



# »» Confidence in Safety – South Bruce

South Bruce Nuclear Exploration Forum  
4-5 April 2023

**nwmo**

NUCLEAR WASTE  
MANAGEMENT  
ORGANIZATION

SOCIÉTÉ DE GESTION  
DES DÉCHETS  
NUCLÉAIRES

# Objective of Preliminary Assessments

To develop confidence on selection of a preferred location to take into detailed site characterization

## Safety

Confidence a deep geological repository can be developed with strong safety case at that location

## Transportation

Confidence a safe, secure and socially acceptable transportation plan can be developed

## Partnership

Confidence a strong partnership can be developed – with interested community, nearby First Nation and Métis and surrounding communities



# Elements of confidence in safety

1. Favourable geological setting;
2. Stability of geological setting;
3. Low risk of future human intrusion into the repository;
4. Site is amenable to geological characterization;
5. Robust multiple barrier system;
6. Ability to safely construct and operate the repository;
7. Able to safely transport fuel to the site;
8. Facility performance will meet regulatory criteria



# Building confidence in safety – a process

Siting  
Process  
Launched  
(2010)

Site Selection  
(~2024)

Impact Assessment/  
Licence to Prepare Site  
(~2025-2029)

Licence to Construct

Desktop studies  
Regional data

Seismic studies

Environmental  
baseline data

Design and safety  
analysis

Initial deep  
boreholes

Rock core  
analysis

Additional deep  
boreholes

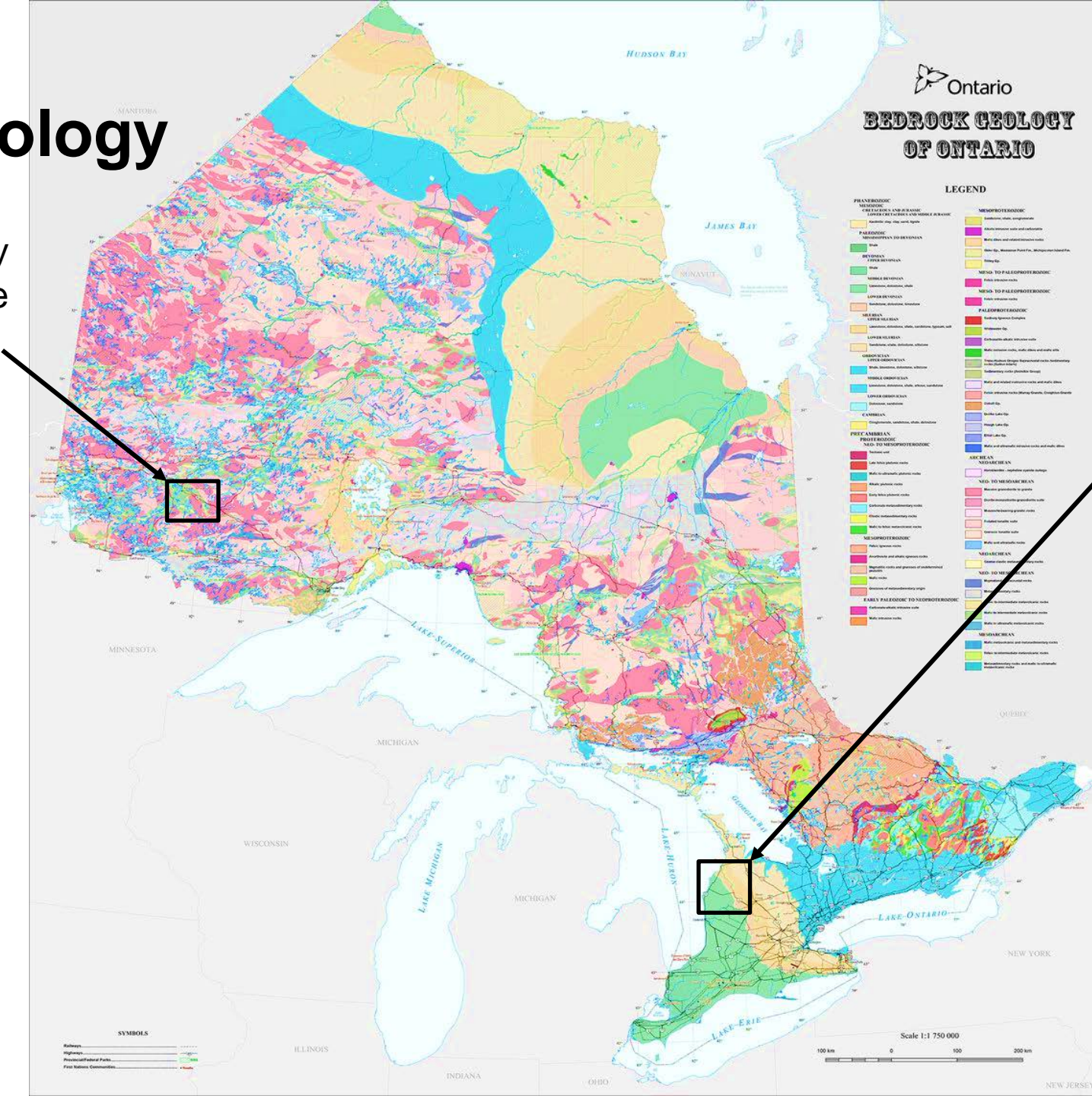
Shaft construction and  
underground studies

# Favourable Regional Geology

Wabigoon Lake Ojibway Nation (WLON) - Ignace Area

Northwestern Ontario

>2.5 billion year old “crystalline rock”



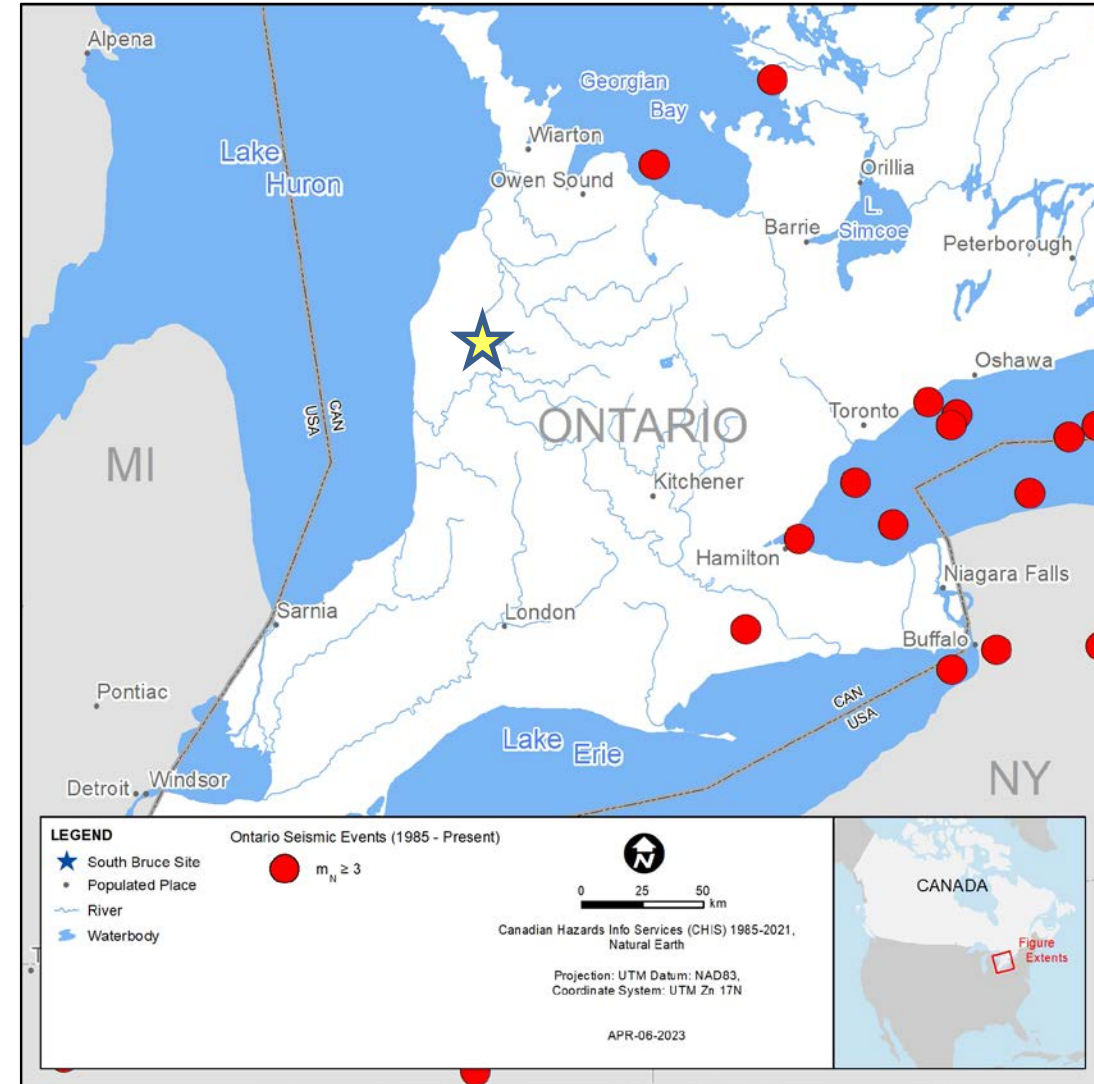
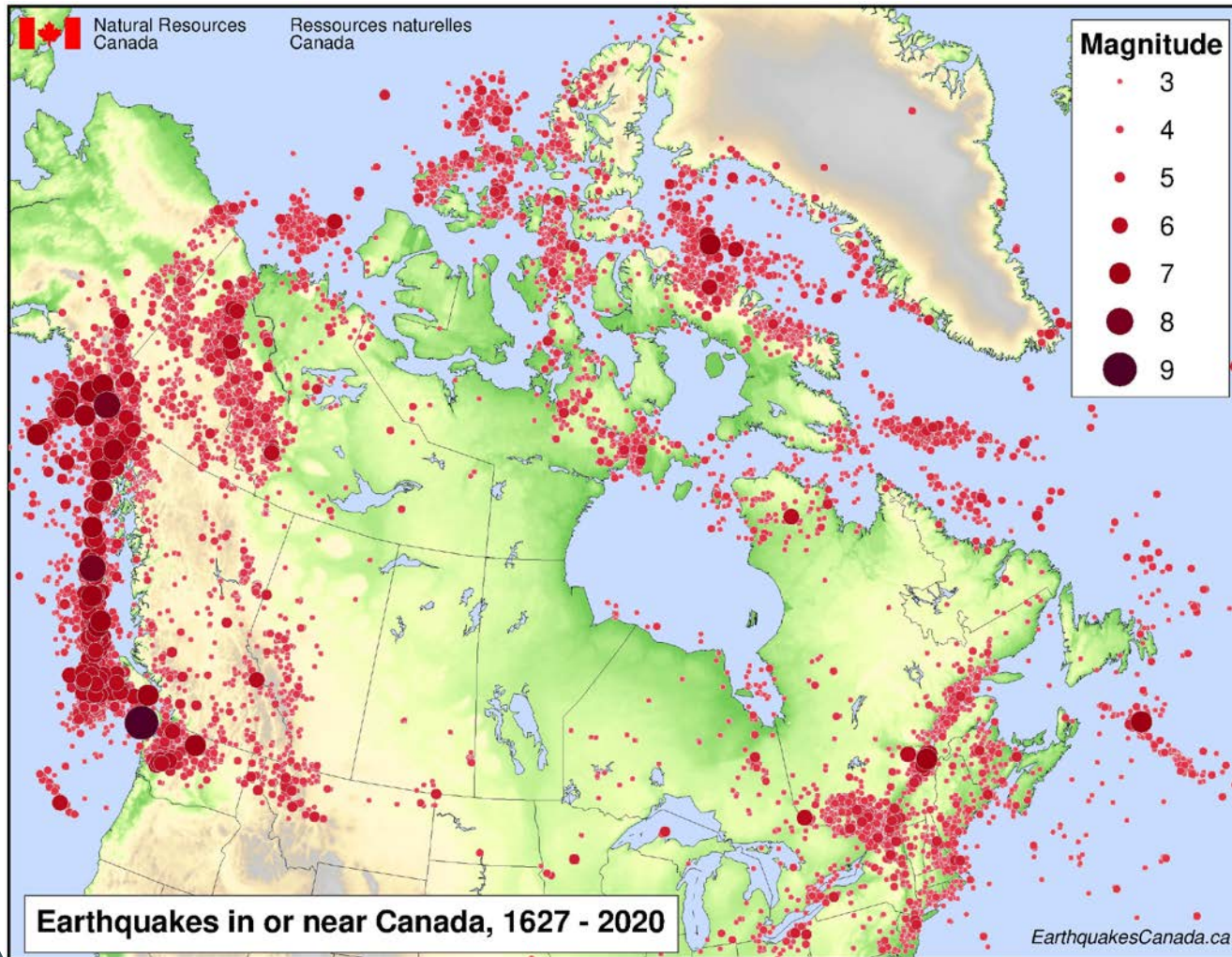
Saugeen Ojibway Nation (SON)-South Bruce Area

