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

For more information, please contact:
Nuclear Waste Management Organization
22 St. Clair Avenue East, Sixth Floor
Toronto, Ontario M4T 2S3 Canada
Tel 416.934.9814
Toll Free 1.866.249.6966
Email contactus@nwmo.ca
www.nwmo.ca

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)

Prepared for:
Nuclear Waste Management Organization
22 ST. Clair Avenue East, 6th Floor
Toronto, Ontario M4T 2S3

Prepared by:

Geofirma Engineering Ltd
1 Raymond St., Suite 200
Ottawa, Ontario K1R 1A2
Tel: (613) 232-2525
Fax: (613) 232-7149
www.geofirma.com

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	
Reviewed by:	Kenneth Raven	
Approved by:	Kenneth Raven	

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.

TABLE OF CONTENTS

FIGURES (IN ORDER FOLLOWING TEXT)

TABLES

APPENDICES

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^2 to 35 km^2 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^2. Water bodies cover 38.7 km^2 or 0.8 % of the land within Area of the Five Communities. Wetlands cover 671.8 km^2 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 1º 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

Million Years Before Present	***Tectonic Activity***	***Reference***
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 • E-W to NW-SE compression, uplift in foreland (Frontenac and Algonquin Arches)	Quinlan and Beaumont (1984), Sloss (1982), McWilliams et al. (2007)
410 – 320	Caledonian/Acadian Orogeny • E-W to NW-SE compression, uplift (Frontenac and Algonquin Arches)	Gross et al. (1992), Marshak and Tabor (1989), Sutter et al. (1985), Kesler and Carrigan (2002)
300 – 250	Alleghenian Orogeny • E-W to NW-SE compression	Gross et al. (1992), Engelder and Geiser (1980)
200 – 50	• Opening of the Atlantic Ocean • St. Lawrence rift system created • Reactivation of Ottawa-Bonnechère Graben • NE-SW extension • Uplift	Kumarapeli (1976, 1985)
Pre-50 – Present	• NE-SW compression (from ridge push) • Post-glacial uplift	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 (aeromagnetics 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).

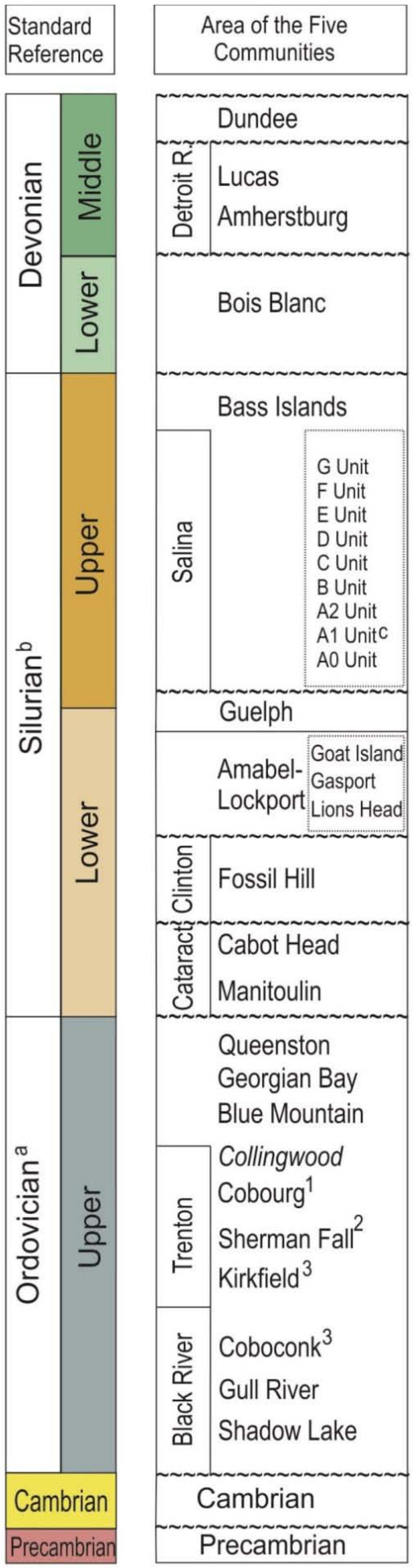
2.2.4.1 Cambrian

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)



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

Line	***725937***	***825938***	***A003900020***	***A002800018***
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 addtitonal 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

Formation Top	***Rationale***	***Confidence***	***Stratigraphic Package***
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 statistics, 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 Statistics:* 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 OGSRL 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

Seismic Marker	*Peak/Trough (normal polarity plots)*	*Quality*	*Geologic Time*
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 ¼ 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

Formation	***Total # with OGSRL picks***	***Unchanged from OGSRL***		***Changed +/- 0 to 5m***		***Changed +/- 5 to 10m***		***Changed > +/- 10m***	
		#	***%***	***#***	***%***	***#***	***%***	***#***	***%***
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
Total	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° and 1° 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 to 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***	***T004881***
		Borehole Geophysics Data	*No*	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*
		Date Drilled	*1948*	*1948*	*1948*	*1948*	*1969*	*1979*	*1942*	*1941*	*1941*	*1978*
		Total Depth (mBGS)	*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	***130.8***
		Salina G Unit*	21.6	9.1		20.4	***189.1***	189.6	177.1	133.2	156.7	172.5
		Salina F Unit*					***197.1***	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
		Guelph Formation					379.5	391.4	359.7	317.0	329.8	365.5
	Lower	Reynales / Fossil Hill Formation					424.9	427.0	393.2			
		Cabot Head Formation*					***427.1***	435.3	402.7			406.7
		Manitoulin Formation						453.3	419.4			425.5
Ordovician	Upper	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*						***678.8***	<u>657.5</u>		<u>659.9</u>	***658.1***
		Cobourg Formation						***692.8***				***673.4***
		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
		Gull River Formation						830.9	802.5			816.3
		Shadow Lake Formation						882.7	861.1			870.8
Precambrian		Precambrian*						888.5	867.8			874.5

<u>Notes:</u>
* 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
<u>underlined</u> 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	***198.4***	182.3	162.2	214.3	183.2	208.5		57.6	44.5
		Salina G Unit*	250.8	***241.9***	***222.4***	***201.4***	267.6	***232.3***	247.5		61.3	***71.1***
		Salina F Unit*		***250.4***	***230.4***	208.2	277.1	***241.0***	255.1			***81.1***
		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
	Upper / Lower	Guelph Formation	516.0	522.4	426.1	331.6	566.6	418.8	471.5	140.2	140.9	210.0
	Lower	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		***600.1***	***576.8***		281.0	***283.4***	***330.1***
		Manitoulin Formation	570.9							290.8	290.2	337.4
Ordovician	Upper	Queenston Formation*	580.0								***310.4***	***359.1***
		Georgian Bay / Blue Mtn Formation	657.7								361.5	416.7
		Collingwood Member*	804.1								***521.4***	***570.1***
		Cobourg Formation									***534.9***	***582.6***
		Sherman Fall Formation	840.6								565.8	612.4
		Kirkfield Formation	890.9									
		Coboconk Formation*									640.1	688.6
		Gull River Formation	932.1									697.1
		Shadow Lake Formation	1009.8								709.9	756.8
Precambrian		Precambrian*	1016.5								***713.4***	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

Bedrock Group	Statistic	Brockton	South Bruce	Huron-Kinloss	Saugeen Shores
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 MNDM 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).

8 REFERENCES

AECOM Canada Ltd., 2012a. Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, The Corporation of the Municipality of Arran-Elderslie, Report prepared for the Nuclear Waste Management Organization, September.

AECOM Canada Ltd., 2012b. Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, Municipality of Brockton, Report prepared for the Nuclear Waste Management Organization, May.

AECOM Canada Ltd., 2012c. Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, The Corporation of the Municipality of South Bruce, Ontario, Report prepared for the Nuclear Waste Management Organization, August.

AECOM Canada Ltd., 2012d. Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, The Corporation of the Township of Huron-Kinloss, Report prepared for the Nuclear Waste Management Organization, August.

AECOM Canada Ltd., 2012e. Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, The Corporation of the Town of Saugeen Shores, Report prepared for the Nuclear Waste Management Organization, September.

Armstrong, D.K. and T.R. Carter. 2010. The Subsurface Paleozoic Stratigraphy of Southern Ontario, Ontario Geological Survey, Special Volume 7.

Armstrong, D.K. and T.R. Carter. 2006. An Updated Guide to the Subsurface Paleozoic Stratigraphy of Southern Ontario, Ontario Geological Survey, Open File Report 6191.

Armstrong, D.K. and W.R. Goodman, 1990. Stratigraphy and Depositional Environments of Niagaran Carbonates, Bruce Peninsula, Ontario. Field Trip No. 4 Guidebook. American Association of Petroleum Geologists, 1990 Eastern Section Meeting, hosted by the Ontario Petroleum Institute. London, Ontario.

Bailey Geological Services Ltd. and R.O. Cochrane, 1984a. Evaluation of the Conventional and Potential Oil and Gas Reserves of the Cambrian of Ontario, Ontario Geological Survey, Open File Report 5498.

Bailey Geological Services Ltd. and R.O. Cochrane, 1984b. Evaluation of the Conventional and Potential Oil and Gas Reserves of the Ordovician of Ontario, Ontario Geological Survey, Open File Report 5499.

Barnett, P. J., 1992. Quaternary geology of Ontario, *In:* Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, pp. 1011-1090.

Boyce, J.I. and W.A. Morris, 2002. Basement-controlled faulting of Paleozoic strata in southern Ontario, Canada: new evidence from geophysical lineament mapping, Tectonophysics, Vol. 353, pp. 151-171.

Brigham, R.J., 1971. Structural geology of southwestern Ontario and southeastern Michigan, Ontario Department of Mines and Northern Affairs, Petroleum Resources Section, Paper 71-2.

Brunton, F.R. and J.E.P. Dodge, 2008. Karst of Southern Ontario and Manitoulin Island, Ontario Geological Survey, Groundwater Resources Study 5.

Carr, S.D., R.M. Easton, R.A. Jamieson and N.G. Culshaw, 2000. Geologic transect across the Grenville Orogen of Ontario and New York, Canadian Journal of Earth Sciences, Vol. 37, No. 2-3, pp. 193–216.

Carter, T.R. and R. M. Easton, 1990. Extension Grenville basement beneath southwestern Ontario: lithology and tectonic subdivisions, *In:* Carter, T.R. (Ed), Subsurface Geology of Southwestern Ontario, a Core Workshop, American Association of Petroleum Geologists, 1990 Eastern Sectional Meeting, Ontario Petroleum Institute, London, Ontario, pp. 9-28.

Carter, T.R., R.A. Trevail and R.M. Easton. 1996. Basement controls on some hydrocarbon traps in southern Ontario. *In:* van der Pluijm, B.A., and P.A. Catacosinos, (Eds.), Basement and Basins of Eastern North America: Geological Society of America Special Paper 308, pp. 95-107.

Coniglio, M. R., M.J. Melchin and M.E Brookfield, 1990. Stratigraphy, sedimentology and biostratigraphy of Ordovician rocks of the Peterborough-Lake Simcoe area of southern Ontario, American Association of Petroleum Geologists, 1990 Eastern Section Meeting, hosted by the Ontario Petroleum Institute, Field Trip Guidebook No. 3, London, Ontario.

Cowan, W.R. 1977. Palmerston, Southern Ontario, Quaternary Geology. Ontario Geological Survey, Map M2383, scale 1:50,000.

Cowan, W.R., A.J. Cooper and J.J. Pinch, 1986. Quaternary Geology of the Wingham-Lucknow Area, Southern Ontario. Ontario Geological Survey, Preliminary Map P2957.

Cowan, W.R. and Pinch, J.J. 1986. Quaternary Geology of the Walkerton-Kincardine Area, Southern Ontario. Ontario Geological Survey, Preliminary Map P2956, scale 1:50,000.

Delorme Topo North America™, version 9.0, www.delorme.com.

Easton, R. M., 1992. The Grenville Province and the Proterozoic history of southern Ontario, *In:* Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, pp. 715-906.

Easton, R.M. and T.R. Carter, 1995. Geology of the Precambrian basement beneath the Paleozoic of southwestern Ontario, *In:* Ojakangas, R.W., A.B. Dickas and J.C. Green (Eds.), Basement Tectonics 10, Kluwer Academic Publishers, The Netherlands, pp. 221-264.

Engelder, T. and P. Geiser, 1980. On the use of regional joint sets as trajectories of paleostress fields during the development of the Appalachian plateau, New York, Journal of Geophysical Research, Vol. 85, No. B11, pp. 6319-6341.

Feenstra, B.H. 1994. Quaternary Geology, Markdale Area, Markdale-Owen, Southern Ontario. Ontario Geological Survey, Preliminary Map P3251, scale 1:50,000.

Gao, C., J.Shirota, R.I. Kelly, F.R. Brunton and S. van Haaften, 2006. Bedrock Topography and Overburden Thickness Mapping, Southern Ontario, Ontario Geological Survey, Miscellaneous Release-Data 207.

Gardner, G.H.F., Gardner, L.W. and Gregory, A.R., 1974 Formation velocity and density – the diagnostic basics for stratigraphic traps: Geophysics, Vol. 39, pp. 770-780.

Geofirma Engineering Ltd., 2014. Phase 1 Geoscientific Desktop Preliminary Assessment of Potential Suitability for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, Municipalities of Arran-Elderslie, Brockton and South Bruce, Township of Huron-Kinloss and Town of Saugeen Shores, Report NWMO APM-REP-061440-0108 prerpared fofr the Nuclear Waste Management Organization, June, Toronto, Canada.

Green, A.G., B. Milkereit, A. Davidson, C. Spencer, D.R. Hutchinson, W.F. Cannon, M.W. Lee, W.F. Agena, J.C. Behrendt and W.J. Hinze. 1988. Crustal structure of the Grenville front and adjacent terranes, Geology, Vol.16, pp. 788-792.

Gross, M.R., T. Engelder and S.R. Poulson, 1992. Veins in the Lockport dolostone: evidence for an Acadian fluid circulation system, Geology, Vol. 20, pp. 971-974.

Hamblin, A., 2003. Detailed Outcrop and Core Measured Sections of the Upper Ordovician/Lower Silurian Succession of Southern Ontario, Geological Survey of Canada, Open File 1525.

Hamblin, A., 1999. Upper Ordovician Strata of Southwestern Ontario: Synthesis of Literature and Concepts, Geological Survey of Canada, Open File 3729.

Hanmer, S. and S.J. McEachern, 1992. Kinematical and rheological evolution of a crustal-scale ductile thrust zone, Central Metasedimentary Belt, Grenville Orogen, Ontario. Canadian Journal of Earth Sciences, Vol. 29, pp.1779-1790.

Howell, P.D., and B.A. van der Pluijm, 1999. Structural sequences and styles of subsidence in the Michigan basin, Geological Society of America Bulletin, Vol. 111, pp. 974-991.

Intera Engineering Ltd., 2011. Descriptive Geosphere Site Model, Report NWMO DGR-TR-2011-24 R000, prepared for the Nuclear Waste Management Organization, March, Toronto, Canada.

JDMA, J.D. Mollard and Associates Ltd., 2014. Phase 1 Geoscientific Desktop Preliminary Assessment, Terrain and Remote Sensing Study, Municipalities of Arran-Elderslie, Brockton and South Bruce, Township of Huron-Kinloss and Town of Saugeen Shores, Report NWMO APM-REP-06144-0109 prepared for Geofirma Engineering Ltd., June, Toronto, Canada.

Johnson, M.D., D.K. Armstrong, B.V. Sanford, P.G. Telford and M.A. Rutka, 1992. Paleozoic and Mesozoic geology of Ontario, *In:* Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, pp. 907-1008.

Karrow, P.F. 1993. Quaternary Geology, Conestogo Area. Ontario Geological Survey, Map M2558, scale 1:50,000.

Karrow, P.F., 1989. Quaternary geology of the Great Lakes Subregion. *In:* Chapter 4, Quaternary Geology of Canada and Greenland. Geological Survey of Canada, Geology of Canada, No. 1, pp. 326-350.

Kesler, S.E. and C.W. Carrigan, 2002. Discussion on "Mississippi Valley-type lead-zinc deposits through geological time: implications from recent age-dating research" by D.L. Leach, D. Bradley, M.T. Lewchuk, D.T.A. Symons, G. de Marsily, and J. Brannon (2001). Mineralium Deposita Vol. 36, pp. 711-740.

Kumarapeli, P.S., 1976. The St. Lawrence rift system, related metallogeny, and plate tectonic models of Appalachian evolution, pp. 301-320. *In:* D.F. Strong (Ed.), Metallogeny and Plate Tectonics. Geological Association of Canada, Special Paper 14.

Kumarapeli, P.S., 1985. Vestiges of Iapetan rifting in the craton west of the northern Appalachians Geoscience Canada, Vol. 12, No. 2.

LIO, Land Information Ontario, 2013. Land Information Ontario. Ontario Ministry of Natural Resources, http://www.mnr.gov.on.ca/en/Business/LIO/index.html.

Lumbers, S.B., L.M. Heaman, V.M. Vertolli and T.W. Wu, 1990. Nature and timing of middle Proterozoic magmatism in the Central Metasedimentary Belt, Grenville Province, Ontario. Special Paper- Geological Association of Canada, Vol. 38, pp. 243-276.

Marshak, S. and J.R. Tabor, 1989. Structure of the Kingston Orocline in the Appalachian fold-thrust belt, New York, Geological Society of America Bulletin. Vol. 101, pp. 683-701.

McWilliams, C.K., R.P. Wintsch and M.J. Kunk, 2007. Scales of equilibrium and disequilibrium during cleavage formation in chlorite and biotite-grade phyllites, SE Vermont, Journal of Metamorphic Geology, Vol. 25, pp. 895-913.

NASA, National Aeronautics and Space Administration, 2006. Shuttle Radar Topography Mission (SRTM) digital topographic data, version 2. http://www2.jpl.nasa.gov/srtm/ [data accessed, 2013].

NWMO, Nuclear Waste Management Organization, 2014a. Preliminary Assessment for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, Municipality of Arran-Elderslie, Ontario – Findings from Step 3, Phase One Studies, Report NWMO APM-REP-06144-0106,Toronto, Canada.

NWMO, Nuclear Waste Management Organization, 2014b. Preliminary Assessment for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, Municipality of Brockton, Ontario – Findings from Step 3, Phase One Studies, Report NWMO APM-REP-06144-0115,Toronto, Canada.

NWMO, Nuclear Waste Management Organization, 2014c. Preliminary Assessment for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, Municipality of South Bruce, Ontario – Findings from Step 3, Phase One Studies, Report NWMO APM-REP-06144-0121,Toronto, Canada.

NWMO, Nuclear Waste Management Organization, 2014d. Preliminary Assessment for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, Township of Huron-Kinloss, Ontario – Findings from Step 3, Phase One Studies, Report NWMO APM-REP-06144-0118,Toronto, Canada.

NWMO, Nuclear Waste Management Organization, 2014e. Preliminary Assessment for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, Town of Saugeen Shores, Ontario – Findings from Step 3, Phase One Studies, Report NWMO APM-REP-06144-0113,Toronto, Canada.

NWMO, Nuclear Waste Management Organization, 2011. Geosynthesis, Report NWMO DGR-TR-2011-11 R000, March, Toronto, Canada.

NWMO, Nuclear Waste Management Organization, 2010. Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel, Nuclear Waste Management Organization. (Available at www.nwmo.ca).

OGS (Ontario Geological Survey), 2011. Regional Structure and Isopach Maps of Potential Hydrocarbon-Bearing Strata for Southern Ontario, Ontario Geological Survey, Miscellaneous Release – Data 276.

OGS, Ontario Geological Survey, 2010. Surficial Geology of Southern Ontario, Miscellaneous Release-Data 128-REV.

OGS (Ontario Geological Survey), 2007. Paleozoic Geology of Southern Ontario, Ontario Geological Survey, Miscellaneous Release Data 219.

OGSRL (Ontario Oil Gas Salt Resources Library), 2013. Subsurface Geology and Petroleum Well Data, http://www.ogsrlibrary.com/ (accessed May, 2013).

O`Hara, N.W. and W.J. Hinze, 1980. Regional basement geology of Lake Huron, Geological Society of America Bulletin, Part I, Vol., 91, pp. 348-358.

PGW, Paterson, Grant & Watson Limited, 2014. Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Geophysical Data, Municipalities of Arran-Elderslie, Brockton and South Bruce, Township of Huron-Kinloss and Town of Saugeen Shores, Report NWMO APM-REP-06144-0111 prepared for Geofirma Engineering Ltd. and Nuclear Waste Management Organization, June, Toronto, Canada.

Percival, J.A., and R.M. Easton, 2007. Geology of the Canadian Shield in Ontario: an Update. Ontario Power Generation, Report No. 06819-REP-01200-10158-R00, OGS Open File Report 6196, GSC Open File Report 5511.

