            | ✓                  |                     |              |          |
| 287   | T009355        | Brine Well No. 6                      | Sifto Canada Inc.                                  | 444348            | 4843144            | Solution Mining  | Abandoned Well               | 217                  | 477.6  | B Salt                | N/A                         | Dec-60  | ✓          |                            | ✓                  |                     |              |          |
| 288   | T010054        | Lyleton Sturdy                        | Lyleton Corporation                                | 447294            | 4834524            | Natural Gas      | Abandoned Well               | 256                  | 665    | Rochester             | N/A                         | Jul-01  | ✓          |                            | ✓                  |                     |              |          |
| 289   | T010686        | Tribute et al #22                     | Tipperary Gas Corp.                                | 449348            | 4826823            | Natural Gas      | Plugged back and whipstocked | 279.7                | 640    | Gasport               | Tipperary Pool              | Aug-04  | ✓          |                            | ✓                  | ✓                   | ✓            |          |
| 290   | T011156        | ONTZINC                               | HudBay Minerals Inc.                               | 504962            | 4868851            | Stratigraphic    | Abandoned Well               | 365.1                | 55.2   | Queenston             | N/A                         | Dec-04  |            |                            | ✓                  |                     |              |          |
| 291   | T011523        | Goderich Salt Co. - No. 2 Brine Well  | Sifto Canada Inc.                                  | 443892            | 4843077            | Solution Mining  | Abandoned Well               | 223.6                | 370.03 | B Salt                | N/A                         | Apr-19  |            |                            | ✓                  |                     |              |          |
| 292   | T011524        | Goderich Salt Co. - No. 3 Brine Well  | Sifto Canada Inc.                                  | 443799            | 4843165            | Solution Mining  | Abandoned Well               | 224.3                | 353.87 | B Salt                | N/A                         | Sep-32  |            |                            | ✓                  |                     |              |          |
| 293   | T011525        | Goderich Salt Co. - No. 4 Brine Well  | Sifto Canada Inc.                                  | 443889            | 4843173            | Solution Mining  | Abandoned Well               | 223.8                | 374.9  | B Salt                | N/A                         | Sep-34  |            |                            | ✓                  |                     |              |          |

| COUNT | LICENSE NUMBER | NAME                                                | OPERATOR                      | UTM NAD83 EASTING | UTM NAD83 NORTHING | PURPOSE                  | WELL MODE      | GROUND ELEVATION (m) | TVD    | TOTAL DEPTH FORMATION | POOL                        | TD_DATE | Geophysics | Armstrong/Carter Reference | Used in BR Surface | Rock Core Available | Oil/Gas Pool | Pin Reef |
|-------|----------------|-----------------------------------------------------|-------------------------------|-------------------|--------------------|--------------------------|----------------|----------------------|--------|-----------------------|-----------------------------|---------|------------|----------------------------|--------------------|---------------------|--------------|----------|
| 294   | T011560        | NCE Fordyce North                                   | Northern Cross Energy Limited | 464022            | 4861410            | Natural Gas              | Active Well    | 320.7                | 541    | Cabot Head            | West Wawanosh 1-25-XII Pool | Sep-07  | ✓          |                            | ✓                  |                     | ✓            |          |
| 295   | T011565        | NCE St. Augustine                                   | Northern Cross Energy Limited | 458012            | 4856413            | Natural Gas              | Abandoned Well | 303.6                | 581.8  | Rochester             | N/A                         | Oct-07  |            |                            | note 5             |                     |              |          |
| 296   | T011582        | DGR-1                                               | Ontario Power Generation Inc. | 454240            | 4907755            | Stratigraphic            | Active Well    | 185.7                | 465.1  | Queenston             | N/A                         | Apr-07  | ✓          |                            | ✓                  | ✓                   |              |          |
| 297   | T011583        | DGR-2                                               | Ontario Power Generation Inc. | 454208            | 4907720            | Stratigraphic            | Active Well    | 185.8                | 864.2  | Precambrian           | N/A                         | Aug-07  | ✓          |                            | ✓                  | ✓                   |              |          |
| 298   | T011634        | Tribute et al #24                                   | Clearwood Resources Inc.      | 446406            | 4819213            | Natural Gas              | Abandoned Well | 242.1                | 78     | Rochester             | N/A                         | Nov-07  |            |                            | note 1             |                     |              |          |
| 299   | T011634A       | Tribute et al #24A                                  | Clearbeach Resources Inc.     | 446410            | 4819213            | Natural Gas              | Abandoned Well | 242.1                | 600    | Gasport               | N/A                         | Apr-08  |            |                            | ✓                  |                     |              |          |
| 300   | T011649        | Tribute et al #23 (Horiz.#1-Lat.#2)                 | Tipperary Gas Corp.           | 449296            | 4826627            | Natural Gas Storage Well | Active Well    | 280                  | 564    | Guelph                | Tipperary South Pool        | Dec-07  |            |                            | note 1             |                     |              |          |
| 301   | T011650        | Tribute et al #23 (Horiz.#1-Lat.#1)                 | Tipperary Gas Corp.           | 449294            | 4826309            | Natural Gas Storage Well | Active Well    | 280                  | 563    | Guelph                | Tipperary South Pool        | Dec-07  |            |                            | note 1             |                     |              |          |
| 302   | T011651        | Tribute et al #23 (Horiz.#1)                        | Tipperary Gas Corp.           | 449293            | 4826254            | Natural Gas Storage Well | Active Well    | 280                  | 564    | Guelph                | Tipperary South Pool        | Dec-07  | ✓          |                            | ✓                  |                     |              |          |
| 303   | T011714        | Tribute et al #22 (Horiz.#1-Lat.#2)                 | Tipperary Gas Corp.           | 449350            | 4827209            | Natural Gas Storage Well | Active Well    | 279.7                | 581    | Guelph                | Tipperary Pool              | Jan-08  |            |                            | note 1             |                     |              |          |
| 304   | T011715        | Tribute et al #22 (Horiz.#1-Lat.#1)                 | Tipperary Gas Corp.           | 449352            | 4827356            | Natural Gas Storage Well | Active Well    | 279.7                | 579    | Guelph                | Tipperary Pool              | Jan-08  |            |                            | note 1             |                     |              |          |
| 305   | T011716        | Tribute et al #22 (Horiz.#1)                        | Tipperary Gas Corp.           | 449353            | 4827476            | Natural Gas Storage Well | Active Well    | 279.7                | 578    | Guelph                | Tipperary Pool              | Jan-08  |            |                            | note 1             |                     |              |          |
| 306   | T011737        | Sifto #12                                           | Sifto Canada Inc.             | 444017            | 4843415            | Solution Mining          | Active Well    | 193.3                | 473    | A-2 Carbonate         | N/A                         | Mar-08  |            |                            | ✓                  |                     |              |          |
| 307   | T011742        | NCE FitzGerald                                      | Northern Cross Energy Limited | 446282            | 4866019            | Natural Gas              | Active Well    | 221.9                | 566    | Goat Island           | N/A                         | Nov-07  | ✓          |                            | ✓                  |                     |              |          |
| 308   | T011771        | HudBay #1                                           | HudBay Minerals Inc.          | 504948            | 4868849            | Stratigraphic            | Abandoned Well | 365.2                | 269.8  | Queenston             | N/A                         | Aug-08  |            |                            | ✓                  | ✓                   |              |          |
| 309   | T011772        | HudBay #2                                           | HudBay Minerals Inc.          | 506018            | 4867745            | Stratigraphic            | Abandoned Well | 374.6                | 280    | Queenston             | N/A                         | May-08  |            |                            | ✓                  |                     |              |          |
| 310   | T011773        | HudBay #3                                           | HudBay Minerals Inc.          | 508297            | 4869336            | Stratigraphic            | Abandoned Well | 376.6                | 261    | Queenston             | N/A                         | Mar-08  |            |                            | ✓                  | ✓                   |              |          |
| 311   | T011811        | DGR-3                                               | Ontario Power Generation Inc. | 453080            | 4907740            | Stratigraphic            | Active Well    | 187.35               | 871.3  | Cambrian              | N/A                         | Jul-08  | ✓          |                            | ✓                  | ✓                   |              |          |
| 312   | T011812        | DGR-4                                               | Ontario Power Generation Inc. | 453378            | 4908744            | Stratigraphic            | Active Well    | 181.6                | 859.2  | Cambrian              | N/A                         | Oct-08  | ✓          |                            | ✓                  | ✓                   |              |          |
| 313   | T011820        | Tribute et al #25                                   | Tribute Resources Inc.        | 447762            | 4814257            | Natural Gas              | Potential      | 263.4                | 583    | Guelph                | Stanley 4-7-XI Pool         | Oct-08  |            |                            | ✓                  | ✓                   | ✓            |          |
| 314   | T011861        | Seaforth Salt No. 1                                 | D. L. Smith Packaging Ltd.    | 467709            | 4822094            | Solution Mining          | Abandoned Well | 307.3                | 338.33 | B Salt                | N/A                         | Mar-43  |            |                            | ✓                  |                     |              |          |
| 315   | T011910        | Tribute et al #30                                   | Tribute Resources Inc.        | 447044            | 4822147            | Stratigraphic            | Abandoned Well | 244.3                | 66     | Rochester             | Bayfield Pool               | Apr-09  |            |                            | note 1             |                     | ✓            | ✓        |
| 316   | T011926        | DGR-5 (Dev.#1)                                      | Ontario Power Generation Inc. | 454220            | 4907482            | Stratigraphic            | Active Well    | 185.65               | 754.9  | Kirkfield             | N/A                         | Oct-09  | ✓          |                            | ✓                  | ✓                   |              |          |
| 317   | T011942        | DGR-6 (Dev.#1)                                      | Ontario Power Generation Inc. | 453953            | 4908371            | Stratigraphic            | Active Well    | 183.5                | 789    | Gull River            | N/A                         | Feb-10  | ✓          |                            | ✓                  | ✓                   |              |          |
| 318   | T011956        | Tribute et al #23 (Horiz.#1-Lat.#3)                 | Tipperary Gas Corp.           | 449292            | 4826094            | Natural Gas Storage Well | Active Well    | 279.9                | 604    | Guelph                | Tipperary South Pool        | Nov-09  |            |                            | note 1             |                     |              |          |
| 319   | T011957        | Huron Tipperary South 10                            | Tipperary Gas Corp.           | 448931            | 4826339            | Observation Well         | Active Well    | 271.8                | 589    | Guelph                | N/A                         | Feb-10  |            |                            | ✓                  |                     |              | ✓        |
| 320   | T011959        | Huron Tipperary North 7                             | Tipperary Gas Corp.           | 449429            | 4827275            | Natural Gas Storage Well | Active Well    | 278.8                | 589    | Guelph                | N/A                         | Feb-10  |            |                            | ✓                  |                     |              | ✓        |
| 321   | T011960        | Huron Tipperary South 9 (Horiz.#1)                  | Tipperary Gas Corp.           | 449262            | 4826060            | Natural Gas Storage Well | Active Well    | 279.6                | 567    | Guelph                | Tipperary South Pool        | Dec-09  |            |                            | note 1             |                     |              | ✓        |
| 322   | T012044        | NottABWa Oil & Gas Company - B. Kocker Estate No. 2 | Kocher, William Joseph        | 488122            | 4943244            | Natural Gas              | Abandoned Well | 211.2                | 457.2  | Coboconk              | Hepworth Pool               | Jun-36  |            |                            | ✓                  |                     | ✓            |          |
| 323   | T012045        | Northern Gas & Gasoline Co.- Kemp No.2              | Atchison, Julie Lynne         | 488506            | 4942909            | Natural Gas              | Abandoned Well | 212.9                | 438.9  | Trenton Group         | Hepworth Pool               | Sep-19  |            |                            | ✓                  |                     | ✓            |          |
| 324   | T012046        | T. Thompkins Well                                   | Chaliner, Terence             | 486704            | 4944719            | Natural Gas              | Abandoned Well | 207.75               | 472.4  | Gull River            | N/A                         | Jan-00  |            |                            | ✓                  |                     |              |          |
| 325   | T012047        | Rankin No. 1                                        | Rankin, Dorothy               | 489454            | 4942094            | Natural Gas              | Abandoned Well | 217.95               | 0      | N/A                   | N/A                         | N/A     |            |                            | ✓                  |                     |              |          |
| 326   | T012065        | NottABWa Oil & Gas Co.- B. Kocker Estate            | Kocher, William Joseph        | 488137            | 4942752            | Natural Gas              | Abandoned Well | 213.9                | 457.2  | Trenton Group         | N/A                         | Jan-36  |            |                            | ✓                  |                     |              |          |
| 327   | T012067        | John Schnurr #1                                     | Schnurr, Scott                | 488932            | 4942146            | Natural Gas              | Abandoned Well | 218                  | 0      | Coboconk              | N/A                         | Jan-00  |            |                            | ✓                  |                     |              |          |
| 328   | T012096        | OGS-SG11-01                                         | ON Geological Survey          | 529257            | 4867501            | Stratigraphic            | Suspended Well | 458.8                | 131.4  | Guelph                | N/A                         | Mar-11  |            |                            | note 1             |                     |              |          |
| 329   | T012100        | OGS-SG11-02                                         | ON Geological Survey          | 529255            | 4867491            | Stratigraphic            | Suspended Well | 458.7                | 496.5  | Cobourg               | N/A                         | Oct-11  |            |                            | ✓                  |                     |              |          |
| 330   | T012102        | DGR-8                                               | Ontario Power Generation Inc. | 453397            | 4908235            | Stratigraphic            | Abandoned Well | 186.25               | 727.1  | Kirkfield             | N/A                         | Sep-11  | ✓          |                            | ✓                  | ✓                   |              |          |
| 331   | T012103        | DGR-7                                               | Ontario Power Generation Inc. | 453473            | 4908216            | Stratigraphic            | Abandoned Well | 186.2                | 190    | F Unit                | N/A                         | May-11  | ✓          |                            | ✓                  | ✓                   |              |          |
| 332   | T012177        | VWP-1                                               | Sifto Canada Inc.             | 441542            | 4843926            | Stratigraphic            | Not Drilled    | 0                    | 0      | N/A                   | N/A                         | N/A     |            |                            | note 2             |                     |              |          |
| 333   | T012178        | VWP-3                                               | Sifto Canada Inc.             | 441531            | 4843994            | Stratigraphic            | Not Drilled    | 0                    | 0      | N/A                   | N/A                         | N/A     |            |                            | note 2             |                     |              |          |
| 334   | T012179        | VWP-2                                               | Sifto Canada Inc.             | 441538            | 4844074            | Stratigraphic            | Not Drilled    | 0                    | 0      | N/A                   | N/A                         | N/A     |            |                            | note 2             |                     |              |          |

**Notes:**

- 1 Borehole did not intersect any of the formatoin anchor picks
- 2 Borehole did not have a ground surface elevation
- 3 Total vertical depth data not reliable
- 4 Unreliable geophysical logs

**Notes:**

- 5 deleted from 3DGFm model
- TVD Total Vertical Depth

## **APPENDIX B**

### **Summary of 2D Seismic Data Collection Parameters**

Client: Nuclear Waste Management  
Area: Ontario  
Processed by: Seiscraft Processing Inc.  
Date Processed: May 2013

RECORDING INFORMATION

| <b>LINE: A002800018 SP RANGE: 400 - 1029</b> |                            |
|----------------------------------------------|----------------------------|
| <b>LINE: A002800020 SP RANGE: 400 - 1001</b> |                            |
| SHOT FOR                                     | Shell Canada Limited       |
| SHOT BY                                      | Teledyne Exploration Ltd.  |
| RECORDING DATE                               | August 1976                |
| GROUP INT                                    | 20 m                       |
| SHOT INT                                     | 20 m                       |
| NUMBER OF TRACES                             | 48                         |
| FOLD                                         | 24                         |
| SPREAD                                       | 500-----40 SP 40-----500 m |
| SOURCE TYPE                                  | Dynamite                   |
| NUMBER OF HOLES                              | One at 10 m                |
| GEOPHONE TYPE                                | GSC 20D 8 hz               |
| PATTERN                                      | 8 X 2 at 1.25 m            |
| INSTRUMENT TYPE                              | DFS IV                     |
| FILTER                                       | Out-124 hz                 |
| SAMPLE RATE                                  | 2 ms                       |
| REC LENGTH                                   | 1000 ms                    |

| <b>LINE: 725937 SP RANGE: 1 - 245</b>  |                            |
|----------------------------------------|----------------------------|
| <b>LINE: 825938 SP RANGE: 17 - 163</b> |                            |
| SHOT FOR                               | Petro Canada               |
| SHOT BY                                | Teledyne Exploration Ltd.  |
| RECORDING DATE                         | May 1977                   |
| GROUP INT                              | 30 m                       |
| SHOT INT                               | 30 m                       |
| NUMBER OF TRACES                       | 24                         |
| FOLD                                   | 12                         |
| SPREAD                                 | 390-----60 SP 60-----390 m |
| SOURCE TYPE                            | Dynamite                   |
| NUMBER OF HOLES                        | One at 12.2m               |
| GEOPHONE TYPE                          | Mark L-12                  |
| PATTERN                                | 9 at 7.6 m                 |
| INSTRUMENT TYPE                        | DFS IV                     |
| FILTER                                 | 12-248 hz                  |
| SAMPLE RATE                            | 1 ms                       |
| REC LENGTH                             | 2000 ms                    |

