Technical Report

Title: ***Bedrock Formations in DGR-1 and DGR-2***

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Author: **Sean Sterling**

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DGR Site Characterization Document
Intera Engineering Project 06-219

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Author:	Sean Sterling	
Technical Review:	Kenneth Raven, Dru Heagle; Branko Semec, Dylan Luhowy, M. Sanchez (NWMO)	
QA Review:	John Avis	
Approved by:	Kenneth Raven	

Document Revision History		
Revision	Effective Date	Description of Changes
0	November 8, 2007	Initial Release
1	April 15, 2008	Conversion from Technical Memorandum to Technical Report; Minor typographical revisions; updated stratigraphic description on Figure 2.
2	February 2, 2009	Formation depths and thicknesses adjusted to conform with results of November 2008 core workshop
3	May 18, 2010	Minor editorial revisions to address NWMO comments

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1 Introduction

Intera Engineering Ltd. has been contracted by the Nuclear Waste Management Organization (NWMO) to implement the Geoscientific Site Characterization Plan (GSCP) for the Bruce nuclear site located near Tiverton, Ontario. The purpose of this site characterization work is to assess the suitability of the Bruce site to construct a Deep Geologic Repository (DGR) to store low-level and intermediate-level radioactive waste. The GSCP is described by Intera Engineering Ltd., (2006, 2008).

This report summarizes the stratigraphy, geological contacts and nomenclature of bedrock formations encountered during drilling of two deep bedrock boreholes (DGR-1 and DGR-2) as part of Phase 1 of the GSCP at the Bruce site. This report also provides the rationale for the nomenclature of each formation and contact selection.

Work described in this Technical Report (TR) was completed with data generated from Test Plan TP-06-09 – DGR-1 & DGR-2 Core Photography and Logging (Intera Engineering Ltd., 2007a) and Test Plan TP-07-05 – DGR-1 & DGR-2 Borehole Geophysical Logging (Intera Engineering Ltd., 2007b), which were prepared following the general requirements of the Intera DGR Project Quality Plan (Intera Engineering Ltd., 2009a).

2 Background

Intera recently completed Phase 1 investigations which included a deep bedrock drilling program of two vertical 152 mm diameter continuously cored boreholes (DGR-1 and DGR-2) to depths of approximately 462 and 862 meters below ground surface (mBGS). Both of these boreholes were drilled at one location at the Bruce site as shown on Figure 1.

DGR-1 was drilled under Ministry of Natural Resources (MNR) Well License No. 11582 under the Oil, Gas and Salt Resources Act and is located at NAD83 UTM Zone 17N, 4907753.243 m Northing and 454239.777 m Easting with a ground surface elevation of 185.71 m above sea level (m ASL). Similarly, DGR-2 was drilled under Ministry of Natural Resources (MNR) Well License No. 11583 and is located at NAD83 UTM Zone 17N, 4907720.300 m Northing and 454208.921 m Easting with a ground surface elevation of 185.84 m ASL.