Quinlan, G. and C. Beaumont, 1984. Appalachian thrusting, lithospheric flexure and the Paleozoic stratigraphy of the Eastern Interior of North America, Canadian Journal of Earth Sciences, Vol. 21, pp. 973-996.

Russell, D.J. and P.G. Telford, 1983. Revisions to the stratigraphy of the Upper Ordovician Collingwood beds in Ontario – A potential oil shale, Canadian Journal of Earth Sciences, Vol. 20, pp. 1780-1790.

Sanford, B.V., 1993. St. Lawrence Platform - Economic Geology, *In:* Sedimentary Cover of the Craton in Canada, Stott, D.F and J.D. Aiken (Eds.), Geological Survey of Canada, Geology of Canada No. 5, pp. 787-798.

Sanford, B.V., 1976. Isopach of the Salina B Salt, Southwestern Ontario, Geological Survey of Canada Open File 401.

Sanford, B.V., F.J. Thompson, F.J. and G.H. McFall, 1985. Plate Tectonics – A possible controlling mechanism in the development of hydrocarbon traps in southwestern Ontario, Bulletin of Canadian Petroleum Geology, Vol. 33, No.1, pp. 52-71.

Sharpe, D. and B.E. Broster, 1977. Geological Series, Quaternary Geology, Durham Area, Southern Ontario. Ontario Geological Survey, Preliminary Map P1556, scale 1:50,000.

Sharpe, D.R. and W.A.D. Edwards, 1979. Quaternary Geology of the Chelsey-Tiverton Area, Southern Ontario. Ontario Geological Survey, Preliminary Map P2314, scale 1:50,000.

Sharpe, D. and G.R. Jamieson, 1982. Geological Series, Quaternary Geology of the Wiarton Area, Southern Ontario. Ontario Geological Survey, Preliminary Map P2559, scale 1:50,000.

Sigma Explorations Inc., 2013. 2D Seismic Data acquired in April.

Sloss, L.L., 1982. The Michigan Basin: Selected structural basins of the Midcontinent, USA. UMR Journal Vol. 3, pp. 25-29.

Sterling, S. 2011. Technical Report: Bedrock Formations in DGR-7 and DGR-8, TR-11-06, Revision 0, December 6, Intera Engineering Ltd., Ottawa.

Sterling, S. and M. Melaney, 2011. Technical Report: Bedrock Formations in DGR-1 to DGR-6, TR-09-11, Revision 0, April 7, Intera Engineering Ltd., Ottawa.

Sutter, J.F., N.M. Ratcliffe and S.B. Mukasa, 1985. $^{40}Ar/^{39}Ar$ and K-Ar data bearing on the metamorphic and tectonic history of western New England, Geological Society of America Bulletin, Vol. 96, pp. 123-136.

Thomas, W.A., 2006. Tectonic inheritance at a continental margin, GSA Today, Vol. 16, No. 2, pp.4-11.

Uyeno, T.T., P.G. Telford and B.V. Sanford, 1982, Devonian conodonts and stratigraphy of southwestern Ontario. Geological Survey of Canada, Bulletin 332.

Van Schmus, W.R., 1992. Tectonic setting of the Midcontinent Rift system, Tectonophysics, Vol. 213, pp. 1-15.

Wallach, J.L., A.A. Mohajer and R.L. Thomas, 1998. Linear zones, seismicity, and the possibility of a major earthquake in the intraplate western Lake Ontario area of eastern North America, Canadian Journal of Earth Sciences, Vol. 35, No. 7, pp. 762-786.

Watts, M., D. Schieck and M. Coniglio. 2009. Technical Report: 2D Seismic Survey of Bruce Site, TR-07-15, Revision 0, February 2, Intera Engineering Ltd., Ottawa.

White, D.J., D.A. Forsyth, I. Asudeh, S.D. Carr, H. Wu, R.M. Easton, and R.F. Mereu, 2000. A seismic-based cross-section of the Grenville Origen in southern Ontario, and western Quebec, Canadian Journal of Earth Sciences, Vol. 37, pp. 183-192.

Williams, H.R., G.M. Stott, P.C. Thurston, R.H. Sutcliff, G. Bennett, R.M. Easton and D.K. Armstrong, 1992. Tectonic evolution of Ontario; summary and synthesis, *In:* Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, pp. 1255-1334.

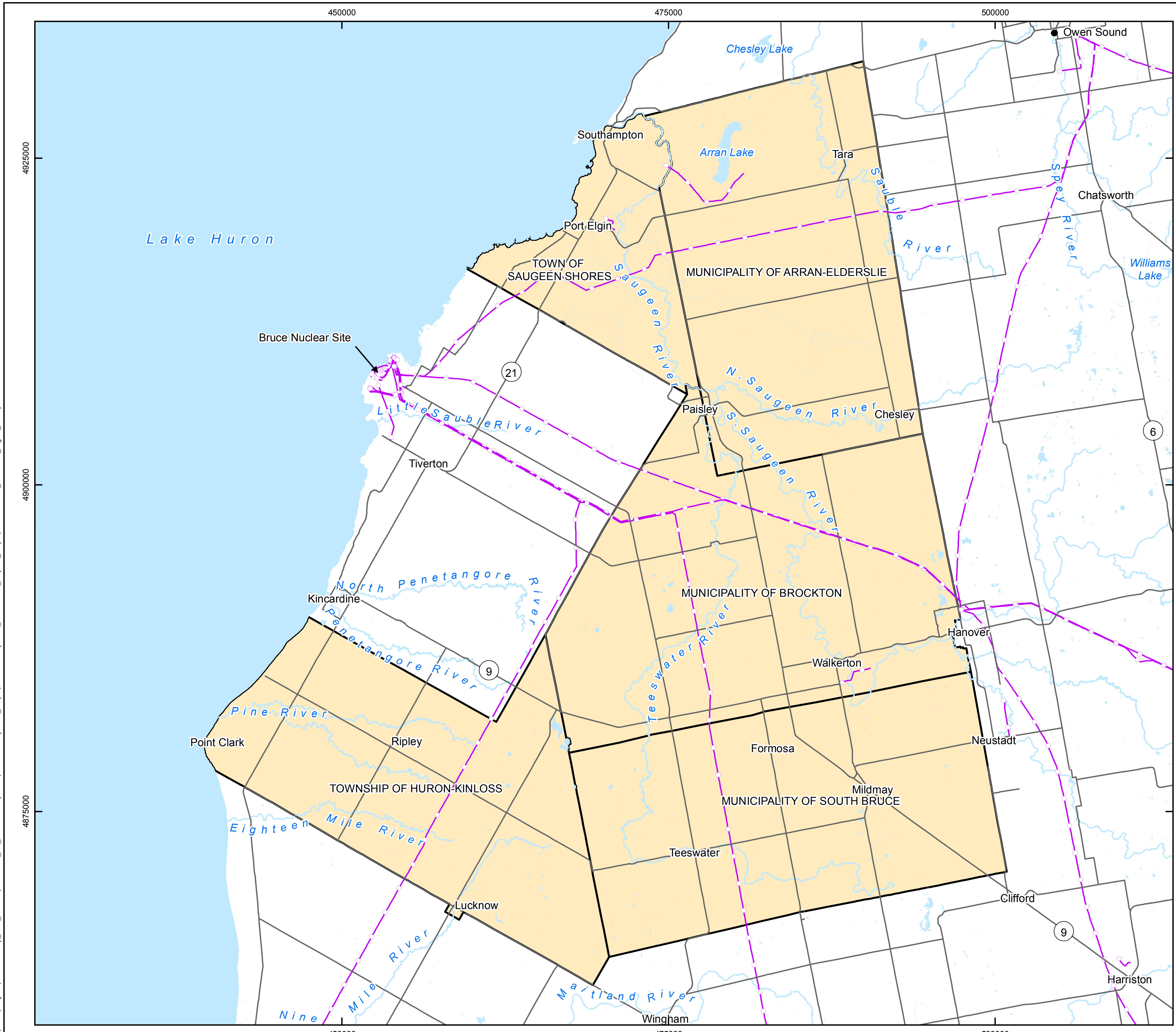
9 REPORT SIGNATURE PAGE

Respectfully submitted,

Geofirma Engineering Ltd.

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

David Schieck, P.Geoph.
Senior Geophysicist



LEGEND

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

SCALE 1:300,000

0 2.5 5 10 15 20
Kilometres

COORDINATE SYSTEM: UTM NAD83 Zone 17N
SOURCE:
Basemap Layers: LIO, MNR, ESRI
Produced by Geofirma Engineering Ltd under license from Ontario Ministry of Natural Resources, ©Queens Printer 2011

NORTH

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

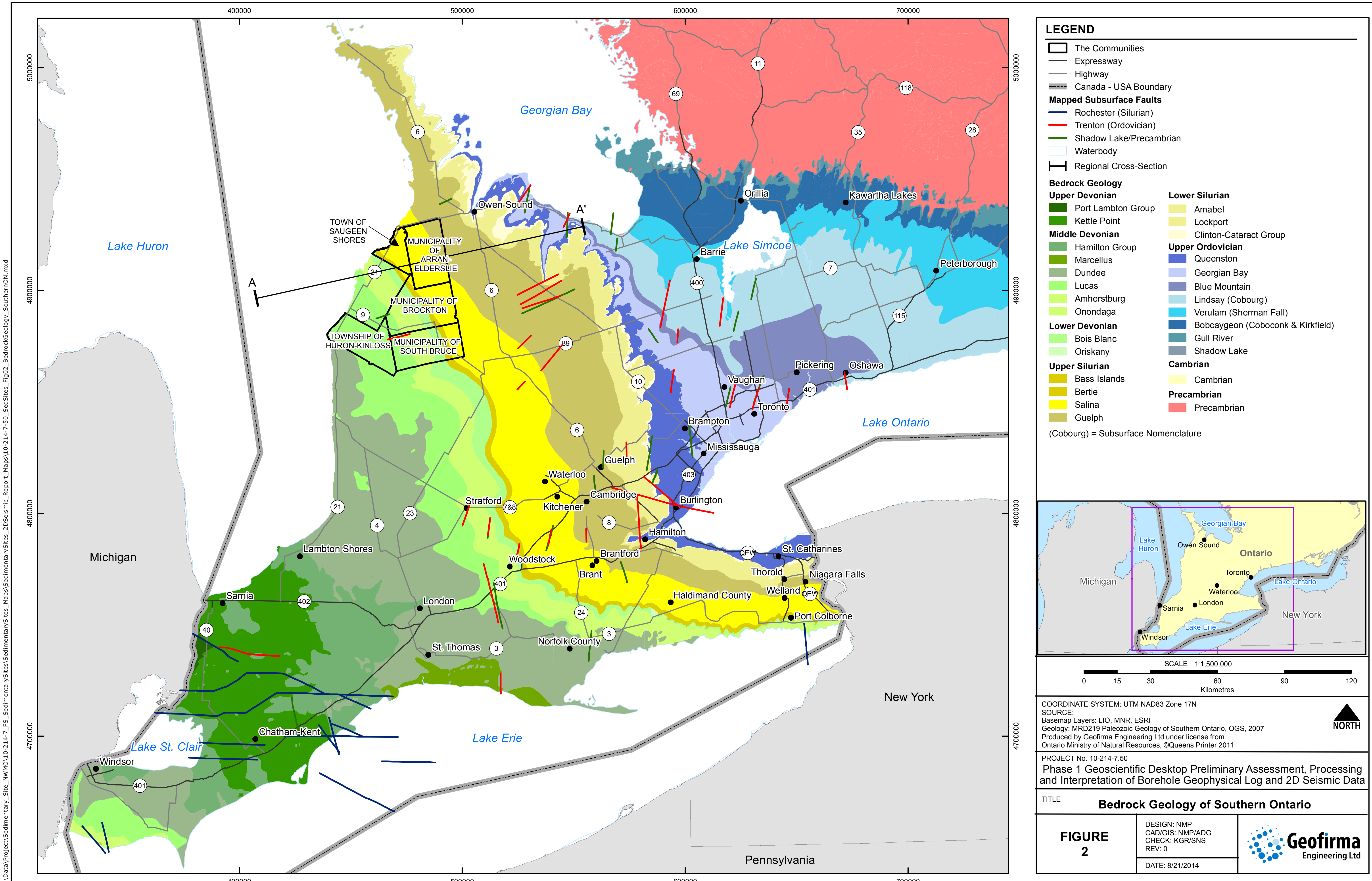
FIGURE 1

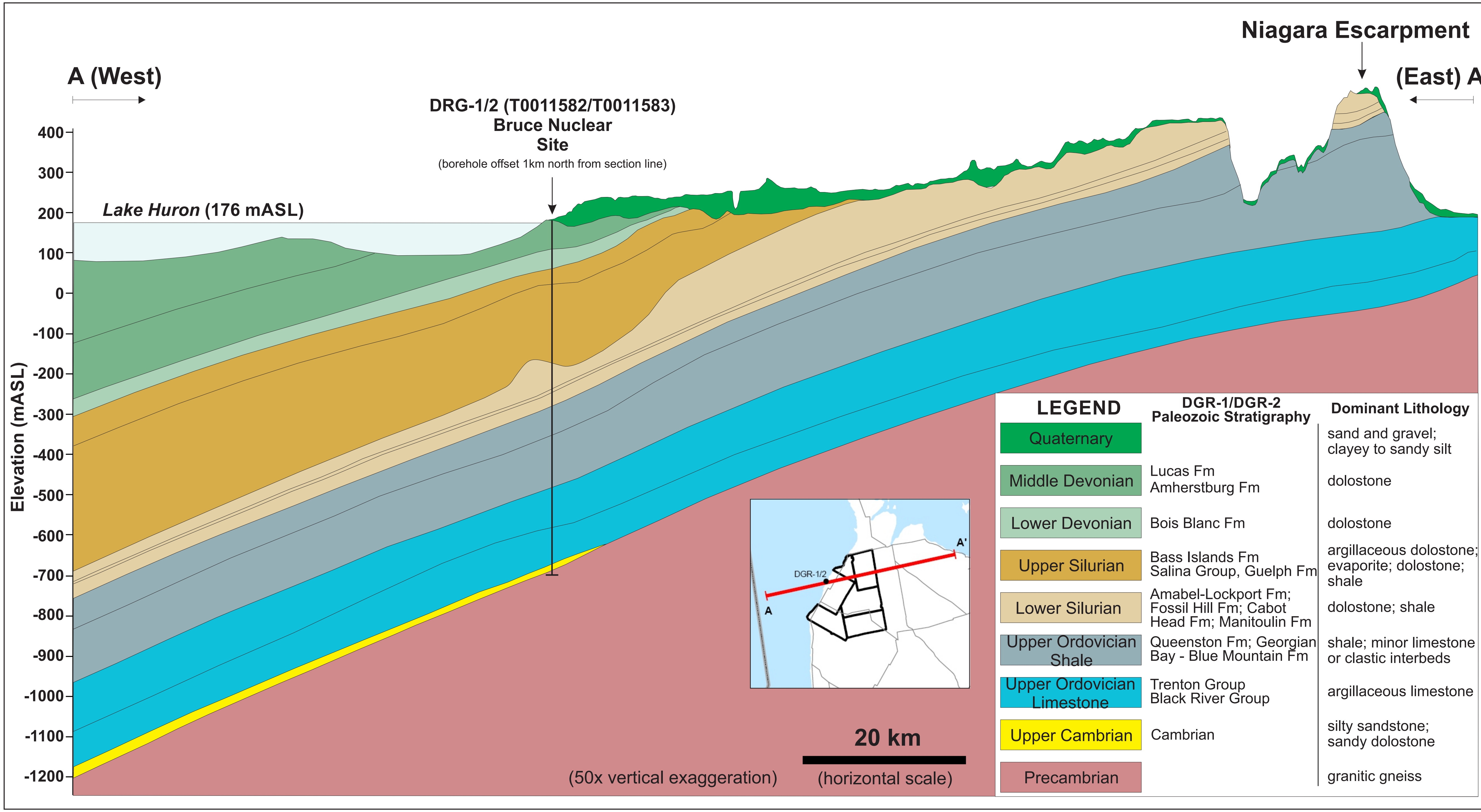
DESIGN: NMP
CAD/GIS: NMP/ADG
CHECK: KGR/SNS
REV: 0

DATE: 8/21/2014

Geofirma Engineering Ltd

G:\Data\Project\Sedimentary_Site_NWMO\10-214-7_FS_SedimentarySites\SedimentarySites_Maps\SedimentarySites_2DSeismic_Report_Maps\10-214-7-50_SedSites_Fig01_StudyAreas.mxd


LEGEND
The Communities
Expressway
Highway
Canada - USA Boundary
Mapped Subsurface Faults
Rochester (Silurian)
Trenton (Ordovician)
Shadow Lake/Precambrian
Waterbody
Regional Cross-Section
Bedrock Geology
Upper Devonian
Port Lambton Group
Kettle Point
Middle Devonian
Hamilton Group
Marcellus
Dundee
Lucas
Amherstburg
Onondaga
Lower Devonian
Bois Blanc
Oriskany
Upper Silurian
Bass Islands
Bertie
Salina
Guelph
Lower Silurian
Amabel
Lockport
Clinton-Cataract Group
Upper Ordovician
Queenston
Georgian Bay
Blue Mountain
Lindsay (Cobourg)
Verulam (Sherman Fall)
Bobcaygeon (Coboconk & Kirkfield)
Gull River
Shadow Lake
Cambrian
Cambrian
Precambrian
Precambrian
(Cobourg) = Subsurface Nomenclature
Georgian Bay
Lake Huron
Lake Simcoe
Lake Ontario
Lake Erie
Lake St. Clair
Michigan
New York
Pennsylvania
TOWN OF SAUGEEN SHORES
MUNICIPALITY OF ARRAN-ELDERSLIE
MUNICIPALITY OF BROCKTON
TOWNSHIP OF HURON-KINLOSS
MUNICIPALITY OF SOUTH BRUCE
A
A'
Owen Sound
Orillia
Kawartha Lakes
Barrie
Peterborough
Pickering
Oshawa
Vaughan
Toronto
Brampton
Mississauga
Guelph
Waterloo
Kitchener
Cambridge
Burlington
Stratford
Hamilton
St. Catharines
Lambton Shores
Woodstock
Brantford
Brant
Thorold
Niagara Falls
Welland
Haldimand County
Sarnia
London
Port Colborne
St. Thomas
Norfolk County
Chatham-Kent
Windsor
400000
500000
600000
700000
5000000
4900000
4800000
4700000
Ontario
SCALE 1:1,500,000
0 15 30 60 90 120
Kilometres
COORDINATE SYSTEM: UTM NAD83 Zone 17N
SOURCE:
Basemap Layers: LIO, MNR, ESRI
Geology: MRD219 Paleozoic Geology of Southern Ontario, OGS, 2007
Produced by Geofirma Engineering Ltd under license from
Ontario Ministry of Natural Resources, ©Queens Printer 2011
NORTH
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
FIGURE
2
DESIGN: NMP
CAD/GIS: NMP/ADG
CHECK: KGR/SNS
REV: 0
DATE: 8/21/2014
Geofirma Engineering Ltd
G:\Data\Project\Sedimentary_Site_NWMO\10-214-7_FS_SedimentarySites\SedimentarySites_Maps\SedimentarySites_2DSeismic_Report_Maps\10-214-7-50_SedSites_Fig02_BedrockGeology_SouthernON.mxd