Southern Ontario

~ 540 to 350 million year old “sedimentary rock”



# Seismically Stable Area

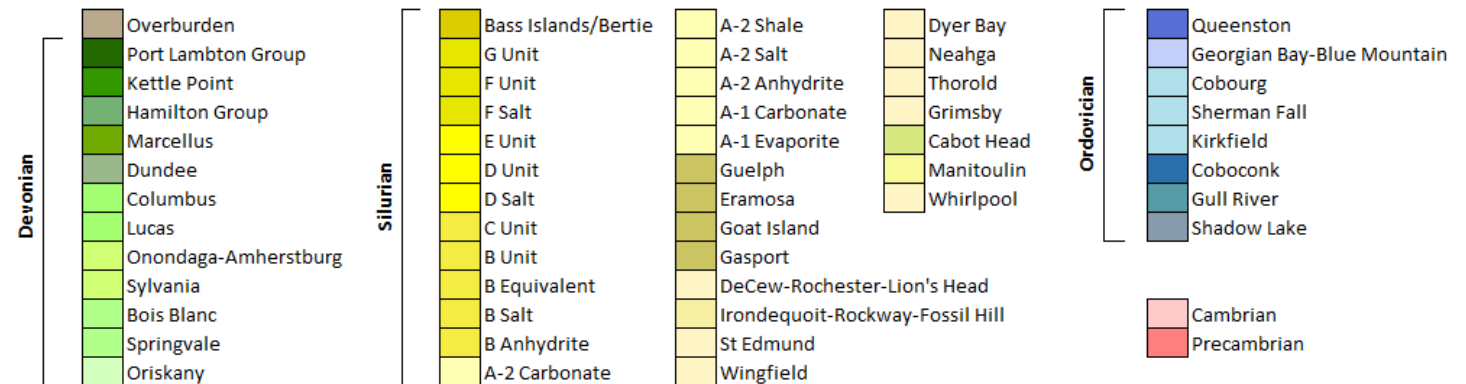
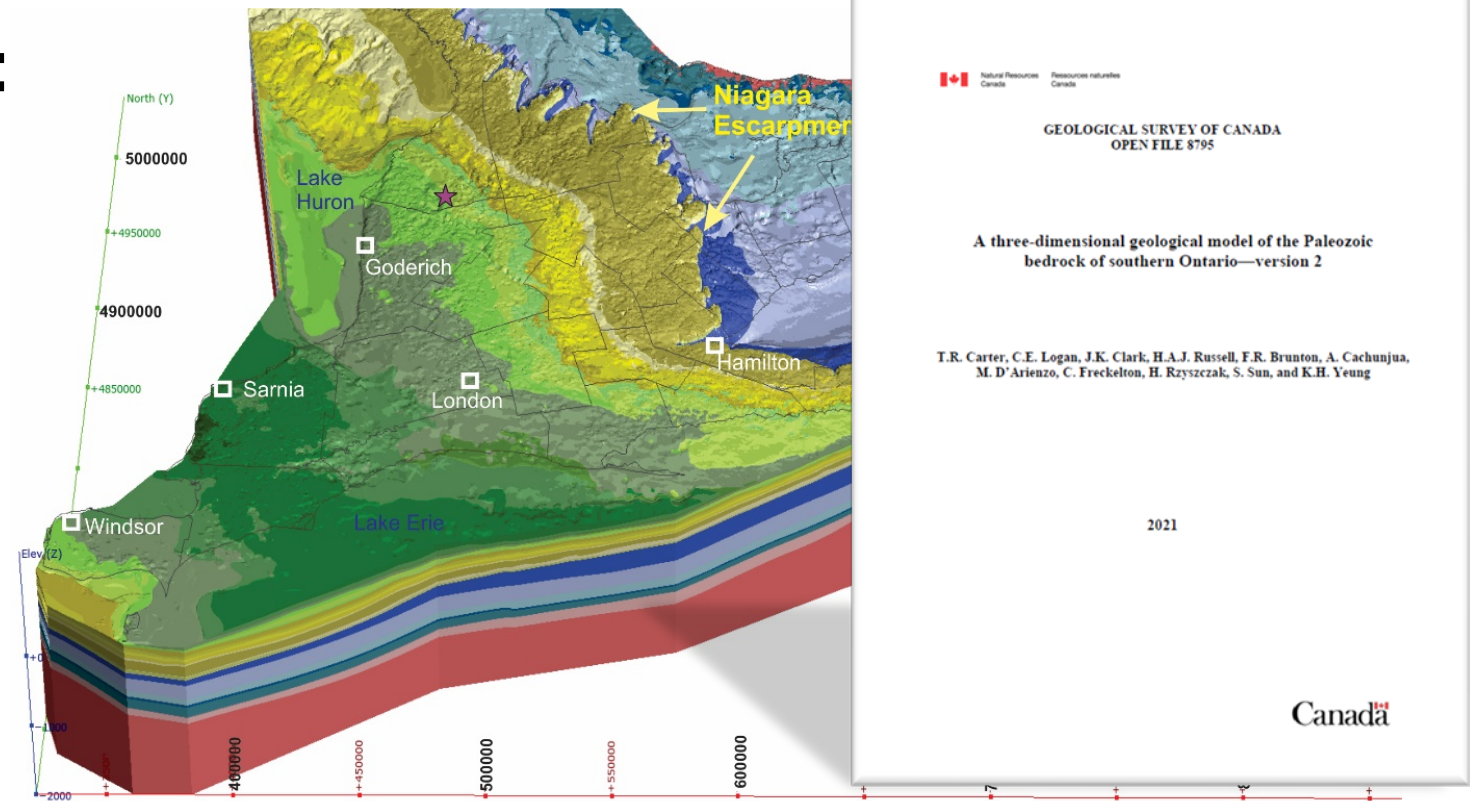
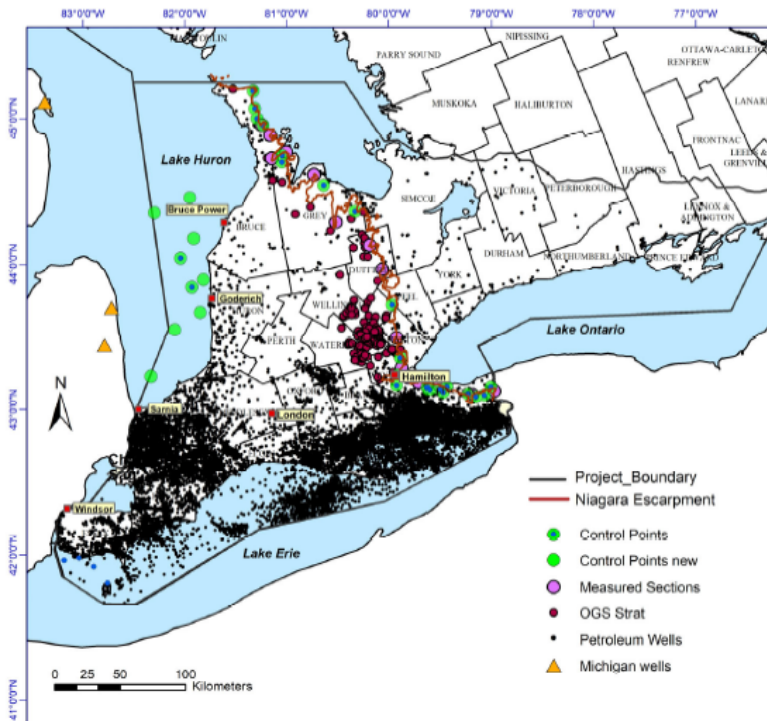