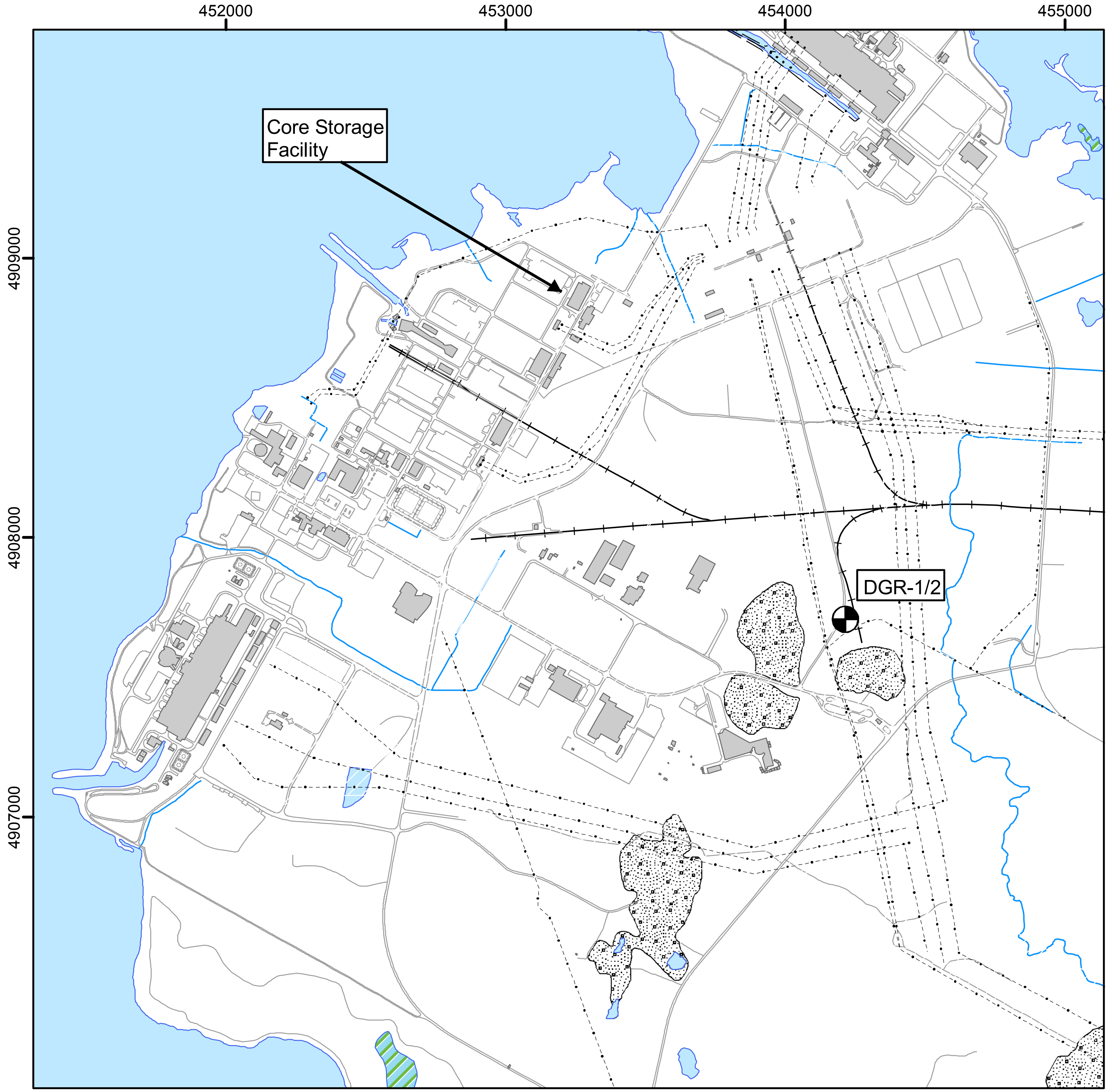
DGR-1 was continuously cored from the top of bedrock (approximately 20 mBGS) to approximately 15 m into the top of the Queenston Shale (approximately 462 mBGS). DGR-2 was rotary drilled from ground surface to approximately 3 m into the top of Queenston Shale (approximately 450 mBGS) and then continuously cored from that depth to approximately 1 m into the Precambrian basement (approximately 862 mBGS).

3 Geosynthesis Core Workshop (September 5 & 6, 2007)

A Geosynthesis Core Workshop was organized on September 5 & 6, 2007 at the Core Storage Facility on the Bruce site with the purpose of obtaining consensus on the stratigraphic nomenclature and formation descriptions for bedrock intersected by DGR-1 and DGR-2. This two day workshop focused on reviewing stratigraphy and geological contacts in the archived rock core and correlation of these contacts with borehole geophysical logs.

This workshop was attended by the following groups participating in the OPG DGR Program:

- Ontario Power Generation Inc. (Nuclear Waste Management Division),
- Intera Engineering Ltd. (GSCP Contractor),
- Gartner Lee Ltd. (Geosynthesis Contractor),
- Hatch Engineering (Engineering Design Contractor), and
- ITASCA (Geomechanical Modelling).



OPG DGR
Site Characterization Plan

Legend

- Location of DGR-1/2
- Buildings
- Roads
- Railway
- Transmission Line
- Pits or Landfills
- Stream or Drainage

Location of DGR-1 and DGR-2 at the Bruce Site

Figure 1

N

Scale 1:20,000 (approx.)