PROCESSING PARAMETERS

|                                     |                                                                  |
|-------------------------------------|------------------------------------------------------------------|
| REFORMATTED FROM SEGA FORMAT        | Processing data length: 1.0 sec                                  |
| TIME POWER SCALING:                 | Exponent: 1.5 to 1.0 sec                                         |
| ENVELOPE SCALING                    | Lowpass Envelope Filter: 4-8 hz                                  |
| FK FILTER                           | Velocity Reject: +/- 300-2000 m/s                                |
| MINIMUM PHASE SPIKING DECONVOLUTION | Operator Length: 40 ms                                           |
|                                     | Pre-Whitening: 3.0 %                                             |
|                                     | Design Gate: 0.6 - 0.6 sec @ 60 m<br>0.2 - 0.65 sec @ 390 m      |
| TIME VARIANT SPECTRAL WHITENING     | Bandwidth 15-20-95-110 hz                                        |
| ENVELOPE SCALING                    | Lowpass Envelope Filter: 4-8 hz                                  |
| TRACE EQUALIZATION                  | Design Gate: 0.6 - 0.6 sec @ 60 m<br>0.2 - 0.65 sec @ 390 m      |
| REFRACTION STATICS                  | Datum: 340 m; Replacement Velocity: 4800 m/sec                   |
|                                     | Processing Datum: 340 m Datum at 0 ms Wx<br>Velocity: 1700 m/sec |
|                                     | Farrell & Euwema Method – 1 Layer Solution                       |
| ENVELOPE SCALING                    | Lowpass Envelope Filter: 2-4                                     |
| AUTOMATIC RESIDUAL STATICS          | Correlation Window: 0.05 - 0.5                                   |
| VELOCITY ANALYSIS                   | Interactive Semblance/Common Offset Stacks/ CDP<br>Stacks        |
| NMO                                 | Velocities Referenced to Datum                                   |
| STACK MUTE                          | 0.010 sec @ 110 m                                                |
|                                     | 0.100 sec @ 330 m                                                |
|                                     | 0.150 sec @ 390 m                                                |
| CDP TRIM STATICS                    | Correlation Window: 0.0 - 0.6 sec                                |
| ENVELOPE SCALING                    | Lowpass Envelope Filter: 1-2 hz                                  |
| TRACE EQUALIZATION                  | Window: 0.1 - 0.6 SEC                                            |
| F/X TIME MIGRATION                  | Time Section Output                                              |
|                                     | 100% Stacking Velocity                                           |
|                                     | Velocity Model: Smoothed Interval Velocities                     |
|                                     | Max Dep: 25 Degrees                                              |
| TRACE EQUALIZATION                  | Bandwith: 15 - 110 hz                                            |
| TRACE EQUALIZATION                  | Window: 0.05 - 0.6 sec                                           |

## **APPENDIX C**

### **Summary of Key Formation Top Picks Using Borehole Geophysics**

Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | Pan - Western Logan 25-2 Panwestern #6, Logan - 29 - II |                      |                 |                       | Pan-Western Oils - Nolan No. 1, McKillop 3 - 17 - I |                      |                 |                       | Imperial 658 - J. Wain No. 1, Goderich - 31 - II |                      |                 |                       | Imperial 573 - J.L. Taylor No. 1, Hullett - 5 - XII |                      |                 |                       | Imperial 583 - P. Fischer No. 1, Colborne - 25 - MC |                      |                 |                       | Imperial 679 - G. Ginn No. 1, Goderich - 12 - MC |                      |                 |                       |
|--------------------------|---------------------------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | F011882                                                 |                      |                 |                       | F011894                                             |                      |                 |                       | F011965                                          |                      |                 |                       | F011978                                             |                      |                 |                       | F011985                                             |                      |                 |                       | F011987                                          |                      |                 |                       |
| Northing (UTM NAD83)     | 4816955.53                                              |                      |                 |                       | 4821046.498                                         |                      |                 |                       | 4829976.14                                       |                      |                 |                       | 4835202.397                                         |                      |                 |                       | 4837290.676                                         |                      |                 |                       | 4839546.799                                      |                      |                 |                       |
| Easting (UTM NAD83)      | 480173.6611                                             |                      |                 |                       | 471522.9858                                         |                      |                 |                       | 443873.4719                                      |                      |                 |                       | 469036.6501                                         |                      |                 |                       | 451442.0289                                         |                      |                 |                       | 449251.5553                                      |                      |                 |                       |
| BH Depth (TVD)           | 449.28                                                  |                      |                 |                       | 482.8                                               |                      |                 |                       | 619.35                                           |                      |                 |                       | 518.16                                              |                      |                 |                       | 610.21                                              |                      |                 |                       | 611.73                                           |                      |                 |                       |
| BH TD Formation          | Cabot Head                                              |                      |                 |                       | Cabot Head                                          |                      |                 |                       | Cabot Head                                       |                      |                 |                       | Cabot Head                                          |                      |                 |                       | Rochester                                           |                      |                 |                       | Cabot Head                                       |                      |                 |                       |
| Kelly Bushing Height (m) | 0.61                                                    |                      |                 |                       | 0.76                                                |                      |                 |                       | 1.22                                             |                      |                 |                       | 0.61                                                |                      |                 |                       | 0.62                                                |                      |                 |                       | 1.22                                             |                      |                 |                       |
| BH Log                   | GR                                                      |                      |                 |                       | GR                                                  |                      |                 |                       | GR                                               |                      |                 |                       | GR NL                                               |                      |                 |                       | GR NL                                               |                      |                 |                       | GR NL                                            |                      |                 |                       |
| Date Acquired            | 1955                                                    |                      |                 |                       | 1955                                                |                      |                 |                       | 1958                                             |                      |                 |                       | 1956 1956                                           |                      |                 |                       | 1956 1956                                           |                      |                 |                       | 1958 1958                                        |                      |                 |                       |
| Top Depth                | 15                                                      |                      |                 |                       | 0                                                   |                      |                 |                       | 0                                                |                      |                 |                       | 0 0                                                 |                      |                 |                       | 0 0                                                 |                      |                 |                       | 0 0                                              |                      |                 |                       |
| Bottom Depth             | 457                                                     |                      |                 |                       | 488                                                 |                      |                 |                       | 610                                              |                      |                 |                       | 518 518                                             |                      |                 |                       | 610 610                                             |                      |                 |                       | 610 610                                          |                      |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)                               | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | dif                                                     | 181.66               | 0               | GR                    | nc                                                  | 168.6                | 0               | GR                    | dif                                              | 216.4                | 0               | GR                    | nc                                                  | 190.8                | 0               | NL                    | nc                                                  | 245.4                | 0               | NL                    | nc                                               | 210.9                | 0               | NL                    |
| Salina (G-unit)          | 212                                                     | np                   | NA              | GR                    | 205                                                 | 214                  | -9              | GR                    | 266                                              | 269.1                | -3.1            | GR                    | 233                                                 | 236.2                | -3.2            | GRNL                  | nc                                                  | 293.8                | 0               | GR                    | 263                                              | 264.6                | -1.6            | GR                    |
| Salina (F-unit)          | nc                                                      | 223.42               | 0               | GR                    | 213                                                 | np                   | NA              | GR                    | nc                                               | 317.3                | 0               | GR                    | 240                                                 | np                   | NA              | GRNL                  | nc                                                  | 301.8                | 0               | GR                    | 272                                              | 268.8                | 3.2             | GR                    |
| Cabot Head               | 446.5                                                   | 444.7                | 1.8             | GR                    | 484                                                 | 482.5                | 1.5             | GR                    | nl                                               | 611.7                | 0               |                       | nc                                                  | 506.3                | 0               | GR                    | nl                                                  | np                   | NA              |                       | 606.5                                            | 605                  | 1.5             | GR                    |
| Queenston                | nl                                                      | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                                                      | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       |
| Cobourg (Lower)          | nl                                                      | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       |
| Coboconk                 | nl                                                      | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       |
| Gull River (if conflict) | nl                                                      | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       |
| Precambrian              | nl                                                      | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                                  | np                   | NA              |                       | nl                                               | np                   | NA              |                       |

| Well Name                | Imperial 557 - J. Yungblut No. 1, Hullett - 38 - XI |                      |                 |                       | Imperial 643 - Buchanan No. 1, Elma - 23 - XIII |                      |                 |                       | Imperial Oil No. 563 - W.W. Hill No. 1, Colborne - 12 - LRE |                      |                 |                       | Felmont Oil Corporation No. 11 - Campbell No. 1, Morris - 26 - II |                      |                 |                       | Imperial 594 - Horn No. 1, Elma - 18 - XIII |                      |                 |                       | Imperial Oil No. 600 - Black No. 1, Ashfield 8 - 8 - IIID |                      |                 |                       |
|--------------------------|-----------------------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------------------------------|----------------------|-----------------|-----------------------|---------------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | F011989                                             |                      |                 |                       | F012015                                         |                      |                 |                       | F012018                                                     |                      |                 |                       | F012021                                                           |                      |                 |                       | F012022                                     |                      |                 |                       | F012025                                                   |                      |                 |                       |
| Northing (UTM NAD83)     | 4841796.154                                         |                      |                 |                       | 4829467.181                                     |                      |                 |                       | 4852039.709                                                 |                      |                 |                       | 4850624.362                                                       |                      |                 |                       | 4830455.784                                 |                      |                 |                       | 4854800.977                                               |                      |                 |                       |
| Easting (UTM NAD83)      | 457162.2277                                         |                      |                 |                       | 498939.4434                                     |                      |                 |                       | 444529.8767                                                 |                      |                 |                       | 481723.0814                                                       |                      |                 |                       | 497118.1254                                 |                      |                 |                       | 448371.5272                                               |                      |                 |                       |
| BH Depth (TVD)           | 570.28                                              |                      |                 |                       | 346.25                                          |                      |                 |                       | 1111                                                        |                      |                 |                       | 435.86                                                            |                      |                 |                       | 348.08                                      |                      |                 |                       | 1083.87                                                   |                      |                 |                       |
| BH TD Formation          | Cabot Head                                          |                      |                 |                       | Cabot Head                                      |                      |                 |                       | Cambrian                                                    |                      |                 |                       | Queenston                                                         |                      |                 |                       | Cabot Head                                  |                      |                 |                       | Precambrian                                               |                      |                 |                       |
| Kelly Bushing Height (m) | 0.61                                                |                      |                 |                       | 0.61                                            |                      |                 |                       | 0.61                                                        |                      |                 |                       | 0                                                                 |                      |                 |                       | 0.6                                         |                      |                 |                       | 0.61                                                      |                      |                 |                       |
| BH Log                   | GR NL                                               |                      |                 |                       | GR NL                                           |                      |                 |                       | GR NL                                                       |                      |                 |                       | GR                                                                |                      |                 |                       | GR NL                                       |                      |                 |                       | GR NL                                                     |                      |                 |                       |
| Date Acquired            | 1956 1956                                           |                      |                 |                       | 1957 1957                                       |                      |                 |                       | 1956 1956                                                   |                      |                 |                       | 1955                                                              |                      |                 |                       | 1957 1957                                   |                      |                 |                       | 1957 1957                                                 |                      |                 |                       |
| Top Depth                | 0 0                                                 |                      |                 |                       | 0 0                                             |                      |                 |                       | 0 0                                                         |                      |                 |                       | 0                                                                 |                      |                 |                       | 0 18.5                                      |                      |                 |                       | 0 0                                                       |                      |                 |                       |
| Bottom Depth             | 564 564                                             |                      |                 |                       | 350 350                                         |                      |                 |                       | 975 975                                                     |                      |                 |                       | 442                                                               |                      |                 |                       | 350 350                                     |                      |                 |                       | 1066 1066                                                 |                      |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)                           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                       | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                                   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                                         | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                                 | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nc                                                  | 221.9                | 0               | NL                    | nc                                              | 83.82                | 0               | NL                    | dif                                                         | 220.4                | 0               | GR                    | dif                                                               | 141.7                | 0               | GR                    | nc                                          | 98.45                | 0               | NL                    | 226                                                       | 217                  | 9               | NL                    |
| Salina (G-unit)          | 265                                                 | 272.8                | -7.8            | GR                    | 111.5                                           | 120.09               | -8.59           | GR                    | 269                                                         | 277.7                | -8.7            | GR                    | nc                                                                | 173.7                | 0               | GR                    | 120                                         | 126.49               | -6.49           | GR                    | 276                                                       | 268.2                | 7.8             | GR                    |
| Salina (F-unit)          | 273                                                 | np                   | NA              | GR                    | 120.5                                           | np                   | NA              | GR                    | 277                                                         | np                   | NA              | GR                    | 182                                                               | np                   | NA              | GR                    | 129                                         | np                   | NA              | GR                    | 285                                                       | np                   | NA              | GR                    |
| Cabot Head               | nl                                                  | 566.9                | 0               |                       | nc                                              | 340.46               | 0               | GR                    | 630                                                         | 630.9                | -0.9            | GR                    | nc                                                                | 403.9                | 0               | GR                    | dif                                         | 344.42               | 0               | GR                    | 635                                                       | 616                  | 19              | GR                    |
| Queenston                | nl                                                  | np                   | NA              |                       | nl                                              | np                   | NA              |                       | 660                                                         | 659                  | 1               | GR                    | nc                                                                | 431.3                | 0               | GR                    | nl                                          | np                   | NA              |                       | 657                                                       | 635.5                | 21.5            | GR                    |
| Cobourg (Collingwood)    | nl                                                  | np                   | NA              |                       | nl                                              | np                   | NA              |                       | 870                                                         | 815.9                | 54.1            | GR                    | nl                                                                | np                   | NA              | GR                    | nl                                          | np                   | NA              |                       | 878                                                       | 808                  | 70              | GR                    |
| Cobourg (Lower)          | nl                                                  | np                   | NA              |                       | nl                                              | np                   | NA              |                       | 884                                                         | 872                  | 12              | GR                    | nl                                                                | np                   | NA              |                       | nl                                          | np                   | NA              |                       | 892.5                                                     | 850.4                | 42.1            | GR                    |
| Coboconk                 | nl                                                  | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                                          | 1010.1               | 0               | GR                    | nl                                                                | np                   | NA              |                       | nl                                          | np                   | NA              |                       | 1015                                                      | 983.6                | 31.4            | GR                    |
| Gull River (if conflict) | nl                                                  | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                                          | 1017.7               | 0               |                       | nl                                                                | np                   | NA              |                       | nl                                          | np                   | NA              |                       | 1021                                                      | 1074.4               | -53.4           | GR                    |
| Precambrian              | nl                                                  | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                                          | np                   | NA              |                       | nl                                                                | np                   | NA              |                       | nl                                          | np                   | NA              |                       | nl                                                        | np                   | 0               |                       |

| Legend |                                                                              | Log Legend  |                                                              |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                |
|        |                                                                              | GR          | Gamma Ray                                                    |
|        |                                                                              | NL          | Neutron Log                                                  |
|        |                                                                              | RHOB        | Bulk Density                                                 |
|        |                                                                              | PE          | Photo-Electric Factor                                        |
|        |                                                                              | NPHI        | Neutron Porosity                                             |
|        |                                                                              | DPHI        | Density Porosity                                             |
|        |                                                                              | DT          | Interval Transit Time                                        |



Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | Felmont Oil Corp. - R. Thompson No. 1, East Wawanosh 5 - 28 - VIII |                      |                 |                       | Felmont MacTavish No. 1, West Wawanosh 5 - 17 - VIII |                      |                 |                       | Felmont Oil No. 13 - M. Berger No. 1, Ashfield 3 - 7 - VIII |                      |                 |                       | Felmont Oil, Huron - 10 - I |                      |                 |                       | Felmont Oil, Huron - 31 - I |                      |                 |                       | Imperial Oil, Huron - 9 - XI |                      |                 |                       |
|--------------------------|--------------------------------------------------------------------|----------------------|-----------------|-----------------------|------------------------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | F012027                                                            |                      |                 |                       | F012047                                              |                      |                 |                       | F012048                                                     |                      |                 |                       | F012063                     |                      |                 |                       | F012066                     |                      |                 |                       | F012078                      |                      |                 |                       |
| Northing (UTM NAD83)     | 4855138.54                                                         |                      |                 |                       | 4858616.974                                          |                      |                 |                       | 4859452.065                                                 |                      |                 |                       | 4871110.618                 |                      |                 |                       | 4874071.473                 |                      |                 |                       | 4881565.156                  |                      |                 |                       |
| Easting (UTM NAD83)      | 462479.5761                                                        |                      |                 |                       | 456656.5422                                          |                      |                 |                       | 449791.2403                                                 |                      |                 |                       | 453514.7523                 |                      |                 |                       | 450275.9702                 |                      |                 |                       | 457446.8353                  |                      |                 |                       |
| BH Depth (TVD)           | 551.69                                                             |                      |                 |                       | 577.6                                                |                      |                 |                       | 601.98                                                      |                      |                 |                       | 568.76                      |                      |                 |                       | 566.93                      |                      |                 |                       | 507.49                       |                      |                 |                       |
| BH TD Formation          | Cabot Head                                                         |                      |                 |                       | Cabot Head                                           |                      |                 |                       | Cabot Head                                                  |                      |                 |                       | Cabot Head                  |                      |                 |                       | Cabot Head                  |                      |                 |                       | Guelph                       |                      |                 |                       |
| Kelly Bushing Height (m) | 0.61                                                               |                      |                 |                       | 0.61                                                 |                      |                 |                       | 0.61                                                        |                      |                 |                       | 0.61                        |                      |                 |                       | 0.61                        |                      |                 |                       | 0.61                         |                      |                 |                       |
| BH Log                   | GR                                                                 | NL                   |                 |                       | GR                                                   | NL                   |                 |                       | GR                                                          |                      |                 |                       | GR                          | NL                   |                 |                       | GR                          | NL                   |                 |                       | GR                           | NL                   |                 |                       |
| Date Acquired            | 1955                                                               | 1955                 |                 |                       | 1958                                                 | 1958                 |                 |                       | 1955                                                        |                      |                 |                       | 1959                        | 1959                 |                 |                       | 1956                        | 1956                 |                 |                       | 1955                         | 1955                 |                 |                       |
| Top Depth                | 0                                                                  | 0                    |                 |                       | 0                                                    | 0                    |                 |                       | 0                                                           |                      |                 |                       | 0                           | 0                    |                 |                       | 0                           |                      |                 |                       | 0                            | 0                    |                 |                       |
| Bottom Depth             | 549                                                                | 549                  |                 |                       | 579                                                  | 579                  |                 |                       | 579                                                         |                      |                 |                       | 579                         | 579                  |                 |                       | 579                         |                      |                 |                       | 518                          | 518                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)                                          | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                            | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                                   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)    | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | dif                                                                | 213.4                | 0               | NL                    | 192                                                  | 188.06               | 3.94            | NL                    | dif                                                         | 217.9                | 0               | GR                    | 199                         | 196.6                | 2.4             | NL                    | dif                         | 182.88               | 0               | GR                    | nc                           | 162.76               | 0               | NL                    |
| Salina (G-unit)          | 257                                                                | 263                  | -6              | GR                    | 273                                                  | 232.87               | 40.13           | GR                    | nc                                                          | 265.2                | 0               | GR                    | 242.5                       | 252.37               | -9.87           | GR                    | 223                         | 233.48               | -10.48          | GR                    | 202                          | 201.17               | 0.83            | GR                    |
| Salina (F-unit)          | 264                                                                | np                   | NA              | GR                    | 281                                                  | np                   | NA              | GR                    | nc                                                          | 274.3                | 0               | GR                    | 251                         | np                   | NA              | GR                    | 231                         | 237.74               | -6.74           | GR                    | nc                           | 208.79               | 0               | GR                    |
| Cabot Head               | nl                                                                 | 547.1                | 0               | GR                    | nl                                                   | 574.24               | 0               | GR                    | nl                                                          | 598.9                | 0               | GR                    | nl                          | 561.44               | 0               | GR                    | nl                          | 562.36               | 0               | GR                    | nl                           | np                   | NA              | GR                    |
| Queenston                | nl                                                                 | np                   | NA              |                       | nl                                                   | np                   | NA              |                       | nl                                                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                           | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                                                                 | np                   | NA              |                       | nl                                                   | np                   | NA              |                       | nl                                                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                           | np                   | NA              |                       |
| Cobourg (Lower)          | nl                                                                 | np                   | NA              |                       | nl                                                   | np                   | NA              |                       | nl                                                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                           | np                   | NA              |                       |
| Coboconk                 | nl                                                                 | np                   | NA              |                       | nl                                                   | np                   | NA              |                       | nl                                                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                           | np                   | NA              |                       |
| Gull River (if conflict) | nl                                                                 | np                   | NA              |                       | nl                                                   | np                   | NA              |                       | nl                                                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                           | np                   | NA              |                       |
| Precambrian              | nl                                                                 | np                   | NA              |                       | nl                                                   | np                   | NA              |                       | nl                                                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                           | np                   | NA              |                       |