Data Source: NWMO, 2011

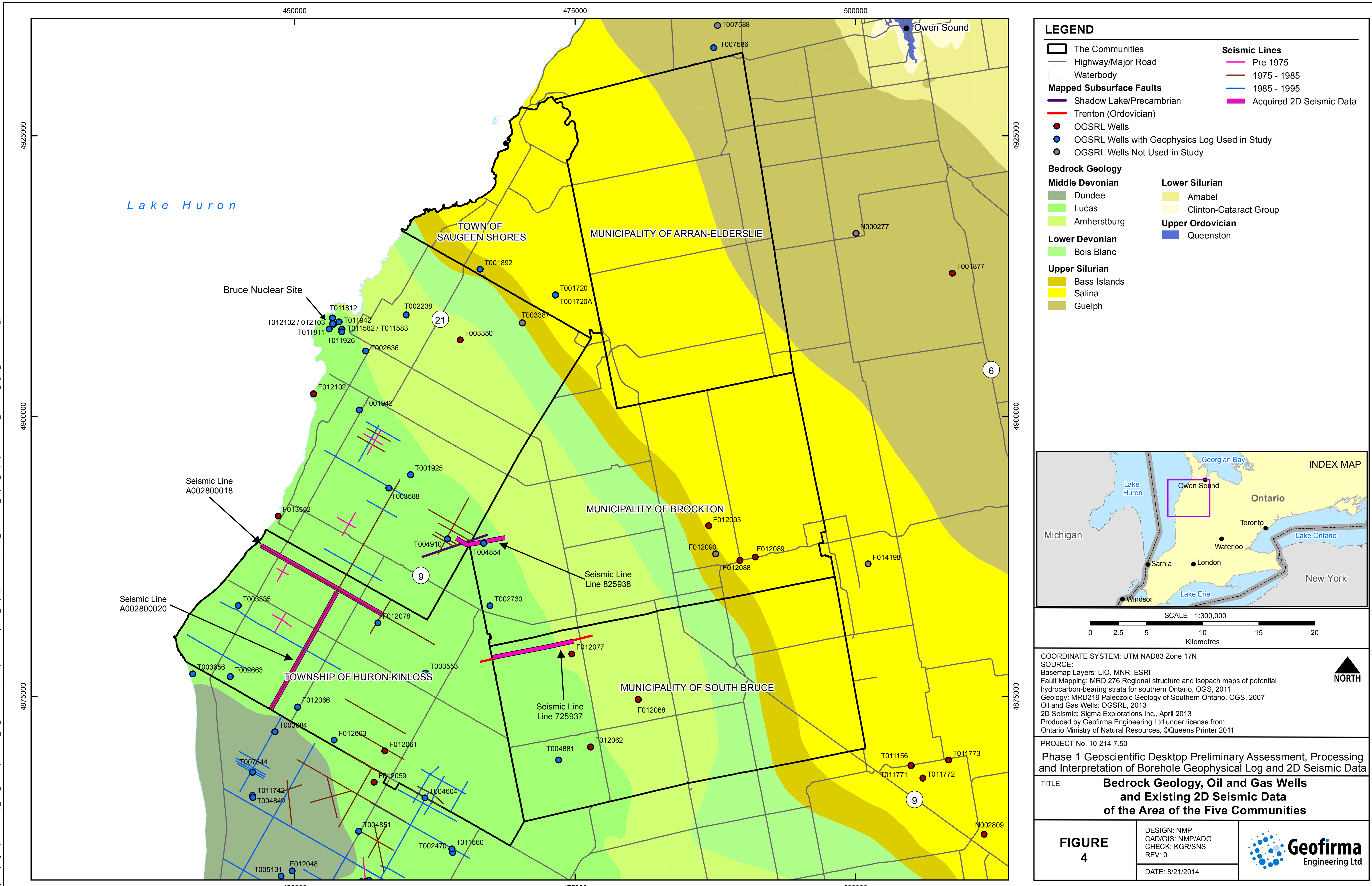
FIGURE 3 - Regional Geological Cross-Section of the Eastern Flank of the Michigan Basin

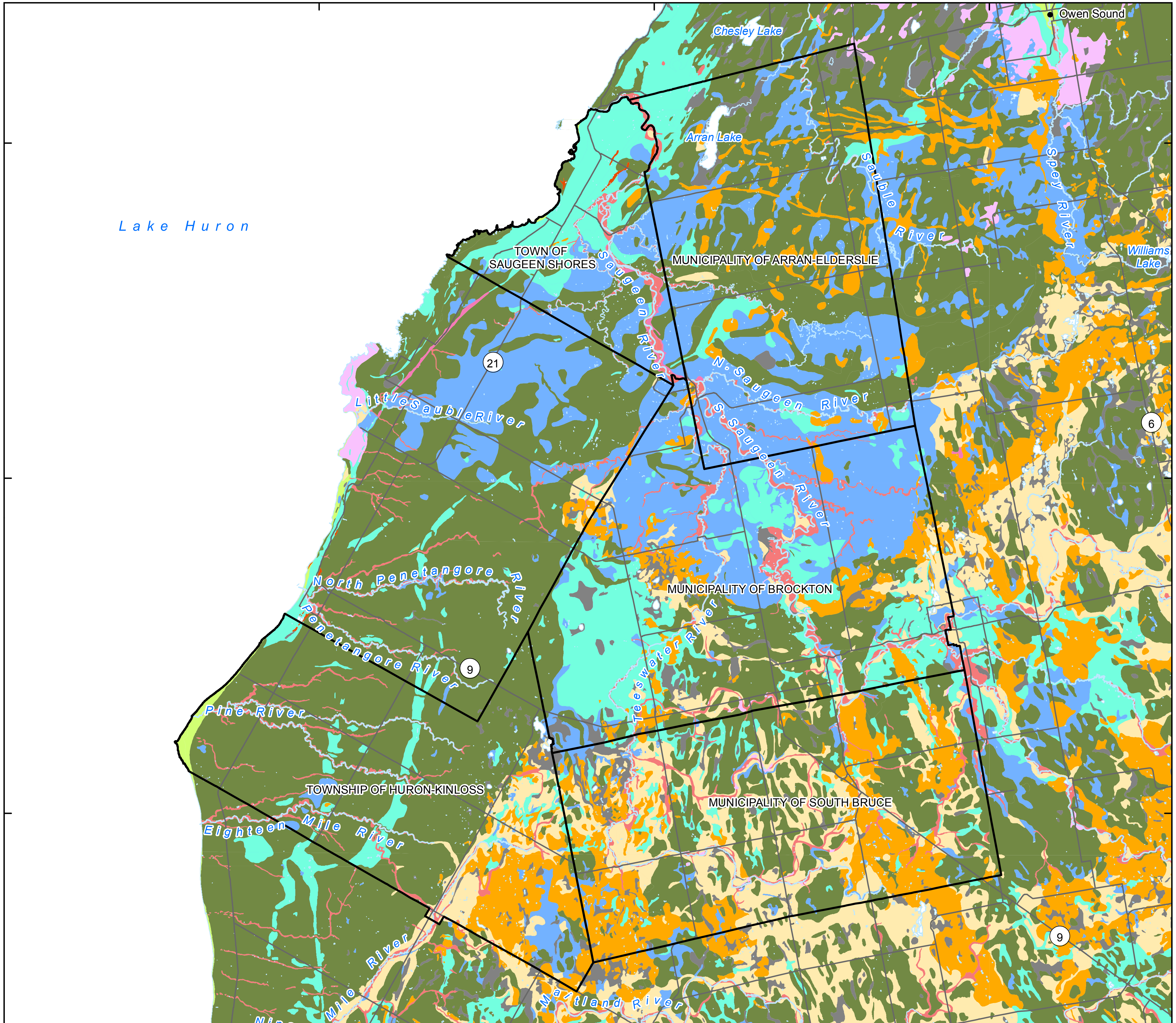
PROJECT No: 10-214-7.50
Phase 1 Geoscientific Desktop Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data

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

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2-D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig03_Cross_Section_EasternFlankMichiganBasin.cdr"


Lake Huron
Owen Sound
TOWN OF SAUGEEN SHORES
MUNICIPALITY OF ARRAN-ELDERSLIE
MUNICIPALITY OF BROCKTON
MUNICIPALITY OF SOUTH BRUCE
TOWNSHIP OF HURON-KINLOSS
Bruce Nuclear Site
Seismic Line A002800018
Seismic Line A002800020
Seismic Line Line 825938
Seismic Line Line 725937
450000
475000
500000
4925000
4900000
4875000
LEGEND
The Communities
Highway/Major Road
Waterbody
Mapped Subsurface Faults
Shadow Lake/Precambrian
Trenton (Ordovician)
OGSRL Wells
OGSRL Wells with Geophysics Log Used in Study
OGSRL Wells Not Used in Study
Seismic Lines
Pre 1975
1975 - 1985
1985 - 1995
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
INDEX MAP
Georgian Bay
Lake Huron
Owen Sound
Ontario
Michigan
Toronto
Waterloo
Lake Ontario
Sarnia
London
New York
Lake Erie
Windsor
SCALE 1:300,000
0 2.5 5 10 15 20
Kilometres
NORTH
COORDINATE SYSTEM: UTM NAD83 Zone 17N
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
FIGURE 4
DESIGN: NMP
CAD/GIS: NMP/ADG
CHECK: KGR/SNS
REV: 0
DATE: 8/21/2014
Geofirma Engineering Ltd
G:\Data\Project\Sedimentary_Site_NWMO\10-214-7_FS_SedimentarySites\SedimentarySites_Maps\SedimentarySites_2DSeismic_Report_Maps\10-214-7-50_SedSites_Fig04_BedrockGeologyOilGasExtents.mxd



LEGEND

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

Surficial Geology

- Wetland
- Colluvial
- Lacustrine
- Fluvial
- Aeolian
- Glaciolacustrine (coarse)
- Glaciolacustrine (fine)
- Glaciofluvial (ice-contact)
- Glaciofluvial (outwash)
- Glacial (morainal)
- Bedrock-drift Complex

SCALE 1:300,000

0 2.5 5 10 15 20

Kilometres

COORDINATE SYSTEM: UTM NAD83 Zone 17N
SOURCE:
Basemap Layers: LIO, MNR, ESRI
Geology: OGS MRD128-REV Surficial Geology of Southern Ontario,1:50,000, 2010
Produced by Geofirma Engineering Ltd under license from
Ontario Ministry of Natural Resources, ©Queens Printer 2011

NORTH

PROJECT No. 10-214-7.50

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

TITLE

Surficial Geology of the Area of the Five Communities

FIGURE 5

DESIGN: NMP
CAD/GIS: NMP
CHECK: KGR/SNS
REV: 0

DATE: 8/21/2014

Geofirma Engineering Ltd

G:\Data\Project\Sedimentary_Site_NWMO\10-214-7_FS_SedimentarySites\SedimentarySites_Maps\SedimentarySites_2DSeismic_Report_Maps\10-214-7-50_SedSites_Fig05_SurficialGeology_Regional.mxd

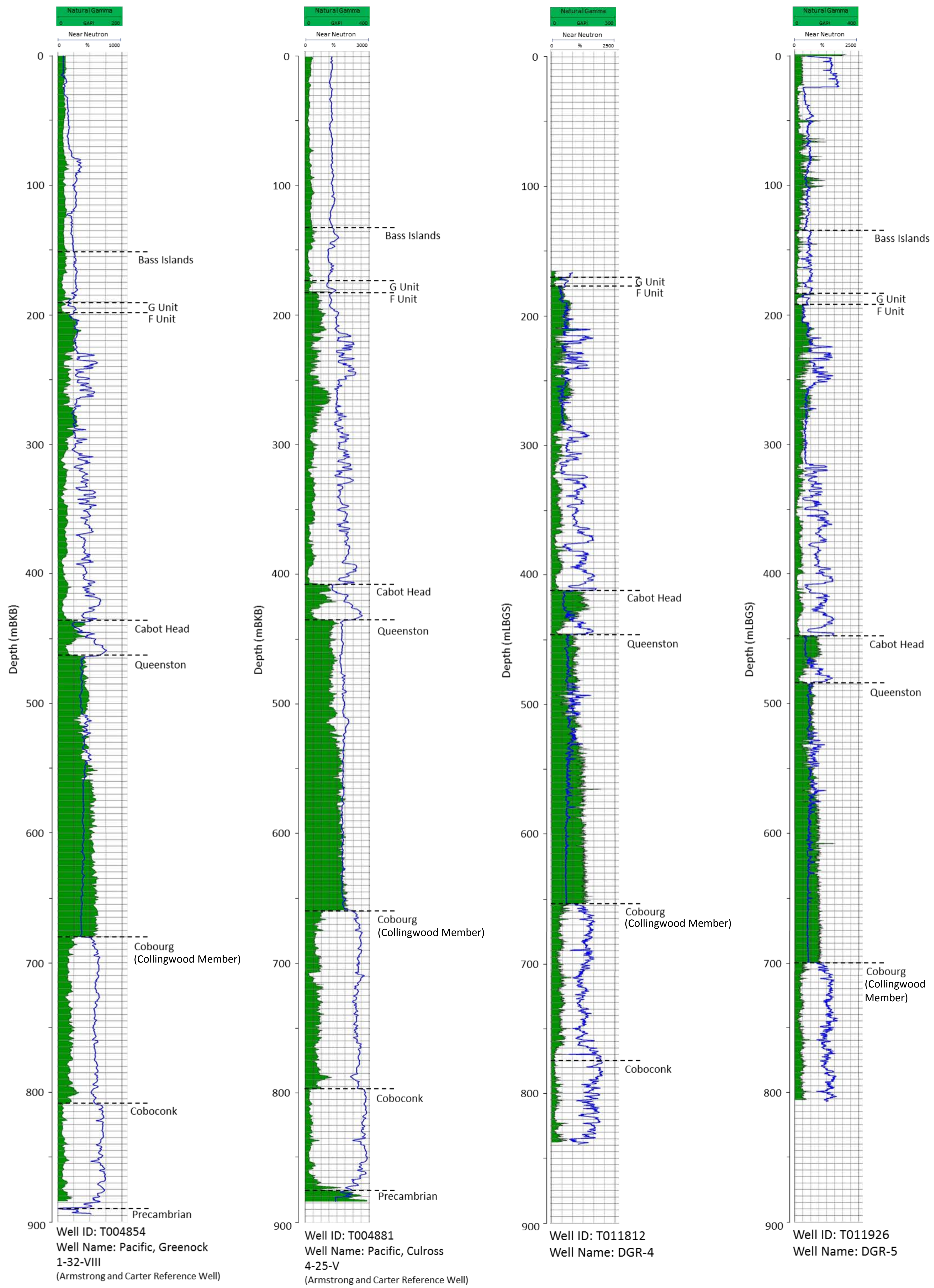


FIGURE 6 - Geophysical Signatures of Key Formation Tops

PROJECT No: 10-214-7-50

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

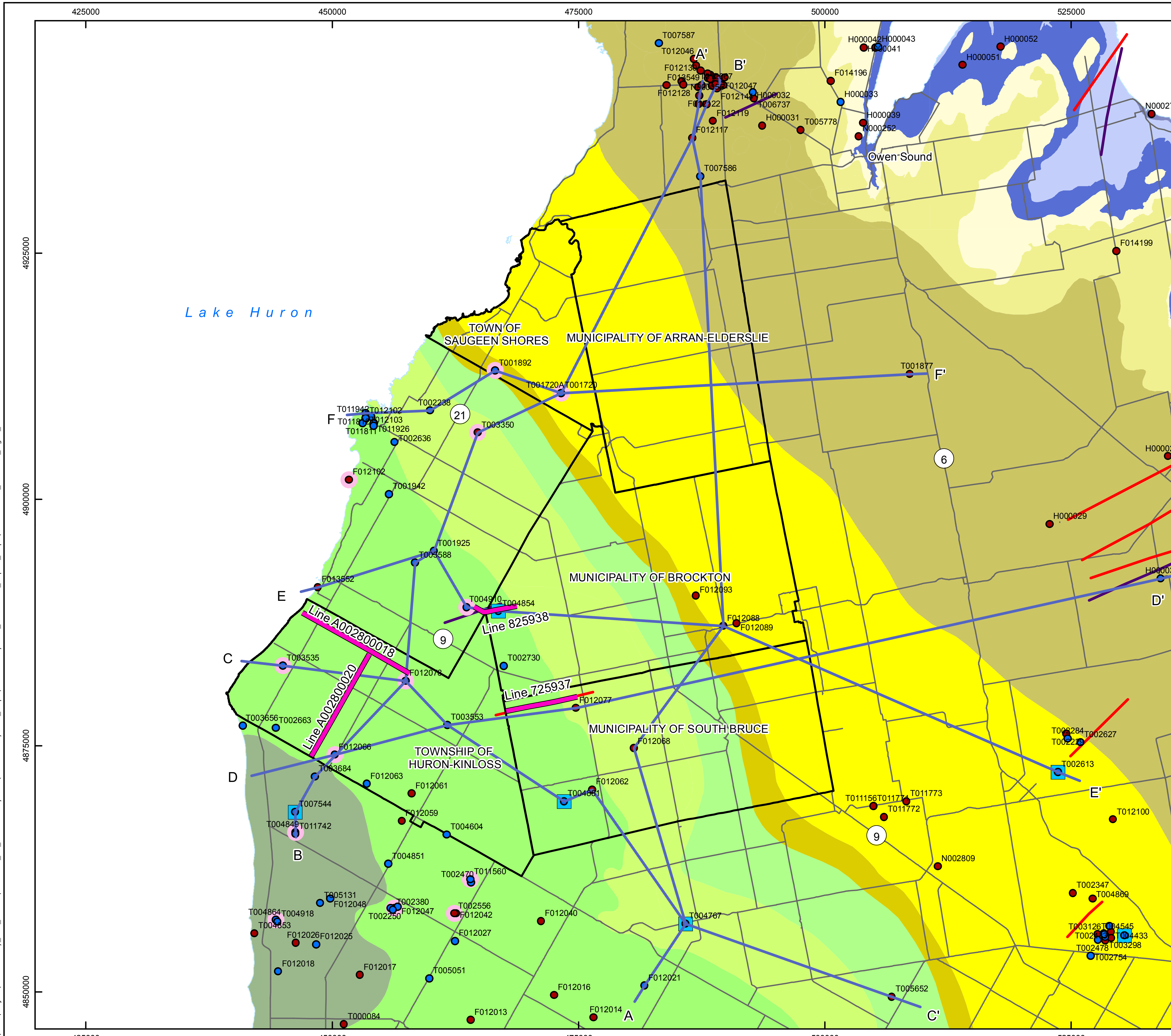
Prepared by: SNG

Reviewed by: SNS

Date: 25-Jun-14

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\Formation Pick Figs\10-214-7.50_Fig 6_Anchor Picks_R0.pptx"



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

Mapped Subsurface Faults

- Shadow Lake/Precambrian
- Trenton (Ordovician)

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

SCALE 1:400,000

0 3.5 7 14 21 28

Kilometres

COORDINATE SYSTEM: UTM NAD83 Zone 17N
SOURCE:
Basemap Layers: LIO, MNR, ESRI
Geology: MRD219 Paleozoic Geology of Southern Ontario, OGS, 2007
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
Produced by Geofirma Engineering Ltd under license from Ontario Ministry of Natural Resources, ©Queens Printer 2011

NORTH

PROJECT No. 10-214-7.50

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

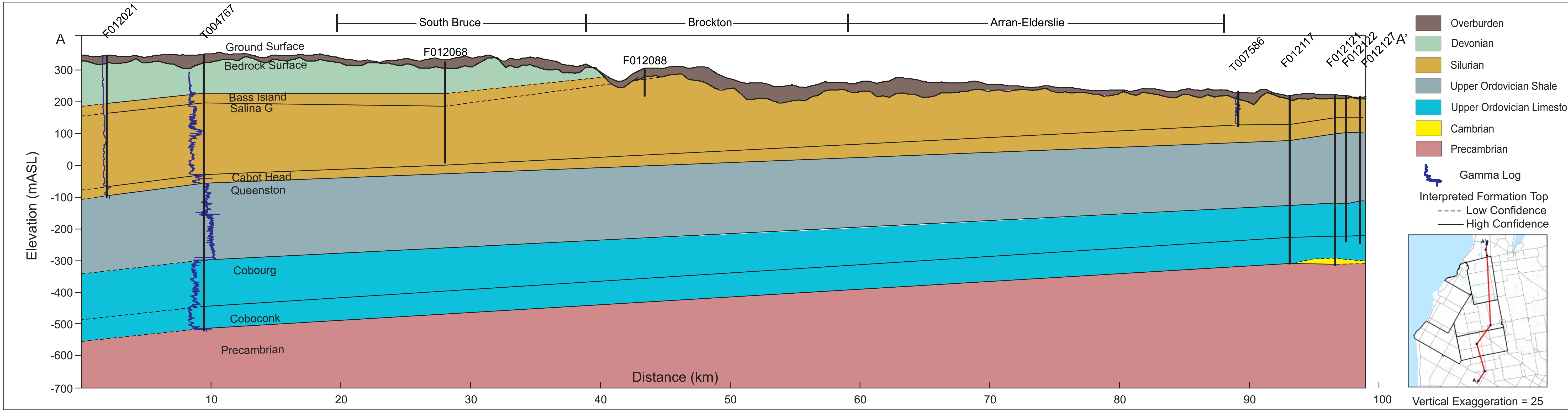
FIGURE 7

DESIGN: NMP
CAD/GIS: NMP/ADG
CHECK: KGR/SNS
REV: 0

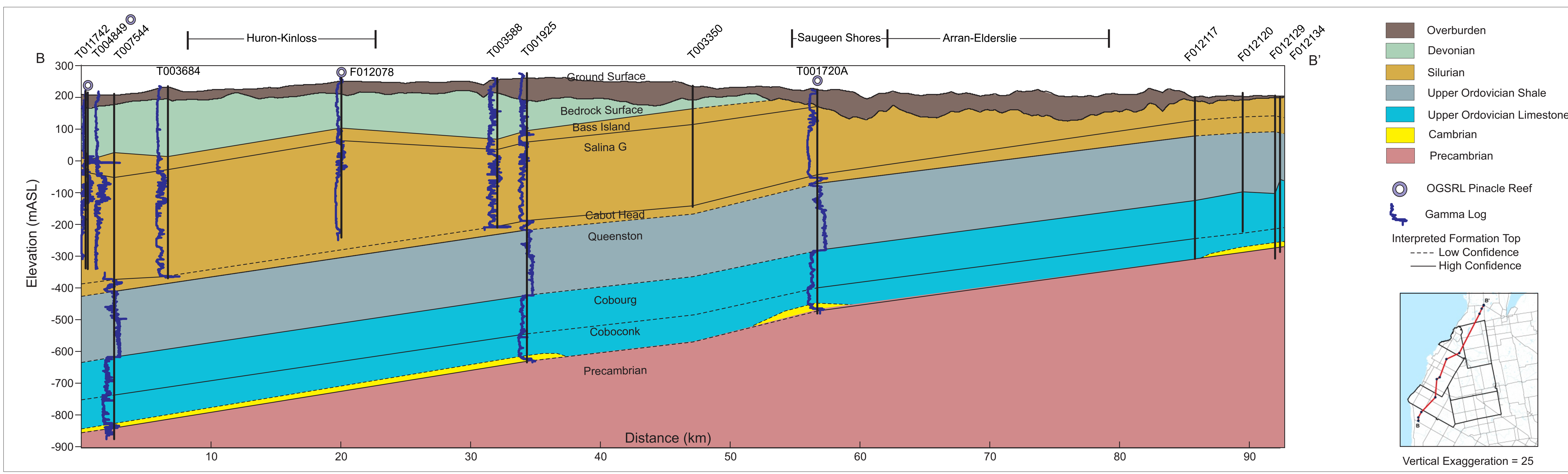
DATE: 8/21/2014

Geofirma Engineering Ltd

G:\Data\Project\Sedimentary_Site_NWMO\10-214-7_FS_SedimentarySites\SedimentarySites_Maps\SedimentarySites_Report_Maps\10-214-7-50_SedSites_Fig07_OrientationofCrossSections.mxd