0 130 260 520 780 1,040 Meters

Date: 17/10/2007
Project: 06-219
P:/Projects/2006/06-219/QMS_DGR/TM_Working Files/TR-07-05/06-219_Site Location.mxd

Drawn: NKP
Checked: SNS

Projection: UTM NAD 83 Zone 17

Data Credits:
NRVIS/OBM, MNR, Ontario Power Generation, Bruce Power

In addition, the following geology experts from the Ontario Government (Ministry of Natural Resources (MNR), Ontario Geological Survey (OGS)), the federal Government (Geological Survey of Canada (GSC)) and university (University of Waterloo) were invited to attend the workshop and assist in reaching consensus pertaining to the identification of bedrock formations:

- Terry Carter, Chief Geologist (MNR, Petroleum Resources Centre).
- Michael Lazorek, Sedimentary Geologist (MNR, Petroleum Resources Centre),
- Derek Armstrong, Paleozoic Geologist (OGS, Ministry of Northern Development and Mines),
- Mike Easton, Precambrian Geologist (Ontario Geological Survey),
- Tony Hamblin (Geological Survey of Canada, Calgary), and
- Mario Coniglio, Professor – Carbonate Sedimentation and Diagenesis (University of Waterloo, Department of Earth Sciences).

At the end of the two day workshop, consensus was achieved pertaining to the bedrock formation contacts described in this Technical Report. Bedrock sequences encountered in DGR-1 and DGR-2 are identified as formations, formation members or formation units based on the nomenclature consensus achieved at the workshop.

4 Bedrock Formation Pick Methodology

During drilling operations, continuous bedrock core (3-inch, 76 mm diameter) was collected in 10 ft (~3 m) core runs and logged by an on-site geologist. Core logging followed the guidelines of Armstrong and Carter (2006) for stratigraphic logging and nomenclature and Test Plan TP-06-09 (Intera Engineering Ltd., 2007a). A summary of core logging results from DGR-1 and DGR-2 drilling operations is included in TR-07-06 - Photography, Logging and Sampling of DGR-1 and DGR-2 Core (Intera Engineering Ltd., 2009b).

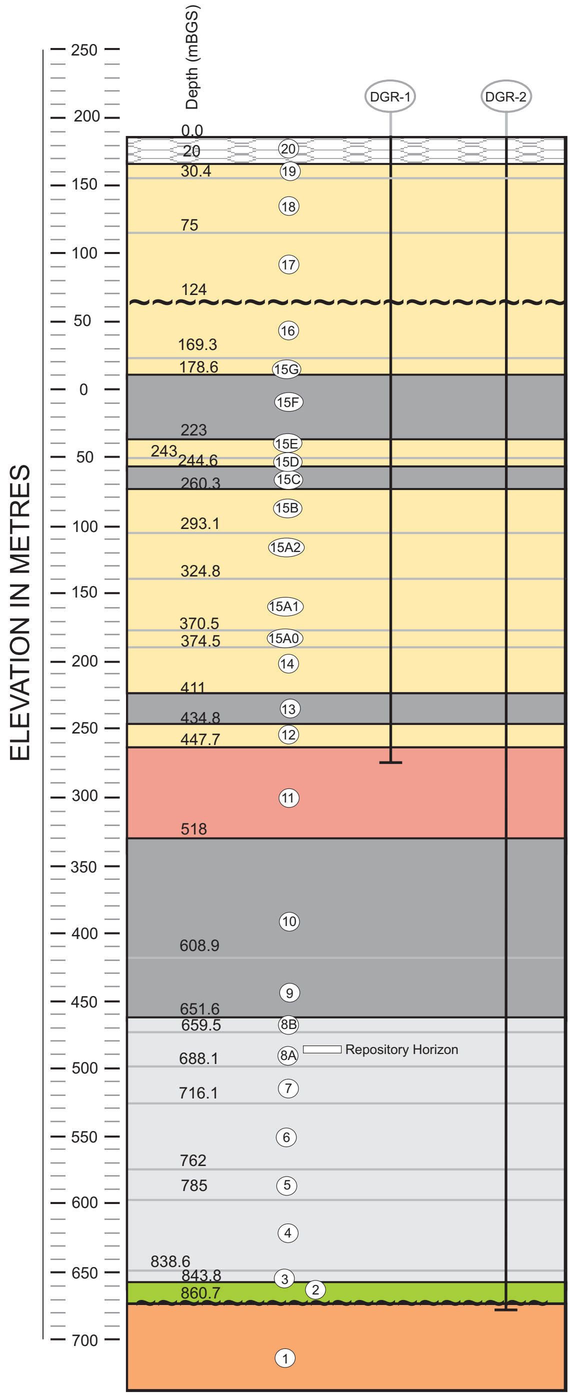
Following drilling operations at each borehole, geophysical logging was completed by Layne Christensen Co. – Colog Division based in Lakewood, Colorado following Test Plan TP-07-05 (Intera Engineering Ltd., 2007b). The results of borehole geophysical logging are summarized and presented as part of TR-07-08 – Borehole Geophysical Logging of DGR-1 and DGR-2 (Intera Engineering Ltd., 2009c).