| Well Name                | Imperial Oil No.536 - Taylor et al No. 1, Amabel - 52 - II |                      |                 |                       | Imperial Oil No. 527 - W. Radbourne No. 1, Keppel 2 - 22 - IIS |                      |                 |                       | Ben Allen Cement Co. - Chambers & Dewus - McMillan No. 1, Keppel 5 - 30 - VIII |                      |                 |                       | Arnora Sulphur Mining Corporation No.1 - A.B. Whyte No. 1, Proton 1 - 10 - XIX |                      |                 |                       | Annan Petroleum No. 1 - D. Morris No. 1, Sarawak 29 - III |                      |                 |                       | BP Triad, (A), Saugeen - 29 - II |                      |                 |                       |
|--------------------------|------------------------------------------------------------|----------------------|-----------------|-----------------------|----------------------------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------------------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------------------------------|----------------------|-----------------|-----------------------|----------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | F012141                                                    |                      |                 |                       | H000032                                                        |                      |                 |                       | H000033                                                                        |                      |                 |                       | H000038                                                                        |                      |                 |                       | H000043                                                   |                      |                 |                       | T001720A                         |                      |                 |                       |
| Northing (UTM NAD83)     | 4950304.141                                                |                      |                 |                       | 4941351.636                                                    |                      |                 |                       | 4940341.934                                                                    |                      |                 |                       | 4891958.835                                                                    |                      |                 |                       | 4945957.915                                               |                      |                 |                       | 4910793.318                      |                      |                 |                       |
| Easting (UTM NAD83)      | 484603.2864                                                |                      |                 |                       | 492711.0118                                                    |                      |                 |                       | 501617.0691                                                                    |                      |                 |                       | 534100.1972                                                                    |                      |                 |                       | 505422.6767                                               |                      |                 |                       | 473240.2468                      |                      |                 |                       |
| BH Depth (TVD)           | 501.4                                                      |                      |                 |                       | 497.43                                                         |                      |                 |                       | 472.44                                                                         |                      |                 |                       | 701.95                                                                         |                      |                 |                       | 368.2                                                     |                      |                 |                       | 722.38                           |                      |                 |                       |
| BH TD Formation          | Precambrian                                                |                      |                 |                       | Precambrian                                                    |                      |                 |                       | Shadow Lake                                                                    |                      |                 |                       | Precambrian                                                                    |                      |                 |                       | Black River Group                                         |                      |                 |                       | Precambrian                      |                      |                 |                       |
| Kelly Bushing Height (m) | 0.6                                                        |                      |                 |                       | 0.61                                                           |                      |                 |                       | 0.1                                                                            |                      |                 |                       | 0                                                                              |                      |                 |                       | 0                                                         |                      |                 |                       | 3.62                             |                      |                 |                       |
| BH Log                   | GR                                                         | NL                   |                 |                       | GR                                                             | NL                   |                 |                       | GR                                                                             | NL                   |                 |                       | GR                                                                             |                      |                 |                       | GR                                                        |                      |                 |                       | GR                               | NL                   |                 |                       |
| Date Acquired            | 1955                                                       | 1955                 |                 |                       | 1955                                                           | 1955                 |                 |                       | 1958                                                                           | 1958                 |                 |                       | 1955                                                                           |                      |                 |                       | 1948                                                      |                      |                 |                       | 1964                             | 1964                 |                 |                       |
| Top Depth                | 55                                                         | 55                   |                 |                       | 91                                                             | 91                   |                 |                       | 0                                                                              | 0                    |                 |                       | 0                                                                              |                      |                 |                       | 0                                                         |                      |                 |                       | 0                                | 0                    |                 |                       |
| Bottom Depth             | 503                                                        | 503                  |                 |                       | 472                                                            | 472                  |                 |                       | 472                                                                            | 472                  |                 |                       | 701                                                                            |                      |                 |                       | 371                                                       |                      |                 |                       | 732                              | 732                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)                                  | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                                      | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                                                      | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                                                      | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                                 | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nl                                                         | np                   | NA              |                       | nl                                                             | np                   | NA              |                       | nl                                                                             | np                   | NA              |                       | nl                                                                             | np                   | NA              |                       | nl                                                        | np                   | NA              |                       | nl                               | np                   | NA              |                       |
| Salina (G-unit)          | nl                                                         | np                   | NA              |                       | nl                                                             | np                   | NA              |                       | nl                                                                             | np                   | NA              |                       | nl                                                                             | np                   | NA              |                       | nl                                                        | np                   | NA              |                       | dif                              | 64.92                | 0               |                       |
| Salina (F-unit)          | nl                                                         | np                   | NA              |                       | nl                                                             | np                   | NA              | GR                    | nl                                                                             | np                   | NA              |                       | nl                                                                             | np                   | NA              |                       | nl                                                        | np                   | NA              |                       | dif                              | np                   | NA              |                       |
| Cabot Head               | 67                                                         | 74.7                 | -7.7            | GR                    | dif                                                            | 57.9                 | 0               |                       | 9.9                                                                            | 10.4                 | -0.5            | GR                    | nc                                                                             | 149.4                | 0               |                       | nl                                                        | np                   | NA              |                       | 287                              | 284.07               | 2.93            | GR                    |
| Queenston                | nc                                                         | 114.3                | 0               | GR                    | dif                                                            | 102.1                | 0               |                       | 54                                                                             | 54.9                 | -0.9            | GR                    | nc                                                                             | 176.2                | 0               | GR                    | nl                                                        | 6.1                  | 0               | GR                    | 314                              | 310.9                | 3.1             | GR                    |
| Cobourg (Collingwood)    | 319                                                        | 288                  | 31              | NL                    | 321                                                            | 300.2                | 20.8            | GRNL                  | 274.5                                                                          | np                   | NA              | GR                    | 449                                                                            | 431.9                | 17.1            | GR                    | 209                                                       | 205.7                | 3.3             | GR                    | 525                              | np                   | NA              | GR                    |
| Cobourg (Lower)          | 333                                                        | 317                  | 16              | GR                    | 334                                                            | 317                  | 17              |                       | 282                                                                            | 274.3                | 7.7             |                       | 469                                                                            | 451.1                | 17.9            |                       | 217.5                                                     | 210.3                | 7.2             |                       | 538.5                            | 522.7                | 15.8            |                       |
| Coboconk                 | nc                                                         | 426.4                | 0               | GR                    | 429.5                                                          | 431                  | -1.5            |                       | nc                                                                             | 388.6                | 0               | GRNL                  | 597                                                                            | 592.84               | 4.16            | GR                    | 362                                                       | np                   | NA              | GR                    | nc                               | 643.7                | 0               | GR                    |
| Gull River (if conflict) | dif                                                        | 447.8                | 0               | GR                    | nc                                                             | 435.3                | 0               |                       | nl                                                                             | np                   | NA              |                       | dif                                                                            | 616.6                | 0               |                       | nl                                                        | np                   | NA              |                       | nc                               | 649.22               | 0               | GR                    |
| Precambrian              | dif                                                        | 497.7                | 0               | GR                    | nl                                                             | 496.2                | NA              |                       | nc                                                                             | 460.25               | 0               | NL                    | nc                                                                             | 651.1                | 0               | GR                    | nl                                                        | np                   | NA              |                       | 717                              | 719.94               | -2.94           |                       |

| Legend |                                                                              | Fm          |                                                              | Δ Elevation |                       | * Issues with geophysical logs? |                       | Log Legend |                       |      |                       |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|-------------|-----------------------|---------------------------------|-----------------------|------------|-----------------------|------|-----------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    | GR          | Gamma Ray             | NPHI                            | Neutron Porosity      | GR         | Gamma Ray             | NPHI | Neutron Porosity      |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   | NL          | Neutron Log           | DPHI                            | Density Porosity      | NL         | Neutron Log           | DPHI | Density Porosity      |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | RHOB        | Bulk Density          | DT                              | Interval Transit Time | RHOB       | Bulk Density          | DT   | Interval Transit Time |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                | PE          | Photo-Electric Factor |                                 |                       | PE         | Photo-Electric Factor |      |                       |

Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | Home C.D.R., Saugeen - 12 - I |                      |                 |                       | BP Triad, Kincardine - 17 - VIII |                      |                 |                       | BP Home, Kincardine - 57 - C |                      |                 |                       | Texaco No.4 Home C.D.R., Bruce - 1 - VIII |                      |                 |                       | Altair et al, West Wawanosh 8 - 16 - VIII |                      |                 |                       | Creasing No.2, Egremont 3 - 8 - IX |                      |                 |                       |
|--------------------------|-------------------------------|----------------------|-----------------|-----------------------|----------------------------------|----------------------|-----------------|-----------------------|------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------|----------------------|-----------------|-----------------------|------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T001892                       |                      |                 |                       | T001925                          |                      |                 |                       | T001942                      |                      |                 |                       | T002238                                   |                      |                 |                       | T002250                                   |                      |                 |                       | T002284                            |                      |                 |                       |
| Northing (UTM NAD83)     | 4913076.684                   |                      |                 |                       | 4894758.957                      |                      |                 |                       | 4900536.342                  |                      |                 |                       | 4909022.351                               |                      |                 |                       | 4858492.069                               |                      |                 |                       | 4875701.348                        |                      |                 |                       |
| Easting (UTM NAD83)      | 466525.877                    |                      |                 |                       | 460321.9592                      |                      |                 |                       | 455764.4025                  |                      |                 |                       | 459943.1843                               |                      |                 |                       | 455946.0204                               |                      |                 |                       | 524655.9084                        |                      |                 |                       |
| BH Depth (TVD)           | 770.5                         |                      |                 |                       | 912.9                            |                      |                 |                       | 897.9                        |                      |                 |                       | 850.4                                     |                      |                 |                       | 1053.08                                   |                      |                 |                       | 672.08                             |                      |                 |                       |
| BH TD Formation          | Precambrian                   |                      |                 |                       | Precambrian                      |                      |                 |                       | Precambrian                  |                      |                 |                       | Precambrian                               |                      |                 |                       | Precambrian                               |                      |                 |                       | Precambrian                        |                      |                 |                       |
| Kelly Bushing Height (m) | 0.89                          |                      |                 |                       | 3.37                             |                      |                 |                       | 1.23                         |                      |                 |                       | 1.5                                       |                      |                 |                       | 0.91                                      |                      |                 |                       | 0.91                               |                      |                 |                       |
| BH Log                   | GR                            | NL                   |                 |                       | GR                               | NL                   |                 |                       | GR                           | NL                   |                 |                       | GR                                        | NL                   |                 |                       | GR                                        | NL                   |                 |                       | GR                                 | NL                   |                 |                       |
| Date Acquired            | 1965                          | 1965                 |                 |                       | 1965                             | 1965                 |                 |                       | 1966                         | 1966                 |                 |                       | 1967                                      | 1967                 |                 |                       | 1967                                      | 1967                 |                 |                       | 1966                               | 1966                 |                 |                       |
| Top Depth                | 0                             | 0                    |                 |                       | 0                                | 0                    |                 |                       | 0                            | 0                    |                 |                       | 0                                         | 0                    |                 |                       | 0                                         | 0                    |                 |                       | 30                                 |                      |                 |                       |
| Bottom Depth             | 762                           | 762                  |                 |                       | 914                              | 914                  |                 |                       | 899                          | 899                  |                 |                       | 853                                       | 853                  |                 |                       | 1036                                      | 1036                 |                 |                       | 670                                |                      |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)     | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)    | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                 | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                 | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)          | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nc                            | 45.42                | 0               | NL                    | 182.5                            | 185.93               | -3.43           | NL                    | 166                          | 167.64               | -1.64           | NL                    | 123                                       | 110.6                | 12.4            | NL                    | dif                                       | 206.3                | 0               |                       | nl                                 | np                   | NA              |                       |
| Salina (G-unit)          | 72                            | 80.47                | -8.47           | GRNL                  | 219                              | 231.65               | -12.65          | GR                    | 206                          | 207.87               | -1.87           | GR                    | 151                                       | 150.3                | 0.7             | GR                    | nc                                        | 311.5                | 0               |                       | nl                                 | np                   | NA              |                       |
| Salina (F-unit)          | 82                            | np                   | NA              | GRNL                  | 227                              | np                   | NA              | GR                    | 217                          | 219.46               | -2.46           | GR                    | 160.5                                     | 160                  | 0.5             | GR                    | nc                                        | 319.4                | 0               |                       | nl                                 | np                   | NA              |                       |
| Cabot Head               | 331                           | 326.14               | 4.86            | GR                    | nc                               | 466.34               | 0               | GR                    | 449                          | 453.24               | -4.24           | NL                    | 409.5                                     | 406.3                | 3.2             | NL                    | 573                                       | 569.1                | 3.9             | GR                    | nc                                 | 174.7                | 0               | GR                    |
| Queenston                | 360                           | 358.44               | 1.56            | GR                    | nc                               | 493.78               | 0               | GR                    | 474                          | 478.54               | -4.54           | NL                    | 438                                       | 435.3                | 2.7             | NL                    | 605                                       | 602.9                | 2.1             | GR                    | nc                                 | 200.3                | 0               | GR                    |
| Cobourg (Collingwood)    | 571                           | np                   | NA              | GR                    | 702                              | np                   | NA              | GR                    | 683                          | 664.46               | 18.54           | GRNL                  | 643                                       | 616.3                | 26.7            | GRNL                  | 817                                       | 795.5                | 21.5            | GR                    | 467                                | 419.1                | 47.9            | GR                    |
| Cobourg (Lower)          | 583.5                         | 573                  | 10.5            |                       | 715.5                            | 701.04               | 14.46           |                       | 695.5                        | 687                  | 8.5             |                       | 659                                       | 642.8                | 16.2            |                       | 834                                       | 819                  | 15              |                       | 481                                | 467.3                | 13.7            | GR                    |
| Coboconk                 | nc                            | 689.5                | 0               | GR                    | 824                              | np                   | NA              | GR                    | 805                          | 806.8                | -1.8            | NL                    | nc                                        | 758                  | 0               | GRNL                  | nc                                        | 956.5                | 0               | GR                    | nc                                 | 613.6                | 0               | GR                    |
| Gull River (if conflict) | nl                            | np                   | NA              |                       | 835                              | np                   | NA              | GR                    | nc                           | 831.8                | 0               |                       | nc                                        | 769                  | 0               |                       | nc                                        | 975.4                | 0               | GR                    | nc                                 | 630.9                | 0               |                       |
| Precambrian              | nl                            | 769.01               | 0               |                       | nc                               | 909.52               | 0               | GR                    | 894                          | 897.3                | -3.3            | NL                    | nc                                        | 833.6                | 0               | GRNL                  | nl                                        | 1042.7               | 0               |                       | nc                                 | 670.3                | 0               | GR                    |

