# GEOLOGICAL ANALYSIS

## The Claim That Shield Geology Makes High-Speed Rail Construction Prohibitively Expensive Does Not Hold Up to Scrutiny

*An independent geological assessment examines the evidence behind publicly circulated cost claims — and finds them unsupported by the geological record.*

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# Executive Summary

**KEY FINDING**

Publicly circulated claims that Canadian Shield geology makes High-Speed Rail (HSR) construction prohibitively expensive rest on an oversimplified and inaccurate characterisation of Shield geology. A 5 km-wide band of easily excavated meta-sedimentary rock runs directly along the Highway 7 corridor, the same geology that allowed 1930s engineers to build a flat, straight highway and 1880s engineers to build a near-level railway with the equipment of their era. No geotechnical evidence has been made public to support the cost differential claims currently in circulation.

## The Central Problem

A decision that will commit billions of dollars of public funds and irreversibly alter eastern Ontario's landscape is being shaped by cost claims with no published geotechnical basis. Specifically:

- Cost estimates of approximately $50M/km (southern) vs. $80M/km (northern) have been publicly circulated, including in a Senate committee submission
- No geotechnical analysis supporting these figures has been made publicly available
- The Shield geology in the northern corridor has been characterised as uniformly hard granite requiring extensive blasting, a characterisation that is incorrect
- The southern corridor's own geological challenges (Frontenac Terrane granite, glacial till foundations, and aggregate logistics) have received no equivalent public scrutiny

## What the Geological Record Shows

The Canadian Shield is not uniform granite. The Grenville Shield is a mosaic of rock types. Directly along the Highway 7 corridor, a 5 km-wide band of meta-sedimentary rocks (former sandstones and limestones)a is easily excavated with minimal or no blasting. This is not a theoretical assertion. Engineers in the 1880s and 1930s independently identified and built along this corridor, leaving measurable proof:

- Former CP Rail line (1880s): 18.82 km Shield crossing with only 30.8 m elevation change, a gradient of 3.0 m/km, well within HSR specifications, built with no powered excavation equipment
- Highway 7 (1930s): Flat and straight for 15 km stretches, only 40 m elevation variation over 40 km
- Hyett & Peterson elevation profiling (2026): The 70 km from west of Sharbot Lake to Madoc confirms flat, easily buildable terrain

# Section 1 — Scope and Basis of Analysis

This document examines geological conditions in proximity to the existing Highway 7 transportation corridor between Carleton Place and Madoc only. It does not assess, and does not endorse, any route running north of Highway 7. The purpose is not to advocate for a northern route. It is to challenge the geological basis of cost claims currently influencing the public consultation process without supporting evidence having been made available for scrutiny.

Wherever a route is ultimately built, including along the southern corridor currently under consultation, the same standard of public geotechnical evidence must apply.

## Claims Under Scrutiny

| CLAIM | THE GEOLOGICAL RECORD |
|---|---|
| The Canadian Shield is hard granite requiring extensive blasting and tunnelling. A northern corridor would therefore be prohibitively expensive. | The Grenville Shield is not uniform granite. A 5 km-wide band of meta-sedimentary rock runs directly along the Highway 7 corridor. This rock type is easily excavated, potentially without blasting as two generations of infrastructure engineers demonstrated in practice. |
| The southern route avoids the Shield and therefore has significantly lower construction costs, potentially saving billions of dollars. | The southern corridor does not avoid difficult geology. It must cross the Frontenac Terrane some of the hardest felsic granite in the Grenville Shield before encountering extensive glacial till requiring deep foundations. It also runs 30 km longer. |
| Cost estimates of approximately $50M/km (southern) vs. $80M/km (northern) are credible and can be relied upon. | These figures have been publicly cited but no geotechnical basis for them has been published. The geological conditions on both corridors suggest these estimates may not reflect actual ground conditions. The assumptions behind them must be released. |

# Section 2 — The Grenville Shield: A Geological Primer

The Grenville Shield was formed approximately one billion years ago through the collision of multiple geological terranes. The result is a mosaic of rock types with fundamentally different construction properties.

### 2.1 Meta-Sedimentary Rocks (dominant along Highway 7 corridor)

Former sandstones and limestones, metamorphosed under heat and pressure. Despite their age, they retain a relatively flat, layered structure aligned with the northeast-to-southwest corridor direction. They are far easier to excavate than igneous rocks: modern equipment can cut through them with minimal or no blasting. This is the dominant rock type along the Highway 7 corridor.

### 2.2 Hard Igneous Rocks (dominant in Frontenac Terrane)

Granite and granite gneiss. Unconfined compressive strength can exceed 250 MPa, among the hardest construction materials encountered in infrastructure projects. Excavation requires extensive blasting, possibly tunnelling, and creates irregular terrain with tighter alignment curves. The Frontenac Terrane, which the southern corridor must cross, is dominated by this rock type.