The depths of each geologic formation, member or unit contact were selected based on a combination of information from rock core and borehole geophysical logs. The borehole geophysical logs that proved most useful in selecting geological contacts included natural gamma, compensated density, and dual neutron. These geophysical logs are also described by Armstrong and Carter (2006) as the pick criteria most useful for identifying sedimentary bedrock formations in southwestern Ontario.

5 Results

Figure 2 summarizes the bedrock stratigraphy and depths in DGR-1 and DGR-2 following completion of the Phase 1 GSCP at the Bruce site. Table 1 summarizes the rationale for identifying each bedrock formation and contact encountered at the Bruce site while drilling DGR-1 and DGR-2. Table 1 includes:

- the geological formation, member or unit name;
- a brief stratigraphic description of each formation, member or unit from the core;
- the top depth, elevation and thickness of each bedrock formation, member or unit;
- the corresponding core run number for future reference to archived core boxes and core photography;
- the primary evidence for each formation, member or unit contact pick (i.e. core, natural gamma log, etc.);



LEGEND - BRUCE SITE STRATIGRAPHY

PLEISTOCENE
20 SURFICIAL DEPOSITS

MIDDLE DEVONIAN
19 LUCAS FORMATION - DOLOSTONE
18 AMHERSTBURG FORMATION - DOLOSTONE

LOWER DEVONIAN
17 BOIS BLANC FORMATION - CHERTY DOLOSTONE
~~~~~~ SILURIAN / DEVONIAN DISCONTINUITY

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15D D UNIT - ANHYDRITIC DOLOSTONE
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8A LOWER MEMBER - ARGILLACEOUS LIMESTONE
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4 GULL RIVER FORMATION - LITHOGRAPHIC LIMESTONE
3 SHADOW LAKE FORMATION - SILTSTONE AND SANDSTONE

CAMBRIAN
2 CAMBRIAN SANDSTONE
~~~~~~ CAMBRIAN / PRECAMBRIAN UNCOMFORMITY

PRECAMBRIAN
1 PRECAMBRIAN BASEMENT - GRANITIC GNEISS

NOTE:
1. SUBSURFACE STRATIGRAPHIC NOMENCLATURE AFTER ARMSTRONG AND CARTER (2006)

Stratigraphic Column at the Bruce Site Based on DGR-1 and DGR-2 Data		Prepared by: ADG Reviewed by: KGR
FIGURE 2	Doc. No.: TR-07-05_Figure 2_R2.cdr	Date: Jan 23, 2009

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Table 1. Summary of Bedrock Formations in DGR-1 and DGR-2 at the Bruce Site

