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240798

April 22, 2025

Sienna Senior Living
320 Town Centre Boulevard, Suite 300
Markham, Ontario
L3R 0E8

**RE:** SLOPE STABILITY ASSESSMENT
PROPOSED LONG TERM CARE FACILITY ADDITION
1541 ST. JOSEPH BOULEVARD
CITY OF OTTAWA, ONTARIO

This letter reports the results of a slope stability assessment for the property known as 1541 St. Joseph Boulevard, Ottawa, Ontario. The purpose of the slope stability assessment was to:

- Assess the condition of the existing slope at the site in order to determine if a slope stability setback distance is required;
- Assess of the stability of the slope with respect to the construction of a multi-unit long term care facility addition verify that the proposed development will not have a detrimental impact to the stability of the slopes at the site.

A topographic survey of the site was completed by Sedun + Kanerva Architects Inc. The topographic survey provided elevation contours, and the top and bottom of slope location (see Kollaard Associates drawing 240798-SLP attached following the text of this letter). Existing subsurface conditions at the site were determined via the advancement of five (5) boreholes and twelve (12) auger holes at the site.

The proposed site is located on a ~2.5 hectare parcel of land along St. Joseph Boulevard approximately 1 kilometre west of the town of Orleans. For the purposes of this letter, the St. Joseph Boulevard is considered to be oriented on an east-west axis adjacent to the site. The property known as 1541 St. Joseph Boulevard, Ottawa, ON is located on the north side of St. Joseph Boulevard and extends approximately 170 metres towards Highway 174. The site is currently occupied by an existing multi-unit residential development located at the top of the existing slope. It is understood the existing residential building is to remain onsite. The newly proposed multi-unit residential development area is approximately 40 metres south from the top of the existing slope.

The proposed development at the site will consist of the construction of a 1,700 square metre multi-unit addition onto an existing building. The height and inclination of the slopes adjacent to the proposed development were determined from a topographic survey supplied by the client (Sedun +

Kanerva Architects Inc.) and verified in the field by Kollaard Associates Inc. during a site visit on April 13, 2025.

The following slope inspection is based on the topographic survey and site observations, Table 4.1 (Slope Inspection Record) of the MNR's "Technical Guide River & Stream Systems: Erosion Hazard Limit" was followed;

Table 4-1

| | |
|---|---|
| Filename/NO.<br>Inspection Date (DDMMYY):<br>Weather:<br>Inspected by: | 240798<br>April 13, 2025<br>Sunny<br>Isaac Bacon |
| Site Location: | 1541 St. Joseph Boulevard, Ottawa, ON |
| Watershed: | Grande Presqu'lle – Ottawa River |
| Property Ownership (name, address, phone):<br>Legal Description<br>Lot<br>Concession<br>Township<br>County<br>Current Land Use | Sienna Senior Living<br><br>Lot 10<br>Concession 1<br>Gloucester Township<br>Carleton County<br>Multi-Unit Long Term Care Facility Building |
| Slope Data<br>Height<br>Inclination | <br>19 metres<br>17.4 degrees |
| Slope Drainage (describe) | The ground surface at the property has a downward slope from the south to the north |
| Slope Soil Stratigraphy<br>Top<br>Face<br>Bottom | <br>Top: Glacial Till, Shallow bedrock<br>Face: Silty Clay, Shallow/Exposed bedrock<br>Bottom: Exposed bedrock |
| Water Course Features | None |
| Vegatation Cover | well vegetated (heavy shrubs, forested with young to mature trees) |
| Structures | Multi-Unit Residential Building |
| Erosion Features | None |
| Slope Slide Features<br>Top<br>Face<br>Bottom | <br>Top: Lawn<br>Face: None<br>Bottom: None |

**Geotechnical Information**

A review of available OGSEarth Mapping (Ontario Surficial Geological maps - MRD128) of the area indicates that the site is underlain by till deposits and shallow bedrock.

The subsurface conditions at the site were determined by means of five (5) boreholes and twelve (12) auger holes (labelled as AH1 to AH12 as illustrated on Kollaard Associates Inc. DWG 240798-SLP). Boreholes BH1 to BH5 were advanced in the southwest portion of the site in the proposed multi-unit residential development area. AH1, AH8 and AH9 were advanced at the top of slope, and AH2 to AH5, AH10, and AH11 were advanced on the slope, and AH6, AH7, and AH12 were advanced at the toe of the slope to confirm the soil conditions.

The results of the boreholes indicated that the subsurface conditions in the area of the proposed development consisted of about a 0.5 to 2.0 metre layer of fill materials (crushed gravel and/or yellow brown sand and gravel) overlying glacial till followed by bedrock. Blow counts within the glacial till indicate that it is in a compact to dense state of packing. Practical refusal was encountered in boreholes BH1, BH2, BH3, and BH5 at depths of about 3.4, 2.9, 5.4, and 2.9 metres, respectively, below existing ground surface. Borehole BH3 encountered some water at about 3.0 metres below the existing ground surface. Boreholes BH1, BH2, BH4, and BH5 were dry at the time of drilling, September 14, 2024. The soil and groundwater conditions encountered at the borehole locations, put down September 14, 2024, can be found following the text of this letter.