*Magnitude 3+ earthquakes recorded since 1985 near the South Bruce Site*

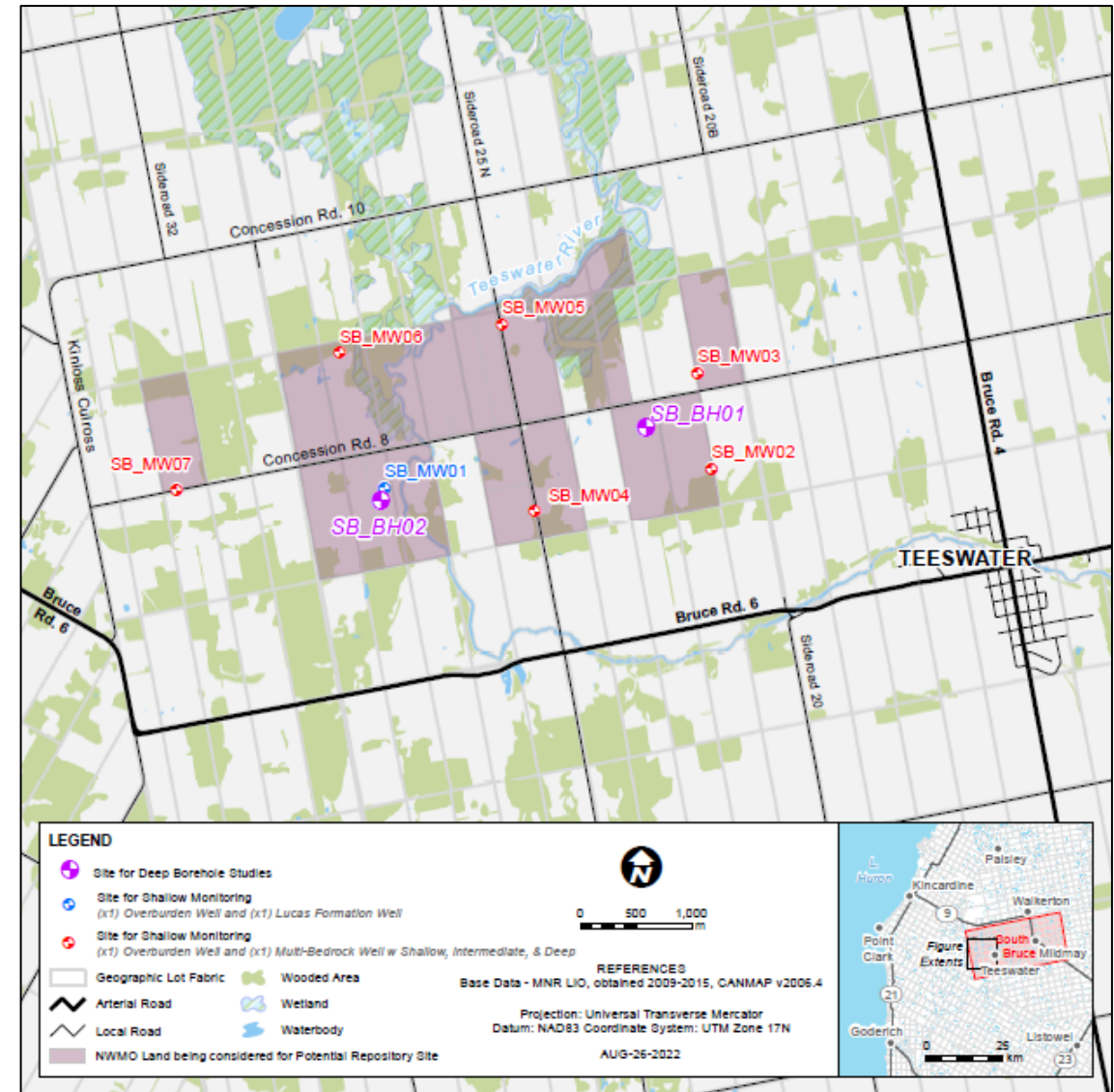
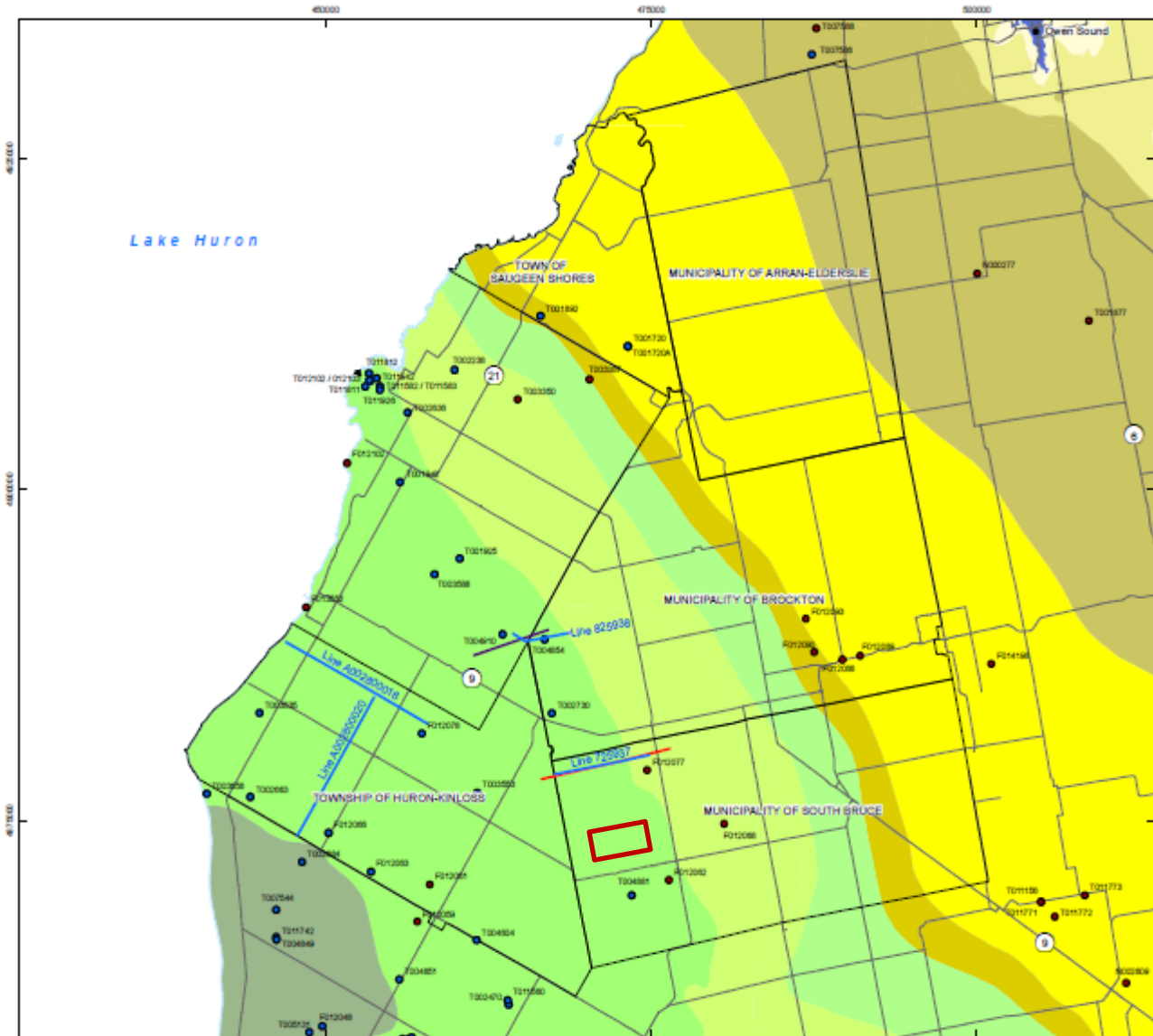