Geological Formation or Member / Unit	Stratigraphic Description	Top Depth[1] (m BGS)	Elevation[2] (m ASL)	Core Run Number	Interpreted Thickness (m)	Primary Evidence for Pick	Geological Contact Description	Core Pick Rationale	BH Geophysical Pick Rationale	Armstrong and Carter (2006)	Difficulty of Pick
Lucas Formation	grey-brown fine-grained, argillaceous dolostone with shale/bituminous laminae	20	165.7		10.4	top of bedrock	top of bedrock	top of bedrock, known lithology	NA		
Amherstburg Formation	brown-grey dolostone with abundant coral	30.4	155.3	DGR-1 3	44.6	core	gradational	First sharp change from tan coloured dolostone to dark brown bituminous dolostone	NA	change from light brown, very fine-grained, evaporitic dolostones of the Lucas change to a dark brown dolostone or limestone with bituminous partings	core = difficult
Bois Blanc Formation	brown-grey dolostone with thin black shaley (bituminous) layers, mudstone / chert clasts and fossils	75	110.7	DGR-1 20	49.0	core	gradational	medium grained dolostone to fine grained limestone	flat natural gamma ray response (no distinguishing features)	dominated by white chert	core = difficult geophysics = difficult
Bass Islands Formation	brown (tan) - grey, very fine grained dolostone, low fossil content	124	61.7	DGR-1 39	45.3	core	sharp	abrupt change from cherty-shaley dolostone to tan-grey very fine grained dolostone	flat natural gamma ray response (no distinguishing features)	oolitic beds in upper few m	core = easy, but core very broken geophysics = difficult
Salina Formation - G Unit	grey shaley dolostone with anhydrite layers	169.3	16.4	DGR-1 62	9.3	core, natural gamma log	sharp	grey shaley dolostone / gr-blue shale interface	sharp increase in natural gamma log	gamma log (9 m above F Unit shale)	core = easy, but can be confused with false "G Unit" at 169 m geophysics = easy
Salina Formation - F Unit	grey-blue dolomitic shale with anhydrite	178.6	7.1	DGR-1 66	44.4	natural gamma log	sharp	start of predominantly grey-blue shale	sharp increase in natural gamma response (higher shale content)	shale and gamma log	core = moderately difficult due to <100% recovery over contact geophysics = extremely easy
Salina Formation - E Unit	brecciated brown dolostone with grey-green dolomitic shale	223	-37.3	DGR-1 82	20.0	core, drilling rate increase, natural gamma log	sharp	brecciated fine grained dolomite mudstone interface / grey-green soft mudstone with anhydrite layers	increase in natural gamma response below low gamma signature of tan dolostone	decrease in gamma response compared to F Unit shale and C Unit shale	core = relatively easy but fragmented tan dolostone unit above contact can be confused with top of E Unit (top of tan dolostone at 217 m BGS) geophysics = easy to see tan dolostone layer
Salina Formation - D Unit	blue-grey to brown, anhydritic dolostone	243	-57.3	DGR-1 88	1.6	core, natural gamma log	gradational	dolostone transitioning to anhydritic dolostone	prominent "scoop dip" decrease in gamma log	thin anhydritic dolostone layer where no Salina D Unit salt is present	core = easy if expecting a thin layer of anhydritic dolostone at that depth, otherwise difficult geophysics = difficult by itself, but aligns with core depths
Salina Formation - C Unit	interlayered red and grey-blue dolomitic shale / shale with minor anhydrite nodules, laminations and thin bedding	244.6	-58.9	DGR-1 89	15.7	natural gamma log, core	gradational	blue-grey and brown anhydritic dolostone transitioning to grey dolostone	increased natural gamma (shale content)	increase in gamma response corresponding to transition from dolostones to shales	core = relatively easy geophysics = easy
Salina Formation - B Unit	grey, fine grained, argillaceous dolostone with anhydrite, brecciated with tan dolostone	260.3	-74.6	DGR-1 94	30.9	core, natural gamma log	sharp	top of thin, brown, anhydritic dolostone layer (B Unit Marker Bed) below red-green shale	start of long decrease in natural gamma log	decrease in gamma response	core = B Unit Marker Bed is easy to identify geophysics = difficult by itself, but aligns with core depths
	B-anhydrite - grey anhydrite in brown dolostone	291.2	-105.5	DGR-1 104	1.9	core, density log	gradational	grey-brown anhydritic dolostone	slight decrease in natural gamma and neutron logs, increase in density log	anhydrite rich zone at bottom of B Unit	core = easy, but slightly below start of tan brown dolostone transition to A2-carbonate member geophysics = difficult by itself but aligns with core depths