The results of the auger holes indicate that the subsurface conditions at the site near the slope generally consist of about a 0.05 to 0.30 metre thick layer of topsoil overlying stiff silty clay with trace to some gravel followed by shallow bedrock. Auger hole AH8 indicated a layer of fill materials over stiff clay followed by bedrock. The auger holes at the top of slope were advanced to depths of about 1.10 to 1.65 metres below the ground surface. The auger holes advanced on the slope (AH2 to AH5, AH10, and AH11) were advanced to depths of about 0.05 to 0.75 metres below ground surface. At the time of the site visit April 13, 2025 all the auger holes were dry. The soil and groundwater conditions encountered at the auger hole locations, put down during the site visit, can be found on Table 1: Record of Auger Holes in the Appendix following the text of this letter.

Upon review of available well records in the vicinity of the site, the subgrade is expected to consist of a very stiff clay overburden with depth varying between 3 to 12 feet (0.9 – 3.7 metres) below the ground surface, followed by limestone or slate bedrock. Available well records have been attached in the Appendix B following the text of this letter.

The groundwater conditions described in this letter refer only to those observed at the location and date of observations noted in the letter. Groundwater conditions may vary seasonally, or may be affected by construction activities on or in the vicinity of the site.

Based on the subsurface conditions encountered at the site, it is considered that there are no subsurface conditions that would preclude the construction of a multi-unit residential building in the proposed location.

**Slope Conditions and Assessment**

In general, the topographic survey information and sections indicate that the ground surface on the tableland above the slope in the area of the proposed development is relatively flat. The surficial drainage across the tableland is directed towards the rear of the property and Highway 174. Based on visual observations during the site visit and on the information obtained from the topographic survey, three sections were selected to be representative of the critical slope conditions at the site.

The slope at Section 1 is inclined downward from St. Joseph Boulevard to the toe of the slope at an angle of about 17.4 degrees from horizontal over a height of about 17 metres. The slope at Section 2 is inclined downward from St. Joseph Boulevard to the toe of the slope at an angle of about 19.5 degrees from horizontal over a height of about 18 metres. The slope at Section 3 is inclined downward from St.

Joseph Boulevard to the toe of the slope at an angle of about 17.4 degrees from horizontal over a height of about 16 metres.

The details of the required investigation have been defined based on Table 4.2 (slope stability rating chart) of the MNR's "Technical Guide River & Stream Systems: Erosion Hazard Limit".

*From Table 4-2 –East Slope Section (slope section 1)*

| **Category** | **Criteria** | **Rating** |
|---|---|---|
| 1. Slope Inclination | 18 or less (17.4 degrees) | 0 |
| 2. Soil Stratigraphy | Glacial Till/Clay, silt (Stiff) | 12 |
| 3. Seepage from Slope Face | None or near bottom only | 0 |
| 4. Slope Height | More than 10 m (17m) | 8 |
| 5. Vegetation | Well vegetated; heavy shrubs or forested with mature trees | 0 |
| 6. Table Land Drainage | Minor drainage over slope, no active erosion | 2 |
| 7. Proximity to Watercourse | More than 15 metres from slope toe | 0 |
| 8. Previous Landslide Activity | No | 0 |
| Total | | 22 |
| *No seepage was noted during the visit by Kollaard Associates Inc. | | |
| <24 – Slight potential = Site Inspection only, confirmation, report letter | | |

*From Table 4-2 –East Slope Section (slope section 2)*

| **Category** | **Criteria** | **Rating** |
|---|---|---|
| 1. Slope Inclination | 18 - 26 (19.5 degrees) | 6 |
| 2. Soil Stratigraphy | Glacial Till/Clay, silt (Stiff) | 12 |
| 3. Seepage from Slope Face | None or near bottom only | 0 |
| 4. Slope Height | More than 10 m (18m) | 8 |
| 5. Vegetation | Well vegetated; heavy shrubs or forested with mature trees | 0 |
| 6. Table Land Drainage | Minor drainage over slope, no active erosion | 2 |
| 7. Proximity to Watercourse | More than 15 metres from slope toe | 0 |
| 8. Previous Landslide Activity | No | 0 |
| Total | | 28 |
| *No seepage was noted during the visit by Kollaard Associates Inc. | | |
| 25-36 – Slight potential = Site Inspection only, and surveying, preliminary study, detailed report | | |