(a) Cross-Section A-A'



Data Source: OGSRL, 2013

(b) Cross-Section B-B'

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

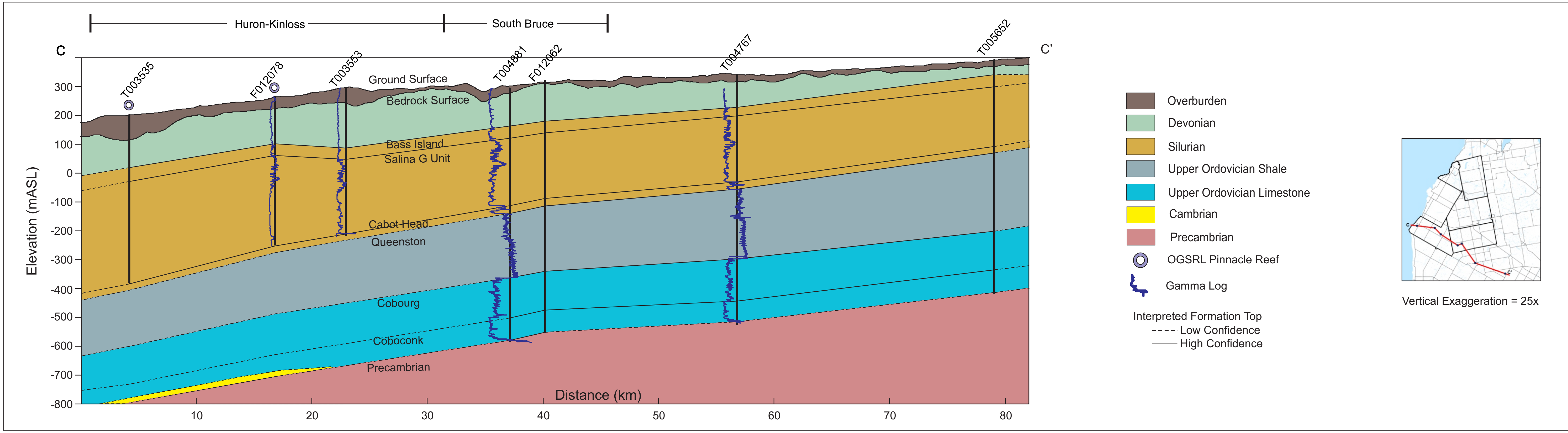
PROJECT No: 10-214-7.50

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

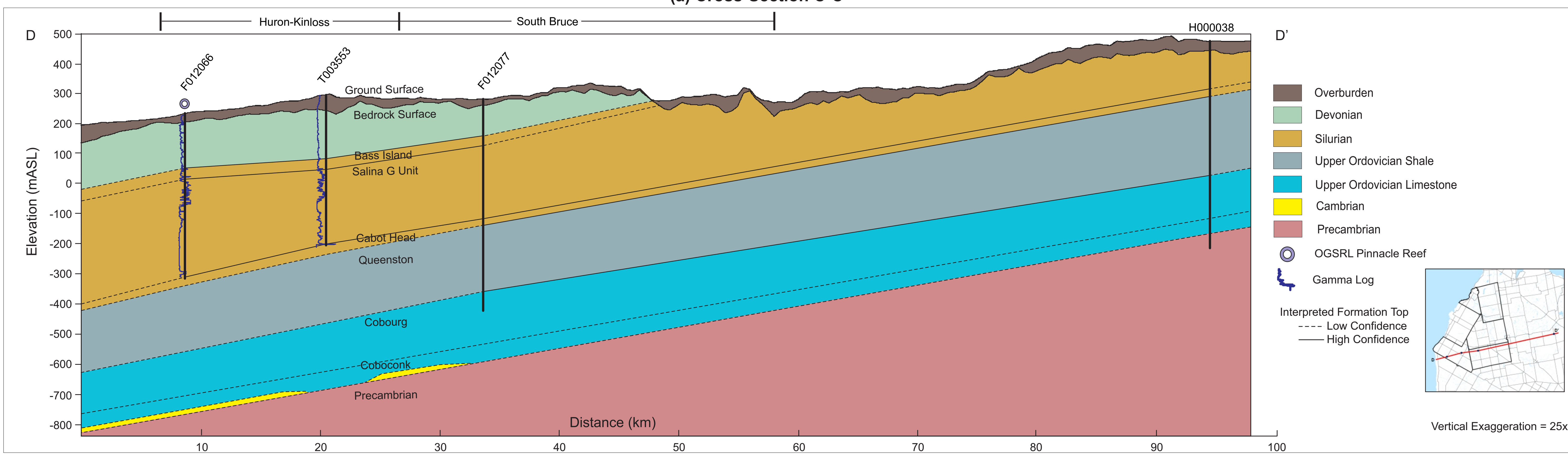
Prepared by: NMP/ADG
Reviewed by: KGR/SNS
Date: 23/06/2014

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig08_CrossSections_A_B.cdr"



(a) Cross-Section C-C'



Data Source: OGSRL, 2013

(b) Cross-Section D-D'

FIGURE 9 - Geological Cross-Sections (a) C-C' and (b) D-D'

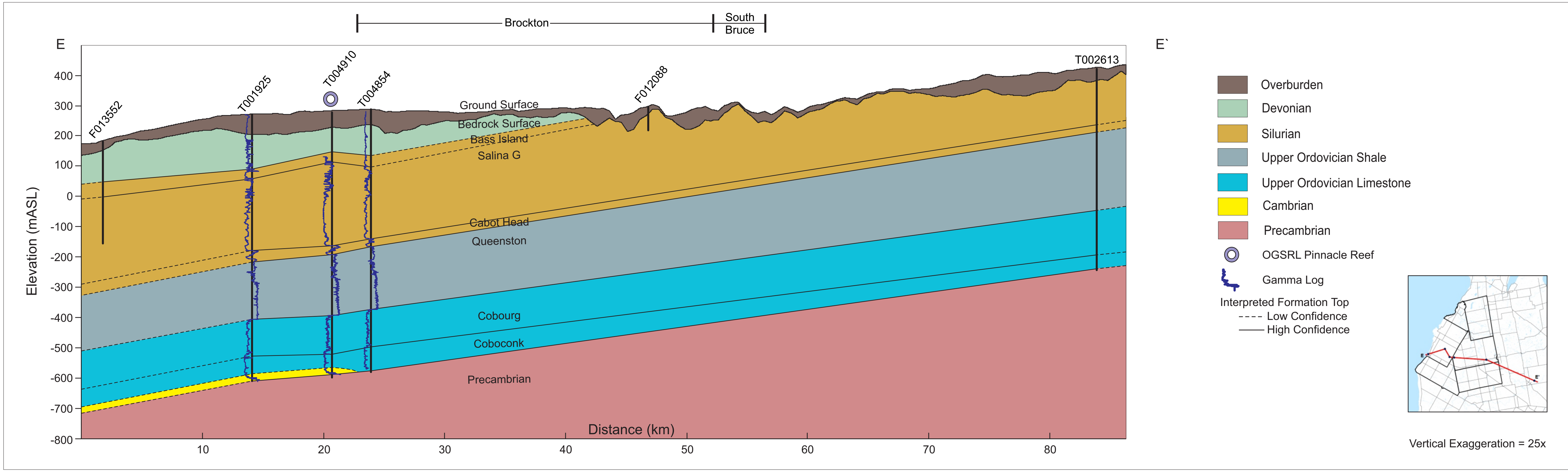
PROJECT No: 10-214-7.50

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

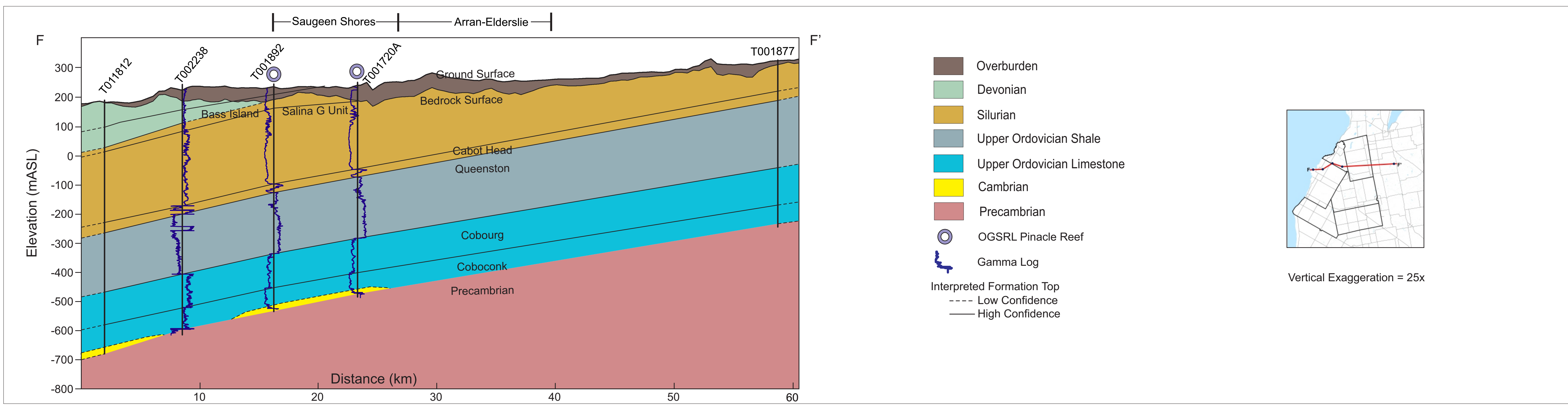
Prepared by: NMP/ADG
Reviewed by: KGR/SNS
Date: 23/06/2014

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig09_CrossSections_C_D.cdr"



(a) Cross-Section E-E'



(b) Cross-Section F-F'

Data Source: OGSRL, 2013

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

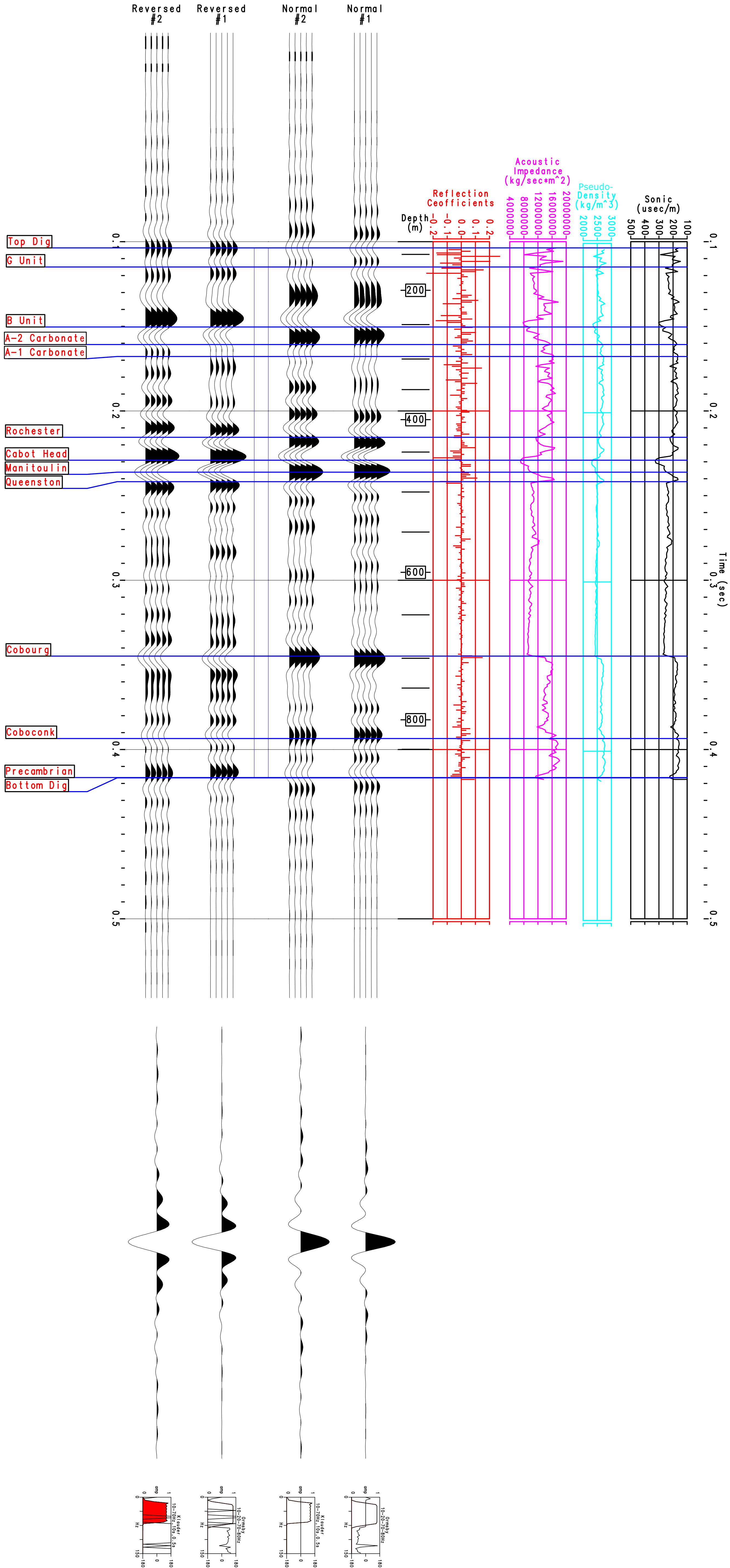
PROJECT No: 10-214-7.50

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

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig10_CrossSections_E_F.cdr"



Source: Borehole Geophysical Logs: OGSRL, 2013

Figure 11 - Synthetic Seismogram for OGSRL Borehole T004910

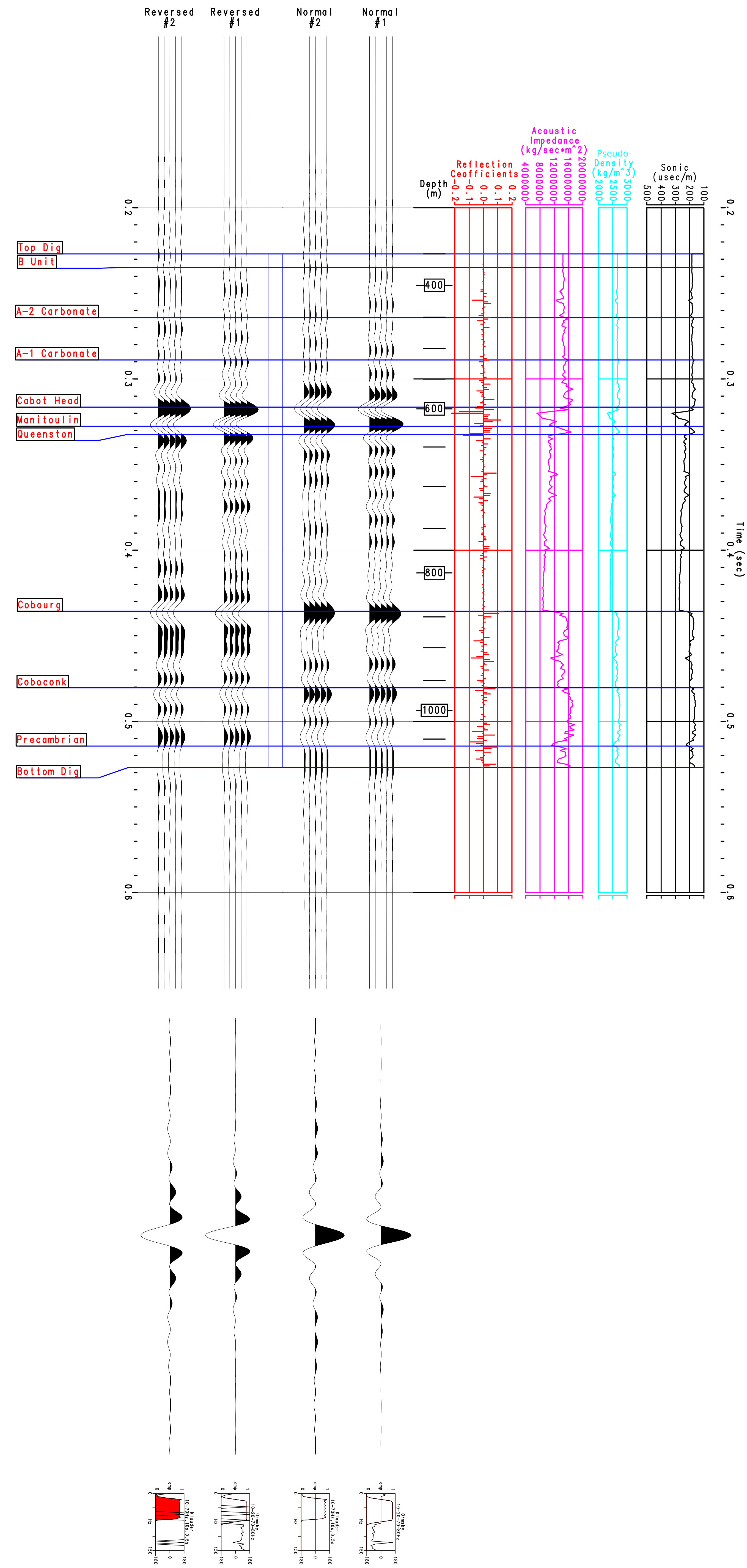
PROJECT No: 10-214-7.50

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

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig11_12_Synthetic Seismogram.cdr"



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

Geofirma Engineering Ltd

""P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig11_12_Synthetic Seismogram.cdr"