Salina Formation - A2 Unit	A2 carbonate - laminated grey-brown dolostone with dark to black (high organic content) thin layers, transition to grey dolostone below 305 m BGS (A2-shale between 306.5 -308.5 m BGS)	293.1	-107.4	DGR-1 105	26.6	core, natural gamma log	sharp	laminated grey-brown dolostone with dark to black (high organic content) thin layers	slight increase in natural gamma compared to B-anhydrite; sharp increase in neutron logs	sharp transition from anhydrite (B Unit) to carbonates (A2 Unit)	core = easy (immediately below anhydrite) geophysics = relatively easy
	A2 evaporite - light gr-blue anhydritic dolostone	319.7	-134.0	DGR-1 113	5.1	core, neutron log	gradational	anhydrite rich dolostone (predominantly anhydrite)	sharp decrease in neutron log, very minor decrease in natural gamma log	below A2 Unit shale bed; anhydrite more prevalent at top and bottom of the A-2 Evaporite Unit	core = easy to pick anhydrite rich zone (contact is where it is predominantly anhydrite - difficult to determine which unit it belongs to) geophysics = difficult by itself (gamma)
Salina Formation - A1 Unit	A1 carbonate - thinly laminated grey-brown dolostone with dark grey to black, high organic content layers and minor anhydrite layering	324.8	-139.1	DGR-1 115	42.2	core, density log	gradational	bottom most anhydritic dolostone evidence	bottom of last anhydrite layers with densities ~ 3 g/cc as shown on density log	sharp transition from anhydrite (A2 Unit evaporite) to carbonates (A1 Unit carbonate)	core = high anhydrite content easy, lower anhydrite content more difficult, therefore exact contact is difficult geophysics = easy (density log) to see last high density spike
	A1 evaporite - light grey-blue anhydritic dolostone	367	-181.3	DGR-1 129	3.5	core, density log	gradational	start of light blue-grey anhydritic dolostone	sharp increase in density log, start of slight decrease in gamma log	sharp transition between dark brown-grey dolostones and lighter grey-blue anhydritic dolostone	core = easy geophysics = easy based on density log
Salina Formation - A0 Unit	dark brown to black, thinly laminated, bituminous dolostone	370.5	-184.8	DGR-1 130	4.0	core, density log	gradational	lower extent of anhydrite nodules in dolostone	small but sharp decrease in density log	dark, thinly laminated bituminous dolostone	core = difficult on own, but aligns with geophysics (density log) geophysics = difficult on own, but aligns with core
Guelph Formation	brown, vuggy, sucrosic dolostone	374.5	-188.8	DGR-1 132	4.1	core, neutron and density logs	relatively sharp	start of brown sucrosic dolostone (upper limit of small vugs)	sharp decrease in neutron log and density log	sucrosic and fossiliferous dolostone	core = easy geophysics = easy based on density log and neutron log
Goat Island Formation	light to dark grey-brown, very fine grained (almost crystalline) dolostone	378.6	-192.9	DGR-1 133	18.8	core, natural gamma log, density log, neutron log	gradational	change from brown porous and sucrosic dolostone (Guelph) to very fine grained, light grey to brown dolostone	sharp increase in neutron log and increase to a steady density value ~ 2.8 g/cc	elevated gamma response, change to finer grained, cleaner carbonates	core = easy geophysics = easy
Gasport Formation	blue-white-grey, fine to coarse grained dolomitic limestone	397.4	-211.7	DGR-1 139	6.85	core, natural gamma log	gradational	lighter grey, coarser grained, more porous dolostone compared to Goat Island	consistently low gamma response below higher response of Goat Island	drop in gamma response, transition from grey, fine grained dolostone to light grey-blue-white, coarser grained, more porous dolostone	core = difficult geophysics = difficult
Lions Head Formation	light grey to grey-brown, fine to crystalline grained, dolostone	404.25	-218.5	DGR-1 141	4.45	core, natural gamma log	gradational	increased brown-grey shale content (thin layers) and smaller grain size	slightly elevated gamma response below Gasport and above Fossil Hill	gradual upward decrease in gamma	core = difficult geophysics = difficult
Fossil Hill Formation	coarse grained, light to medium brownish grey dolostone with increased stylolites and fossils	408.7	-223.0	DGR-1 143	2.3	core, natural gamma log	relatively sharp	lighter colour, finer grained, presence of numerous shale partings	small and gradual decrease (spoon shaped dip) in gamma log		core = moderately difficult due to gradational nature and ambiguity of formation names/descriptions geophysics = moderately difficult but directly above Cabot Head and aligns with core
Cabot Head Formation	green and red non-calcareous shale at top grading to interbedded grey carbonate and black shale (many fossils)	411	-225.3	DGR-1 143	23.8	natural gamma log and neutron log	sharp	massive gr dolostone / massive green shale interface	sharp increase in gamma response, sharp decrease in neutron log	massive grey shale and increase in gamma response	core = extremely easy geophysics = extremely easy