| Well Name                | MESA PETROLEUMS, West Wawanosh 7 - 17 - VIII |                      |                 |                       | MESA ET AL TEESWATER, West Wawanosh 2 - 26 - XII |                      |                 |                       | Kenartha No.3, Arthur 8 - 25 - VII |                      |                 |                       | MESA ET AL BELMORE NO.1, West Wawanosh 8 - 26 - X |                      |                 |                       | Monray No.1, Egremont 5 - 4 - VI |                      |                 |                       | Monray No.2, Egremont 1 - 11 - VIII |                      |                 |                       |
|--------------------------|----------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------------------|----------------------|-----------------|-----------------------|------------------------------------|----------------------|-----------------|-----------------------|---------------------------------------------------|----------------------|-----------------|-----------------------|----------------------------------|----------------------|-----------------|-----------------------|-------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T002380                                      |                      |                 |                       | T002470                                          |                      |                 |                       | T002478                            |                      |                 |                       | T002556*                                          |                      |                 |                       | T002613                          |                      |                 |                       | T002627                             |                      |                 |                       |
| Northing (UTM NAD83)     | 4858314.811                                  |                      |                 |                       | 4861102.66                                       |                      |                 |                       | 4857947.097                        |                      |                 |                       | 4872321.501                                       |                      |                 |                       | 4875339.757                      |                      |                 |                       |                                     |                      |                 |                       |
| Easting (UTM NAD83)      | 456156.8628                                  |                      |                 |                       | 464081.5429                                      |                      |                 |                       | 527739.2694                        |                      |                 |                       | 462409.2597                                       |                      |                 |                       | 523661.5377                      |                      |                 |                       | 525961.6589                         |                      |                 |                       |
| BH Depth (TVD)           | 577.6                                        |                      |                 |                       | 526.69                                           |                      |                 |                       | 731.82                             |                      |                 |                       | 543.5                                             |                      |                 |                       | 677.57                           |                      |                 |                       | 679.7                               |                      |                 |                       |
| BH TD Formation          | Cabot Head                                   |                      |                 |                       | Cabot Head                                       |                      |                 |                       | Precambrian                        |                      |                 |                       | Reynales/Fossil Hill                              |                      |                 |                       | Precambrian                      |                      |                 |                       | Precambrian                         |                      |                 |                       |
| Kelly Bushing Height (m) | 1.53                                         |                      |                 |                       | 0.61                                             |                      |                 |                       | 1.2                                |                      |                 |                       | 0.56                                              |                      |                 |                       | 1.22                             |                      |                 |                       | 0.91                                |                      |                 |                       |
| BH Log                   | GR                                           | NL                   |                 |                       | GR                                               | NL                   |                 |                       | GR                                 | NL                   |                 |                       | GR                                                | NL                   |                 |                       | GR                               | NL                   |                 |                       | GR                                  | NL                   |                 |                       |
| Date Acquired            | 1967                                         | 1967                 |                 |                       | 1968                                             | 1968                 |                 |                       | 1968                               | 1968                 |                 |                       | 1968                                              | 1968                 |                 |                       | 1968                             | 1968                 |                 |                       | 1968                                | 1968                 |                 |                       |
| Top Depth                | 0                                            | 0                    |                 |                       | 0                                                | 0                    |                 |                       | 655                                | 655                  |                 |                       | 304                                               | 304                  |                 |                       | 0                                | 0                    |                 |                       | 30                                  | 30                   |                 |                       |
| Bottom Depth             | 576                                          | 576                  |                 |                       | 533                                              | 533                  |                 |                       | 719                                | 719                  |                 |                       | 542                                               | 542                  |                 |                       | 671                              | 671                  |                 |                       | 670                                 | 670                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)                    | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)          | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                         | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nc                                           | 195.1                | 0               | GR                    | dif                                              | 214.6                | 0               | GR                    | nl                                 | np                   | NA              |                       | nl                                                | 189                  | 0               |                       | nl                               | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Salina (G-unit)          | nc                                           | 314.6                | 0               | GR                    | nc                                               | 252.4                | 0               | GR                    | nl                                 | np                   | NA              |                       | nl                                                | 249.6                | 0               |                       | nl                               | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Salina (F-unit)          | nc                                           | 319.4                | 0               | GR                    | nc                                               | 259.7                | 0               | GR                    | nl                                 | np                   | NA              |                       | nl                                                | 257.3                | 0               |                       | nl                               | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Cabot Head               | 571.5                                        | 574.5                | -3              | GR                    | nc                                               | 519.1                | 0               | GR                    | nl                                 | 201.8                | 0               |                       | nl                                                | np                   | NA              |                       | nc                               | 179.8                | 0               | GR                    | nc                                  | 176.8                | 0               | GR                    |
| Queenston                | nl                                           | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                 | 222.5                | 0               |                       | nl                                                | np                   | NA              |                       | nc                               | 204.2                | 0               | GR                    | nc                                  | 206.3                | 0               | GR                    |
| Cobourg (Collingwood)    | nl                                           | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                 | 499.9                | 0               |                       | nl                                                | np                   | NA              |                       | nc                               | 472.4                | 0               | GR                    | 473.5                               | 459.6                | 13.9            | GR                    |
| Cobourg (Lower)          | nl                                           | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                 | 517.6                | 0               |                       | nl                                                | np                   | NA              |                       | nc                               | 484.6                | 0               |                       | 484.5                               | 472.4                | 12.1            | GR                    |
| Coboconk                 | nl                                           | np                   | NA              |                       | nl                                               | np                   | NA              |                       | 672                                | 661.4                | 10.6            | GR                    | nl                                                | np                   | NA              |                       | nc                               | 624.5                | 0               | GR                    | 619.5                               | 620.88               | -1.38           | GR                    |
| Gull River (if conflict) | nl                                           | np                   | NA              |                       | nl                                               | np                   | NA              |                       | 692.5                              | 673.6                | 18.9            |                       | nl                                                | np                   | NA              |                       | nc                               | 637.6                | 0               |                       | nc                                  | 635.51               | 0               |                       |
| Precambrian              | nl                                           | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                 | 728.8                | 0               |                       | nl                                                | np                   | NA              |                       | nl                               | 672.4                | 0               |                       | nl                                  | 677.3                | 0               | GR                    |

| Legend |                                                                              |             |                                                              | Log Legend |                       |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|------------|-----------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    | GR         | Gamma Ray             |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   | NL         | Neutron Log           |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | RHOB       | Bulk Density          |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                | DT         | Interval Transit Time |
|        |                                                                              |             |                                                              | PE         | Photo-Electric Factor |

Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | Texaco No.6 Bruce 8-E-IV, Bruce - E - IV |                      |                 |                       | PINETREE MID-NORTHERN NO.1, Huron - 63 - I |                      |                 |                       | Buxton Bozlan No.1, Arthur 8 - 25 - V |                      |                 |                       | PINETREE ET AL NO.1, Greenock - 3 - IN |                      |                 |                       | Zurich et al Goderich No.1A, Goderich - 38 - IX |                      |                 |                       | Buxton No.2, Maryborough 1 - 12 - XVI |                      |                 |                       |
|--------------------------|------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------------|----------------------|-----------------|-----------------------|---------------------------------------|----------------------|-----------------|-----------------------|----------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------------|----------------------|-----------------|-----------------------|---------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T002636                                  |                      |                 |                       | T002663                                    |                      |                 |                       | T002713                               |                      |                 |                       | T002730                                |                      |                 |                       | T002731A                                        |                      |                 |                       | T002754                               |                      |                 |                       |
| Northing (UTM NAD83)     | 4905796.314                              |                      |                 |                       | 4876779.029                                |                      |                 |                       | 4855695.156                           |                      |                 |                       | 4883088.07                             |                      |                 |                       | 4827136.723                                     |                      |                 |                       | 4853659.456                           |                      |                 |                       |
| Easting (UTM NAD83)      | 456347.2124                              |                      |                 |                       | 444273.8091                                |                      |                 |                       | 530430.0595                           |                      |                 |                       | 467410.7814                            |                      |                 |                       | 449437.6831                                     |                      |                 |                       | 526986.6648                           |                      |                 |                       |
| BH Depth (TVD)           | 881.5                                    |                      |                 |                       | 608.69                                     |                      |                 |                       | 716.28                                |                      |                 |                       | 429.46                                 |                      |                 |                       | 626.67                                          |                      |                 |                       | 743.41                                |                      |                 |                       |
| BH TD Formation          | Cambrian                                 |                      |                 |                       | Cabot Head                                 |                      |                 |                       | Precambrian                           |                      |                 |                       | Cabot Head                             |                      |                 |                       | Rochester                                       |                      |                 |                       | Precambrian                           |                      |                 |                       |
| Kelly Bushing Height (m) | 0.9                                      |                      |                 |                       | 0.92                                       |                      |                 |                       | 0.9                                   |                      |                 |                       | 0.9                                    |                      |                 |                       | 0.93                                            |                      |                 |                       | 1                                     |                      |                 |                       |
| BH Log                   | GR                                       | NL                   |                 |                       | GR                                         | NL                   |                 |                       | GR                                    | NL                   |                 |                       | GR                                     | NL                   |                 |                       | GR                                              | NL                   |                 |                       | GR                                    | NL                   |                 |                       |
| Date Acquired            | 1969                                     | 1969                 |                 |                       | 1969                                       | 1969                 |                 |                       | 1969                                  | 1969                 |                 |                       | 1969                                   | 1969                 |                 |                       | 1969                                            | 1969                 |                 |                       | 1969                                  | 1969                 |                 |                       |
| Top Depth                | 0                                        | 0                    |                 |                       | 0                                          | 0                    |                 |                       | 0                                     | 0                    |                 |                       | 0                                      | 0                    |                 |                       | 0                                               | 0                    |                 |                       | 0                                     | 0                    |                 |                       |
| Bottom Depth             | 884                                      | 884                  |                 |                       | 609.5                                      | 609.5                |                 |                       | 716                                   | 716                  |                 |                       | 430                                    | 430                  |                 |                       | 625                                             | 625                  |                 |                       | 740                                   | 740                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)                | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                  | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)             | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)              | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                       | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)             | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nc                                       | 148.1                | 0               | NL                    | nc                                         | 215.19               | 0               | NL                    | nl                                    | np                   | NA              |                       | dif                                    | 161.2                | 0               | GRNL                  | 282.5                                           | 278                  | 4.5             | NL                    | nl                                    | np                   | NA              |                       |
| Salina (G-unit)          | nc                                       | 190.2                | 0               | GR                    | nc                                         | 268.53               | 0               | GRNL                  | nl                                    | np                   | NA              |                       | 190                                    | 190.8                | -0.8            | GR                    | 357.5                                           | 356.6                | 0.9             | GRNL                  | nl                                    | np                   | NA              |                       |
| Salina (F-unit)          | nc                                       | 199                  | 0               | GR                    | nc                                         | 277.98               | 0               | GRNL                  | nl                                    | np                   | NA              |                       | 198                                    | 199.3                | -1.3            | GRNL                  | nc                                              | 364.2                | 0               | GRNL                  | nl                                    | np                   | NA              |                       |
| Cabot Head               | nc                                       | 436.8                | 0               | GR                    | 601                                        | np                   | NA              | GR                    | nc                                    | 185.9                | 0               |                       | 428                                    | 427.3                | 0.7             | GR                    | nl                                              | np                   | NA              |                       | nc                                    | 208.5                | 0               | GR                    |
| Queenston                | nc                                       | 472.4                | 0               | GR                    | nl                                         | np                   | NA              |                       | nc                                    | 211.5                | 0               |                       | nl                                     | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nc                                    | 230.7                | 0               | GR                    |
| Cobourg (Collingwood)    | 679                                      | 646.8                | 32.2            | GR                    | nl                                         | np                   | NA              |                       | 505                                   | 506                  | -1              | GR                    | nl                                     | np                   | NA              |                       | nl                                              | np                   | NA              |                       | 526                                   | 502.3                | 23.7            | GR                    |
| Cobourg (Lower)          | 691.7                                    | 679.4                | 12.3            |                       | nl                                         | np                   | NA              |                       | nc                                    | 518.2                | 0               | GR                    | nl                                     | np                   | NA              |                       | nl                                              | np                   | NA              |                       | 544.5                                 | 526.1                | 18.4            | GR                    |
| Coboconk                 | nc                                       | 792.5                | 0               | GR                    | nl                                         | np                   | NA              |                       | nc                                    | 659.9                | 0               | GR                    | nl                                     | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nc                                    | 679.1                | 0               | GR                    |
| Gull River (if conflict) | nc                                       | 804.7                | 0               | GR                    | nl                                         | np                   | NA              |                       | nc                                    | 670.6                | 0               | GR                    | nl                                     | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                    | 691.9                | 0               |                       |
| Precambrian              | nl                                       | np                   | NA              | GR                    | nl                                         | np                   | NA              |                       | 709                                   | 707.1                | 1.9             | GR                    | nl                                     | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nc                                    | 732.7                | 0               | GRNL                  |

| Well Name                | MID-NORTHERN NO.1, Grey 1 - 3 - IX |                          |                 |                       | Zurich et al Goderich No.2, Goderich 1 - 38 - IX |                          |                 |                       | Kenartha No.4, Arthur 4 - 24 - VII |                          |                 |                       | Barr Cormack No. 1, Bruce - 22 - XIII |                          |                 |                       | FITZGERALD, Huron 1 - 33 - LR |                          |                 |                       | FITZGERALD, Kinloss 3 - 6 - IX |                          |                 |                       |
|--------------------------|------------------------------------|--------------------------|-----------------|-----------------------|--------------------------------------------------|--------------------------|-----------------|-----------------------|------------------------------------|--------------------------|-----------------|-----------------------|---------------------------------------|--------------------------|-----------------|-----------------------|-------------------------------|--------------------------|-----------------|-----------------------|--------------------------------|--------------------------|-----------------|-----------------------|
| BH ID                    | T002783                            |                          |                 |                       | T002842                                          |                          |                 |                       | T003126                            |                          |                 |                       | T003387*                              |                          |                 |                       | T003535                       |                          |                 |                       | T003553                        |                          |                 |                       |
| Northing (UTM NAD83)     | 4843921.249                        |                          |                 |                       | 4827352.491                                      |                          |                 |                       | 4855815.617                        |                          |                 |                       | 4908300.657                           |                          |                 |                       | 4883101.264                   |                          |                 |                       | 4877090.105                    |                          |                 |                       |
| Easting (UTM NAD83)      | 481402.7195                        |                          |                 |                       | 449607.161                                       |                          |                 |                       | 528368.8181                        |                          |                 |                       | 470293.1905                           |                          |                 |                       | 444998.6962                   |                          |                 |                       | 461679.6592                    |                          |                 |                       |
| BH Depth (TVD)           | 420.01                             |                          |                 |                       | 616.92                                           |                          |                 |                       | 800.4                              |                          |                 |                       | 335.89                                |                          |                 |                       | 583.69                        |                          |                 |                       | 511.45                         |                          |                 |                       |
| BH TD Formation          | Cabot Head                         |                          |                 |                       | Rochester                                        |                          |                 |                       | Precambrian                        |                          |                 |                       | Cabot Head                            |                          |                 |                       | Cabot Head                    |                          |                 |                       | Cabot Head                     |                          |                 |                       |
| Kelly Bushing Height (m) | 1.22                               |                          |                 |                       | 1.22                                             |                          |                 |                       | 0.63                               |                          |                 |                       | 0.6                                   |                          |                 |                       | 1.22                          |                          |                 |                       | 1.22                           |                          |                 |                       |
| BH Log                   | GR                                 | NL                       |                 |                       | GR                                               | NL                       |                 |                       | GR                                 | NL                       |                 |                       | GR*                                   | NL*                      |                 |                       | GR                            | NL                       |                 |                       | GR                             | NL                       |                 |                       |
| Date Acquired            | 1969                               | 1969                     |                 |                       | 1969                                             | 1969                     |                 |                       | 1971                               | 1971                     |                 |                       | 1972                                  | 1972                     |                 |                       | 1973                          | 1973                     |                 |                       | 1973                           | 1973                     |                 |                       |
| Top Depth                | 0                                  | 0                        |                 |                       | 0                                                | 0                        |                 |                       | 0                                  | 0                        |                 |                       | 0                                     | 0                        |                 |                       | 0                             | 0                        |                 |                       | 0                              | 0                        |                 |                       |
| Bottom Depth             | 609                                | 609                      |                 |                       | 728                                              | 728                      |                 |                       | 728                                | 728                      |                 |                       | 609                                   | 609                      |                 |                       | 579                           | 579                      |                 |                       | 518                            | 518                      |                 |                       |
| Formation Tops           | Geofirma Formation Top (mBKB)      | MNR Formation Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Formation Top (mBKB)                    | MNR Formation Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Formation Top (mBKB)      | MNR Formation Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Formation Top (mBKB)         | MNR Formation Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Formation Top (mBKB) | MNR Formation Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Formation Top (mBKB)  | MNR Formation Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | 160                                | 159.4                    | 0.6             | NL                    | 279                                              | 271.3                    | 7.7             | NL                    | nl                                 | np                       | NA              |                       | dif                                   | 34.1                     | 0               | NL                    | nc                            | 184.4                    | 0               | NL                    | dif                            | 210.01                   | 0               | NL                    |
| Salina (G-unit)          | nc                                 | 195.7                    | 0               | GR                    | 341.3                                            | 342                      | -0.7            | GRNL                  | nl                                 | np                       | NA              |                       | 62                                    | np                       | NA              | GRNL                  | 233.5                         | 235                      | -1.5            | GRNL                  | nc                             | 249.02                   | 0               | GR                    |
| Salina (F-unit)          | nc                                 | 203.6                    | 0               | GR                    | 350.5                                            | 351.7                    | -1.2            | GRNL                  | nl                                 | np                       | NA              |                       | nc                                    | 68.9                     | 0               | GRNL                  | 242.25                        | 243.84                   | -1.59           | GRNL                  | nc                             | 256.64                   | 0               | GR                    |
| Cabot Head               | 416                                | 415.7                    | 0.3             | GR                    | nl                                               | np                       | NA              |                       | nc                                 | 197.5                    | 0               | GR                    | 597                                   | 327.7                    | 269.3           | GR                    | 578                           | 579.12                   | -1.12           | GR                    | nc                             | 507.49                   | 0               | GR                    |
| Queenston                | nl                                 | np                       | NA              |                       | nl                                               | np                       | NA              |                       | nc                                 | 223.4                    | 0               | GR                    | nl                                    | np                       | NA              |                       | nl                            | np                       | NA              |                       | nl                             | np                       | NA              | GR                    |
| Cobourg (Collingwood)    | nl                                 | np                       | NA              |                       | nl                                               | np                       | NA              |                       | 518                                | 494.7                    | 23.3            | GR                    | nl                                    | np                       | NA              |                       | nl                            | np                       | NA              |                       | nl                             | np                       | NA              |                       |
| Cobourg (Lower)          | nl                                 | np                       | NA              |                       | nl                                               | np                       | NA              |                       | 537                                | 518.2                    | 18.8            | GR                    | nl                                    | np                       | NA              |                       | nl                            | np                       | NA              |                       | nl                             | np                       | NA              |                       |
| Coboconk                 | nl                                 | np                       | NA              |                       | nl                                               | np                       | NA              |                       | 670                                | 665.4                    | 4.6             | GRNL                  | nl                                    | np                       | NA              |                       | nl                            | np                       | NA              |                       | nl                             | np                       | NA              |                       |
| Gull River (if conflict) | nl                                 | np                       | NA              |                       | nl                                               | np                       | NA              |                       | 685                                | 670.9                    | 14.1            | GRNL                  | nl                                    | np                       | NA              |                       | nl                            | np                       | NA              |                       | nl                             | np                       | NA              |                       |
| Precambrian              | nl                                 | np                       | NA              |                       | nl                                               | np                       | NA              |                       | nc                                 | 720.2                    | 0               | GRNL                  | nl                                    | np                       | NA              |                       | nl                            | np                       | NA              |                       | nl                             | np                       | NA              |                       |

| Legend |                                                                              | Fm          |                                                              | Δ Elevation |                       | * Issues with geophysical logs? |                       | Log Legend |                       |      |                       |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|-------------|-----------------------|---------------------------------|-----------------------|------------|-----------------------|------|-----------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    | GR          | Gamma Ray             | NPHI                            | Neutron Porosity      | GR         | Gamma Ray             | NPHI | Neutron Porosity      |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   | NL          | Neutron Log           | DPHI                            | Density Porosity      | NL         | Neutron Log           | DPHI | Density Porosity      |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | RHOB        | Bulk Density          | DT                              | Interval Transit Time | RHOB       | Bulk Density          | DT   | Interval Transit Time |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                | PE          | Photo-Electric Factor |                                 |                       | PE         | Photo-Electric Factor |      |                       |

Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | FITZGERALD, Kincardine 1 - 14 - VIN |                      |                 |                       | POUNDER & HARMON, Hullett 1 - 31 - V |                      |                 |                       | THIMAC YOUNG CATHERINE NO.1, Logan 4 - 21 - XVI |                      |                 |                       | Pounder & Harmon, Hullett 3 - 18 - I |                      |                 |                       | JACKLIN, Ashfield - 44 - FCNPA |                      |                 |                       | THIMAC, Grey 1 - 15 - VIII |                      |                 |                       |
|--------------------------|-------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------|----------------------|-----------------|-----------------------|--------------------------------|----------------------|-----------------|-----------------------|----------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T003588                             |                      |                 |                       | T003607                              |                      |                 |                       | T003625                                         |                      |                 |                       | T003632A                             |                      |                 |                       | T003656                        |                      |                 |                       | T003661*                   |                      |                 |                       |
| Northing (UTM NAD83)     | 4893570.605                         |                      |                 |                       | 4835277.5                            |                      |                 |                       | 4827079.871                                     |                      |                 |                       | 4828488.322                          |                      |                 |                       | 4877016.8                      |                      |                 |                       | 4842407.615                |                      |                 |                       |
| Easting (UTM NAD83)      | 458401.2511                         |                      |                 |                       | 456629.9708                          |                      |                 |                       | 490214.9977                                     |                      |                 |                       | 458883.8912                          |                      |                 |                       | 440912.8255                    |                      |                 |                       | 486100.8313                |                      |                 |                       |
| BH Depth (TVD)           | 481.89                              |                      |                 |                       | 540.72                               |                      |                 |                       | 401.73                                          |                      |                 |                       | 536.45                               |                      |                 |                       | 643.13                         |                      |                 |                       | 390.14                     |                      |                 |                       |
| BH TD Formation          | Cabot Head                          |                      |                 |                       | Goat Island                          |                      |                 |                       | 0                                               |                      |                 |                       | Goat Island                          |                      |                 |                       | Cabot Head                     |                      |                 |                       | Rochester                  |                      |                 |                       |
| Kelly Bushing Height (m) | 1.22                                |                      |                 |                       | 1.21                                 |                      |                 |                       | 0.61                                            |                      |                 |                       | 1.22                                 |                      |                 |                       | 1.21                           |                      |                 |                       | 0.61                       |                      |                 |                       |
| BH Log                   | GR                                  | NL                   |                 |                       | GR                                   | NL                   |                 |                       | GR                                              | NL                   |                 |                       | GR                                   | NL                   |                 |                       | GR                             | NL                   |                 |                       | GR                         | NL                   |                 |                       |
| Date Acquired            | 1973                                | 1973                 |                 |                       | 1973                                 | 1973                 |                 |                       | 1973                                            | 1973                 |                 |                       | 1973                                 | 1973                 |                 |                       | 1973                           | 1973                 |                 |                       | 1973                       | 1973                 |                 |                       |
| Top Depth                | 0                                   | 0                    |                 |                       | 0                                    | 0                    |                 |                       | 0                                               | 0                    |                 |                       | 0                                    | 0                    |                 |                       | 0                              | 0                    |                 |                       | 0                          | 0                    |                 |                       |
| Bottom Depth             | 487                                 | 487                  |                 |                       | 533                                  | 533                  |                 |                       | 411                                             | 411                  |                 |                       | 532                                  | 532                  |                 |                       | 640                            | 640                  |                 |                       | 396                        | 396                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)            | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                       | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)            | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)      | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)  | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | 201                                 | 190.2                | 10.8            | NL                    | 201                                  | 207.6                | -6.6            | NL                    | 136                                             | 134.72               | 1.28            | NL                    | 213                                  | 212.14               | 0.86            | NL                    | 192                            | 231.6                | -39.6           | NL                    | 101                        | 151.5                | -50.5           | NL                    |
| Salina (G-unit)          | 234.5                               | 234.7                | -0.2            | GRNL                  | nc                                   | 258.5                | 0               | GR                    | 160                                             | np                   | NA              | GR                    | nc                                   | 261.52               | 0               | GRNL                  | nc                             | 290.5                | 0               | GRNL                  | nc                         | 171.3                | 0               | GR                    |
| Salina (F-unit)          | 243.5                               | 237.44               | 6.06            | GRNL                  | nc                                   | 267                  | 0               | GR                    | 169.5                                           | 177.7                | -8.2            | GR                    | 270                                  | 267                  | 3               | GRNL                  | nc                             | 299.6                | 0               | GRNL                  | nc                         | 179.2                | 0               | GR                    |
| Cabot Head               | nc                                  | 476.1                | 0               | GR                    | nl                                   | np                   | NA              |                       | 394                                             | 401.42               | -7.42           | GR                    | nl                                   | np                   | NA              |                       | nc                             | 638.9                | 0               | GR                    | nl                         | np                   | NA              |                       |
| Queenston                | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                         | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                         | np                   | NA              |                       |
| Cobourg (Lower)          | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                         | np                   | NA              |                       |
| Coboconk                 | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                         | np                   | NA              |                       |
| Gull River (if conflict) | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                         | np                   | NA              |                       |
| Precambrian              | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                         | np                   | NA              |                       |

| Well Name                | THIMAC, Ashfield 2 - 6 - XIIIWD |                      |                 |                       | MOFFAT LAKE GODERICH #3, Goderich 3 - 37 - IX |                      |                 |                       | Domtar No.9 Brine Well, Goderich 6 - 2 - MC |                      |                 |                       | Kenartha No.6, Arthur 8 - 23 - VI |                      |                 |                       | Fitzgerald, Tuckersmith 2 - 26 - I |                      |                 |                       | Shell, West Wawanosh 1 - 18 - XIV |                      |                 |                       |
|--------------------------|---------------------------------|----------------------|-----------------|-----------------------|-----------------------------------------------|----------------------|-----------------|-----------------------|---------------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------|----------------------|-----------------|-----------------------|------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T003684                         |                      |                 |                       | T003785                                       |                      |                 |                       | T003895                                     |                      |                 |                       | T004315                           |                      |                 |                       | T004413                            |                      |                 |                       | T004604                           |                      |                 |                       |
| Northing (UTM NAD83)     | 4871845.721                     |                      |                 |                       | 4827632.346                                   |                      |                 |                       | 4842833.871                                 |                      |                 |                       | 4856669.347                       |                      |                 |                       | 4817531.812                        |                      |                 |                       | 4865950.959                       |                      |                 |                       |
| Easting (UTM NAD83)      | 448245.8633                     |                      |                 |                       | 449582.6949                                   |                      |                 |                       | 444461.248                                  |                      |                 |                       | 528883.0756                       |                      |                 |                       | 459110.9214                        |                      |                 |                       | 461635.638                        |                      |                 |                       |
| BH Depth (TVD)           | 612.34                          |                      |                 |                       | 624.84                                        |                      |                 |                       | 495.3                                       |                      |                 |                       | 773.58                            |                      |                 |                       | 528.52                             |                      |                 |                       | 528.52                            |                      |                 |                       |
| BH TD Formation          | Cabot Head                      |                      |                 |                       | Gasport                                       |                      |                 |                       | B Salt                                      |                      |                 |                       | Precambrian                       |                      |                 |                       | Goat Island                        |                      |                 |                       | Gasport                           |                      |                 |                       |
| Kelly Bushing Height (m) | 0.61                            |                      |                 |                       | 0.6                                           |                      |                 |                       | 3.7                                         |                      |                 |                       | 0.7                               |                      |                 |                       | 1.53                               |                      |                 |                       | 1.52                              |                      |                 |                       |
| BH Log                   | GR                              | NL                   |                 |                       | GR                                            | NL                   |                 |                       | GR                                          | NL                   |                 |                       | GR                                | NL                   |                 |                       | GR                                 | NL                   |                 |                       | GR                                | NL                   |                 |                       |
| Date Acquired            | 1974                            | 1974                 |                 |                       | 1975                                          | 1975                 |                 |                       | 1997                                        | 1997                 |                 |                       | 1977                              | 1977                 |                 |                       | 1977                               | 1977                 |                 |                       | 1978                              |                      |                 |                       |
| Top Depth                | 0                               | 0                    |                 |                       | 0                                             | 0                    |                 |                       | 0                                           | 0                    |                 |                       | 506                               | 506                  |                 |                       | 0                                  | 0                    |                 |                       | 45                                |                      |                 |                       |
| Bottom Depth             | 609                             | 609                  |                 |                       | 624                                           | 624                  |                 |                       | 493                                         | 493                  |                 |                       | 768                               | 768                  |                 |                       | 527                                | 527                  |                 |                       | 530                               |                      |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)       | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                     | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)         | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)          | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)         | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nc                              | 224.9                | 0               | NL                    | 257                                           | 270.4                | -13.4           | NL                    | dif                                         | 225.25               | 0               | NL                    | nl                                | np                   | NA              |                       | nc                                 | 204.8                | 0               | NL                    | dif                               | 192.6                | 0               | GR                    |
| Salina (G-unit)          | nc                              | 270.1                | 0               | GRNL                  | nc                                            | 361.5                | 0               | GRNL                  | nc                                          | 282.85               | 0               | GRNL                  | nl                                | np                   | NA              |                       | nc                                 | 248.1                | 0               | GRNL                  | nc                                | 238.7                | 0               | GR                    |
| Salina (F-unit)          | nc                              | 278.3                | 0               | GRNL                  | nc                                            | 368.2                | 0               | GRNL                  | nc                                          | 291.39               | 0               | GRNL                  | nl                                | np                   | NA              |                       | nc                                 | 256.6                | 0               | GRNL                  | nc                                | 246                  | 0               | GR                    |
| Cabot Head               | nc                              | 605.3                | 0               | GR                    | nl                                            | np                   | NA              |                       | nl                                          | np                   | NA              |                       | nl                                | 196.6                | 0               |                       | nl                                 | np                   | NA              |                       | nl                                | np                   | NA              |                       |
| Queenston                | nl                              | np                   | NA              |                       | nl                                            | np                   | NA              |                       | nl                                          | np                   | NA              |                       | nl                                | 224.6                | 0               |                       | nl                                 | np                   | NA              |                       | nl                                | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                              | np                   | NA              |                       | nl                                            | np                   | NA              |                       | nl                                          | np                   | NA              |                       | 515.5                             | 496.8                | 18.7            | GR                    | nl                                 | np                   | NA              |                       | nl                                | np                   | NA              |                       |
| Cobourg (Lower)          | nl                              | np                   | NA              |                       | nl                                            | np                   | NA              |                       | nl                                          | np                   | NA              |                       | 534                               | 515.7                | 18.3            | GR                    | nl                                 | np                   | NA              |                       | nl                                | np                   | NA              |                       |
| Coboconk                 | nl                              | np                   | NA              |                       | nl                                            | np                   | NA              |                       | nl                                          | np                   | NA              |                       | 668                               | 659.6                | 8.4             | GRNL                  | nl                                 | np                   | NA              |                       | nl                                | np                   | NA              |                       |
| Gull River (if conflict) | nl                              | np                   | NA              |                       | nl                                            | np                   | NA              |                       | nl                                          | np                   | NA              |                       | 682                               | 666.3                | 15.7            | GRNL                  | nl                                 | np                   | NA              |                       | nl                                | np                   | NA              |                       |
| Precambrian              | nl                              | np                   | NA              |                       | nl                                            | np                   | NA              |                       | nl                                          | np                   | NA              |                       | nc                                | 721.2                | 0               | GRNL                  | nl                                 | np                   | NA              |                       | nl                                | np                   | NA              |                       |

| Legend |                                                                              | Fm   |                            | Δ Elevation |                                                              | *    |                       | Log Legend |                       |    |             |      |                  |
|--------|------------------------------------------------------------------------------|------|----------------------------|-------------|--------------------------------------------------------------|------|-----------------------|------------|-----------------------|----|-------------|------|------------------|
| nc     | no change                                                                    | Fm   | Formation                  | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | GR   | Gamma Ray             | NPHI       | Neutron Porosity      | NL | Neutron Log | DPHI | Density Porosity |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB | metres below Kelly Bushing |             |                                                              | RHOB | Bulk Density          | DT         | Interval Transit Time |    |             |      |                  |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) |      |                            | *           | Issues with geophysical logs?                                | PE   | Photo-Electric Factor |            |                       |    |             |      |                  |
| dif    | difficult, not easy to pick based on geophysical logs                        |      |                            |             |                                                              |      |                       |            |                       |    |             |      |                  |

Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | Pacific Elma 2-13-XI, Elma 2 - 13 - XI |                      |                 |                       | Pacific, Turnberry 1 - 1 - II |                      |                 |                       | Kenartha, Arthur 3 - 25 - VII |                      |                 |                       | FITZGERALD, Ashfield 4 - 5 - IX |                      |                 |                       | Total et al, Ashfield 1 - 12 - IXED |                      |                 |                       | Pacific, Greenock 1 - 32 - VIII |                      |                 |                       |
|--------------------------|----------------------------------------|----------------------|-----------------|-----------------------|-------------------------------|----------------------|-----------------|-----------------------|-------------------------------|----------------------|-----------------|-----------------------|---------------------------------|----------------------|-----------------|-----------------------|-------------------------------------|----------------------|-----------------|-----------------------|---------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T004730                                |                      |                 |                       | T004767                       |                      |                 |                       | T004848                       |                      |                 |                       | T004849                         |                      |                 |                       | T004851                             |                      |                 |                       | T004854                         |                      |                 |                       |
| Northing (UTM NAD83)     | 4833006.684                            |                      |                 |                       | 4856904.889                   |                      |                 |                       | 4855544.573                   |                      |                 |                       | 4866187.845                     |                      |                 |                       | 4862979.699                         |                      |                 |                       | 4888669.131                     |                      |                 |                       |
| Easting (UTM NAD83)      | 496269.7068                            |                      |                 |                       | 485863.2041                   |                      |                 |                       | 528474.9082                   |                      |                 |                       | 446265.2406                     |                      |                 |                       | 455710.4304                         |                      |                 |                       | 466865.2542                     |                      |                 |                       |
| BH Depth (TVD)           | 873.25                                 |                      |                 |                       | 865.94                        |                      |                 |                       | 739.14                        |                      |                 |                       | 567.54                          |                      |                 |                       | 1037.23                             |                      |                 |                       | 894                             |                      |                 |                       |
| BH TD Formation          | Precambrian                            |                      |                 |                       | Precambrian                   |                      |                 |                       | Precambrian                   |                      |                 |                       | Goat Island                     |                      |                 |                       | Precambrian                         |                      |                 |                       | Precambrian                     |                      |                 |                       |
| Kelly Bushing Height (m) | 1.21                                   |                      |                 |                       | 1.2                           |                      |                 |                       | 1.2                           |                      |                 |                       | 1.1                             |                      |                 |                       | 1.22                                |                      |                 |                       | 1.2                             |                      |                 |                       |
| BH Log                   | GR                                     |                      |                 |                       | GR                            |                      |                 |                       | RHOB                          |                      |                 |                       | GR NL                           |                      |                 |                       | GR                                  |                      |                 |                       | GR NL                           |                      |                 |                       |
| Date Acquired            | 1978                                   |                      |                 |                       | 1978                          |                      |                 |                       | 1978                          |                      |                 |                       | 1979 1979                       |                      |                 |                       | 1978                                |                      |                 |                       | 1979 1979                       |                      |                 |                       |
| Top Depth                | 403                                    |                      |                 |                       | 50                            |                      |                 |                       | 512                           |                      |                 |                       | 0 0                             |                      |                 |                       | 300                                 |                      |                 |                       | 0 0                             |                      |                 |                       |
| Bottom Depth             | 891                                    |                      |                 |                       | 865                           |                      |                 |                       | 739                           |                      |                 |                       | 563 563                         |                      |                 |                       | 1025                                |                      |                 |                       | 894 894                         |                      |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)              | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)     | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)     | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)       | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)       | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nl                                     | 93.88                | 0               |                       | dif                           | 115.5                | 0               | GR                    | nl                            | np                   | NA              |                       | 222                             | 214                  | 8               | NL                    | nl                                  | 214.3                | 0               |                       | nc                              | 151.8                | 0               | NL                    |
| Salina (G-unit)          | nl                                     | 113.39               | 0               |                       | 146                           | 146                  | 0               | GR                    | nl                            | np                   | NA              |                       | nc                              | 260.6                | 0               | GRNL                  | nl                                  | 255.1                | 0               |                       | nc                              | 190.8                | 0               | GR                    |
| Salina (F-unit)          | nl                                     | np                   | NA              |                       | 157                           | 157.3                | -0.3            | GR                    | nl                            | np                   | NA              |                       | nc                              | 269.4                | 0               | GRNL                  | nl                                  | 263                  | 0               |                       | nc                              | 198.1                | 0               | GR                    |
| Cabot Head               | nl                                     | 349                  | 0               |                       | 372                           | 372.5                | -0.5            | GR                    | nl                            | 194.2                | 0               |                       | nl                              | np                   | NA              |                       | 560                                 | 560.8                | -0.8            | GR                    | nc                              | 436.5                | 0               | GR                    |
| Queenston                | nc                                     | 371.25               | 0               |                       | 399                           | 398.7                | 0.3             | GR                    | nl                            | 221.3                | 0               |                       | nl                              | np                   | NA              |                       | 595                                 | 595.6                | -0.6            | GR                    | nc                              | 463.3                | 0               | GR                    |
| Cobourg (Collingwood)    | 681                                    | 615.09               | 65.91           | GR                    | 640                           | 607.8                | 32.2            | GR                    | 518                           | 499.9                | 18.1            | RHOB                  | nl                              | np                   | NA              |                       | 811                                 | 776.3                | 34.7            | GR                    | 680                             | 633.4                | 46.6            | GR                    |
| Cobourg (Lower)          | 700.5                                  | 642.2                | 58.3            | GR                    | 657                           | 639.8                | 17.2            |                       | 536                           | 517.6                | 18.4            | RHOB                  | nl                              | np                   | NA              |                       | 826                                 | 810.5                | 15.5            |                       | 694                             | 679.4                | 14.6            |                       |
| Coboconk                 | 835                                    | 791.3                | 43.7            | GR                    | 787                           | 787                  | 0               | GR                    | 671                           | 665.1                | 5.9             | RHOB                  | nl                              | np                   | NA              |                       | nc                                  | 944.6                | 0               | GR                    | nc                              | 808.3                | 0               | GR                    |
| Gull River (if conflict) | 851                                    | 796.75               | 54.25           | GR                    | nc                            | 805.5                | 0               |                       | 692                           | 670.9                | 21.1            | RHOB                  | nl                              | np                   | NA              |                       | nc                                  | 969.9                | 0               |                       | nc                              | 832.1                | 0               |                       |
| Precambrian              | nl                                     | 868.07               | 0               | GR                    | 859                           | 860                  | -1              | GR                    | nc                            | 726.9                | 0               |                       | nl                              | np                   | NA              |                       | nl                                  | 1034.8               | 0               |                       | nl                              | 889.7                | 0               |                       |