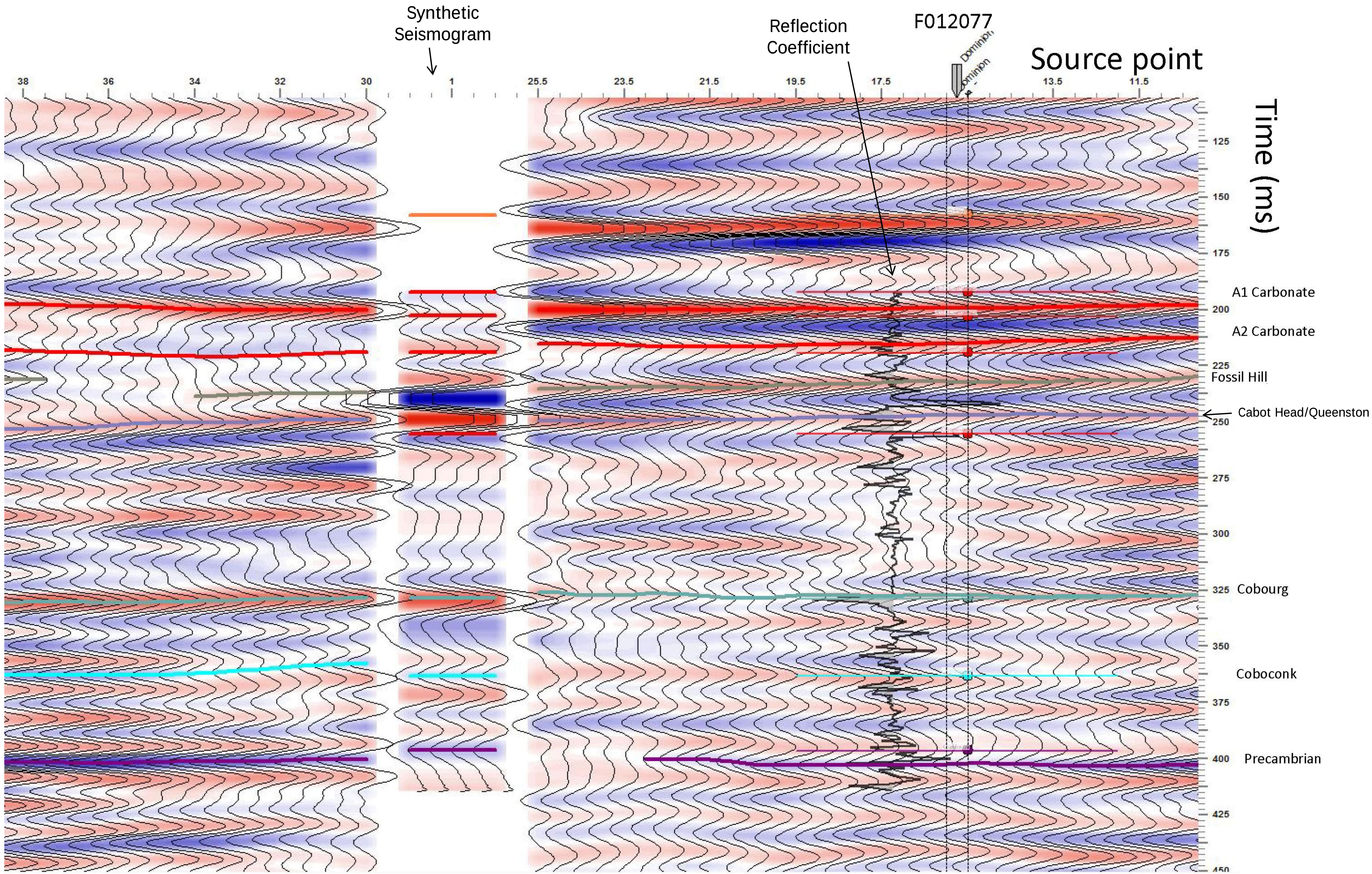


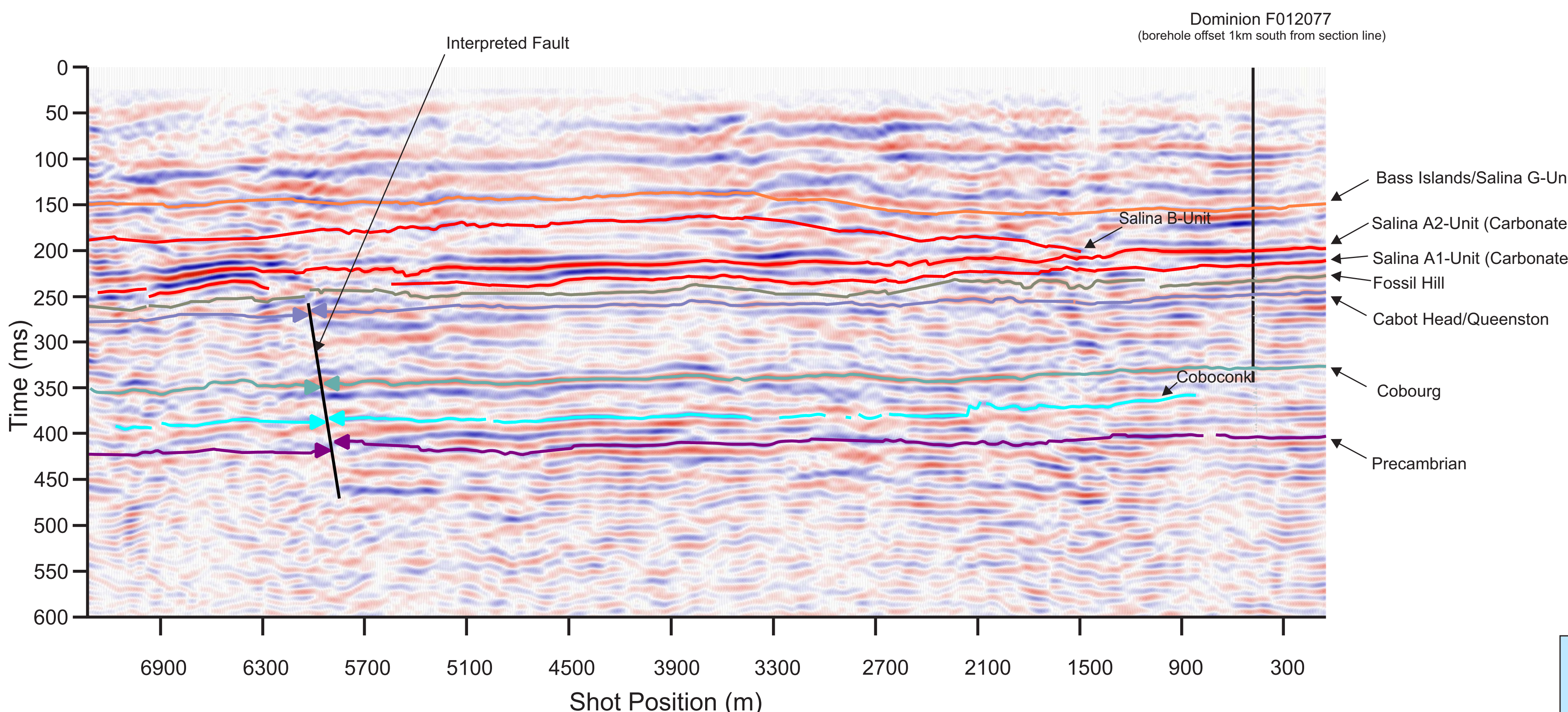
Figure 13 – Combined Synthetic Seismogram for OGSRL Boreholes F012077 and T007544

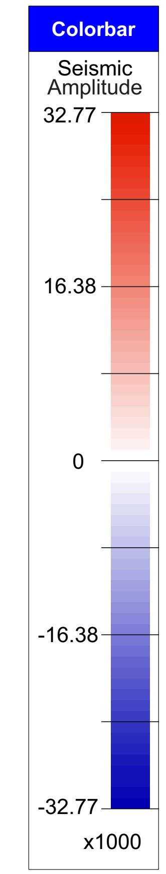
PROJECT No: 10-214-7.50

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

Geofirma Engineering Ltd





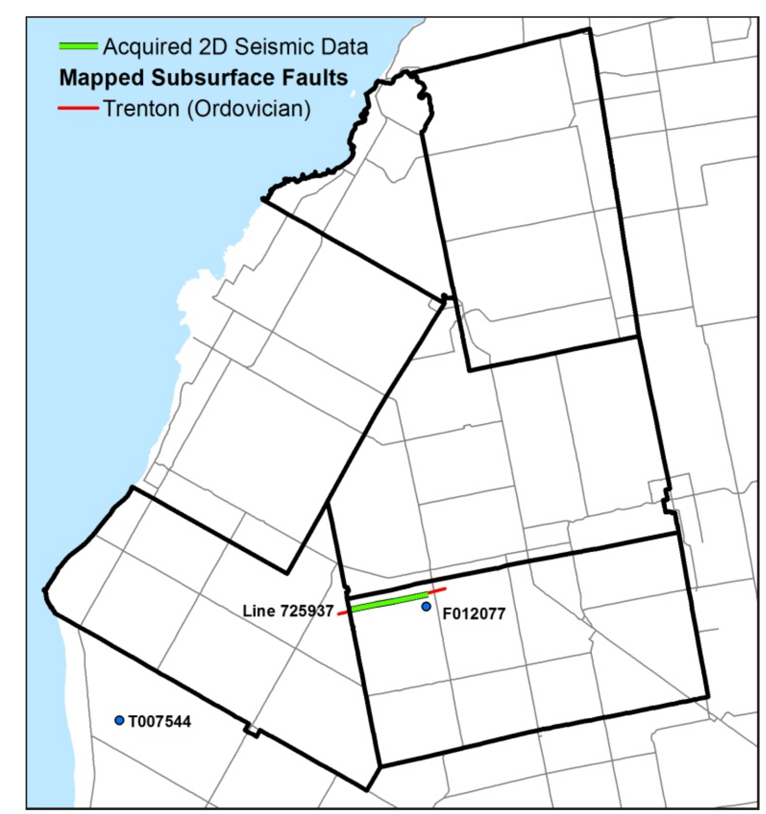


Figure 14 - 2D Seismic Interpretation of Line 725937 in the Municipality of South Bruce

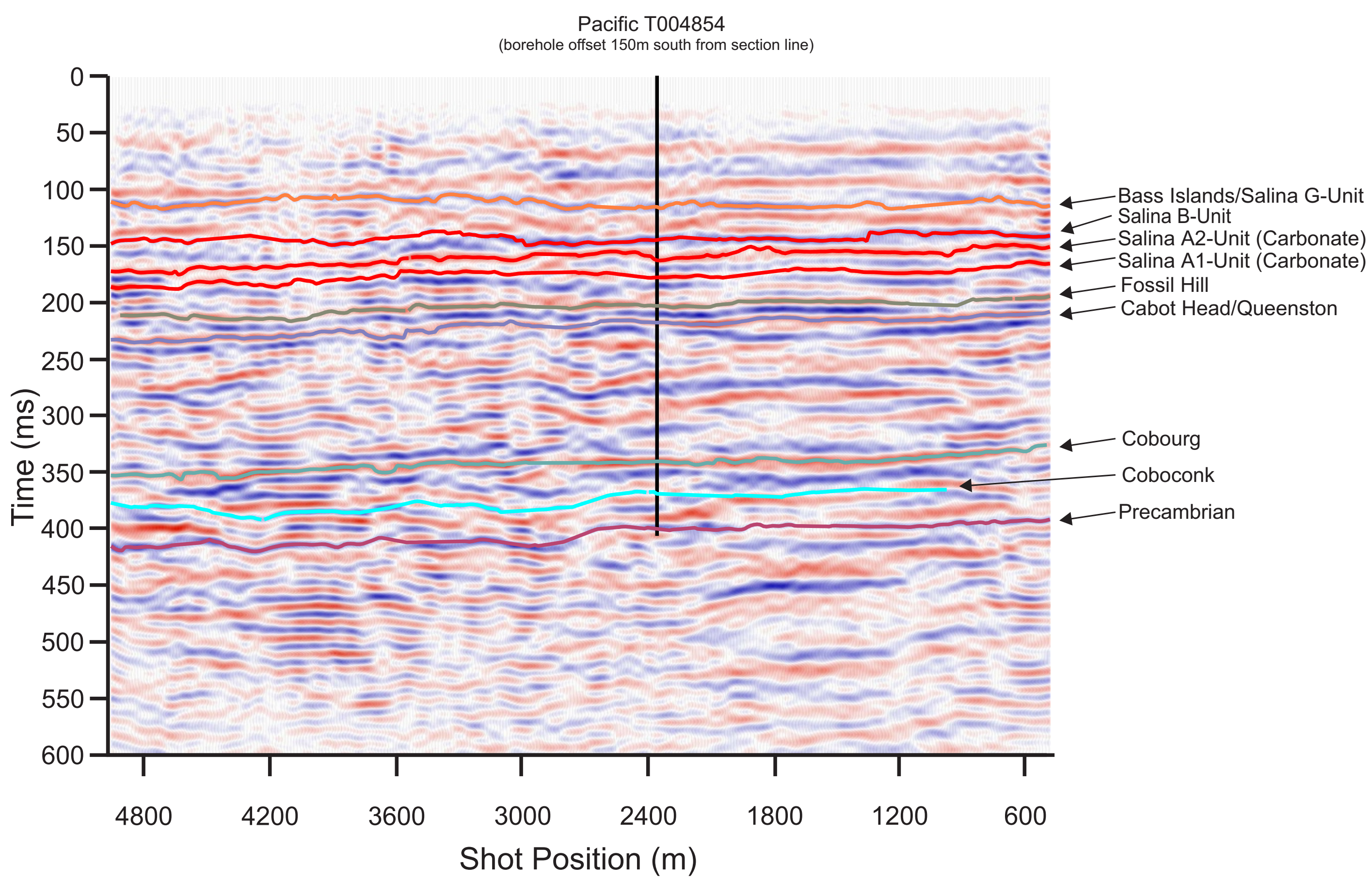
PROJECT No: 10-214-7.50

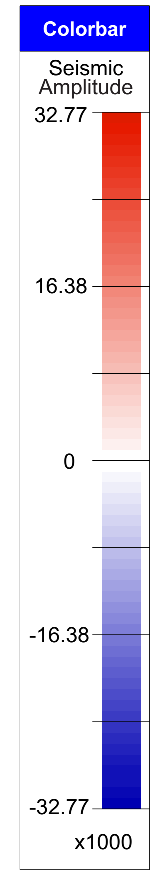
Phase 1 Geoscientific Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data

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

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig14_15_SeismicLines_Line7and8.cdr"





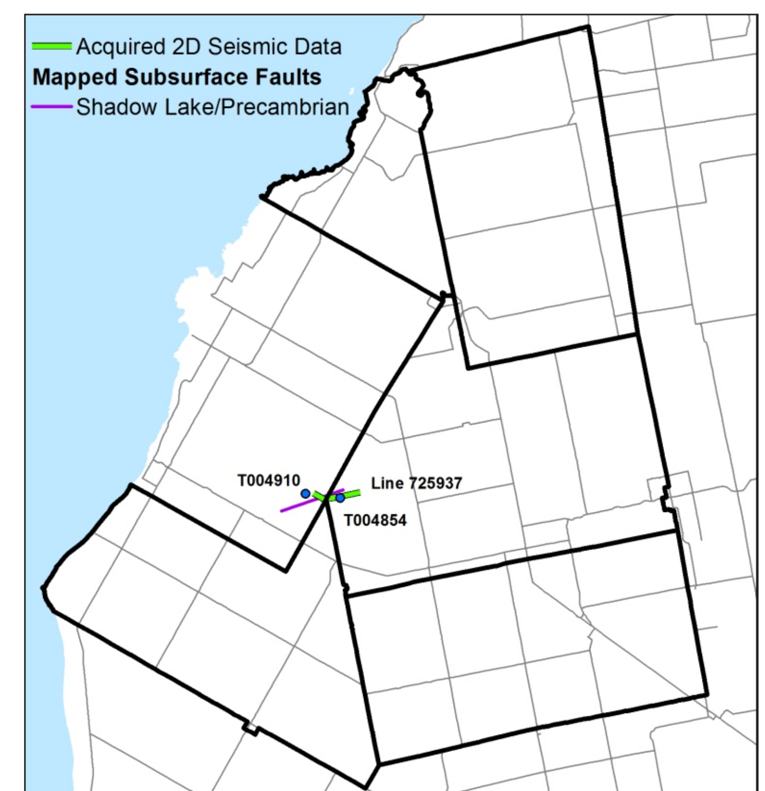


Figure 15 - 2D Seismic Interpretation of Line 825938 in the Municipality of Brockton

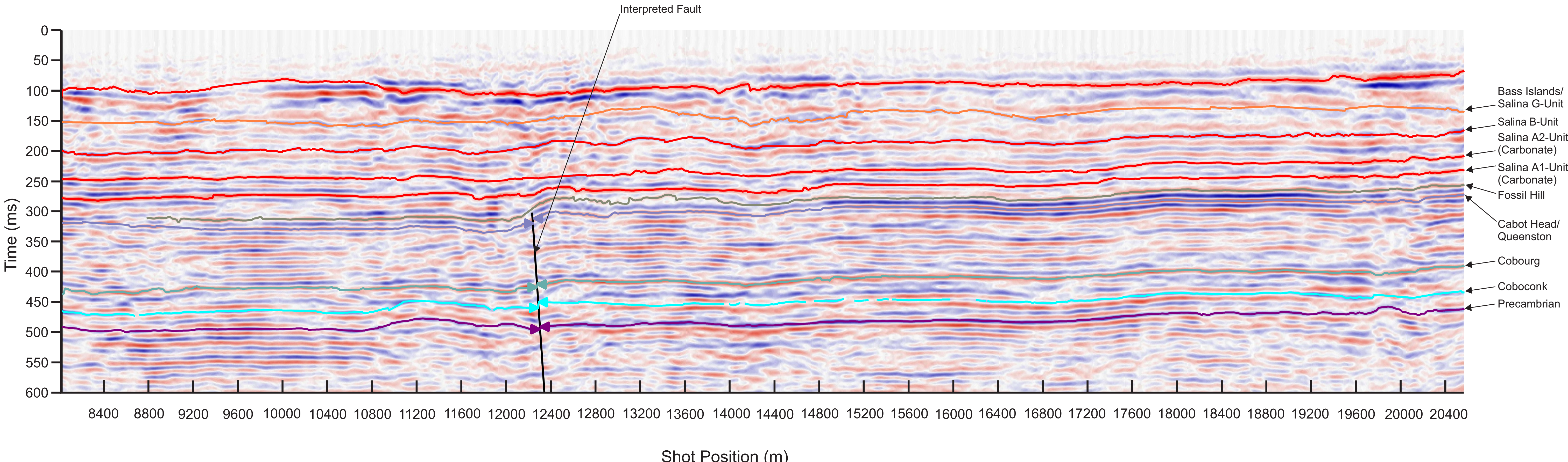
PROJECT No: 10-214-7.50

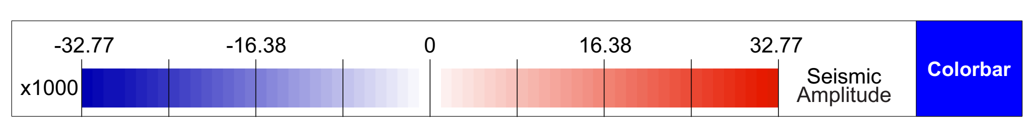
Phase 1 Geoscientific Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data

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

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig14_15_SeismicLines_Line7and8.cdr"





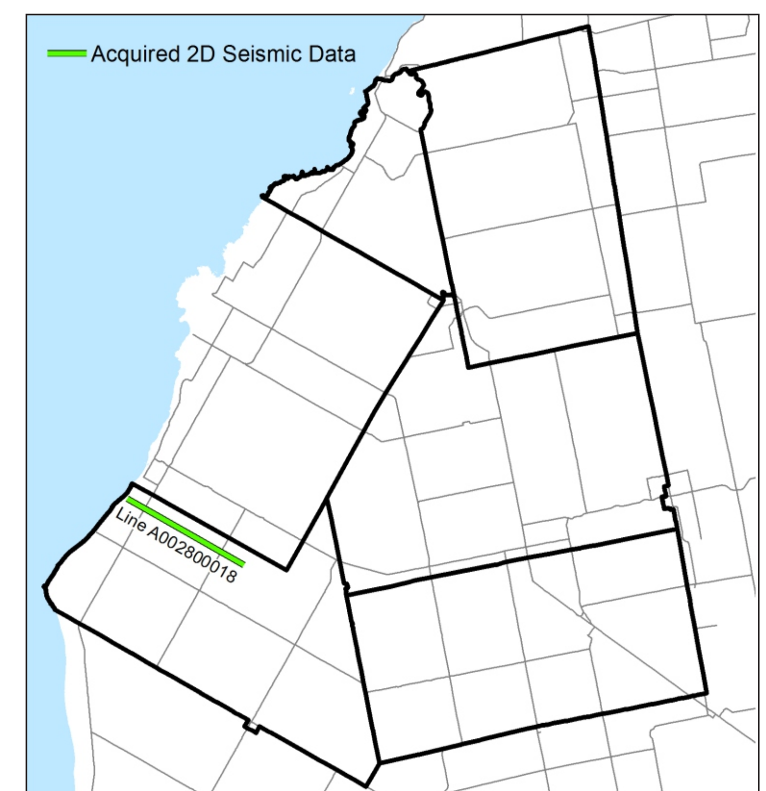


Figure 16 - 2D Seismic Interpretation of Line A002800018 in the Township of Huron-Kinloss