Prepared by : SNS
Reviewed by : KGR
TR-07-05 Table 1_R3.xls

Table 1. Summary of Bedrock Formations in DGR-1 and DGR-2 at the Bruce Site

Geological Formation or Member / Unit	Stratigraphic Description	Top Depth[1] (m BGS)	Elevation[2] (m ASL)	Core Run Number	Interpreted Thickness (m)	Primary Evidence for Pick	Geological Contact Description	Core Pick Rationale	BH Geophysical Pick Rationale	Armstrong and Carter (2006)	Difficulty of Pick
Manitoulin Formation	grey, fine to medium to crystalline grained, mottled texture dolostone with minor grey-green non-calcareous shale. Abundant chert nodules and silicified fossil lenses.	434.8	-249.1	DGR-1 151	12.85	natural gamma log	gradational	lowermost significant shale bed of Cabot Head Fm	drop in gamma response after lower most shale beds of Cabot Head Fm above, sharp near neutron log increase. Lighter colour in ATV.	lowermost significant shale bed as indicated by drop in gamma response	core = moderately difficult geophysics = moderately difficult
Queenston Formation	massive, dense, red-maroon shale interbedded with green shale, minor occurrences of small fossils. Increase in thin bedding of grey carbonate with depth.	447.65	-261.9	DGR-1 156	70.22	core, natural gamma and neutron logs	sharp	sharp contact from coarse grained fossiliferous dolostone to predominantly red/green interbedded shale (near 1st evidence of red shale)	increased natural gamma (shale content) compared to Manitoulin, decreased neutron	transition from tan to grey dolostones (Manitoulin) / red shales (Queenston), with elevated natural gamma in Queenston	core = easy geophysics = easy
Georgian Bay Formation	dark greenish-grey shale, interbedded (decreasing with depth) with grey siliceous sandstone / siltstone / limestone with fossil fragments. Core disking below ~ 530 m BGS. Sulfurous and petroliferous odour below 585 m BGS.	518	-332.2	DGR-2 23	90.9	core	gradational	below lowest evidence of red shale which coincides with start of grey carbonate layers laminated with green shale	spikey gamma response due to elevated gamma in shale layers and decrease in gamma in limestone beds	highest negative limestone spike on gamma ray which coincides with downward transition from red to green shale	core = relatively easy geophysics = difficult
Blue Mountain Formation	upper member like "Thornbury Member" - blue to grey, soft, non-calcareous shale with decreased content of calcareous limestone/sandstone beds. Core disking is prevalent, sulfurous odour throughout.	608.9	-423.1	DGR-2 52	38.1	core	gradational	lowest significant thin calcareous limestone bed > 3-5 cm thick	less variable gamma log due to thinner and less frequent limestone beds	most difficult pick that is not attempted, however it is arbitrarily defined as base of lowest "significant" limestone bed.	core = relatively easy geophysics = extremely difficult
	lower member of Blue Mountain "like Rouge River Member"	647	-461.2	DGR-2 65	4.6	core	sharp	dark grey-black, very hard, thin disking shale	no change in gamma log response		core = easy geophysics = extremely difficult
Coburg Formation - Collingwood Member	dark grey to black calcareous shale (highly disking), interbedded with grey argillaceous limestone	651.6	-465.8	DGR-2 67	7.9	core	sharp	top of grey-brown-black calcareous shale	lower natural gamma log response compared to Blue Mountain	increase in carbonate and decrease in clay content, changes in colour from blue-grey to dark grey-black to grey-brown, slight decrease in gamma log	core = relatively easy geophysics = extremely easy
Cobourg Formation - Lower Member	light to dark brownish grey, mottled texture, massive, very fine to crystalline, hard, dense limestone and argillaceous limestone. Abundant fossils.	659.5	-473.7	DGR-2 70	28.6	core, natural gamma log, neutron log	relatively sharp	below lowest black shale calcareous shale bed and start of massive, non-disking brownish grey, argillaceous limestone	flat gamma response below spikey gamma response of collingwood	change from carbonates of Cobourg from calcareous shales of Collingwood, matched by slightly lower gamma response	core = easy geophysics = relatively easy
Sherman Fall Formation	upper - coarse grained, grey-brown shaley limestone lower - interbedded grey argillaceous limestone and dark grey calcareous shale	688.1	-502.3	DGR-2 79	28.0	core, natural gamma log	gradational	gradational contact from gr-br argillaceous limestone to grey argillaceous limestone (shaley interbeds more well defined)	upper unit = low gamma response with broad negative dish shape; lower unit = spikey gamma response	transition from finer grain size of bluish grey Cobourg to tan or grey-brown of Sherman Fall	core = difficult, gradational geophysics = difficult (lower unit is similar to Cobourg)
Kirkfield Formation	tan to dark grey, fine grained, calcareous, irregular bedded limestone with dark shale layers	716.1	-530.3	DGR-2 89	45.9	natural gamma log	gradational	gradational change from tan coloured, very fine grained argillaceous limestone to lighter grey argillaceous limestone	decrease in gamma log	decrease in gamma log	core = difficult geophysics = moderate
Coboconk Formation	light grey, fine grained, bioturbated limestone	762	-576.2	DGR-2 105	23.00	core, natural gamma log	gradational	transition from shalier limestones of Kirkfield to cleaner, lighter grey coloured limestone	decrease in gamma log below spikey gamma response of Kirkfield	decrease in gamma log and transition out of shaley limestones	core = moderate geophysics = relatively easy
Gull River Formation	medium grey, fine to very fine grained (lithographic), limestone/mudstone laminated with thin dark grey shale. Fossiliferous.	785	-599.2	DGR-2 114	53.60	core, natural gamma log	sharp	transition from fine grained bioclastic limestones (Coboconk) to very fine grained, lithographic lime-mudstones (Gull River)	elevated and spikey gamma log	first shaley spike below low gamma response of Coboconk coinciding with transition from to very fine grained lithographic lime mudstones	core = easy geophysics = relatively easy
Shadow Lake Formation	Mix of grey-green sandy mudstone and green-grey siltstone and sandstone	838.6	-652.8	DGR-2 132	5.2	core	relatively sharp	top of first grey-green silty sandstone	not collected due to bridge plug in borehole to prevent flowing artesian conditions from Cambrian	top of largest shift in gamma log coinciding with change from carbonates (Gull River) to argillaceous silt/sandstone (Shadow Lake)	core = easy geophysics = not collected due to bridge plug in bottom of DGR-2 to prevent flowing artesian conditions.
Cambrian Formation	tan to grey, fine to medium grained, very hard, silty sandstone / sandy dolostones with clasts of granitic gneiss and calcite.	843.8	-658.0	DGR-2 133	16.9	core	sharp	sharp contact from green coarse grained sandstone (very porous) to tan-grey fine grained sandstone (hard) with nodules of calcite	not collected due to bridge plug in borehole to prevent flowing artesian conditions	transition from greenish, shaley clastics to clean quartzose sandstones, dolomitic sandstones or sandy dolostones	core = extremely easy geophysics = not collected due to bridge plug in bottom of DGR-2 to prevent flowing artesian conditions.
Precambrian Formation	pink to black, fine to medium grained, felsic granitic gneiss	860.7	-674.9	DGR-2 146	NA	core	sharp	sharp contact from overlying tan-grey sandstone to granitic gneiss	not collected due to bridge plug in borehole to prevent flowing artesian conditions	increase in gamma response coincident with sharp contact with granitic gneiss	core = easy geophysics = not collected due to bridge plug in bottom of DGR-2 to prevent flowing artesian conditions.