| Well Name                | Fitzgerald, Tuckersmith 3 - 25 - I |                      |                 |                       | SHELL, Ashfield 7 - 1 - IIID |                      |                 |                       | Pacific, Culross 4 - 25 - V |                      |                 |                       | Amoco A-1, Kincardine 2 - 31 - V |                      |                 |                       | SHELL, Ashfield 8 - 1 - IIID |                      |                 |                       | Petromark et al, Elma 2 - 36 - XIV |                      |                 |                       |  |
|--------------------------|------------------------------------|----------------------|-----------------|-----------------------|------------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|----------------------------------|----------------------|-----------------|-----------------------|------------------------------|----------------------|-----------------|-----------------------|------------------------------------|----------------------|-----------------|-----------------------|--|
| BH ID                    | T004855                            |                      |                 |                       | T004864                      |                      |                 |                       | T004881                     |                      |                 |                       | T004910                          |                      |                 |                       | T004918                      |                      |                 |                       | T004985*                           |                      |                 |                       |  |
| Northing (UTM NAD83)     | 4817079.432                        |                      |                 |                       | 4857305.018                  |                      |                 |                       | 4869343.455                 |                      |                 |                       | 4889056.394                      |                      |                 |                       | 4857109.385                  |                      |                 |                       | 4825710.271                        |                      |                 |                       |  |
| Easting (UTM NAD83)      | 458926.2813                        |                      |                 |                       | 444283.3788                  |                      |                 |                       | 473529.9803                 |                      |                 |                       | 463644.0134                      |                      |                 |                       | 444455.3857                  |                      |                 |                       | 503006.9414                        |                      |                 |                       |  |
| BH Depth (TVD)           | 544.4                              |                      |                 |                       | 639                          |                      |                 |                       | 882.7                       |                      |                 |                       | 909                              |                      |                 |                       | 626.4                        |                      |                 |                       | 875.1                              |                      |                 |                       |  |
| BH TD Formation          | Cabot Head                         |                      |                 |                       | Cabot Head                   |                      |                 |                       | Precambrian                 |                      |                 |                       | Precambrian                      |                      |                 |                       | Cabot Head                   |                      |                 |                       | Precambrian                        |                      |                 |                       |  |
| Kelly Bushing Height (m) | 1.2                                |                      |                 |                       | 1.2                          |                      |                 |                       | 1.2                         |                      |                 |                       | 4.8                              |                      |                 |                       | 1.1                          |                      |                 |                       | 1.2                                |                      |                 |                       |  |
| BH Log                   | GR NL                              |                      |                 |                       | GR NPHI DPHI DT              |                      |                 |                       | GR NL                       |                      |                 |                       | GR NL                            |                      |                 |                       | GR                           |                      |                 |                       | no logs                            |                      |                 |                       |  |
| Date Acquired            | 1979 1979                          |                      |                 |                       | 1979 1979 1979               |                      |                 |                       | 1979 1979                   |                      |                 |                       | 1979 1979                        |                      |                 |                       | 1979                         |                      |                 |                       | 1979                               |                      |                 |                       |  |
| Top Depth                | 0 0                                |                      |                 |                       | 25 300 300                   |                      |                 |                       | 25 0 0                      |                      |                 |                       | 140 150                          |                      |                 |                       | 15                           |                      |                 |                       |                                    |                      |                 |                       |  |
| Bottom Depth             | 548 548                            |                      |                 |                       | 639 639 640                  |                      |                 |                       | 635 884 894                 |                      |                 |                       | 900 920                          |                      |                 |                       | 624                          |                      |                 |                       |                                    |                      |                 |                       |  |
| Formation Tops           | Geofirma Form. Top (mBKB)          | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)    | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)    | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)          | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |  |
| Bass Island              | 204                                | 199.3                | 4.7             | NL                    | dif                          | 209.1                | 0               | GR                    | 132                         | 137.2                | -5.2            | NL                    | nl                               | 136                  | 0               |                       | dif                          | 204                  | 0               | GR                    | nl                                 | 77.1                 | 0               |                       |  |
| Salina (G-unit)          | 243                                | 243.2                | -0.2            | GRNL                  | nc                           | 259.7                | 0               | GR                    | nc                          | 173.7                | 0               | GR                    | nc                               | 169.5                | 0               | GRNL                  | 256                          | 257.4                | -1.4            | GR                    | nl                                 | 80.8                 | 0               |                       |  |
| Salina (F-unit)          | 252                                | 252.4                | -0.4            | GRNL                  | nc                           | 267.9                | 0               | GR                    | nc                          | 182.6                | 0               | GR                    | nc                               | 177.8                | 0               | GRNL                  | nc                           | 265.5                | 0               |                       | nl                                 | 83.8                 | 0               |                       |  |
| Cabot Head               | nc                                 | 539.5                | 0               |                       | dif                          | 618.7                | 0               | NPHI                  | nc                          | 407.9                | 0               | GR                    | 456.5                            | 460                  | -3.5            | GRNL                  | nc                           | 612.3                | 0               |                       | nl                                 | 328.6                | 0               |                       |  |
| Queenston                | nl                                 | np                   | NA              |                       | nl                           | np                   | NA              |                       | nc                          | 435.3                | 0               | GR                    | 487.5                            | 487.3                | 0.2             | GRNL                  | nl                           | np                   | NA              |                       | nl                                 | 351.1                | 0               |                       |  |
| Cobourg (Collingwood)    | nl                                 | np                   | NA              |                       | nl                           | np                   | NA              |                       | nc                          | 659.3                | 632.2           | 27.1                  | GR                               | 696.7                | 573.4           | 123.3                 |                              | nl                   | np              | NA                    |                                    | nl                   | 572.6           | 0                     |  |
| Cobourg (Lower)          | nl                                 | np                   | NA              |                       | nl                           | np                   | NA              |                       | 674.6                       | 659.3                | 15.3            |                       | 711.1                            | 696.7                | 14.4            |                       | nl                           | np                   | NA              |                       | nl                                 | 638.3                | 0               |                       |  |
| Coboconk                 | nl                                 | np                   | NA              |                       | nl                           | np                   | NA              |                       | nc                          | 797.1                | 0               | GR                    | nc                               | 830                  | 0               |                       | nl                           | np                   | NA              |                       | nl                                 | 797.4                | 0               |                       |  |
| Gull River (if conflict) | nl                                 | np                   | NA              |                       | nl                           | np                   | NA              |                       | nc                          | 817.5                | 0               |                       | nl                               | 859.6                | 0               |                       | nl                           | np                   | NA              |                       | nl                                 | 813.5                | 0               |                       |  |
| Precambrian              | nl                                 | np                   | NA              |                       | nl                           | np                   | NA              |                       | nc                          | 875.7                | 0               | GRNL                  | nl                               | 903.7                | 0               |                       | nl                           | np                   | NA              |                       | nl                                 | 868.7                | 0               |                       |  |

| Legend |                                                                              |             |                                                              | Log Legend |                       |      |                       |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|------------|-----------------------|------|-----------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    | GR         | Gamma Ray             | NPHI | Neutron Porosity      |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   | NL         | Neutron Log           | DPHI | Density Porosity      |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | RHOB       | Bulk Density          | DT   | Interval Transit Time |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                | PE         | Photo-Electric Factor |      |                       |

Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | SHELL, East Wawanosh 7 - 28 - V |                      |                 |                       | AMOCO, McKillop 4 - 33 - III |                      |                 |                       | Shell, Stanley 3 - 16 - VII |                      |                 |                       | FITZGERALD, Ashfield 2 - 6 - VED |                      |                 |                       | Shell, Goderich 4 - 40 - IX |                      |                 |                       | Kenartha Arthur 4-24-VII, Arthur 4 - 24 - VII |                      |                 |                       |
|--------------------------|---------------------------------|----------------------|-----------------|-----------------------|------------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|----------------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|-----------------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T005051                         |                      |                 |                       | T005124                      |                      |                 |                       | T005130                     |                      |                 |                       | T005131                          |                      |                 |                       | T005166                     |                      |                 |                       | T005177                                       |                      |                 |                       |
| Northing (UTM NAD83)     | 4851355.797                     |                      |                 |                       | 4825796.655                  |                      |                 |                       | 4818492.556                 |                      |                 |                       | 4859000.012                      |                      |                 |                       | 4826279.437                 |                      |                 |                       | 4855921.196                                   |                      |                 |                       |
| Easting (UTM NAD83)      | 459873.3191                     |                      |                 |                       | 466979.2949                  |                      |                 |                       | 451474.0848                 |                      |                 |                       | 448788.0246                      |                      |                 |                       | 448978.2021                 |                      |                 |                       | 528340.8859                                   |                      |                 |                       |
| BH Depth (TVD)           | 594                             |                      |                 |                       | 525                          |                      |                 |                       | 604                         |                      |                 |                       | 573.4                            |                      |                 |                       | 644                         |                      |                 |                       | 883.9                                         |                      |                 |                       |
| BH TD Formation          | Cabot Head                      |                      |                 |                       | Cabot Head                   |                      |                 |                       | Queenston                   |                      |                 |                       | Goat Island                      |                      |                 |                       | Cabot Head                  |                      |                 |                       | Precambrian                                   |                      |                 |                       |
| Kelly Bushing Height (m) | 1.2                             |                      |                 |                       | 3.8                          |                      |                 |                       | 1.4                         |                      |                 |                       | 1.2                              |                      |                 |                       | 1.2                         |                      |                 |                       | 1.5                                           |                      |                 |                       |
| BH Log                   | GR                              | NL                   |                 |                       | GR                           | NPHI                 | DT              | GR#2                  | GR                          | NL                   |                 |                       | GR                               | NL                   |                 |                       | GR#3                        | NPHI                 | DT              | DPHI                  | GR                                            | NL                   |                 |                       |
| Date Acquired            | 1979                            | 1979                 |                 |                       | 1979                         | 1979                 | 1979            | 1979                  | 1979                        | 1979                 |                 |                       | 1979                             | 1979                 |                 |                       | 1979                        | 1979                 | 1979            | 1979                  | 1980                                          | 1980                 |                 |                       |
| Top Depth                | 0                               | 0                    |                 |                       | 200                          | 180                  | 200             | 180                   | 810                         | 810                  |                 |                       | 0                                | 0                    |                 |                       | 30                          | 110                  | 335             | 345                   | 652                                           | 652                  |                 |                       |
| Bottom Depth             | 565                             | 565                  |                 |                       | 500                          | 600                  | 500             | 600                   | 975                         | 975                  |                 |                       | 575                              | 575                  |                 |                       | 650                         | 649                  | 650             | 650                   | 817                                           | 817                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)       | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)    | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                     | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | 212                             | 217.9                | -5.9            | NL                    | nl                           | 184.5                | 0               |                       | nc                          | 207                  | 0               | GR                    | dif                              | 211.5                | 0               | NL                    | dif                         | 284                  | 0               | GR&NPHI               | nl                                            | np                   | NA              |                       |
| Salina (G-unit)          | 256                             | 261.6                | -5.6            | GRNL                  | nc                           | 226                  | 0               | GR                    | nc                          | 250.6                | 0               | GR                    | 260                              | 260.4                | -0.4            | GRNL                  | nc                          | 339.5                | 0               | GR&NPHI               | nl                                            | np                   | NA              |                       |
| Salina (F-unit)          | 263                             | 272.6                | -9.6            | GRNL                  | nc                           | 234.5                | 0               | GR                    | nc                          | 258                  | 0               | GR                    | nc                               | 268                  | 0               | GRNL                  | nc                          | 347                  | 0               | GR&NPHI               | nl                                            | np                   | NA              |                       |
| Cabot Head               | 556                             | 555.2                | 0.8             | GRNL                  | nl                           | 512.5                | 0               | GR                    | nc                          | 564.4                | 0               | GR                    | nl                               | np                   | NA              |                       | nc                          | 640.5                | 0               | GR                    | nl                                            | 195                  | 0               |                       |
| Queenston                | nl                              | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                          | 599.8                | 0               | GR                    | nl                               | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                            | 225.1                | 0               |                       |
| Cobourg (Collingwood)    | nl                              | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                               | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                            | 494.7                | 0               |                       |
| Cobourg (Lower)          | nl                              | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                               | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                            | 511.1                | 0               |                       |
| Coboconk                 | nl                              | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                               | np                   | NA              |                       | nl                          | np                   | NA              |                       | 672                                           | 635.9                | 36.1            | GR                    |
| Gull River (if conflict) | nl                              | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                               | np                   | NA              |                       | nl                          | np                   | NA              |                       | 691                                           | 670.9                | 20.1            | GR                    |
| Precambrian              | nl                              | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                               | np                   | NA              |                       | nl                          | np                   | NA              |                       | 722                                           | 719.8                | 2.2             | GR                    |

| Well Name                | FITZGERALD, Stanley 3 - 30 - I |                      |                 |                       | SHELL, Goderich 1 - 9 - HRC |                      |                 |                       | SHELL, Colborne 1 - 8 - I |                      |                 |                       | HURON 1, Stanley 1 - 10 - X |                      |                 |                       | Huron 3, Stanley 4 - 7 - XI |                      |                 |                       | MILTON RESOURCE, Goderich 1 - 26 - II |                      |                 |                       |
|--------------------------|--------------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|---------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|---------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T005182                        |                      |                 |                       | T005326                     |                      |                 |                       | T005404                   |                      |                 |                       | T005554                     |                      |                 |                       | T005885                     |                      |                 |                       | T006251                               |                      |                 |                       |
| Northing (UTM NAD83)     | 4825121.127                    |                      |                 |                       | 4831467.573                 |                      |                 |                       | 4841008.735               |                      |                 |                       | 4815723.477                 |                      |                 |                       | 4814372.664                 |                      |                 |                       | 4832166.722                           |                      |                 |                       |
| Easting (UTM NAD83)      | 456649.4076                    |                      |                 |                       | 452932.5494                 |                      |                 |                       | 452247.7537               |                      |                 |                       | 449183.2605                 |                      |                 |                       | 447663.7489                 |                      |                 |                       | 443499.7137                           |                      |                 |                       |
| BH Depth (TVD)           | 545                            |                      |                 |                       | 601                         |                      |                 |                       | 625.5                     |                      |                 |                       | 592                         |                      |                 |                       | 615                         |                      |                 |                       | 623.8                                 |                      |                 |                       |
| BH TD Formation          | Goat Island                    |                      |                 |                       | Cabot Head                  |                      |                 |                       | Cabot Head                |                      |                 |                       | Cabot Head                  |                      |                 |                       | Cabot Head                  |                      |                 |                       | Cabot Head                            |                      |                 |                       |
| Kelly Bushing Height (m) | 1.2                            |                      |                 |                       | 1.2                         |                      |                 |                       | 1.2                       |                      |                 |                       | 0.3                         |                      |                 |                       | 0.5                         |                      |                 |                       | 1.2                                   |                      |                 |                       |
| BH Log                   | GR                             | NL                   |                 |                       | GR                          | DT                   |                 |                       | GR                        |                      |                 |                       | GR                          | NL                   |                 |                       | GR                          | NPHI                 |                 |                       | GR                                    | NL                   |                 |                       |
| Date Acquired            | 1980                           | 1980                 |                 |                       | 1980                        | 1980                 |                 |                       | 1980                      |                      |                 |                       | 1982                        | 1982                 |                 |                       | 1982                        | 1982                 |                 |                       | 1983                                  | 1983                 |                 |                       |
| Top Depth                | 0                              | 0                    |                 |                       | 10                          | 275                  |                 |                       | 0                         |                      |                 |                       | 0                           | 0                    |                 |                       | 80                          | 80                   |                 |                       | 0                                     | 0                    |                 |                       |
| Bottom Depth             | 545                            | 550                  |                 |                       | 600                         | 600                  |                 |                       | 625                       |                      |                 |                       | 594                         | 594                  |                 |                       | 614                         | 614                  |                 |                       | 625                                   | 625                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)      | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB) | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)             | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | dif                            | 201.9                | 0               | NL                    | dif                         | 223.2                | 0               | GR                    | dif                       | 245.4                | 0               | GR                    | nc                          | 214                  | 0               | NL                    | nc                          | 239.9                | 0               | NPHI                  | nc                                    | 228                  | 0               | NL                    |
| Salina (G-unit)          | nc                             | 252.3                | 0               | GRNL                  | 267.5                       | 272.3                | -4.8            | GR                    | nc                        | 292                  | 0               | GR                    | nc                          | 264.6                | 0               | GRNL                  | nc                          | 284.2                | 0               | GR&NPHI               | nc                                    | 277                  | 0               | GRNL                  |
| Salina (F-unit)          | nc                             | 261                  | 0               | GRNL                  | 280                         | 280.6                | -0.6            | GR                    | nc                        | 301.2                | 0               | GR                    | nc                          | 273.1                | 0               | GRNL                  | nc                          | 292.4                | 0               | GR&NPHI               | nc                                    | 285                  | 0               | GRNL                  |
| Cabot Head               | nl                             | np                   | NA              |                       | nc                          | 589                  | 0               | GR                    | nc                        | 617                  | 0               | GR                    | nc                          | 589.8                | 0               | GR                    | nl                          | 612.3                | 0               |                       | nc                                    | 622                  | 0               | NL                    |
| Queenston                | nl                             | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                    | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                             | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                    | np                   | NA              |                       |
| Cobourg (Lower)          | nl                             | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                    | np                   | NA              |                       |
| Coboconk                 | nl                             | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                    | np                   | NA              |                       |
| Gull River (if conflict) | nl                             | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                    | np                   | NA              |                       |
| Precambrian              | nl                             | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                          | np                   | NA              |                       | nl                                    | np                   | NA              |                       |

| Legend |                                                                              | Fm          |                                                              | Log Legend |                       |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|------------|-----------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    | GR         | Gamma Ray             |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   | NL         | Neutron Log           |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | RHOB       | Bulk Density          |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                | DT         | Interval Transit Time |
|        |                                                                              |             |                                                              | PE         | Photo-Electric Factor |
|        |                                                                              |             |                                                              | NPHI       | Neutron Porosity      |
|        |                                                                              |             |                                                              | DPHI       | Density Porosity      |

Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | HURON #4, Stanley 3 - 7 - XI |                      |                 |                       | HURON #5, Stanley 2 - 10 - X |                      |                 |                       | TIPPERARY #6, Goderich 1 - 33 - III |                      |                 |                       | Tipperary S #2, Goderich 4 - 40 - IX |                      |                 |                       | Tipperary No.4, Goderich 2 - 37 - IX |                      |                 |                       | Florentine et al 1, Stanley 3 - 20 - XI |                      |                 |                       |
|--------------------------|------------------------------|----------------------|-----------------|-----------------------|------------------------------|----------------------|-----------------|-----------------------|-------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T006307                      |                      |                 |                       | T006322                      |                      |                 |                       | T006341                             |                      |                 |                       | T006346                              |                      |                 |                       | T006364                              |                      |                 |                       | T007104                                 |                      |                 |                       |
| Northing (UTM NAD83)     | 4814467.418                  |                      |                 |                       | 4815783.076                  |                      |                 |                       | 4829333.824                         |                      |                 |                       | 4826391.06                           |                      |                 |                       | 4827488.33                           |                      |                 |                       | 4819475.245                             |                      |                 |                       |
| Easting (UTM NAD83)      | 447698.2279                  |                      |                 |                       | 449053.439                   |                      |                 |                       | 444686.2898                         |                      |                 |                       | 448905.0477                          |                      |                 |                       | 449451.5449                          |                      |                 |                       | 447155.2354                             |                      |                 |                       |
| BH Depth (TVD)           | 576                          |                      |                 |                       | 604                          |                      |                 |                       | 632.8                               |                      |                 |                       | 610                                  |                      |                 |                       | 1134                                 |                      |                 |                       | 613.5                                   |                      |                 |                       |
| BH TD Formation          | Guelph                       |                      |                 |                       | Cabot Head                   |                      |                 |                       | Queenston                           |                      |                 |                       | Cabot Head                           |                      |                 |                       | Precambrian                          |                      |                 |                       | Cabot Head                              |                      |                 |                       |
| Kelly Bushing Height (m) | 2.01                         |                      |                 |                       | 1.96                         |                      |                 |                       | 1.95                                |                      |                 |                       | 2                                    |                      |                 |                       | 2.05                                 |                      |                 |                       | 1.5                                     |                      |                 |                       |
| BH Log                   | GR                           | NPHI                 |                 |                       | GR                           | NPHI                 |                 |                       | GR                                  | NPHI                 |                 |                       | GR                                   | NPHI                 | DPHI            |                       | GR                                   | NPHI                 | RHOB            |                       | GR                                      | NPHI                 |                 |                       |
| Date Acquired            | 1983                         |                      |                 |                       | 1983                         |                      |                 |                       | 1983                                |                      |                 |                       | 1983                                 |                      |                 |                       | 1983                                 |                      |                 |                       | 1987                                    |                      |                 |                       |
| Top Depth                | 15                           | 50                   |                 |                       | 20                           | 20                   |                 |                       | 20                                  | 20                   |                 |                       | 0                                    | 0                    | 334             |                       | 32                                   | 30                   | 360             |                       | 25                                      | 25                   |                 |                       |
| Bottom Depth             | 565                          | 570                  |                 |                       | 567                          | 575                  |                 |                       | 620                                 | 620                  |                 |                       | 641                                  | 650                  | 650             |                       | 1130                                 | 1134                 | 1135            |                       | 615                                     | 615                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)    | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)    | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)            | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)            | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)               | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | dif                          | 247                  | 0               | GR&NPHI               | nc                           | 215.2                | 0               | GR&NPHI               | dif                                 | 222.3                | 0               | GR&NPHI               | dif                                  | 288.2                | 0               | GR&NPHI               | nc                                   | 257                  | 0               | GR                    | dif                                     | 221.6                | 0               | GR                    |
| Salina (G-unit)          | nc                           | 284                  | 0               | GR&NPHI               | 284                          | 268.3                | 15.7            | GR&NPHI               | nc                                  | 273.5                | 0               | GR&NPHI               | 338                                  | 350.4                | -12.4           | GR                    | nc                                   | 350.5                | 0               | GR                    | nc                                      | 271.9                | 0               | GR                    |
| Salina (F-unit)          | nc                           | 292.1                | 0               | GR&NPHI               | 292                          | 276.4                | 15.6            | GR&NPHI               | nc                                  | 281                  | 0               | GR&NPHI               | 346                                  | 358.6                | -12.6           | GR                    | nc                                   | 357                  | 0               | GR                    | nc                                      | 279.5                | 0               | GR                    |
| Cabot Head               | nl                           | np                   | NA              |                       | nl                           | 594.8                | 0               |                       | nl                                  | 613.8                | 0               |                       | 634                                  | 635.6                | -1.6            | GR                    | nc                                   | 638.2                | 0               | GR                    | 605.5                                   | 603.5                | 2               | NPHI                  |
| Queenston                | nl                           | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                                  | 619.4                | 0               |                       | nl                                   | np                   | NA              |                       | nc                                   | 668.6                | 0               | GR                    | nl                                      | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                           | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | 885.5                                | np                   | NA              | GR                    | nl                                      | np                   | NA              |                       |
| Cobourg (Lower)          | nl                           | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | 901                                  | 885.5                | 15.5            | GR                    | nl                                      | np                   | NA              |                       |
| Coboconk                 | nl                           | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | nc                                   | 1029.3               | 0               | GR                    | nl                                      | np                   | NA              |                       |
| Gull River (if conflict) | nl                           | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | dif                                  | 1053.6               | 0               | GR                    | nl                                      | np                   | NA              |                       |
| Precambrian              | nl                           | np                   | NA              |                       | nl                           | np                   | NA              |                       | nl                                  | np                   | NA              |                       | nl                                   | np                   | NA              |                       | 1126                                 | 1123.8               | 2.2             | GR                    | nl                                      | np                   | NA              |                       |

| Well Name                | Owenbrook et al 1, Goderich 1 - 21 - BAC |                      |                 |                       | Orford Res et al 1, Stanley 3 - 5 - X |                      |                 |                       | Orford Res et al #2, Stanley 3 - 15 - VII |                      |                 |                       | BP 1, Ashfield 2 - 6 - XWD |                      |                 |                       | OGS 90-2, Amabel - 7 - A  |                      |                 |                       | OGS 90-3, Amabel - 16 - XIV |                      |                 |                       |
|--------------------------|------------------------------------------|----------------------|-----------------|-----------------------|---------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------|----------------------|-----------------|-----------------------|----------------------------|----------------------|-----------------|-----------------------|---------------------------|----------------------|-----------------|-----------------------|-----------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T007179                                  |                      |                 |                       | T007307                               |                      |                 |                       | T007412                                   |                      |                 |                       | T007544                    |                      |                 |                       | T007586                   |                      |                 |                       | T007587                     |                      |                 |                       |
| Northing (UTM NAD83)     | 4824195.758                              |                      |                 |                       | 4813784.836                           |                      |                 |                       | 4818270.665                               |                      |                 |                       | 4868248.575                |                      |                 |                       | 4932813.621               |                      |                 |                       | 4946326.428                 |                      |                 |                       |
| Easting (UTM NAD83)      | 450366.6979                              |                      |                 |                       | 448923.7323                           |                      |                 |                       | 451441.0505                               |                      |                 |                       | 446247.5951                |                      |                 |                       | 487360.3989               |                      |                 |                       | 483154.3356                 |                      |                 |                       |
| BH Depth (TVD)           | 598                                      |                      |                 |                       | 1114.7                                |                      |                 |                       | 572                                       |                      |                 |                       | 1100                       |                      |                 |                       | 106.4                     |                      |                 |                       | 91.1                        |                      |                 |                       |
| BH TD Formation          | Cabot Head                               |                      |                 |                       | Precambrian                           |                      |                 |                       | Cabot Head                                |                      |                 |                       | Precambrian                |                      |                 |                       | Cabot Head                |                      |                 |                       | Cabot Head                  |                      |                 |                       |
| Kelly Bushing Height (m) | 1.5                                      |                      |                 |                       | 1.4                                   |                      |                 |                       | 2.5                                       |                      |                 |                       | 3.6                        |                      |                 |                       | 0                         |                      |                 |                       | 0                           |                      |                 |                       |
| BH Log                   | GR                                       | NPHI                 |                 |                       | GR                                    | GR#1                 | GR#2            | NPHI                  | GR                                        | NPHI                 |                 |                       | GR                         | GR#1                 | GR#2            | NL                    | GR                        |                      |                 |                       | GR                          |                      |                 |                       |
| Date Acquired            | 1987                                     |                      |                 |                       | 1987                                  |                      |                 |                       | 1988                                      |                      |                 |                       | 1988                       |                      |                 |                       | 1990                      |                      |                 |                       | 1990                        |                      |                 |                       |
| Top Depth                | 15                                       | 15                   |                 |                       | 25                                    | 0                    | 285             | 267                   | 0                                         | 0                    |                 |                       | 575                        | 350                  | 275             | 275                   | 0                         |                      |                 |                       | 0                           |                      |                 |                       |
| Bottom Depth             | 600                                      | 600                  |                 |                       | 1100                                  | 285                  | 1100            | 1100                  | 570                                       | 570                  |                 |                       | 1100                       | 1095                 | 1090            | 1090                  | 104                       |                      |                 |                       | 91                          |                      |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)                | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)             | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                 | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)  | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB) | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)   | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nc                                       | 235.5                | 0               | GR&NPHI               | dif                                   | 218.5                | 0               | DT                    | dif                                       | 211                  | 0               | GR&NPHI               | nl                         | 198                  | 0               |                       | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |
| Salina (G-unit)          | nc                                       | 285.2                | 0               | GR&NPHI               | nc                                    | 270.9                | 0               | GR&DT                 | nc                                        | 251.6                | 0               | GR&NPHI               | 278.5                      | 268.1                | 10.4            | NL                    | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |
| Salina (F-unit)          | nc                                       | 292.8                | 0               | GR&NPHI               | nc                                    | 278.6                | 0               | GR&DT                 | nc                                        | 260.2                | 0               | GR&NPHI               | 283                        | 276.4                | 6.6             | GRNL                  | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |
| Cabot Head               | nl                                       | np                   | NA              |                       | 598                                   | 598                  | 0               | GR&DT                 | 567.5                                     | 568.4                | -0.9            | GR                    | nc                         | 596                  | 0               | GR                    | 100                       | 105.2                | -5.2            | GR                    | nc                          | 89.1                 | 0               | GR                    |
| Queenston                | nl                                       | np                   | NA              |                       | nc                                    | 636                  | 0               | GR&DT                 | nl                                        | np                   | NA              |                       | nc                         | 634.1                | 0               | GR                    | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                                       | np                   | NA              |                       | 861.1                                 | np                   | NA              | GR&DT                 | nl                                        | np                   | NA              |                       | 841.4                      | np                   | NA              | GR                    | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |
| Cobourg (Lower)          | nl                                       | np                   | NA              |                       | 879                                   | 861.1                | 17.9            | GR&DT                 | nl                                        | np                   | NA              |                       | 855                        | 841.4                | 13.6            | GR                    | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |
| Coboconk                 | nl                                       | np                   | NA              |                       | nc                                    | 1009.8               | 0               | GR&DT                 | nl                                        | np                   | NA              |                       | nc                         | 960.5                | 0               | GR                    | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |
| Gull River (if conflict) | nl                                       | np                   | NA              |                       | nl                                    | 1035                 | 0               |                       | nl                                        | np                   | NA              |                       | nl                         | 991.8                | 0               |                       | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |
| Precambrian              | nl                                       | np                   | NA              |                       | nl                                    | 1104                 | 0               |                       | nl                                        | np                   | NA              |                       | dif                        | 1066                 | 0               | GR                    | nl                        | np                   | NA              |                       | nl                          | np                   | NA              |                       |

| Legend |                                                                              |             |                                                              | Log Legend |                       |      |                       |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|------------|-----------------------|------|-----------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    | GR         | Gamma Ray             | NPHI | Neutron Porosity      |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   | NL         | Neutron Log           | DPHI | Density Porosity      |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | RHOB       | Bulk Density          | DT   | Interval Transit Time |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                | PE         | Photo-Electric Factor |      |                       |

Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | Sifto #10 Brine Well, Goderich 6 - 2 - MC |                      |                 |                       | Paragon Bayfield #1, Stanley 1 - 10 - RE |                      |                 |                       | Clearwood et al #12, Tuckersmith 2 - 30 - IIISHR |                      |                 |                       | Tribute et al #16, Goderich 2 - 66 - VIII |                      |                 |                       | Sifto #11, Goderich 5 - 13 - A |                      |                 |                       | Brine Well No. 6, Goderich - 1 - MC |                      |                 |                       |
|--------------------------|-------------------------------------------|----------------------|-----------------|-----------------------|------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------|----------------------|-----------------|-----------------------|--------------------------------|----------------------|-----------------|-----------------------|-------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T008004*                                  |                      |                 |                       | T008250                                  |                      |                 |                       | T008657                                          |                      |                 |                       | T008843                                   |                      |                 |                       | T009126                        |                      |                 |                       | T009355                             |                      |                 |                       |
| Northing (UTM NAD83)     | 4842709.42                                |                      |                 |                       | 4822580.896                              |                      |                 |                       | 4824266.412                                      |                      |                 |                       | 4823294.773                               |                      |                 |                       | 4843329.594                    |                      |                 |                       | 4843143.655                         |                      |                 |                       |
| Easting (UTM NAD83)      | 444482.2927                               |                      |                 |                       | 445366.5836                              |                      |                 |                       | 460213.32                                        |                      |                 |                       | 448232.7801                               |                      |                 |                       | 444083.4693                    |                      |                 |                       | 444347.6169                         |                      |                 |                       |
| BH Depth (TVD)           | 498.6                                     |                      |                 |                       | 612                                      |                      |                 |                       | 539                                              |                      |                 |                       | 623                                       |                      |                 |                       | 470                            |                      |                 |                       | 477.6                               |                      |                 |                       |
| BH TD Formation          | B Salt                                    |                      |                 |                       | Cabot Head                               |                      |                 |                       | Goat Island                                      |                      |                 |                       | Cabot Head                                |                      |                 |                       | A-2 Carbonate                  |                      |                 |                       | B Salt                              |                      |                 |                       |
| Kelly Bushing Height (m) | 3.2                                       |                      |                 |                       | 1.3                                      |                      |                 |                       | 1.35                                             |                      |                 |                       | 1.3                                       |                      |                 |                       | 3.2                            |                      |                 |                       | 0.3                                 |                      |                 |                       |
| BH Log                   | no logs?                                  |                      |                 |                       | GR DT                                    |                      |                 |                       | GR DT                                            |                      |                 |                       | GR NPHI ZNPHI                             |                      |                 |                       | GR NL DT#2 DT#3                |                      |                 |                       | GR                                  |                      |                 |                       |
| Date Acquired            | 1993                                      |                      |                 |                       | 1995 1995                                |                      |                 |                       | 1998 1998                                        |                      |                 |                       | 1999 1999 1999                            |                      |                 |                       | 2000 2000 2000 2000            |                      |                 |                       | 1960                                |                      |                 |                       |
| Top Depth                |                                           |                      |                 |                       | 325 325                                  |                      |                 |                       | 0 16                                             |                      |                 |                       | 0 0 335                                   |                      |                 |                       | 0 0 60 385                     |                      |                 |                       | 35                                  |                      |                 |                       |
| Bottom Depth             |                                           |                      |                 |                       | 610 610                                  |                      |                 |                       | 525 530                                          |                      |                 |                       | 625 625 625                               |                      |                 |                       | 470 470 385 465                |                      |                 |                       | 195                                 |                      |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)                 | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                        | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                 | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)      | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)           | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nl                                        | np                   | NA              |                       | nl                                       | 227                  | 0               |                       | dif                                              | 178.2                | 0               | GR&DT                 | dif                                       | 256.5                | 0               |                       | dif                            | 183                  | 0               | NL                    | nl                                  | 210.31               | 0               |                       |
| Salina (G-unit)          | nl                                        | np                   | NA              |                       | nl                                       | 271.4                | 0               |                       | nc                                               | 270                  | 0               | GR                    | nc                                        | 304.3                | 0               |                       | 246                            | 248.9                | -2.9            | GRNL                  | nl                                  | 268.53               | 0               |                       |
| Salina (F-unit)          | nl                                        | np                   | NA              |                       | nl                                       | 279.7                | 0               |                       | nc                                               | 278                  | 0               | GR                    | nc                                        | 312.2                | 0               |                       | 255                            | 257.2                | -2.2            | GRNL                  | nl                                  | 276.15               | 0               |                       |
| Cabot Head               | nl                                        | np                   | NA              |                       | 603.5 (dif)                              | 604.8                | -1.3            | DT                    | nl                                               | np                   | NA              |                       | dif                                       | 621                  | 0               | GR                    | nl                             | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Queenston                | nl                                        | np                   | NA              |                       | nl                                       | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                        | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                                        | np                   | NA              |                       | nl                                       | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                        | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Cobourg (Lower)          | nl                                        | np                   | NA              |                       | nl                                       | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                        | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Coboconk                 | nl                                        | np                   | NA              |                       | nl                                       | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                        | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Gull River (if conflict) | nl                                        | np                   | NA              |                       | nl                                       | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                        | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                                  | np                   | NA              |                       |
| Precambrian              | nl                                        | np                   | NA              |                       | nl                                       | np                   | NA              |                       | nl                                               | np                   | NA              |                       | nl                                        | np                   | NA              |                       | nl                             | np                   | NA              |                       | nl                                  | np                   | NA              |                       |