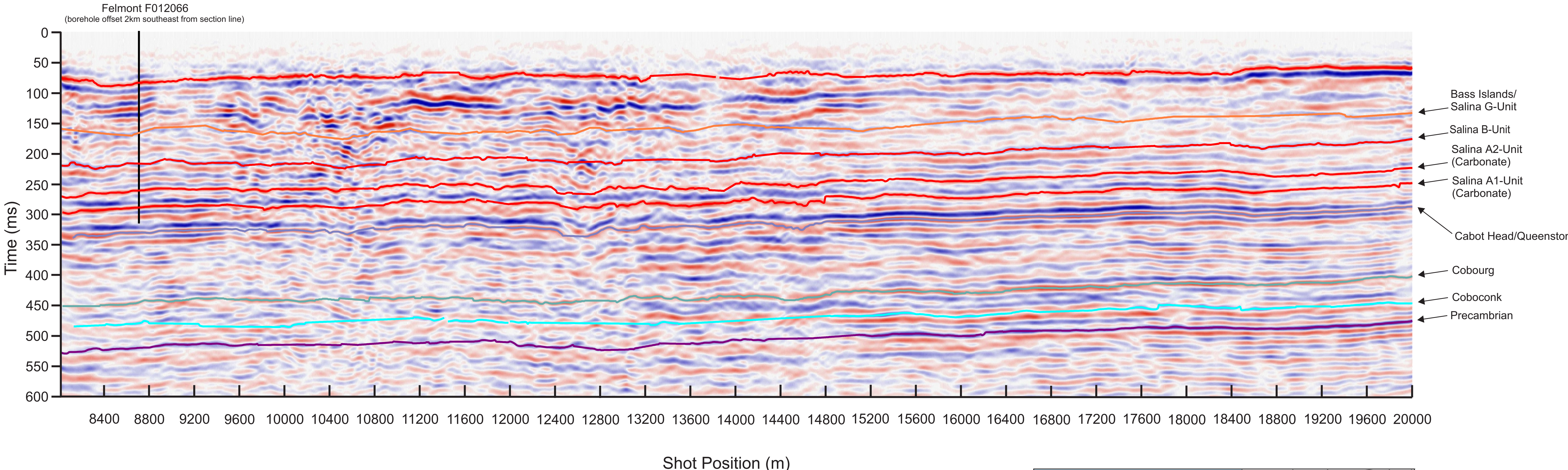
PROJECT No: 10-214-7.50

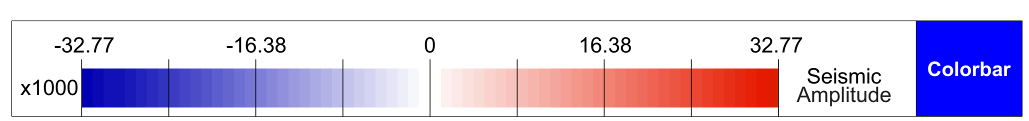
Phase 1 Geoscientific Preliminary Assessment, Processing and Interpretation of Borehole Geophysical Log and 2D Seismic Data

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

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig16_17_SeismicLines_LineA18andA20.cdr"





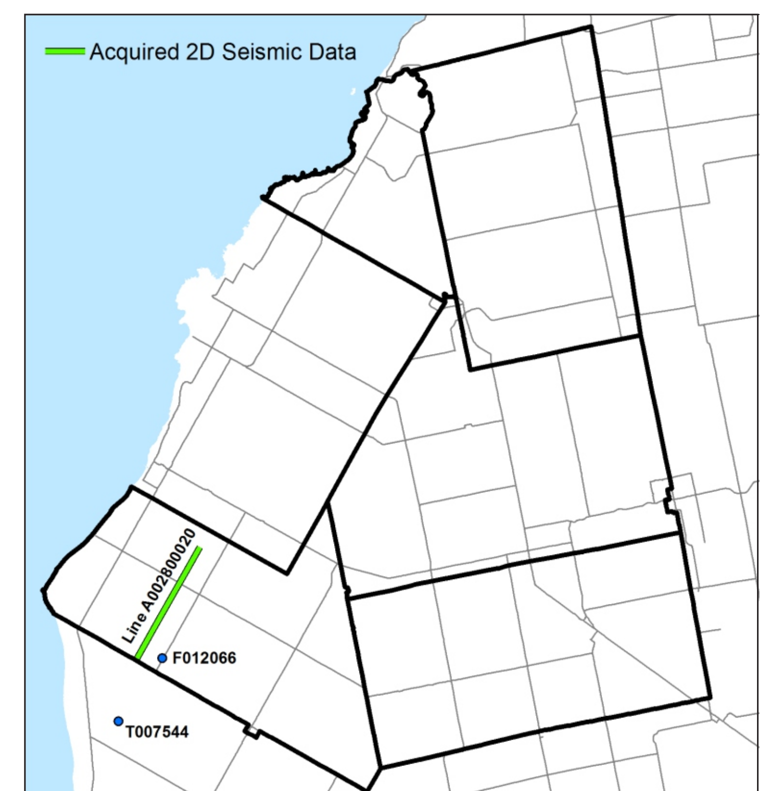


Figure 17 - 2D Seismic Interpretation of Line A002800020 in the Township of Huron-Kinloss

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

Geofirma Engineering Ltd

"P:\Projects\2010\10-214 NWMO APM Site Screening\10-214-7 Sedimentary Sites FS\50 2D Seismic and Borehole Geophysics\Figures\working_files\R0\10-214-7-50_SedSites_Fig16_17_SeismicLines_LineA18andA20.cdr"

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	OilGasPool	PinReef
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	OilGasPool	PinReef
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	OilGasPool	PinReef
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	Wiarton Local Co. - G. Farrow No. 1	Wiarton 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	OilGasPool	PinReef
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 Petroleums 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 Petroleums	Silver City Petroleums 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	Creesing No.1	Creesing 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	Creesing 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 Petroleums 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	OilGasPool	PinReef
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			note 1			
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	√		note 4			√
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	OilGasPool	PinReef
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	OilGasPool	PinReef
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	Chalinor, 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

LINE: A002800018 SP RANGE: 400 - 1029 **LINE: A002800020 SP RANGE: 400 - 1001**	
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

LINE: 725937 SP RANGE: 1 - 245 **LINE: 825938 SP RANGE: 17 - 163**	
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 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 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 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 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
	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 - IIIED			
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	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		

Prepared by: SNS
Reviewed by: VMS
Date:11/11/2014
10-214-7.50_BHGeophys2DSeismicRpt_Appendices_R0

Geofirma Engineering Ltd

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			
BH ID	F012027			
Northing (UTM NAD83)	4855138.54			
Easting (UTM NAD83)	462479.5761			
BH Depth (TVD)	551.69			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	0.61			
BH Log	GR	NL		
Date Acquired	1955	1955		
Top Depth	0	0		
Bottom Depth	549	549		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	213.4	0	NL
Salina (G-unit)	257	263	-6	GR
Salina (F-unit)	264	np	NA	GR
Cabot Head	nl	547.1	0	GR
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	

Well Name	Felmont MacTavish No. 1, West Wawanosh 5 - 17 - VIII			
BH ID	F012047			
Northing (UTM NAD83)	4858616.974			
Easting (UTM NAD83)	456656.5422			
BH Depth (TVD)	577.6			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	0.61			
BH Log	GR	NL		
Date Acquired	1958	1958		
Top Depth	0	0		
Bottom Depth	579	579		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	192	188.06	3.94	NL
Salina (G-unit)	273	232.87	40.13	GR
Salina (F-unit)	281	np	NA	GR
Cabot Head	nl	574.24	0	GR
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	

Well Name	Felmont Oil No. 13 - M. Berger No. 1, Ashfield 3 - 7 - VIED			
BH ID	F012048			
Northing (UTM NAD83)	4859452.065			
Easting (UTM NAD83)	449791.2403			
BH Depth (TVD)	601.98			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	0.61			
BH Log	GR			
Date Acquired	1955			
Top Depth	0			
Bottom Depth	579			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	217.9	0	GR
Salina (G-unit)	nc	265.2	0	GR
Salina (F-unit)	nc	274.3	0	GR
Cabot Head	nl	598.9	0	GR
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	

Well Name	Felmont Oil, Huron - 10 - I			
BH ID	F012063			
Northing (UTM NAD83)	4871110.618			
Easting (UTM NAD83)	453514.7523			
BH Depth (TVD)	568.76			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	0.61			
BH Log	GR	NL		
Date Acquired	1959	1959		
Top Depth	0	0		
Bottom Depth	579	579		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	199	196.6	2.4	NL
Salina (G-unit)	242.5	252.37	-9.87	GR
Salina (F-unit)	251	np	NA	GR
Cabot Head	nl	561.44	0	GR
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	

Well Name	Felmont Oil, Huron - 31 - I			
BH ID	F012066			
Northing (UTM NAD83)	4874071.473			
Easting (UTM NAD83)	450275.9702			
BH Depth (TVD)	566.93			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	0.61			
BH Log	GR	NL		
Date Acquired	1956	1956		
Top Depth	0			
Bottom Depth	579			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	182.88	0	GR
Salina (G-unit)	223	233.48	-10.48	GR
Salina (F-unit)	231	237.74	-6.74	GR
Cabot Head	nl	562.36	0	GR
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	

Well Name	Imperial Oil, Huron - 9 - XI			
BH ID	F012078			
Northing (UTM NAD83)	4881565.156			
Easting (UTM NAD83)	457446.8353			
BH Depth (TVD)	507.49			
BH TD Formation	Guelph			
Kelly Bushing Height (m)	0.61			
BH Log	GR	NL		
Date Acquired	1955	1955		
Top Depth	0	0		
Bottom Depth	518	518		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nc	162.76	0	NL
Salina (G-unit)	202	201.17	0.83	GR
Salina (F-unit)	nc	208.79	0	GR
Cabot Head	nl	np	NA	GR
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	

Well Name	Imperial Oil No.536 - Taylor et al No. 1, Amabel - 52 - II			
BH ID	F012141			
Northing (UTM NAD83)	4950304.141			
Easting (UTM NAD83)	484603.2864			
BH Depth (TVD)	501.4			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	0.6			
BH Log	GR	NL		
Date Acquired	1955	1955		
Top Depth	55	55		
Bottom Depth	503	503		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	nl	np	NA	
Salina (F-unit)	nl	np	NA	
Cabot Head	67	74.7	-7.7	GR
Queenston	nc	114.3	0	GR
Cobourg (Collingwood)	319	288	31	NL
Cobourg (Lower)	333	317	16	GR
Coboconk	nc	426.4	0	GR
Gull River (if conflict)	dif	447.8	0	GR
Precambrian	dif	497.7	0	GR

Well Name	Imperial Oil No. 527 - W. Radbourne No. 1, Keppel 2 - 22 - IIS			
BH ID	H000032			
Northing (UTM NAD83)	4941351.636			
Easting (UTM NAD83)	492711.0118			
BH Depth (TVD)	497.43			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	0.61			
BH Log	GR	NL		
Date Acquired	1955	1955		
Top Depth	91	91		
Bottom Depth	472	472		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	nl	np	NA	
Salina (F-unit)	nl	np	NA	GR
Cabot Head	dif	57.9	0	
Queenston	dif	102.1	0	
Cobourg (Collingwood)	321	300.2	20.8	GRNL
Cobourg (Lower)	334	317	17	
Coboconk	429.5	431	-1.5	
Gull River (if conflict)	nc	435.3	0	
Precambrian	nl	496.2	NA	

Well Name	Ben Allen Cement Co. - Chambers & Dewus - McMillan No. 1, Keppel 5 - 30 - VIII			
BH ID	H000033			
Northing (UTM NAD83)	4940341.934			
Easting (UTM NAD83)	501617.0691			
BH Depth (TVD)	472.44			
BH TD Formation	Shadow Lake			
Kelly Bushing Height (m)	0.1			
BH Log	GR	NL		
Date Acquired	1958	1958		
Top Depth	0	0		
Bottom Depth	472	472		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	nl	np	NA	
Salina (F-unit)	nl	np	NA	
Cabot Head	9.9	10.4	-0.5	GR
Queenston	54	54.9	-0.9	GR
Cobourg (Collingwood)	274.5	np	NA	GR
Cobourg (Lower)	282	274.3	7.7	
Coboconk	nc	388.6	0	GRNL
Gull River (if conflict)	nl	np	NA	
Precambrian	nc	460.25	0	NL

Well Name	Arnora Sulphur Mining Corporation No.1 - A.B. Whyte No. 1, Proton 1 - 10 - XIX			
BH ID	H000038			
Northing (UTM NAD83)	4891958.835			
Easting (UTM NAD83)	534100.1972			
BH Depth (TVD)	701.95			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	0			
BH Log	GR			
Date Acquired	1955			
Top Depth	0			
Bottom Depth	701			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	nl	np	NA	
Salina (F-unit)	nl	np	NA	
Cabot Head	nc	149.4	0	
Queenston	nc	176.2	0	GR
Cobourg (Collingwood)	449	431.9	17.1	GR
Cobourg (Lower)	469	451.1	17.9	
Coboconk	597	592.84	4.16	GR
Gull River (if conflict)	dif	616.6	0	
Precambrian	nc	651.1	0	GR

Well Name	Annan Petroleum No. 1 - D. Morris No. 1, Sarawak 2 - 29 - III			
BH ID	H000043			
Northing (UTM NAD83)	4945957.915			
Easting (UTM NAD83)	505422.6767			
BH Depth (TVD)	368.2			
BH TD Formation	Black River Group			
Kelly Bushing Height (m)	0			
BH Log	GR			
Date Acquired	1948			
Top Depth	0			
Bottom Depth	371			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	nl	np	NA	
Salina (F-unit)	nl	np	NA	
Cabot Head	nl	np	NA	
Queenston	nl	6.1	0	GR
Cobourg (Collingwood)	209	205.7	3.3	GR
Cobourg (Lower)	217.5	210.3	7.2	
Coboconk	362	np	NA	GR
Gull River (if conflict)	nl	np	NA	
Precambrian	nl	np	NA	

Well Name	BP Triad, (A), Saugeen - 29 - II			
BH ID	T001720A			
Northing (UTM NAD83)	4910793.318			
Easting (UTM NAD83)	473240.2468			
BH Depth (TVD)	722.38			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	3.62			
BH Log	GR	NL		
Date Acquired	1964	1964		
Top Depth	0	0		
Bottom Depth	732	732		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	dif	64.92	0	
Salina (F-unit)	dif	np	NA	
Cabot Head	287	284.07	2.93	GR
Queenston	314	310.9	3.1	GR
Cobourg (Collingwood)	525	np	NA	GR
Cobourg (Lower)	538.5	522.7	15.8	
Coboconk	nc	643.7	0	GR
Gull River (if conflict)	nc	649.22	0	GR
Precambrian	717	719.94	-2.94	

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		

Prepared by: SNS
Reviewed by: VMS
Date:11/11/2014
10-214-7.50_BHGeophys2DSeismicRpt_Appendices_R0

Geofirma Engineering Ltd

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				Creesing 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				4855269.966				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	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		

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				**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	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			
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

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?

Log Legend

GR	Gamma Ray	NPHI	Neutron Porosity
NL	Neutron Log	DPHI	Density Porosity
RHOB	Bulk Density	DT	Interval Transit Time
PE	Photo-Electric Factor		

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

Well Name	Pacific Elma 2-13-XI, Elma 2 - 13 - XI			
BH ID	T004730			
Northing (UTM NAD83)	4833006.684			
Easting (UTM NAD83)	496269.7068			
BH Depth (TVD)	873.25			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	1.21			
BH Log	GR			
Date Acquired	1978			
Top Depth	403			
Bottom Depth	891			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	93.88	0	
Salina (G-unit)	nl	113.39	0	
Salina (F-unit)	nl	np	NA	
Cabot Head	nl	349	0	
Queenston	nc	371.25	0	
Cobourg (Collingwood)	681	615.09	65.91	GR
Cobourg (Lower)	700.5	642.2	58.3	GR
Coboconk	835	791.3	43.7	GR
Gull River (if conflict)	851	796.75	54.25	GR
Precambrian	nl	868.07	0	GR

Well Name	Pacific, Turnberry 1 - 1 - II			
BH ID	T004767			
Northing (UTM NAD83)	4856904.889			
Easting (UTM NAD83)	485863.2041			
BH Depth (TVD)	865.94			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	1.2			
BH Log	GR			
Date Acquired	1978			
Top Depth	50			
Bottom Depth	865			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	115.5	0	GR
Salina (G-unit)	146	146	0	GR
Salina (F-unit)	157	157.3	-0.3	GR
Cabot Head	372	372.5	-0.5	GR
Queenston	399	398.7	0.3	GR
Cobourg (Collingwood)	640	607.8	32.2	GR
Cobourg (Lower)	657	639.8	17.2	
Coboconk	787	787	0	GR
Gull River (if conflict)	nc	805.5	0	
Precambrian	859	860	-1	GR

Well Name	Kenartha, Arthur 3 - 25 - VII			
BH ID	T004848			
Northing (UTM NAD83)	4855544.573			
Easting (UTM NAD83)	528474.9082			
BH Depth (TVD)	739.14			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	1.2			
BH Log	RHOB			
Date Acquired	1978			
Top Depth	512			
Bottom Depth	739			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	nl	np	NA	
Salina (F-unit)	nl	np	NA	
Cabot Head	nl	194.2	0	
Queenston	nl	221.3	0	
Cobourg (Collingwood)	518	499.9	18.1	RHOB
Cobourg (Lower)	536	517.6	18.4	RHOB
Coboconk	671	665.1	5.9	RHOB
Gull River (if conflict)	692	670.9	21.1	RHOB
Precambrian	nc	726.9	0	

Well Name	FITZGERALD, Ashfield 4 - 5 - IX			
BH ID	T004849			
Northing (UTM NAD83)	4866187.845			
Easting (UTM NAD83)	446265.2406			
BH Depth (TVD)	567.54			
BH TD Formation	Goat Island			
Kelly Bushing Height (m)	1.1			
BH Log	GR	NL		
Date Acquired	1979	1979		
Top Depth	0	0		
Bottom Depth	563	563		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	222	214	8	NL
Salina (G-unit)	nc	260.6	0	GRNL
Salina (F-unit)	nc	269.4	0	GRNL
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	

Well Name	Total et al, Ashfield 1 - 12 - IXED			
BH ID	T004851			
Northing (UTM NAD83)	4862979.699			
Easting (UTM NAD83)	455710.4304			
BH Depth (TVD)	1037.23			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	1.22			
BH Log	GR			
Date Acquired	1978			
Top Depth	300			
Bottom Depth	1025			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	214.3	0	
Salina (G-unit)	nl	255.1	0	
Salina (F-unit)	nl	263	0	
Cabot Head	560	560.8	-0.8	GR
Queenston	595	595.6	-0.6	GR
Cobourg (Collingwood)	811	776.3	34.7	GR
Cobourg (Lower)	826	810.5	15.5	
Coboconk	nc	944.6	0	GR
Gull River (if conflict)	nc	969.9	0	
Precambrian	nl	1034.8	0	

Well Name	Pacific, Greenock 1 - 32 - VIII			
BH ID	T004854			
Northing (UTM NAD83)	4888669.131			
Easting (UTM NAD83)	466865.2542			
BH Depth (TVD)	894			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	1.2			
BH Log	GR	NL		
Date Acquired	1979	1979		
Top Depth	0	0		
Bottom Depth	894	894		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nc	151.8	0	NL
Salina (G-unit)	nc	190.8	0	GR
Salina (F-unit)	nc	198.1	0	GR
Cabot Head	nc	436.5	0	GR
Queenston	nc	463.3	0	GR
Cobourg (Collingwood)	680	633.4	46.6	GR
Cobourg (Lower)	694	679.4	14.6	
Coboconk	nc	808.3	0	GR
Gull River (if conflict)	nc	832.1	0	
Precambrian	nl	889.7	0	

Well Name	Fitzgerald, Tuckersmith 3 - 25 - I			
BH ID	T004855			
Northing (UTM NAD83)	4817079.432			
Easting (UTM NAD83)	458926.2813			
BH Depth (TVD)	544.4			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	1.2			
BH Log	GR	NL		
Date Acquired	1979	1979		
Top Depth	0	0		
Bottom Depth	548	548		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	204	199.3	4.7	NL
Salina (G-unit)	243	243.2	-0.2	GRNL
Salina (F-unit)	252	252.4	-0.4	GRNL
Cabot Head	nc	539.5	0	
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	

Well Name	SHELL, Ashfield 7 - 1 - IIIED			
BH ID	T004864			
Northing (UTM NAD83)	4857305.018			
Easting (UTM NAD83)	444283.3788			
BH Depth (TVD)	639			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	1.2			
BH Log	GR	NPHI	DPHI	DT
Date Acquired	1979	1979	1979	1979
Top Depth	25	300	300	25
Bottom Depth	639	639	640	635
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	209.1	0	GR
Salina (G-unit)	nc	259.7	0	GR
Salina (F-unit)	nc	267.9	0	GR
Cabot Head	dif	618.7	0	NPHI
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	