# South Bruce Regional Area: Existing Borehole Data and 3D Geological Model

- ~27,000 wells with ~300,000 formation tops

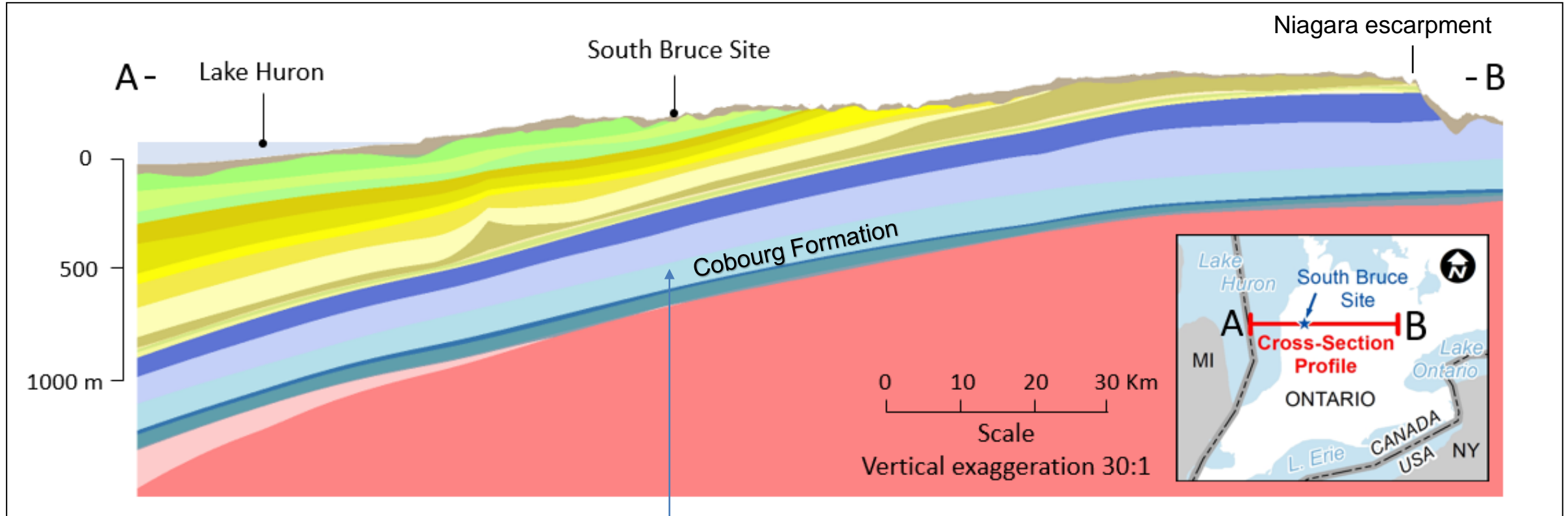


# South Bruce Site





# Potential Repository Location



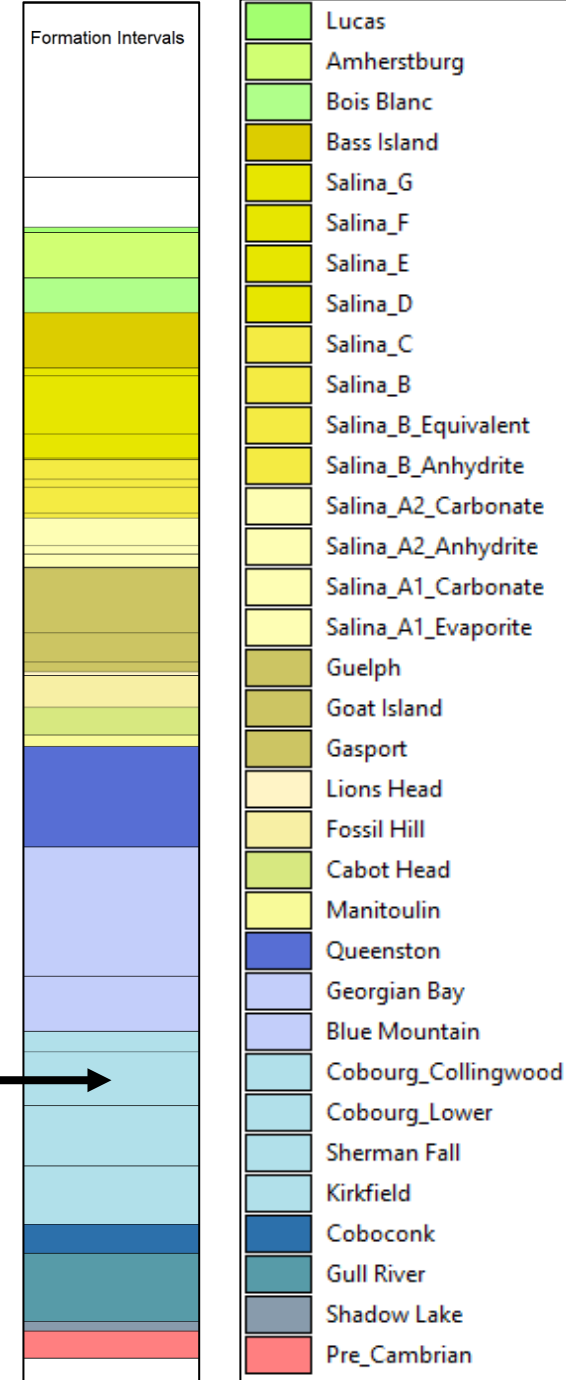
Proposed repository location

# South Bruce – Deep Borehole Drilling, Coring and Testing

- Two vertical boreholes drilled to Precambrian Basement (~900m)
- PQ3 size borehole (122 mm drilling, 83 mm core)

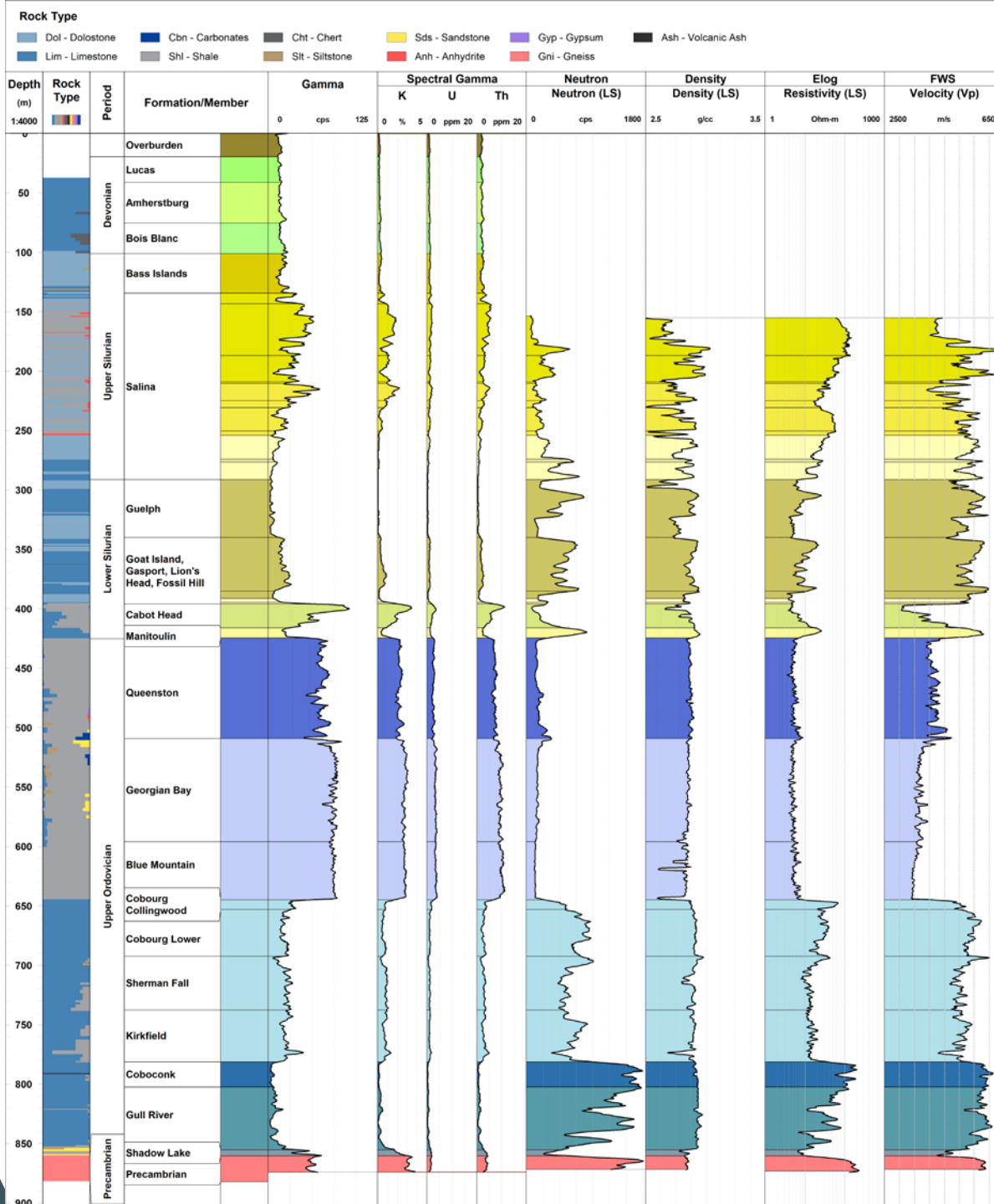
## Specific Objectives

- Confirm the stratigraphy of the sedimentary sequence, including confirming the depth and thickness of the **Cobourg Formation**
- Assess various geoscientific characteristics of the sedimentary sequence (e.g., hydraulic conductivity, fracture density, hydrogeochemistry)
- Assess and refine understanding of the presence and thickness of salt beds and the potential for hydrocarbon resources