| Well Name                | Lyleton Sturdy, Goderich 3 - 20 - VII |                      |                 |                       | Tribute et al #22, Goderich 2 - 39 - IX |                      |                 |                       | NCE Fordyce North, West Wawanosh 1 - 25 - XIIWD |                      |                 |                       | DGR-1, Bruce 4 - 20 - LR  |                      |                 |                       | DGR-2, Bruce 4 - 20 - LR  |                      |                 |                       | Tribute et al #23 (Horiz.#1), Goderich 2 - 39 - IX |                      |                 |                       |
|--------------------------|---------------------------------------|----------------------|-----------------|-----------------------|-----------------------------------------|----------------------|-----------------|-----------------------|-------------------------------------------------|----------------------|-----------------|-----------------------|---------------------------|----------------------|-----------------|-----------------------|---------------------------|----------------------|-----------------|-----------------------|----------------------------------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T010054                               |                      |                 |                       | T010686                                 |                      |                 |                       | T011560                                         |                      |                 |                       | T011582                   |                      |                 |                       | T011583                   |                      |                 |                       | T011651                                            |                      |                 |                       |
| Northing (UTM NAD83)     | 4834523.749                           |                      |                 |                       | 4826822.838                             |                      |                 |                       | 4861410.397                                     |                      |                 |                       | 4907754.913               |                      |                 |                       | 4907719.803               |                      |                 |                       | 4826253.755                                        |                      |                 |                       |
| Easting (UTM NAD83)      | 447293.854                            |                      |                 |                       | 449347.573                              |                      |                 |                       | 464022.2215                                     |                      |                 |                       | 454239.7915               |                      |                 |                       | 454208.4902               |                      |                 |                       | 449293.2441                                        |                      |                 |                       |
| BH Depth (TVD)           | 665                                   |                      |                 |                       | 640                                     |                      |                 |                       | 541                                             |                      |                 |                       | 465.1                     |                      |                 |                       | 864.2                     |                      |                 |                       | 564                                                |                      |                 |                       |
| BH TD Formation          | Rochester                             |                      |                 |                       | Gasport                                 |                      |                 |                       | Cabot Head                                      |                      |                 |                       | Queenston                 |                      |                 |                       | Precambrian               |                      |                 |                       | Guelph                                             |                      |                 |                       |
| Kelly Bushing Height (m) | 3.6                                   |                      |                 |                       | 1.3                                     |                      |                 |                       | 3.3                                             |                      |                 |                       | 2.21                      |                      |                 |                       | 2.14                      |                      |                 |                       | 4.6                                                |                      |                 |                       |
| BH Log                   | GR GR#1 NPHI DT                       |                      |                 |                       | GR GR#1 NPHI PE                         |                      |                 |                       | GR DT                                           |                      |                 |                       | GR NL                     |                      |                 |                       | GR                        |                      |                 |                       | GR                                                 |                      |                 |                       |
| Date Acquired            | 2001 2001 2001 2001                   |                      |                 |                       | 2004 2004 2004 2004                     |                      |                 |                       | 2007 2007                                       |                      |                 |                       | 2007 2007                 |                      |                 |                       | 2007                      |                      |                 |                       | 2007                                               |                      |                 |                       |
| Top Depth                | 0 295 0 300                           |                      |                 |                       | 0 360 0 368                             |                      |                 |                       | 10 250                                          |                      |                 |                       | 177 0                     |                      |                 |                       | 0                         |                      |                 |                       | 5                                                  |                      |                 |                       |
| Bottom Depth             | 650 650 655 655                       |                      |                 |                       | 655 640 640 640                         |                      |                 |                       | 540 540                                         |                      |                 |                       | 462.5 463                 |                      |                 |                       | 836                       |                      |                 |                       | 345                                                |                      |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB)             | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)               | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                       | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB) | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB) | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)                          | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | 244                                   | np                   | NA              | GR                    | nc                                      | 291.8                | 0               | GR                    | dif                                             | 198.4                | 0               | GR                    | 128.3                     | 126.2                | 2.1             | NL                    | nc                        | 124                  | 0               | NL                    | dif                                                | 292                  | 0               | GR                    |
| Salina (G-unit)          | nc                                    | 303                  | 0               |                       | nc                                      | 365.5                | 0               | GR                    | nc                                              | 246                  | 0               | GR                    | nc                        | 180.2                | 0               | NL                    | nc                        | 169.3                | 0               | GR                    | nl                                                 | 366                  | 0               | GR                    |
| Salina (F-unit)          | nc                                    | 312                  | 0               |                       | nc                                      | 373                  | 0               | GR                    | nc                                              | 253.8                | 0               | GR                    | nc                        | 185.2                | 0               | GRNL                  | nc                        | 178.6                | 0               | GR                    | nl                                                 | 374                  | 0               | GR                    |
| Cabot Head               | nl                                    | np                   | NA              |                       | nl                                      | np                   | NA              |                       | nc                                              | 531                  | 0               | DT                    | nc                        | 413.2                | 0               | GR                    | nc                        | 411                  | 0               | GR                    | nl                                                 | np                   | NA              |                       |
| Queenston                | nl                                    | np                   | NA              |                       | nl                                      | np                   | NA              |                       | nl                                              | np                   | NA              |                       | 447.6                     | 449.9                | -2.3            | GR                    | nc                        | 447.7                | 0               | GR                    | nl                                                 | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                                    | np                   | NA              |                       | nl                                      | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                        | np                   | NA              |                       | nc                        | 651.6                | 0               | GR                    | nl                                                 | np                   | NA              |                       |
| Cobourg (Lower)          | nl                                    | np                   | NA              |                       | nl                                      | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                        | np                   | NA              |                       | nc                        | 659.5                | 0               | GR                    | nl                                                 | np                   | NA              |                       |
| Coboconk                 | nl                                    | np                   | NA              |                       | nl                                      | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                        | np                   | NA              |                       | nc                        | 762                  | 0               | GR                    | nl                                                 | np                   | NA              |                       |
| Gull River (if conflict) | nl                                    | np                   | NA              |                       | nl                                      | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                        | np                   | NA              |                       | nc                        | 785                  | 0               | GR                    | nl                                                 | np                   | NA              |                       |
| Precambrian              | nl                                    | np                   | NA              |                       | nl                                      | np                   | NA              |                       | nl                                              | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                        | 860.7                | 0               | GR                    | nl                                                 | np                   | NA              |                       |

| Legend |                                                                              |             |                                                              | Log Legend |                       |      |                       |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|------------|-----------------------|------|-----------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    | GR         | Gamma Ray             | NPHI | Neutron Porosity      |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   | NL         | Neutron Log           | DPHI | Density Porosity      |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | RHOB       | Bulk Density          | DT   | Interval Transit Time |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                | PE         | Photo-Electric Factor |      |                       |





Appendix C. Summary of Key Formation Top Picks Using Borehole Geophysics

| Well Name                | NCE FitzGerald, Ashfield 5 - 5 - IXWD |                      |                 |                       | DGR-3, Bruce 8 - 18 - LR  |                      |                 |                       | DGR-4, Bruce 9 - 23 - LR  |                      |                 |                       | DGR-5 (Dev.#1), Bruce 4 - 20 - LR |                      |                 |                       | DGR-6 (Dev.#1), Bruce 6 - 22 - LR |                      |                 |                       | DGR-8, Bruce 8 - 20 - LR  |                      |                 |                       |
|--------------------------|---------------------------------------|----------------------|-----------------|-----------------------|---------------------------|----------------------|-----------------|-----------------------|---------------------------|----------------------|-----------------|-----------------------|-----------------------------------|----------------------|-----------------|-----------------------|-----------------------------------|----------------------|-----------------|-----------------------|---------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T011742                               |                      |                 |                       | T011811                   |                      |                 |                       | T011812                   |                      |                 |                       | T011926                           |                      |                 |                       | T011942                           |                      |                 |                       | T012102                   |                      |                 |                       |
| Northing (UTM NAD83)     | 4866018.938                           |                      |                 |                       | 4907739.802               |                      |                 |                       | 490743.902                |                      |                 |                       | 4907481.642                       |                      |                 |                       | 4908371.35                        |                      |                 |                       | 4908235.175               |                      |                 |                       |
| Easting (UTM NAD83)      | 446281.9276                           |                      |                 |                       | 453080.4944               |                      |                 |                       | 453378.3014               |                      |                 |                       | 454219.9807                       |                      |                 |                       | 453953.3784                       |                      |                 |                       | 453397.2654               |                      |                 |                       |
| BH Depth (TVD)           | 566                                   |                      |                 |                       | 871.3                     |                      |                 |                       | 859.2                     |                      |                 |                       | 754.9                             |                      |                 |                       | 789                               |                      |                 |                       | 727.1                     |                      |                 |                       |
| BH TD Formation          | Goat Island                           |                      |                 |                       | Cambrian                  |                      |                 |                       | Cambrian                  |                      |                 |                       | Kirkfield                         |                      |                 |                       | Gull River                        |                      |                 |                       | Kirkfield                 |                      |                 |                       |
| Kelly Bushing Height (m) | 3.3                                   |                      |                 |                       | 2.15                      |                      |                 |                       | 2.2                       |                      |                 |                       | 2.75                              |                      |                 |                       | 3.5                               |                      |                 |                       | 3.32                      |                      |                 |                       |
| BH Log                   | GR                                    | NPHI                 |                 |                       | GR                        | NL                   |                 |                       | GR                        | GR#2                 | NL              | NL(U)                 | GR                                | NL                   |                 |                       | GR                                |                      |                 |                       | GR (U)                    | GR                   | NL              | NL#4                  |
| Date Acquired            | 2007                                  | 2007                 |                 |                       | 2008                      | 2008                 |                 |                       | 2008                      | 2008                 | 2008            | 2008                  | 2009                              | 2009                 |                 |                       | 2010                              |                      |                 |                       | 2011                      | 2011                 | 2011            | 2011                  |
| Top Depth                | 5                                     | 5                    |                 |                       | 0                         | 1                    |                 |                       | 0                         | 165                  | 166             | 0                     | 0                                 | 0                    |                 |                       | 0                                 |                      |                 |                       | 0                         | 205                  | 0               | 198                   |
| Bottom Depth             | 535                                   | 535                  |                 |                       | 847                       | 849                  |                 |                       | 187                       | 838                  | 839             | 189                   | 806                               | 806                  |                 |                       | 896                               |                      |                 |                       | 192                       | 732                  | 192             | 726                   |
| Formation Tops           | Geofirma Form. Top (mBKB)             | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB) | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB) | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)         | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB)         | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick | Geofirma Form. Top (mBKB) | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | dif                                   | 190.5                | 0               | GR                    | 144.5                     | 143.3                | 1.2             | NL                    | nl                        | 128.2                | 0               | NL                    | nc                                | 134.8                | 0               | NL                    | nc                                | 145.3                | 0               | GR                    | nc                        | 138.9                | 0               | NL                    |
| Salina (G-unit)          | nc                                    | 261.2                | 0               | GR                    | nc                        | 187.3                | 0               | GR                    | nc                        | 170.1                | 0               | GRNL                  | nc                                | 184                  | 0               | GRNL                  | nc                                | 193                  | 0               | GR                    | nc                        | 182.8                | 0               | GRNL                  |
| Salina (F-unit)          | nc                                    | 270.2                | 0               | GR                    | nc                        | 196.5                | 0               | GR                    | nc                        | 177.4                | 0               | GRNL                  | nc                                | 192.5                | 0               | GRNL                  | nc                                | 203                  | 0               | GR                    | nc                        | 190.3                | 0               | GRNL                  |
| Cabot Head               | nl                                    | np                   | NA              |                       | nc                        | 422.8                | 0               | GR                    | nc                        | 411.5                | 0               | GR                    | nc                                | 447.8                | 0               | GR                    | nc                                | 467.9                | 0               | GR                    | nc                        | 420.5                | 0               | GR                    |
| Queenston                | nl                                    | np                   | NA              |                       | nc                        | 457                  | 0               | GR                    | nc                        | 446.3                | 0               | GR                    | 483                               | 486.6                | -3.6            | GR                    | nc                                | 507.9                | 0               | GR                    | 453                       | 454.9                | -1.9            | GR                    |
| Cobourg (Collingwood)    | nl                                    | np                   | NA              |                       | nc                        | 664.3                | 0               | GR                    | nc                        | 653.1                | 0               | GR                    | nc                                | 699.9                | 0               | GR                    | nc                                | 738.3                | 0               | GR                    | nc                        | 661.3                | 0               | GR                    |
| Cobourg (Lower)          | nl                                    | np                   | NA              |                       | 676                       | 673                  | 3               | GR                    | nc                        | 661.5                | 0               | GR                    | nc                                | 708.7                | 0               |                       | nc                                | 746.1                | 0               | GR                    | nc                        | 669.2                | 0               |                       |
| Coboconk                 | nl                                    | np                   | NA              |                       | nc                        | 775.6                | 0               | GR                    | nc                        | 763                  | 0               | GR                    | nl                                | np                   | NA              |                       | nc                                | 870.5                | 0               | GR                    | nl                        | np                   | NA              |                       |
| Gull River (if conflict) | nl                                    | np                   | NA              |                       | nl                        | 799.3                | 0               | GR                    | nl                        | 786.8                | 0               | GR                    | nl                                | np                   | NA              |                       | nc                                | 897.2                | 0               |                       | nl                        | np                   | NA              |                       |
| Precambrian              | nl                                    | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                        | np                   | NA              |                       | nl                                | np                   | NA              |                       | nl                                | np                   | NA              |                       | nl                        | np                   | NA              |                       |

| Well Name                | DGR-7, Bruce - -          |                      |                 |                       |
|--------------------------|---------------------------|----------------------|-----------------|-----------------------|
| BH ID                    | T012103                   |                      |                 |                       |
| Northing (UTM NAD83)     | 4908215.659               |                      |                 |                       |
| Easting (UTM NAD83)      | 453473.1433               |                      |                 |                       |
| BH Depth (TVD)           | 190                       |                      |                 |                       |
| BH TD Formation          | F Unit                    |                      |                 |                       |
| Kelly Bushing Height (m) | 3.2                       |                      |                 |                       |
| BH Log                   | GR                        | NL                   |                 |                       |
| Date Acquired            | 2011                      | 2011                 |                 |                       |
| Top Depth                | 8                         | 1                    |                 |                       |
| Bottom Depth             | 188                       | 190                  |                 |                       |
| Formation Tops           | Geofirma Form. Top (mBKB) | MNR Form. Top (mBKB) | Δ Elevation (m) | Log Used to Make Pick |
| Bass Island              | nc                        | 138.3                | 0               | NL                    |
| Salina (G-unit)          | nc                        | 182                  | 0               | GRNL                  |
| Salina (F-unit)          | nc                        | 190.7                | 0               | NL                    |
| Cabot Head               | nl                        | np                   | NA              |                       |
| Queenston                | nl                        | np                   | NA              |                       |
| Cobourg (Collingwood)    | nl                        | np                   | NA              |                       |
| Cobourg (Lower)          | nl                        | np                   | NA              |                       |
| Coboconk                 | nl                        | np                   | NA              |                       |
| Gull River (if conflict) | nl                        | np                   | NA              |                       |
| Precambrian              | nl                        | np                   | NA              |                       |

| Legend |                                                                              | Fm          |                                                              | Log Legend |                       |
|--------|------------------------------------------------------------------------------|-------------|--------------------------------------------------------------|------------|-----------------------|
| nc     | no change                                                                    | Fm          | Formation                                                    | GR         | Gamma Ray             |
| nl     | not logged BH geophysical data does not cover this formation                 | mBKB        | metres below Kelly Bushing                                   | NL         | Neutron Log           |
| np     | not present (not picked in MNR interpretation and not evident in geophysics) | Δ Elevation | change in elevation of Fm top from MNR pick to Geofirma pick | RHOB       | Bulk Density          |
| dif    | difficult, not easy to pick based on geophysical logs                        | *           | Issues with geophysical logs?                                | DT         | Interval Transit Time |
|        |                                                                              |             |                                                              | PE         | Photo-Electric Factor |
|        |                                                                              |             |                                                              | NPHI       | Neutron Porosity      |
|        |                                                                              |             |                                                              | DPHI       | Density Porosity      |

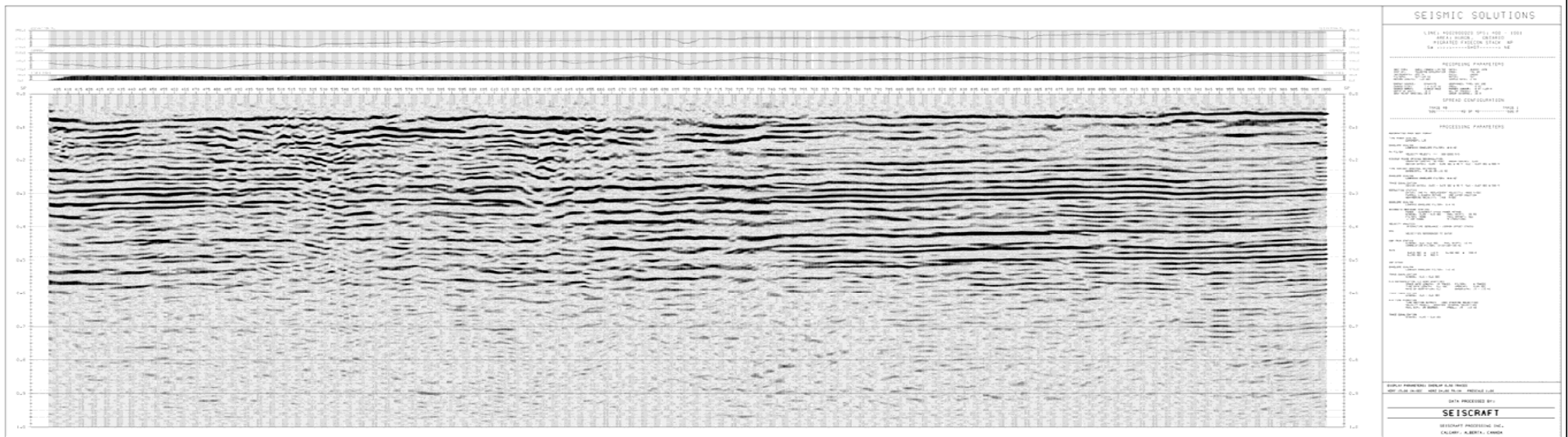
## **APPENDIX D**

### **Summary of 2D Seismic Processed Data**









Processed 2D Seismic Data (Line A0028020)  
 Interpretation of Borehole Geophysical Well Log and 2D Seismic Data – Sedimentary Sites

Prepared by: SNS

Reviewed by: DS

Date: 10-Nov-14

Figure D.4

Doc. No. 10-214-7.50\_Appendix D\_Seismic Data\_R0