Well Name	Pacific, Culross 4 - 25 - V			
BH ID	T004881			
Northing (UTM NAD83)	4869343.455			
Easting (UTM NAD83)	473529.9803			
BH Depth (TVD)	882.7			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	1.2			
BH Log	GR	NL		
Date Acquired	1979	1979		
Top Depth	0	0		
Bottom Depth	884	894		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	132	137.2	-5.2	NL
Salina (G-unit)	nc	173.7	0	GR
Salina (F-unit)	nc	182.6	0	GR
Cabot Head	nc	407.9	0	GR
Queenston	nc	435.3	0	GR
Cobourg (Collingwood)	659.3	632.2	27.1	GR
Cobourg (Lower)	674.6	659.3	15.3	
Coboconk	nc	797.1	0	GR
Gull River (if conflict)	nc	817.5	0	
Precambrian	nc	875.7	0	GRNL

Well Name	Amoco A-1, Kincardine 2 - 31 - V			
BH ID	T004910			
Northing (UTM NAD83)	4889056.394			
Easting (UTM NAD83)	463644.0134			
BH Depth (TVD)	909			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	4.8			
BH Log	GR	NL		
Date Acquired	1979	1979		
Top Depth	140	150		
Bottom Depth	900	920		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	136	0	
Salina (G-unit)	nc	169.5	0	GRNL
Salina (F-unit)	nc	177.8	0	GRNL
Cabot Head	456.5	460	-3.5	GRNL
Queenston	487.5	487.3	0.2	GRNL
Cobourg (Collingwood)	696.7	573.4	123.3	
Cobourg (Lower)	711.1	696.7	14.4	
Coboconk	nc	830	0	
Gull River (if conflict)	nl	859.6	0	
Precambrian	nl	903.7	0	

Well Name	SHELL, Ashfield 8 - 1 - IIIED			
BH ID	T004918			
Northing (UTM NAD83)	4857109.385			
Easting (UTM NAD83)	444455.3857			
BH Depth (TVD)	626.4			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	1.1			
BH Log	GR			
Date Acquired	1979			
Top Depth	15			
Bottom Depth	624			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	204	0	GR
Salina (G-unit)	256	257.4	-1.4	GR
Salina (F-unit)	nc	265.5	0	
Cabot Head	nc	612.3	0	
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	

Well Name	Petromark et al, Elma 2 - 36 - XIV			
BH ID	T004985*			
Northing (UTM NAD83)	4825710.271			
Easting (UTM NAD83)	503006.9414			
BH Depth (TVD)	875.1			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	1.2			
BH Log	no logs			
Date Acquired	1979			
Top Depth				
Bottom Depth				
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	77.1	0	
Salina (G-unit)	nl	80.8	0	
Salina (F-unit)	nl	83.8	0	
Cabot Head	nl	328.6	0	
Queenston	nl	351.1	0	
Cobourg (Collingwood)	nl	572.6	0	
Cobourg (Lower)	nl	638.3	0	
Coboconk	nl	797.4	0	
Gull River (if conflict)	nl	813.5	0	
Precambrian	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		

Prepared by: SNS
Reviewed by: VMS
Date:11/11/2014
10-214-7.50_BHGeophys2DSeismicRpt_Appendices_R0

Geofirma Engineering Ltd

Well Name	SHELL, East Wawanosh 7 - 28 - V				AMOCO, McKillop 4 - 33 - III			
BH ID	T005051				T005124			
Northing (UTM NAD83)	4851355.797				4825796.655			
Easting (UTM NAD83)	459873.3191				466979.2949			
BH Depth (TVD)	594				525			
BH TD Formation	Cabot Head				Cabot Head			
Kelly Bushing Height (m)	1.2				3.8			
BH Log	GR	NL			GR	NPHI	DT	GR#2
Date Acquired	1979	1979			1979	1979	1979	1979
Top Depth	0	0			200	180	200	180
Bottom Depth	565	565			500	600	500	600
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**
Bass Island	212	217.9	-5.9	NL	nl	184.5	0	
Salina (G-unit)	256	261.6	-5.6	GRNL	nc	226	0	GR
Salina (F-unit)	263	272.6	-9.6	GRNL	nc	234.5	0	GR
Cabot Head	556	555.2	0.8	GRNL	nl	512.5	0	GR
Queenston	nl	np	NA		nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	

Well Name	Shell, Stanley 3 - 16 - VII				FITZGERALD, Ashfield 2 - 6 - VED			
BH ID	T005130				T005131			
Northing (UTM NAD83)	4818492.556				4859000.012			
Easting (UTM NAD83)	451474.0848				448788.0246			
BH Depth (TVD)	604				573.4			
BH TD Formation	Queenston				Goat Island			
Kelly Bushing Height (m)	1.4				1.2			
BH Log	GR	NL			GR	NL		
Date Acquired	1979	1979			1979	1979		
Top Depth	810	810			0	0		
Bottom Depth	975	975			575	575		
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**
Bass Island	nc	207	0	GR	dif	211.5	0	NL
Salina (G-unit)	nc	250.6	0	GR	260	260.4	-0.4	GRNL
Salina (F-unit)	nc	258	0	GR	nc	268	0	GRNL
Cabot Head	nc	564.4	0	GR	nl	np	NA	
Queenston	nl	599.8	0	GR	nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	

Well Name	Shell, Goderich 4 - 40 - IX				Kenartha Arthur 4-24-VII, Arthur 4 - 24 - VII			
BH ID	T005166				T005177			
Northing (UTM NAD83)	4826279.437				4855921.196			
Easting (UTM NAD83)	448978.2021				528340.8859			
BH Depth (TVD)	644				883.9			
BH TD Formation	Cabot Head				Precambrian			
Kelly Bushing Height (m)	1.2				1.5			
BH Log	GR#3	NPHI	DT	DPHI	GR	NL		
Date Acquired	1979	1979	1979	1979	1980	1980		
Top Depth	30	110	335	345	652	652		
Bottom Depth	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**
Bass Island	dif	284	0	GR&NPHI	nl	np	NA	
Salina (G-unit)	nc	339.5	0	GR&NPHI	nl	np	NA	
Salina (F-unit)	nc	347	0	GR&NPHI	nl	np	NA	
Cabot Head	nc	640.5	0	GR	nl	195	0	
Queenston	nl	np	NA		nl	225.1	0	
Cobourg (Collingwood)	nl	np	NA		nl	494.7	0	
Cobourg (Lower)	nl	np	NA		nl	511.1	0	
Coboconk	nl	np	NA		672	635.9	36.1	GR
Gull River (if conflict)	nl	np	NA		691	670.9	20.1	GR
Precambrian	nl	np	NA		722	719.8	2.2	GR

Well Name	FITZGERALD, Stanley 3 - 30 - I				SHELL, Goderich 1 - 9 - HRC			
BH ID	T005182				T005326			
Northing (UTM NAD83)	4825121.127				4831467.573			
Easting (UTM NAD83)	456649.4076				452932.5494			
BH Depth (TVD)	545				601			
BH TD Formation	Goat Island				Cabot Head			
Kelly Bushing Height (m)	1.2				1.2			
BH Log	GR	NL			GR	DT		
Date Acquired	1980	1980			1980	1980		
Top Depth	0	0			10	275		
Bottom Depth	545	550			600	600		
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**
Bass Island	dif	201.9	0	NL	dif	223.2	0	GR
Salina (G-unit)	nc	252.3	0	GRNL	267.5	272.3	-4.8	GR
Salina (F-unit)	nc	261	0	GRNL	280	280.6	-0.6	GR
Cabot Head	nl	np	NA		nc	589	0	GR
Queenston	nl	np	NA		nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	

Well Name	SHELL, Colborne 1 - 8 - I				HURON 1, Stanley 1 - 10 - X			
BH ID	T005404				T005554			
Northing (UTM NAD83)	4841008.735				4815723.477			
Easting (UTM NAD83)	452247.7537				449183.2605			
BH Depth (TVD)	625.5				592			
BH TD Formation	Cabot Head				Cabot Head			
Kelly Bushing Height (m)	1.2				0.3			
BH Log	GR				GR	NL		
Date Acquired	1980				1982	1982		
Top Depth	0				0	0		
Bottom Depth	625				594	594		
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**
Bass Island	dif	245.4	0	GR	nc	214	0	NL
Salina (G-unit)	nc	292	0	GR	nc	264.6	0	GRNL
Salina (F-unit)	nc	301.2	0	GR	nc	273.1	0	GRNL
Cabot Head	nc	617	0	GR	nc	589.8	0	GR
Queenston	nl	np	NA		nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	

Well Name	Huron 3, Stanley 4 - 7 - XI				MILTON RESOURCE, Goderich 1 - 26 - II			
BH ID	T005885				T006251			
Northing (UTM NAD83)	4814372.664				4832166.722			
Easting (UTM NAD83)	447663.7489				443499.7137			
BH Depth (TVD)	615				623.8			
BH TD Formation	Cabot Head				Cabot Head			
Kelly Bushing Height (m)	0.5				1.2			
BH Log	GR	NPHI			GR	NL		
Date Acquired	1982	1982			1983	1983		
Top Depth	80	80			0	0		
Bottom Depth	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**
Bass Island	nc	239.9	0	NPHI	nc	228	0	NL
Salina (G-unit)	nc	284.2	0	GR&NPHI	nc	277	0	GRNL
Salina (F-unit)	nc	292.4	0	GR&NPHI	nc	285	0	GRNL
Cabot Head	nl	612.3	0		nc	622	0	NL
Queenston	nl	np	NA		nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	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		

Prepared by: SNS
Reviewed by: VMS
Date:11/11/2014
10-214-7.50_BHGeophys2DSeismicRpt_Appendices_R0

Geofirma Engineering Ltd

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

Well Name	HURON #4, Stanley 3 - 7 - XI			
BH ID	T006307			
Northing (UTM NAD83)	4814467.418			
Easting (UTM NAD83)	447698.2279			
BH Depth (TVD)	576			
BH TD Formation	Guelph			
Kelly Bushing Height (m)	2.01			
BH Log	GR	NPHI		
Date Acquired	1983	1983		
Top Depth	15	50		
Bottom Depth	565	570		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	247	0	GR&NPHI
Salina (G-unit)	nc	284	0	GR&NPHI
Salina (F-unit)	nc	292.1	0	GR&NPHI
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	

Well Name	HURON #5, Stanley 2 - 10 - X			
BH ID	T006322			
Northing (UTM NAD83)	4815783.076			
Easting (UTM NAD83)	449053.439			
BH Depth (TVD)	604			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	1.96			
BH Log	GR	NPHI		
Date Acquired	1983	1983		
Top Depth	20	20		
Bottom Depth	567	575		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nc	215.2	0	GR&NPHI
Salina (G-unit)	284	268.3	15.7	GR&NPHI
Salina (F-unit)	292	276.4	15.6	GR&NPHI
Cabot Head	nl	594.8	0	
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	

Well Name	TIPPERARY #6, Goderich 1 - 33 - III			
BH ID	T006341			
Northing (UTM NAD83)	4829333.824			
Easting (UTM NAD83)	444686.2898			
BH Depth (TVD)	632.8			
BH TD Formation	Queenston			
Kelly Bushing Height (m)	1.95			
BH Log	GR	NPHI		
Date Acquired	1983	1983		
Top Depth	20	20		
Bottom Depth	620	620		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	222.3	0	GR&NPHI
Salina (G-unit)	nc	273.5	0	GR&NPHI
Salina (F-unit)	nc	281	0	GR&NPHI
Cabot Head	nl	613.8	0	
Queenston	nl	619.4	0	
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	

Well Name	Tipperary S #2, Goderich 4 - 40 - IX			
BH ID	T006346			
Northing (UTM NAD83)	4826391.06			
Easting (UTM NAD83)	448905.0477			
BH Depth (TVD)	610			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	2			
BH Log	GR	NPHI	DPHI	
Date Acquired	1983	1983	1983	
Top Depth	0	0	334	
Bottom Depth	641	650	650	
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	288.2	0	GR&NPHI
Salina (G-unit)	338	350.4	-12.4	GR
Salina (F-unit)	346	358.6	-12.6	GR
Cabot Head	634	635.6	-1.6	GR
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	

Well Name	Tipperary No.4, Goderich 2 - 37 - IX			
BH ID	T006364			
Northing (UTM NAD83)	4827488.33			
Easting (UTM NAD83)	449451.5449			
BH Depth (TVD)	1134			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	2.05			
BH Log	GR	NPHI	RHOB	
Date Acquired	1983	1983	1983	
Top Depth	32	30	360	
Bottom Depth	1130	1134	1135	
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nc	257	0	GR
Salina (G-unit)	nc	350.5	0	GR
Salina (F-unit)	nc	357	0	GR
Cabot Head	nc	638.2	0	GR
Queenston	nc	668.6	0	GR
Cobourg (Collingwood)	885.5	np	NA	GR
Cobourg (Lower)	901	885.5	15.5	GR
Coboconk	nc	1029.3	0	GR
Gull River (if conflict)	dif	1053.6	0	GR
Precambrian	1126	1123.8	2.2	GR

Well Name	Florentine et al 1, Stanley 3 - 20 - XI			
BH ID	T007104			
Northing (UTM NAD83)	4819475.245			
Easting (UTM NAD83)	447155.2354			
BH Depth (TVD)	613.5			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	1.5			
BH Log	GR	NPHI		
Date Acquired	1987	1987		
Top Depth	25	25		
Bottom Depth	615	615		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	221.6	0	GR
Salina (G-unit)	nc	271.9	0	GR
Salina (F-unit)	nc	279.5	0	GR
Cabot Head	605.5	603.5	2	NPHI
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	

Well Name	Owenbrook et al 1, Goderich 1 - 21 - BAC			
BH ID	T007179			
Northing (UTM NAD83)	4824195.758			
Easting (UTM NAD83)	450366.6979			
BH Depth (TVD)	598			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	1.5			
BH Log	GR	NPHI		
Date Acquired	1987	1987		
Top Depth	15	15		
Bottom Depth	600	600		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nc	235.5	0	GR&NPHI
Salina (G-unit)	nc	285.2	0	GR&NPHI
Salina (F-unit)	nc	292.8	0	GR&NPHI
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	

Well Name	Orford Res et al 1, Stanley 3 - 5 - X			
BH ID	T007307			
Northing (UTM NAD83)	4813784.836			
Easting (UTM NAD83)	448923.7323			
BH Depth (TVD)	1114.7			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	1.4			
BH Log	GR	GR#1	GR#2	NPHI
Date Acquired	1988	1988	1988	1988
Top Depth	25	0	285	267
Bottom Depth	1100	285	1100	1100
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	218.5	0	DT
Salina (G-unit)	nc	270.9	0	GR&DT
Salina (F-unit)	nc	278.6	0	GR&DT
Cabot Head	598	598	0	GR&DT
Queenston	nc	636	0	GR&DT
Cobourg (Collingwood)	861.1	np	NA	GR&DT
Cobourg (Lower)	879	861.1	17.9	GR&DT
Coboconk	nc	1009.8	0	GR&DT
Gull River (if conflict)	nl	1035	0	
Precambrian	nl	1104	0	

Well Name	Orford Res et al #2, Stanley 3 - 15 - VII			
BH ID	T007412			
Northing (UTM NAD83)	4818270.665			
Easting (UTM NAD83)	451441.0505			
BH Depth (TVD)	572			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	2.5			
BH Log	GR	NPHI		
Date Acquired	1988	1988		
Top Depth	0	0		
Bottom Depth	570	570		
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	dif	211	0	GR&NPHI
Salina (G-unit)	nc	251.6	0	GR&NPHI
Salina (F-unit)	nc	260.2	0	GR&NPHI
Cabot Head	567.5	568.4	-0.9	GR
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	

Well Name	BP 1, Ashfield 2 - 6 - XWD			
BH ID	T007544			
Northing (UTM NAD83)	4868248.575			
Easting (UTM NAD83)	446247.5951			
BH Depth (TVD)	1100			
BH TD Formation	Precambrian			
Kelly Bushing Height (m)	3.6			
BH Log	GR	GR#1	GR#2	NL
Date Acquired	1990	1990	1990	1990
Top Depth	575	350	275	275
Bottom Depth	1100	1095	1090	1090
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	198	0	
Salina (G-unit)	278.5	268.1	10.4	NL
Salina (F-unit)	283	276.4	6.6	GRNL
Cabot Head	nc	596	0	GR
Queenston	nc	634.1	0	GR
Cobourg (Collingwood)	841.4	np	NA	GR
Cobourg (Lower)	855	841.4	13.6	GR
Coboconk	nc	960.5	0	GR
Gull River (if conflict)	nl	991.8	0	
Precambrian	dif	1066	0	GR

Well Name	OGS 90-2, Amabel - 7 - A			
BH ID	T007586			
Northing (UTM NAD83)	4932813.621			
Easting (UTM NAD83)	487360.3989			
BH Depth (TVD)	106.4			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	0			
BH Log	GR			
Date Acquired	1990			
Top Depth	0			
Bottom Depth	104			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	nl	np	NA	
Salina (F-unit)	nl	np	NA	
Cabot Head	100	105.2	-5.2	GR
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	

Well Name	OGS 90-3, Amabel - 16 - XIV			
BH ID	T007587			
Northing (UTM NAD83)	4946326.428			
Easting (UTM NAD83)	483154.3356			
BH Depth (TVD)	91.1			
BH TD Formation	Cabot Head			
Kelly Bushing Height (m)	0			
BH Log	GR			
Date Acquired	1990			
Top Depth	0			
Bottom Depth	91			
Formation Tops	Geofirma Form. Top (mBKB)	MNR Form. Top (mBKB)	Δ Elevation (m)	Log Used to Make Pick
Bass Island	nl	np	NA	
Salina (G-unit)	nl	np	NA	
Salina (F-unit)	nl	np	NA	
Cabot Head	nc	89.1	0	GR
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				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		

Prepared by: SNS
Reviewed by: VMS
Date:11/11/2014
10-214-7.50_BHGeophys2DSeismicRpt_Appendices_R0

Geofirma Engineering Ltd

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			
BH ID	T008004*				T008250			
Northing (UTM NAD83)	4842709.42				4822580.896			
Easting (UTM NAD83)	444482.2927				445366.5836			
BH Depth (TVD)	498.6				612			
BH TD Formation	B Salt				Cabot Head			
Kelly Bushing Height (m)	3.2				1.3			
BH Log	no logs?				GR	DT		
Date Acquired	1993				1995	1995		
Top Depth					325	325		
Bottom Depth					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
Bass Island	nl	np	NA		nl	227	0	
Salina (G-unit)	nl	np	NA		nl	271.4	0	
Salina (F-unit)	nl	np	NA		nl	279.7	0	
Cabot Head	nl	np	NA		603.5 (dif)	604.8	-1.3	DT
Queenston	nl	np	NA		nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	

Well Name	Clearwood et al #12, Tuckersmith 2 - 30 - IIISHR				Tribute et al #16, Goderich 2 - 66 - VIII			
BH ID	T008657				T008843			
Northing (UTM NAD83)	4824266.412				4825294.773			
Easting (UTM NAD83)	460213.32				448232.7801			
BH Depth (TVD)	539				623			
BH TD Formation	Goat Island				Cabot Head			
Kelly Bushing Height (m)	1.35				1.3			
BH Log	GR	DT			GR	NPHI	ZNPHI	
Date Acquired	1998	1998			1999	1999	1999	
Top Depth	0	16			0	0	335	
Bottom Depth	525	530			625	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
Bass Island	dif	178.2	0	GR&DT	dif	256.5	0	
Salina (G-unit)	nc	270	0	GR	nc	304.3	0	
Salina (F-unit)	nc	278	0	GR	nc	312.2	0	
Cabot Head	nl	np	NA		dif	621	0	GR
Queenston	nl	np	NA		nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	

Well Name	Sifto #11, Goderich 5 - 13 - A				Brine Well No. 6, Goderich - 1 - MC			
BH ID	T009126				T009355			
Northing (UTM NAD83)	4843329.594				4843143.655			
Easting (UTM NAD83)	444083.4693				444347.6169			
BH Depth (TVD)	470				477.6			
BH TD Formation	A-2 Carbonate				B Salt			
Kelly Bushing Height (m)	3.2				0.3			
BH Log	GR	NL	DT#2	DT#3	GR			
Date Acquired	2000	2000	2000	2000	1960			
Top Depth	0	0	60	385	35			
Bottom Depth	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
Bass Island	dif	183	0	NL	nl	210.31	0	
Salina (G-unit)	246	248.9	-2.9	GRNL	nl	268.53	0	
Salina (F-unit)	255	257.2	-2.2	GRNL	nl	276.15	0	
Cabot Head	nl	np	NA		nl	np	NA	
Queenston	nl	np	NA		nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	