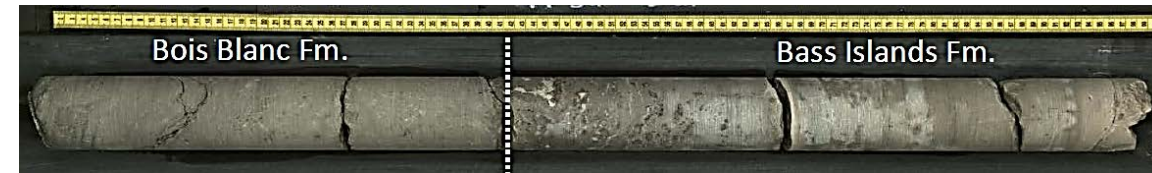
Not to Scale





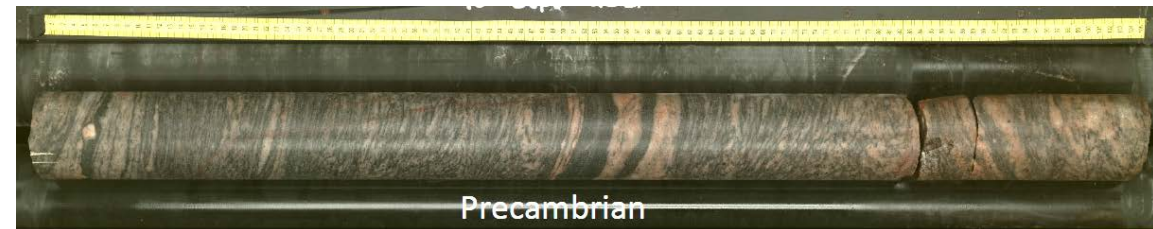
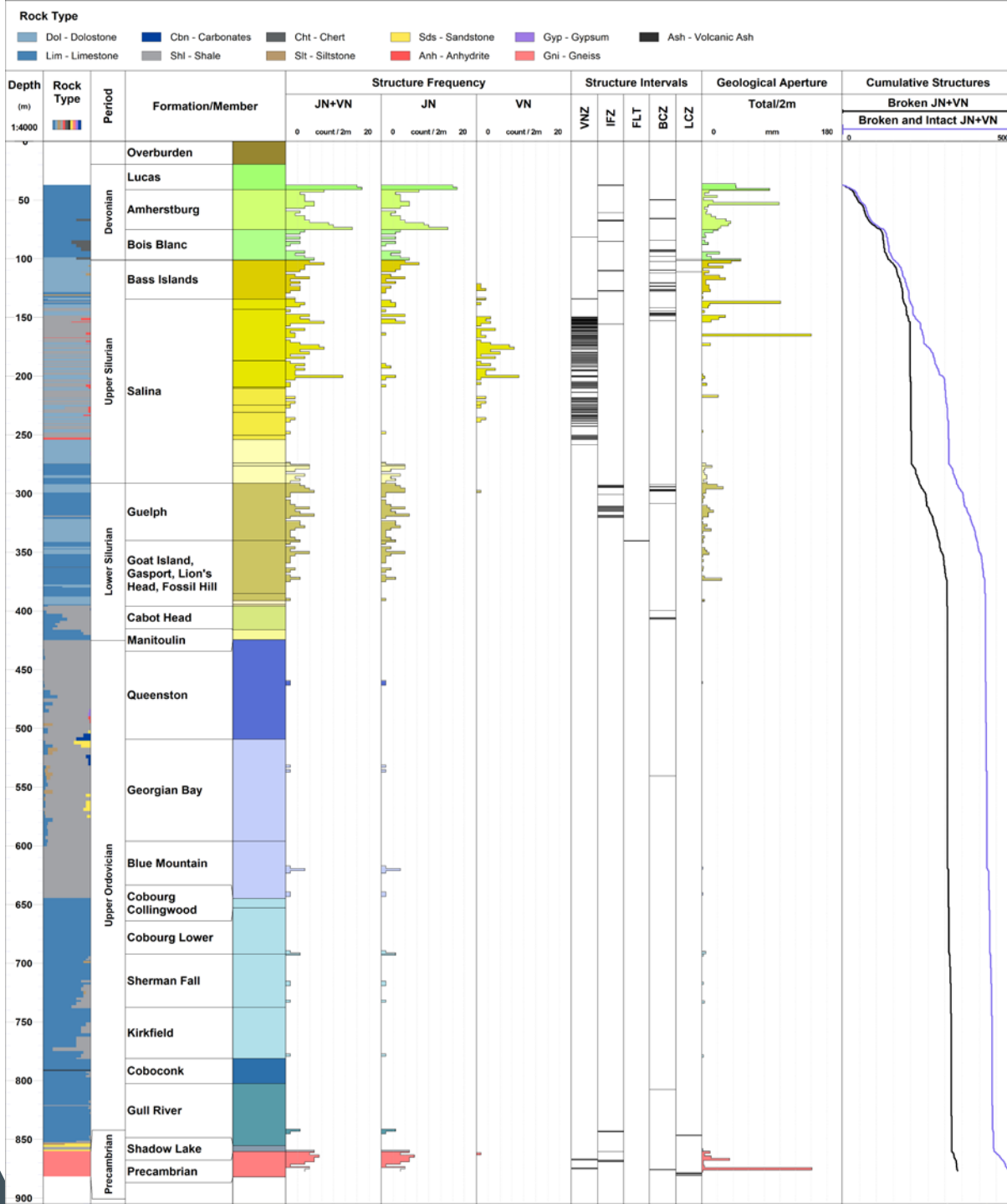
# South Bruce – Deep Borehole Drilling, Coring and Testing

Geophysical well logs – SB\_BH01



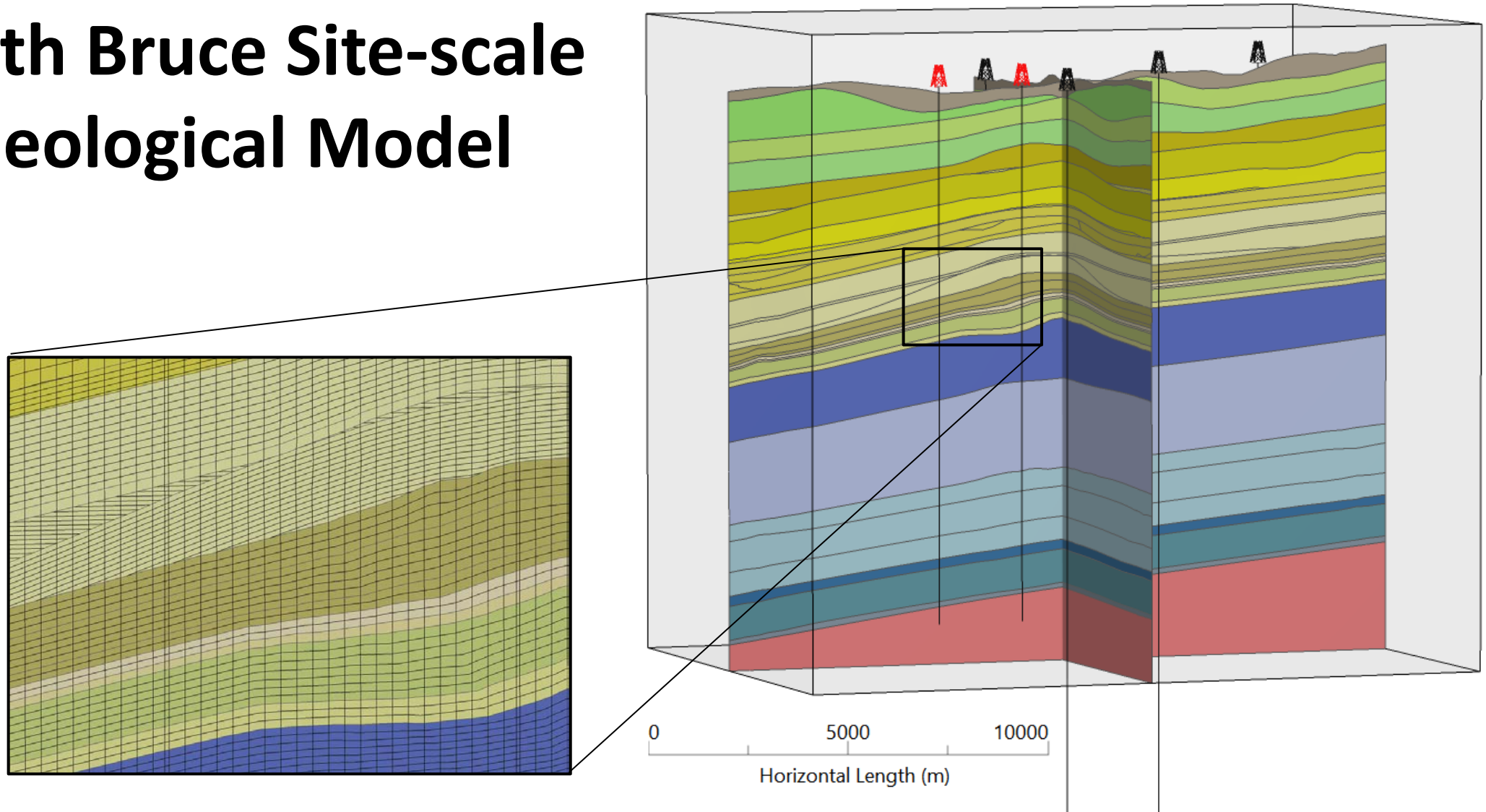
# South Bruce – Deep Borehole Drilling, Coring and Testing