# Section 3 — The Highway 7 Meta-Sedimentary Corridor

A 5 km-wide band of meta-sedimentary rock runs continuously through the Canadian Shield between Carleton Place and Madoc, directly along the Highway 7 corridor. Two independent infrastructure projects, built generations apart with the technology of their respective eras, have demonstrated these conditions in practice.

### 3.1 Former CP Rail Line (1880s)

Built along the meta-sedimentary corridor using Victorian-era equipment with no powered excavation. Achieved a Shield crossing of 18.82 km with 30.8 m total elevation change, a gradient of 3.0 m/km, well within modern HSR operational parameters. This is not history: it is measurable geological evidence preserved in the landscape.

### 3.2 Highway 7 (1930s)

Engineers in the 1930s independently chose to build Highway 7 along the same meta-sedimentary corridor. The result: flat and straight for 15 km stretches north and west of Kaladar, with only 40 m elevation variation over 40 km. This was not engineering triumph over difficult terrain; it was engineering that recognised and followed the geology.

### 3.3 Hyett & Peterson Elevation Profiling (2026)

Original elevation profiling of the corridor confirms the historical record. The zone from west of Sharbot Lake to Madoc, approximately 70 km, is remarkably flat. Sharbot Lake to Kaladar (34.1 km): 34 m elevation variation (±15 m). Sharbot Lake to Carleton Place (32.3 km): 28 m elevation variation (±17 m).

# Section 4 — Geological Context for the Southern Corridor

This section does not argue that the southern corridor is unworkable. It corrects the asymmetry in public debate: the southern corridor's geological challenges have not received scrutiny equivalent to the unverified claims made about the northern Shield corridor.

### 4.1 The Frontenac Terrane

The southern corridor crosses the Frontenac Terrane, hard felsic granite and granite gneiss with unconfined compressive strength potentially exceeding 250 MPa. Construction requires extensive blasting, possibly tunnelling, tighter alignment curves around terrain obstacles, and crossings of major lakes. The "avoids the Shield" framing misrepresents geological reality: the route crosses the Shield's hardest geology.

### 4.2 Glacial Till and Foundation Complexity

South of the Shield, the southern corridor encounters extensive glacial till, Champlain sediments characterised by high variability, frost susceptibility, perched water tables, moisture sensitivity, and slope instability. Estimated 4–5 million tonnes of glacial till spoil requiring removal, compared to less than 2 million tonnes on the Highway 7 alignment. Deep piling likely required for HSR-standard foundations.

### 4.3 Aggregate Supply and Logistics

HSR construction requires 2–3 million tonnes of premium crushed granite ballast. The southern corridor requires import from distant quarries, estimated 1 million truck journeys for aggregate delivery plus 500,000 for waste spoil removal, generating over 25,000 tonnes of additional $CO_2$ emissions and imposing costs on municipal road networks. The Highway 7 corridor would encounter suitable felsic granite as a natural by-product of its limited igneous zone crossings, primarily a local material handling operation.

### Comparative Assessment

| Metric | Hwy 7 Corridor (meta-sedimentary zone) | Southern Corridor (as proposed) |
|---|---|---|
| **Distance** | 239 km | 269 km (+12.5%) |
| **Hard igneous rock** | <6 km crossing | Extensive Frontenac granite |
| **Dominant terrain** | Flat meta-sedimentary | Rugged granite, then glacial till |
| **Glacial till volume** | <2 million tonnes | 4–5 million tonnes |
| **Aggregate sourcing** | Local on-site felsic | Imported (~1M truck journeys) |
| **Excavation method** | Largely without blasting | Extensive blasting / tunnelling |
| **Foundation type** | Standard embankment | Deep piling in glacial till |

## Section 5 — What Must Be Made Public Before a Route Decision

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| 1 | Release the geotechnical assumptions behind all published cost estimates — rock types, excavation methods, foundation specifications, and material volumes — so they can be independently verified. |
| 2 | Commission and publish a geotechnical investigation of the Highway 7 meta-sedimentary corridor before a route decision is finalised. |
| 3 | Apply equal geological scrutiny to all corridor options, including the Frontenac Terrane crossings, glacial till foundations, and aggregate logistics for the southern corridor. |
| 4 | Do not foreclose any route on the basis of unverified cost claims. |
| 5 | Establish an independent geological review mechanism with access to cost assumptions before any route decision is locked in by planning expenditure. |

## Conclusion

The geological case against a route in the northern corridor has been stated publicly and repeatedly, but the evidence behind it has never been made available for scrutiny. This independent assessment demonstrates that the claim does not survive contact with the geological record.

The meta-sedimentary corridor along Highway 7 is not a theoretical proposition. Engineers in the 1880s and again in the 1930s independently identified and built infrastructure along it, with the technology of their era, leaving measurable proof in the landscape of what the geology permits. No equivalent public evidence has been produced to support the cost claims currently influencing the consultation process.

This is not an argument for the northern route. It is an argument that no route should be advanced or dismissed on the basis of cost claims that have never been subjected to independent geological review. The geology has not changed. The obligation to account for it has not either.

# References

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