Notes:

[yellow] ***Formation contact determined from DGR-1 core and borehole geophysical logs***

[blue] ***Formation contact determined from DGR-2 core and borehole geophysical logs***

1 = Geosynthesis Geology Workshop (MNR, OGS, GSC) September 5-6, 2007 updated with 2nd core worksop of November 2008.

2 = DGR-1 ground surface elevation (185.71 m ASL) used for all contacts picked from DGR-1 information; DGR-2 ground surface elevation (185.84 m ASL) used for all contacts picked from DGR-2 information

- a description of the geological contact (gradational, sharp);
- the rationale for picking the contact based on core;
- the rationale for picking the contact based on borehole geophysical logs;
- the rationale for picking the contact from Armstrong and Carter (2006); and,
- a brief comment on the difficulty of each pick based on core and geophysical logging data.

6 Data Quality and Use

Data on bedrock formation nomenclature and occurrence in this Technical Report are based on expert geological review of conditions observed in boreholes DGR-1 and DGR-2 at the Bruce site. Many contacts between individual bedrock formations in DGR-1 and DGR-2 are gradational rather than sharp and the selected contacts reflect the consensus opinion of the geological experts.

The data presented in this Technical Report are suitable for providing the framework for development of Phase 1 geological, hydrogeological and geomechanical descriptive site models of the Bruce DGR site. Subsequent to the initial core workshop a second core workshop was held at the completion of drilling of boreholes DGR-3 and DGR-4. Several formation contacts in DGR-1 and DGR-2 established in the initial core workshop were revised in the second workshop. Revised formation depths are included in this Technical Report in accordance with the results of the second core workshop as summarized in TR-08-12 (Intera Engineering Ltd., 2009d).

7 References

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