Geological Structure logs – SB\_BH01



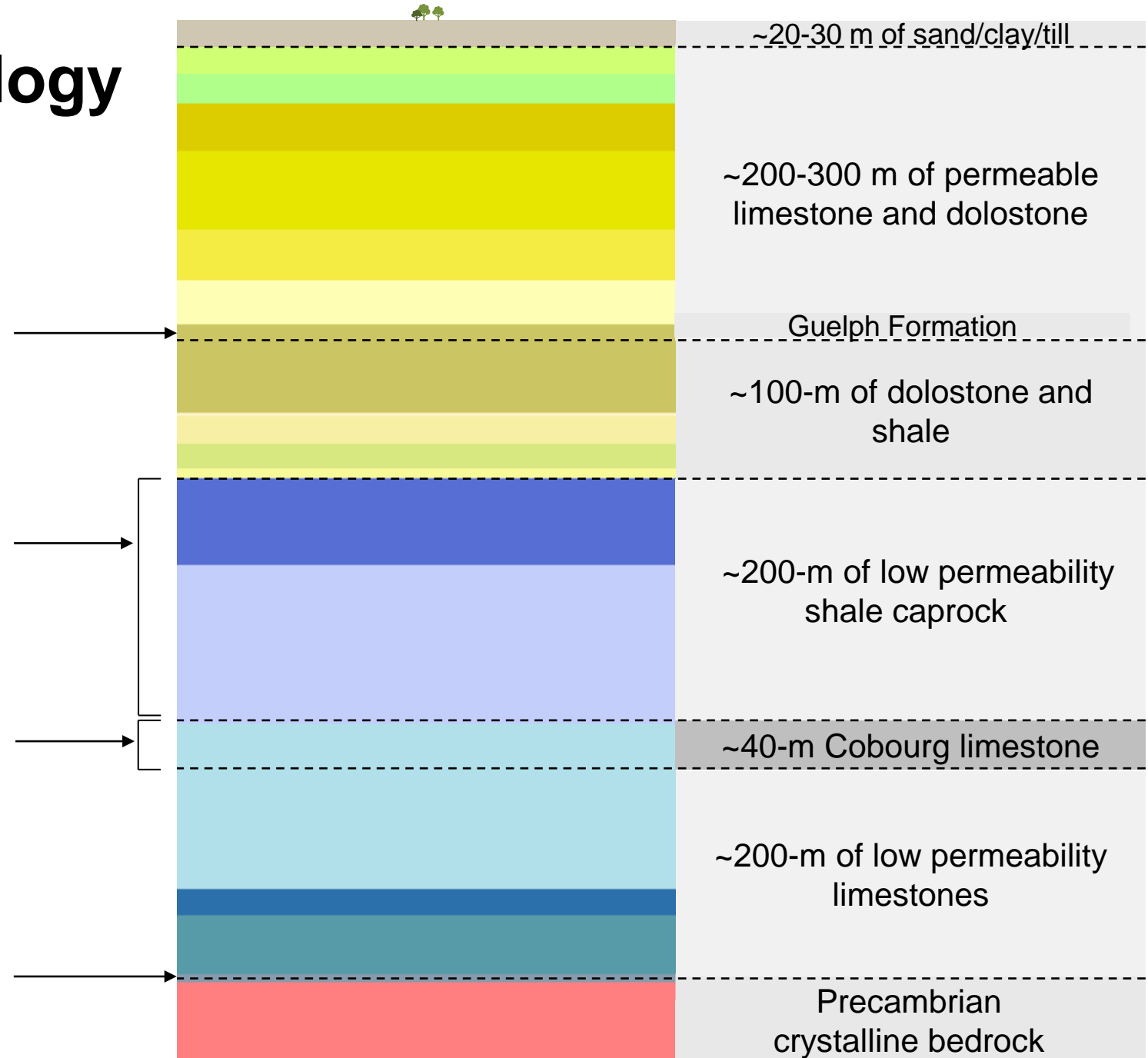


# South Bruce Site-scale Geological Model



# Favourable Site Geology

- Lowest water-bearing layer is at 325 m depth
- 200-m of low-porosity shales provide a strong caprock
- Cobourg Formation at 650-m depth; a low-porosity limestone layer
- No water-bearing Cambrian Formation above the bedrock





# Cobourg Formation



*Typical Cobourg Formation rock core samples from South Bruce site*

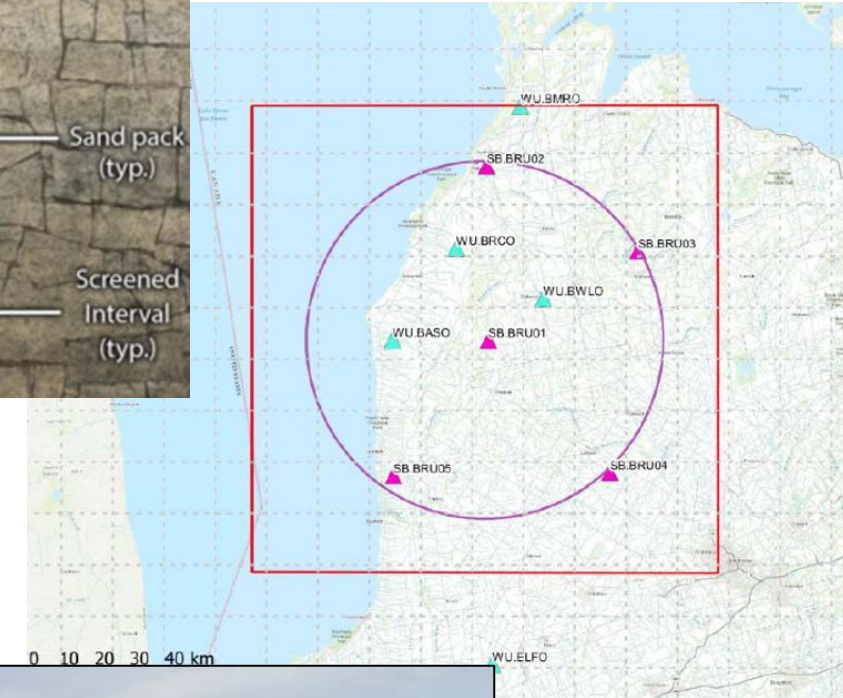
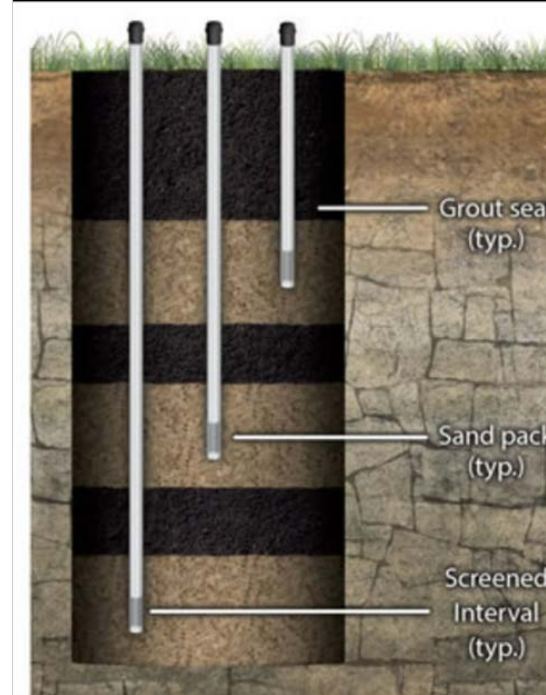


*Darlington Intake/Discharge Tunnels (under Lake Ontario)*

# Additional Geoscientific Studies

## Shallow Groundwater Wells

- Installation of a pair of overburden and bedrock wells at seven sites
- Total of 26 monitoring intervals
- Collection of continuous pressure data and quarterly groundwater sampling



## Microseismic Network Array

- Five (5) stations installed within a 50 km radius
- Able to detect magnitude and location of seismic events down to 1 ML magnitude

## 3D Seismic:

- Total of 14 km<sup>2</sup>.
- Interpretation ongoing.





# Natural Resources

Based on regional data, no economic concentrations of mineral, oil, gas, or salt resources were expected at depth

No economic occurrences observed at the South Bruce Site

No potable water below 200 m (too salty)