Well Name	Lyleton Sturdy, Goderich 3 - 20 - VII				Tribute et al #22, Goderich 2 - 39 - IX			
BH ID	T010054				T010686			
Northing (UTM NAD83)	4834523.749				4826822.838			
Easting (UTM NAD83)	447293.854				449347.573			
BH Depth (TVD)	665				640			
BH TD Formation	Rochester				Gasport			
Kelly Bushing Height (m)	3.6				1.3			
BH Log	GR	GR#1	NPHI	DT	GR	GR#1	NPHI	PE
Date Acquired	2001	2001	2001	2001	2004	2004	2004	2004
Top Depth	0	295	0	300	0	360	0	368
Bottom Depth	650	650	655	655	655	640	640	640
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
Bass Island	244	np	NA	GR	nc	291.8	0	GR
Salina (G-unit)	nc	303	0		nc	365.5	0	GR
Salina (F-unit)	nc	312	0		nc	373	0	GR
Cabot Head	nl	np	NA		nl	np	NA	
Queenston	nl	np	NA		nl	np	NA	
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	
			0				0	

Well Name	NCE Fordyce North, West Wawanosh 1 - 25 - XIIWD				DGR-1, Bruce 4 - 20 - LR			
BH ID	T011560				T011582			
Northing (UTM NAD83)	4861410.397				4907754.913			
Easting (UTM NAD83)	464022.2215				454239.7915			
BH Depth (TVD)	541				465.1			
BH TD Formation	Cabot Head				Queenston			
Kelly Bushing Height (m)	3.3				2.21			
BH Log	GR	DT			GR	NL		
Date Acquired	2007	2007			2007	2007		
Top Depth	10	250			177	0		
Bottom Depth	540	540			462.5	463		
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
Bass Island	dif	198.4	0	GR	128.3	126.2	2.1	NL
Salina (G-unit)	nc	246	0	GR	nc	180.2	0	NL
Salina (F-unit)	nc	253.8	0	GR	nc	185.2	0	GRNL
Cabot Head	nc	531	0	DT	nc	413.2	0	GR
Queenston	nl	np	NA		447.6	449.9	-2.3	GR
Cobourg (Collingwood)	nl	np	NA		nl	np	NA	
Cobourg (Lower)	nl	np	NA		nl	np	NA	
Coboconk	nl	np	NA		nl	np	NA	
Gull River (if conflict)	nl	np	NA		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA	
			0				2	

Well Name	DGR-2, Bruce 4 - 20 - LR				Tribute et al #23 (Horiz.#1), Goderich 2 - 39 - IX			
BH ID	T011583				T011651			
Northing (UTM NAD83)	4907719.803				4826253.755			
Easting (UTM NAD83)	454208.4902				449293.2441			
BH Depth (TVD)	864.2				564			
BH TD Formation	Precambrian				Guelph			
Kelly Bushing Height (m)	2.14				4.6			
BH Log	GR				GR			
Date Acquired	2007				2007			
Top Depth	0				5			
Bottom Depth	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
Bass Island	nc	124	0	NL	dif	292	0	GR
Salina (G-unit)	nc	169.3	0	GR	nl	366	0	GR
Salina (F-unit)	nc	178.6	0	GR	nl	374	0	GR
Cabot Head	nc	411	0	GR	nl	np	NA	
Queenston	nc	447.7	0	GR	nl	np	NA	
Cobourg (Collingwood)	nc	651.6	0	GR	nl	np	NA	
Cobourg (Lower)	nc	659.5	0	GR	nl	np	NA	
Coboconk	nc	762	0	GR	nl	np	NA	
Gull River (if conflict)	nc	785	0	GR	nl	np	NA	
Precambrian	nl	860.7	0	GR	nl	np	NA	
			0				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		

Prepared by: SNS
Reviewed by: VMS
Date:11/11/2014
10-214-7.50_BHGeophys2DSeismicRpt_Appendices_R0

Geofirma Engineering Ltd

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			
BH ID	T011742				T011811				T011812			
Northing (UTM NAD83)	4866018.938				4907739.802				4908743.902			
Easting (UTM NAD83)	446281.9276				453080.4944				453378.3014			
BH Depth (TVD)	566				871.3				859.2			
BH TD Formation	Goat Island				Cambrian				Cambrian			
Kelly Bushing Height (m)	3.3				2.15				2.2			
BH Log	GR	NPHI			GR	NL			GR	GR#2	NL	NL(U)
Date Acquired	2007	2007			2008	2008			2008	2008	2008	2008
Top Depth	5	5			0	1			0	165	166	0
Bottom Depth	535	535			847	849			187	838	839	189
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**
Bass Island	dif	190.5	0	GR	144.5	143.3	1.2	NL	nl	128.2	0	NL
Salina (G-unit)	nc	261.2	0	GR	nc	187.3	0	GR	nc	170.1	0	GRNL
Salina (F-unit)	nc	270.2	0	GR	nc	196.5	0	GR	nc	177.4	0	GRNL
Cabot Head	nl	np	NA		nc	422.8	0	GR	nc	411.5	0	GR
Queenston	nl	np	NA		nc	457	0	GR	nc	446.3	0	GR
Cobourg (Collingwood)	nl	np	NA		nc	664.3	0	GR	nc	653.1	0	GR
Cobourg (Lower)	nl	np	NA		676	673	3	GR	nc	661.5	0	GR
Coboconk	nl	np	NA		nc	775.6	0	GR	nc	763	0	GR
Gull River (if conflict)	nl	np	NA		nl	799.3	0	GR	nl	786.8	0	GR
Precambrian	nl	np	NA		nl	np	NA		nl	np	NA	

Well Name	DGR-5 (Dev.#1), Bruce 4 - 20 - LR				DGR-6 (Dev.#1), Bruce 6 - 22 - LR				DGR-8, Bruce 8 - 20 - LR			
BH ID	T011926				T011942				T012102			
Northing (UTM NAD83)	4907481.642				4908371.35				4908235.175			
Easting (UTM NAD83)	454219.9807				453953.3784				453397.2654			
BH Depth (TVD)	754.9				789				727.1			
BH TD Formation	Kirkfield				Gull River				Kirkfield			
Kelly Bushing Height (m)	2.75				3.5				3.32			
BH Log	GR	NL			GR				GR (U)	GR	NL	NL#4
Date Acquired	2009	2009			2010				2011	2011	2011	2011
Top Depth	0	0			0				0	205	0	198
Bottom Depth	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**
Bass Island	nc	134.8	0	NL	nc	145.3	0	GR	nc	138.9	0	NL
Salina (G-unit)	nc	184	0	GRNL	nc	193	0	GR	nc	182.8	0	GRNL
Salina (F-unit)	nc	192.5	0	GRNL	nc	203	0	GR	nc	190.3	0	GRNL
Cabot Head	nc	447.8	0	GR	nc	467.9	0	GR	nc	420.5	0	GR
Queenston	483	486.6	-3.6	GR	nc	507.9	0	GR	453	454.9	-1.9	GR
Cobourg (Collingwood)	nc	699.9	0	GR	nc	738.3	0	GR	nc	661.3	0	GR
Cobourg (Lower)	nc	708.7	0		nc	746.1	0	GR	nc	669.2	0	
Coboconk	nl	np	NA		nc	870.5	0	GR	nl	np	NA	
Gull River (if conflict)	nl	np	NA		nc	897.2	0		nl	np	NA	
Precambrian	nl	np	NA		nl	np	NA		nl	np	NA	

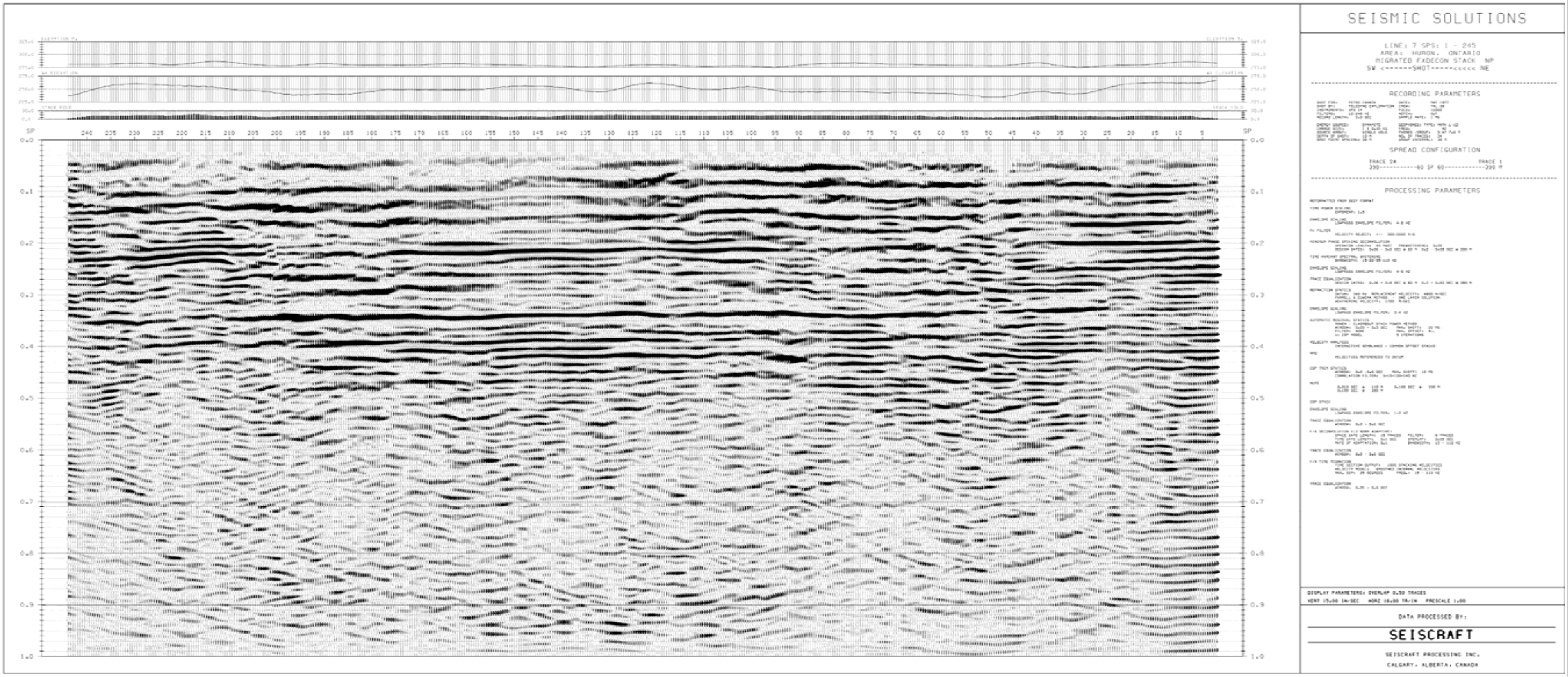
Well Name	DGR-7, Bruce - -			
BH ID	T012103			
Northing (UTM NAD83)	4908215.659			
Easting (UTM NAD83)	453473.1433			
BH Depth (TVD)	190			
BH TD Formation	F Unit			
Kelly Bushing Height (m)	3.2			
BH Log	GR	NL		
Date Acquired	2011	2011		
Top Depth	8	1		
Bottom Depth	188	190		
Formation Tops	**Geofirma 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				**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		

Prepared by: SNS
Reviewed by: VMS
Date:11/11/2014

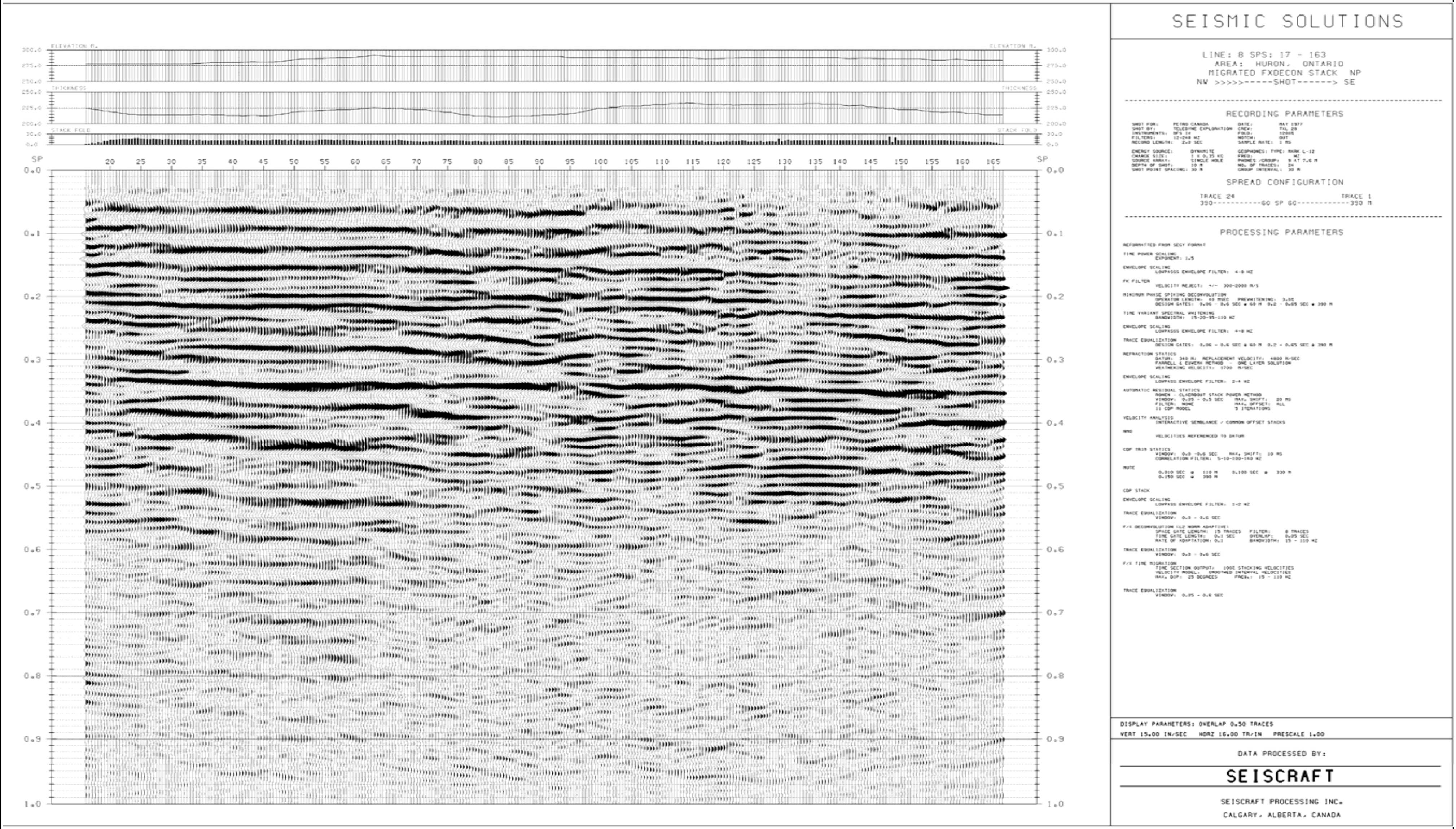
APPENDIX D

Summary of 2D Seismic Processed Data



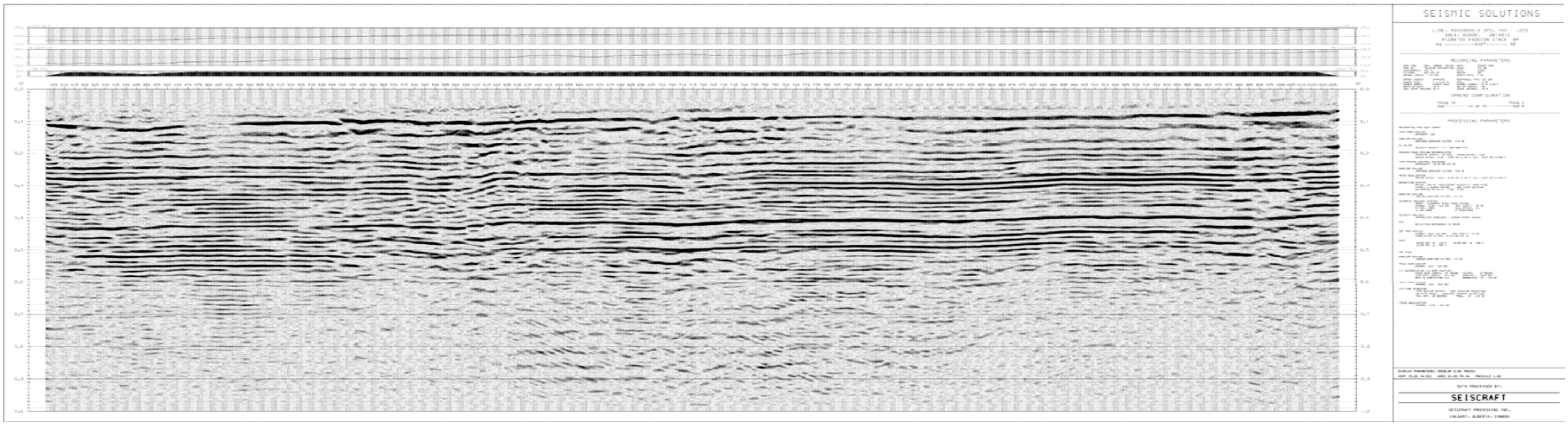
Processed 2D Seismic Data (Line 725937)		Prepared by: SNS
Interpretation of Borehole Geophysical Well Log and 2D Seismic Data – Sedimentary Sites		Reviewed by: DS
Figure D.1	Doc. No. 10-214-7.50_Appendix D_Seismic Data_R0	Date: 10-Nov-14

Geofirma Engineering Ltd



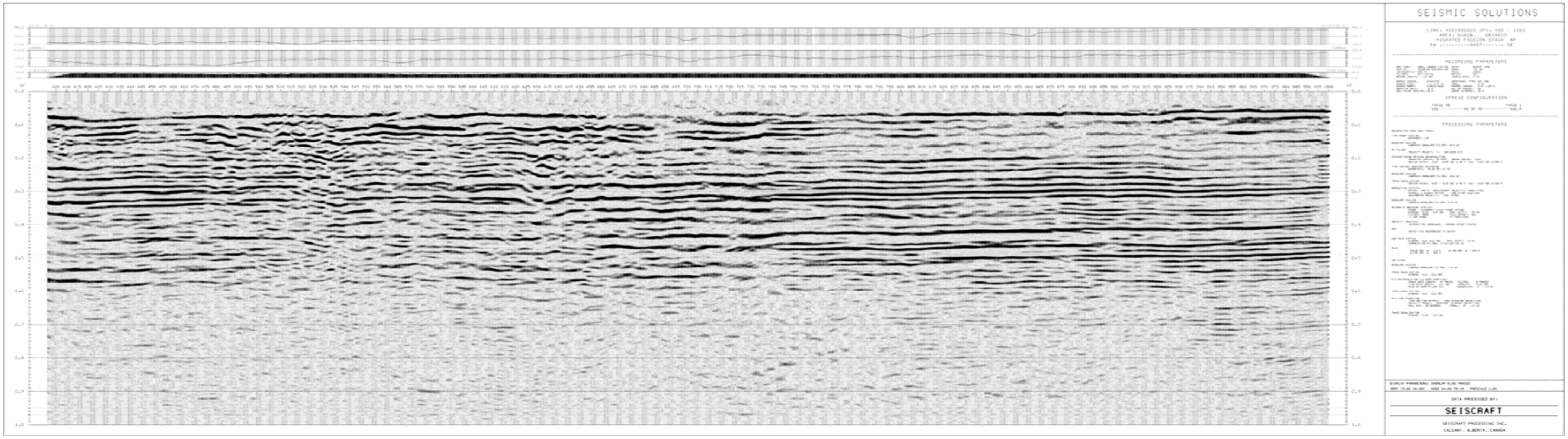
Processed 2D Seismic Data (Line 825938)		Prepared by: SNS
Interpretation of Borehole Geophysical Well Log and 2D Seismic Data – Sedimentary Sites		Reviewed by: DS
Figure D.2	Doc. No. 10-214-7.50_Appendix D_Seismic Data_R0	Date: 10-Nov-14

Geofirma Engineering Ltd



Processed 2D Seismic Data (Line A0028018) **Interpretation of Borehole Geophysical Well Log and 2D Seismic Data – Sedimentary Sites**	Prepared by: SNS Reviewed by: DS
Figure D.3	Doc. No. 10-214-7.50_Appendix D_Seismic Data_R0
	Date: 10-Nov-14

Geofirma Engineering Ltd



Processed 2D Seismic Data (Line A0028020) **Interpretation of Borehole Geophysical Well Log and 2D Seismic Data – Sedimentary Sites**	Prepared by: SNS Reviewed by: DS
Figure D.4 — Doc. No. 10-214-7.50_Appendix D_Seismic Data_R0	Date: 10-Nov-14

Geofirma Engineering Ltd