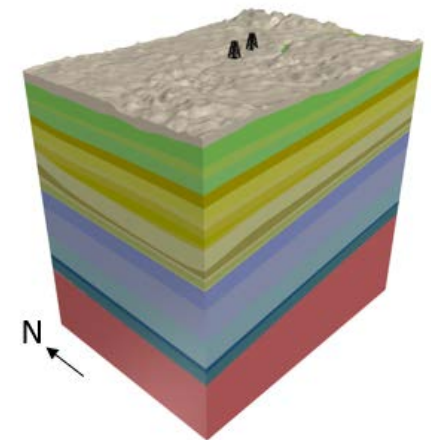


*Oil and gas pools shown in color*

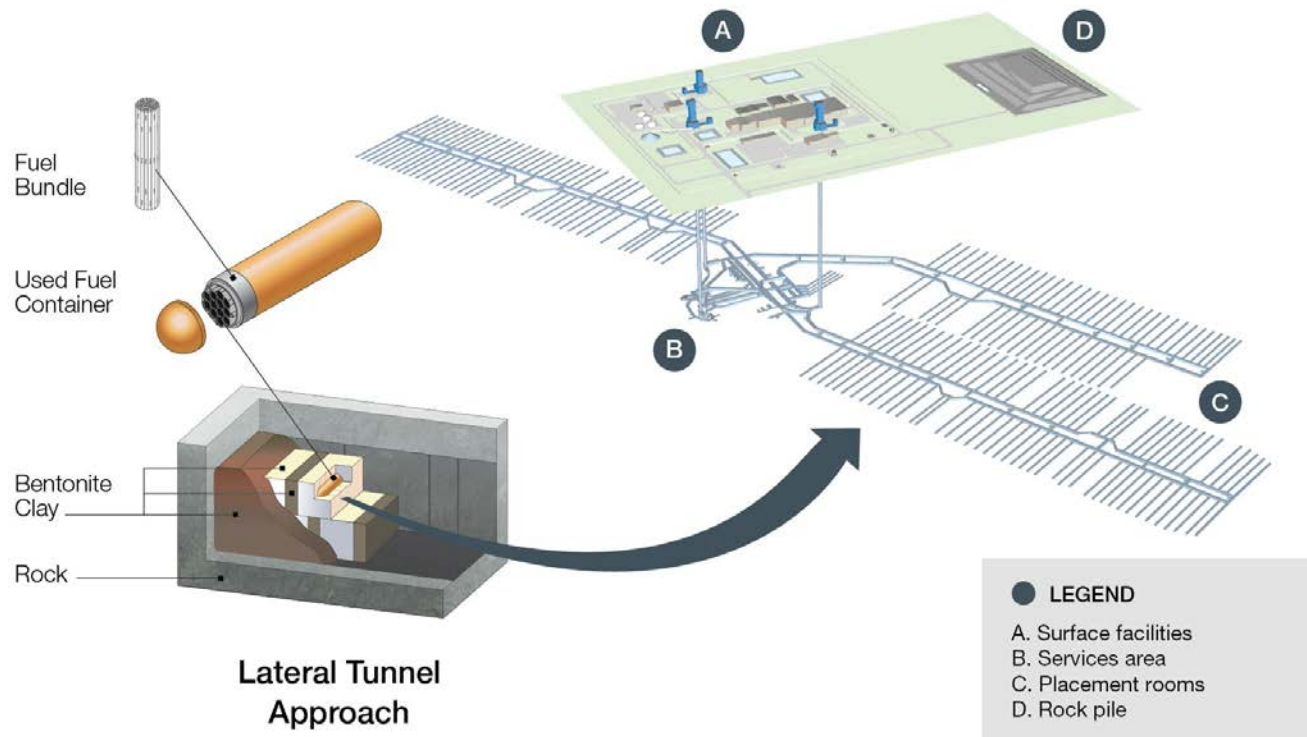
# Confidence in Safety: South Bruce Site - Geology

## Key Points

- The Cobourg Formation was encountered where expected, at around 650 m depth.
- No inflowing groundwater into boreholes below 325 m, consistent with very few fractures at greater depth.
- The Cobourg Formation is approximately 40 m thick, and will provide stable, virtually dry openings.
- The Cobourg Formation, and surrounding shale and limestone formations, represent an approximately 400 m thick, and laterally extensive, natural barrier.



# Multiple Barrier System



*1 billion year old natural copper sheet from mine in Keweenaw, Michigan*



# Engineering Proof Testing



**Fabrication,  
inspection,  
testing**

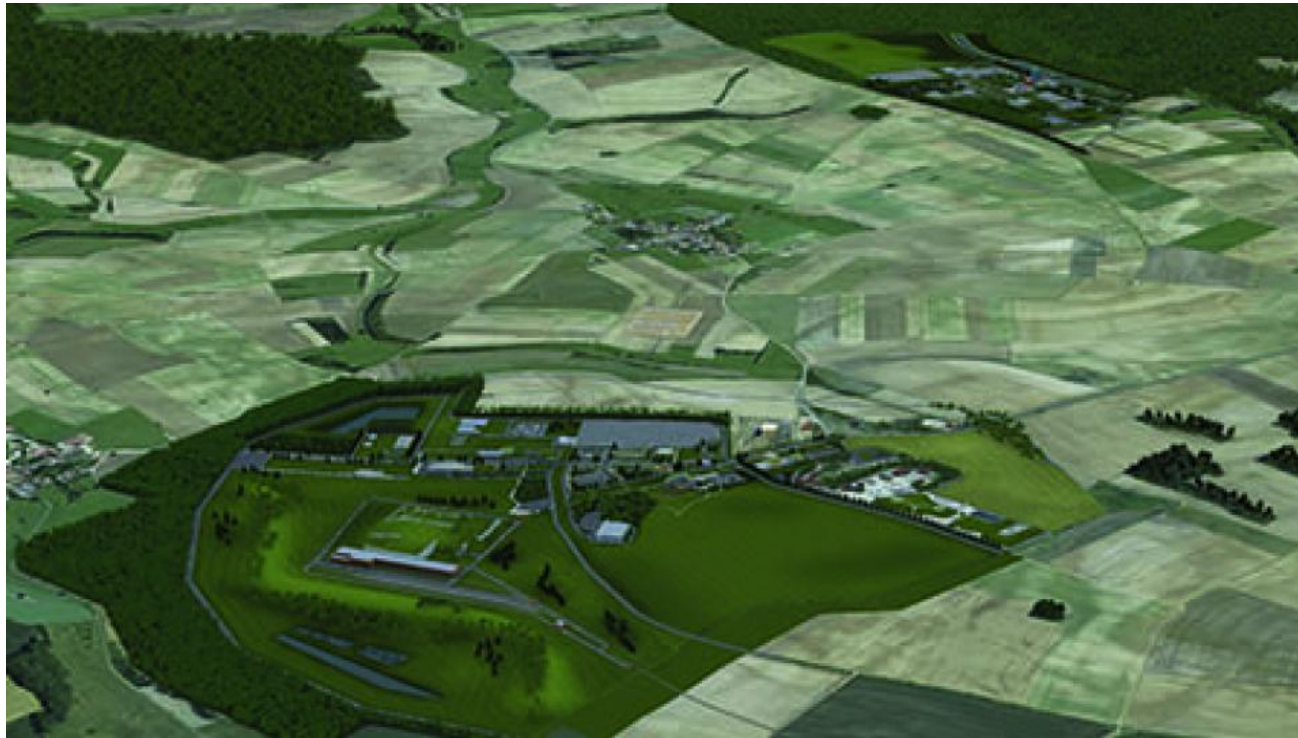
**Handling and  
emplacement**



Emplacement video on NWMO website (also <https://youtu.be/9GkW4tPUhcU> )

# International Precedence

South Bruce sedimentary rock setting is broadly similar to sites selected in France and Switzerland for a used fuel / high-level waste repository.



Proposed French facility (Source: ANDRA)



Location of proposed French and Swiss facilities (Base map: Alexrk2/Wiki Commons )

# Safety Assessment

## Operations

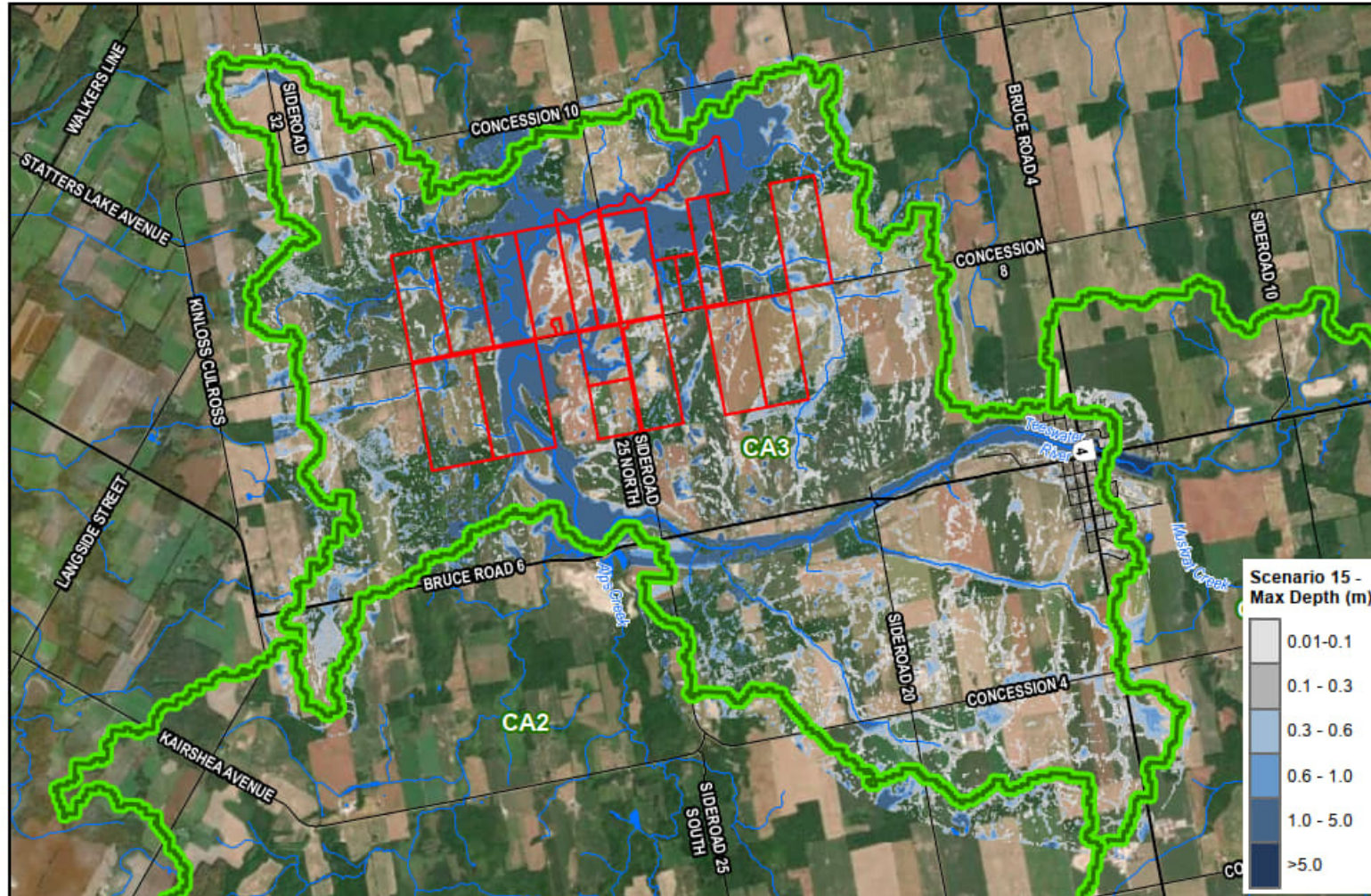
- External hazards
  - e.g. Flooding
- Internal hazards
  - e.g. Handling accidents
- Site specific safety analyses underway

## Post-closure

- Normal evolution scenario
- Disruptive or “what if” scenarios
- Generic safety assessment (case study) completed
- Site-scale safety analyses underway

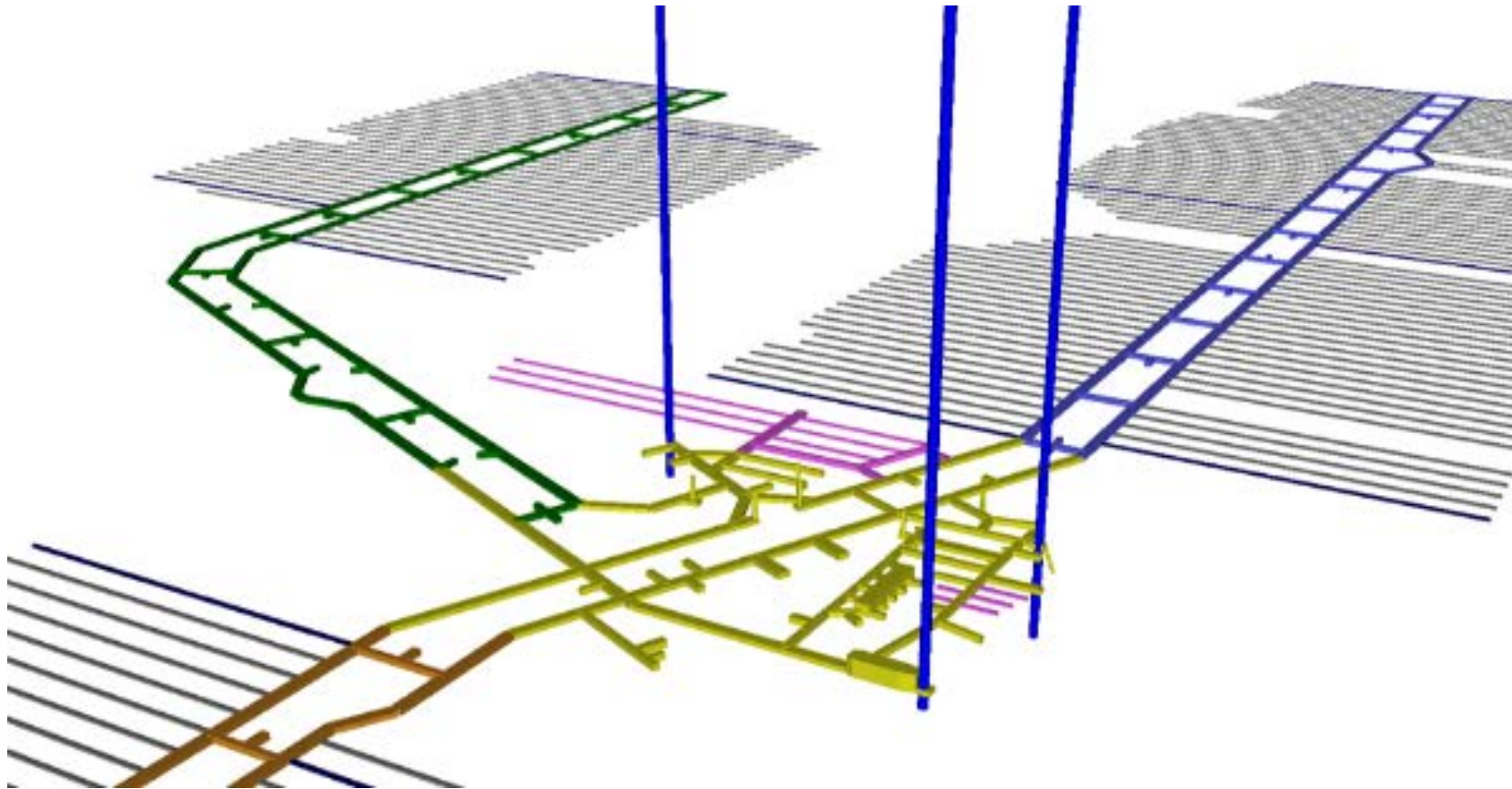


# Flood Risk Assessment – 500 Year Storm Event (174 mm in 1 day)



# Site Testing and Monitoring

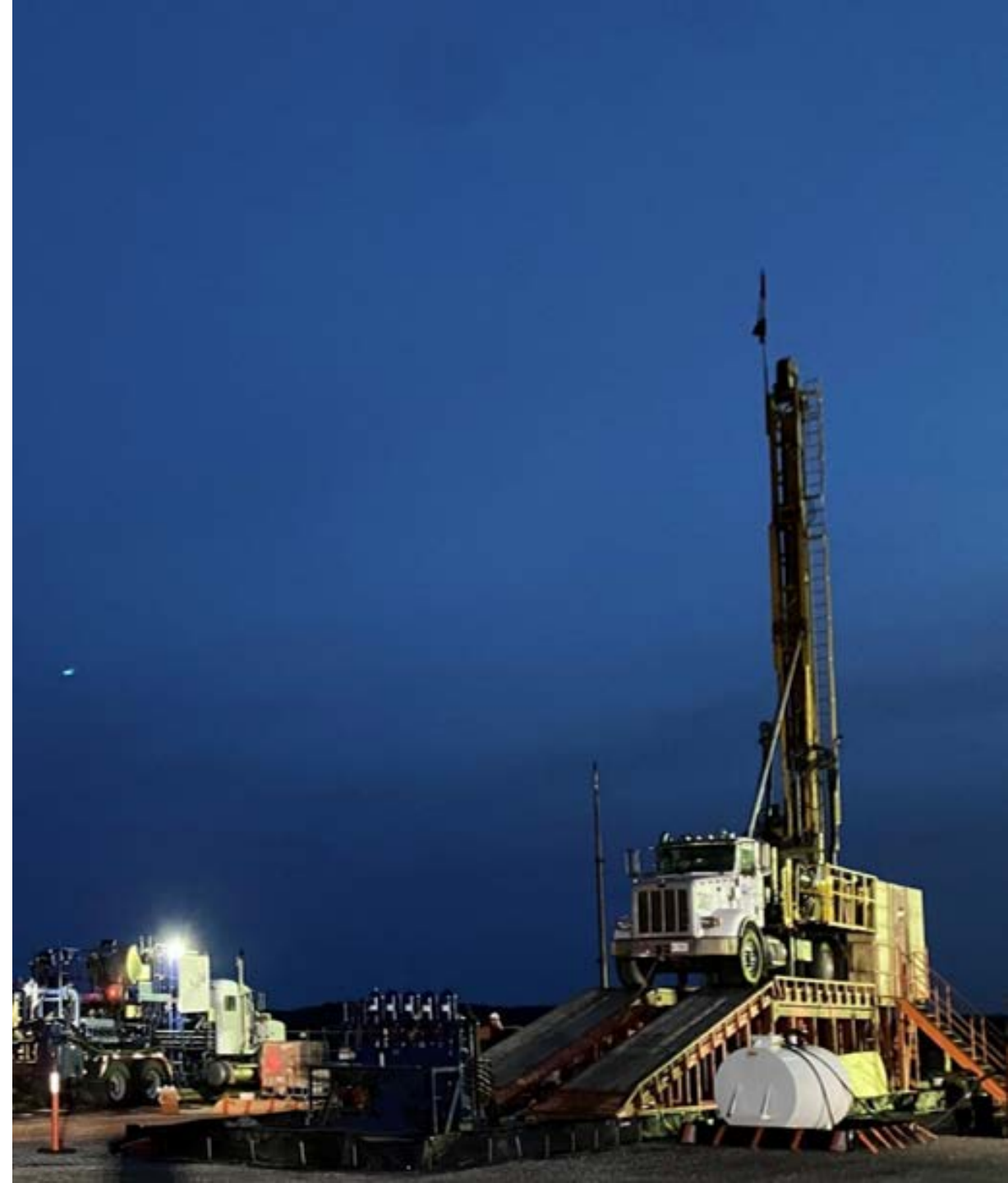
- DGR Plan includes testing and demonstration areas





# More Work to Do

- Detailed site characterization is planned should the site be selected.
- Remaining uncertainties are less about the suitability of the rock, and more about developing a quantitative understanding of the site.
- One area that will require additional work is the high salinity in the proposed host rock.
  - Favorable indicator of long-term hydrogeochemical stability
  - Effects on the engineered systems will require additional analysis.





# Future Site Work

- Additional boreholes
- Measuring conditions in boreholes
- Lab analysis/testing of samples from boreholes
- Continue shallow groundwater monitoring wells
- Continue seismicity monitoring
- Continue environmental monitoring
- Site specific analyses



*One of five microseismic monitoring stations installed in area*

# Conclusion

Overall, based on the assessment results to date, the NWMO is confident that a deep geological repository could be constructed at the South Bruce Site in a manner that would provide safe long-term management for Canada's used nuclear fuel.

Confidence in Safety –  
South Bruce Site

NWMO-TR-2022-15

March 2022

Nuclear Waste Management Organization

**nwmo**  
NUCLEAR WASTE MANAGEMENT ORGANIZATION  
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Available at [www.nwmo.ca/reports](http://www.nwmo.ca/reports)



# Thank you.



@nwmocanada / @LaSGDN



/company/nwmocanada



[www.nwmo.ca](http://www.nwmo.ca)