*From Table 4-2 –East Slope Section (slope section 3)*

| Category | Criteria | Rating |
|---|---|---|
| 1. Slope Inclination | 18 or less (17.4 degrees) | 0 |
| 2. Soil Stratigraphy | Glacial Till/Clay, silt (Stiff) | 12 |
| 3. Seepage from Slope Face | None or near bottom only | 0 |
| 4. Slope Height | More than 10 m (16m) | 8 |
| 5. Vegetation | Well vegetated; heavy shrubs or forested with mature trees | 0 |
| 6. Table Land Drainage | Minor drainage over slope, no active erosion | 2 |
| 7. Proximity to Watercourse | More than 15 metres from slope toe | 0 |
| 8. Previous Landslide Activity | No | 0 |
| Total | | 22 |
| *No seepage was noted during the visit by Kollaard Associates Inc. | | |
| <24 – Slight potential = Site Inspection only, confirmation, report letter | | |

The following is considered to be a professional assessment of the stability of the slope at the site and is reviewed by the undersigned qualified professional civil and geotechnical engineer.

For the purposes of this slope stability assessment:

*Under Static conditions:*

Slopes with a factor of safety of 1.1 to 1.3 are considered marginally stable, slopes with a factor of safety of greater than 1.3 are considered stable, and slopes with a factor of safety of 1.4 to 1.5 and greater are considered to be adequately stable for dwellings or structures located close to or on the slope.

*Under seismic conditions:*

Slopes with a minimum factor of safety of 1.1 are considered to be stable.

**Soil Strength Parameters**

The soil conditions used in the stability analyses were based, in part, on the results of the boreholes and auger holes advanced across the site. The stability analyses were carried out using parameters for glacial till based on the results of the boreholes completed at the site as well as our experience in the vicinity of the subject site and surficial geology maps of the area. BH1 to BH5 encountered fill materials and glacial till to depths of 1.5 and 5.4 metres below ground surface. Blow counts within the glacial till indicated it is in a compact to dense state of packing. In-situ vane shear testing was attempted (over 100 kpa) within the auger holes, however testing could not be completed as the shear strength of the silty clays encountered were greater than the testing equipment capacity.

The results of the in situ vane shear testing and tactile examination carried out with the auger holes indicate that the silty clay is very stiff in consistency. The soil parameters are also in conformance with the soil parameters provided in the City of Ottawa Slope Stability Guidelines which can be seen below:

| Soil Type | Bulk Unit Weight ($kN/m^3$) | Effective Cohesion (kPa) | Effective Internal Friction Angle (kPa) |
|---|---|---|---|
| Sand | 17 – 21 | 0 | 28 – 40 |
| Weathered Silty Clay Crust | 15.5 – 19 | 0 – 12 | 25 – 38 |
| Grey Silty Clay | 15.5 – 19 | 0 - 12 | 25 – 38 |
| Glacial Till | 19 - 22 | 0 - 3 | 30 – 35 |

The following table summarizes the soil parameters used in the analysis:

Soil Parameters

| Soil Type | Effective Angle of Internal Friction (degrees) | Effective Cohesion (kPa) | Unit Weight $kN/m^3$ |
|---|---|---|---|
| Glacial Till | 33 | 3 | 20 |
| Fill Materials | 30 | 0.5 | 19 |
| Bedrock | Impenetrable | | |

- Soil Strength properties obtained from the City of Ottawa Slope Stability Guidelines Section 4.4

The results of the stability analyses are dependent on the assumed groundwater conditions. As previously indicated, borehole BH3 encountered water at about 3.0 metres below existing ground surface. All other boreholes and auger holes were dry at the time of excavation. As a conservative approach, the slope stability analysis was completed using a ground water level of about 0.5 metres below the ground surface to represent near saturated conditions.

The stability assessment was completed using GeoStudio: Slope/W (2019 R2) slope stability software for both static and seismic conditions. The results of the slope stability assessment for each section under both static and seismic conditions are provided in the Appendix.

Seismic Stability was modelled using a seismic coefficient of k = 0.15 where k is equal to one half of the Peak (horizontal) Ground Acceleration at 2% probability of exceedance in 50 years. A PGA of 0.300 was obtained for the site from the 2015 National Building Code Seismic Hazard Calculation (attached following the text of this letter).

The following table summarizes the minimum factor of safety for each analyzed section:

| Section | Minimum Factor of Safety | | Minimum Setback for Origin of Slip Surface with FS≥1.5 [1] |
|---|---|---|---|
| | Static | Seismic | |
| Section 1 – Predevelopment | 1.90 | 1.35 | none encountered [2] |
| Section 1 – Post development | 1.90 | 1.50 | none encountered [2] |
| Section 2 | 1.39 | 1.05 | 3.3 metres |
| Section 3 | 2.11 | 1.46 | none encountered [2] |

1) The location of the origin of the slip surface with an FS≥ 1.5 defines the point on the slope above which all of the factors of safety originating beyond that point will be greater than 1.5 in normal static conditions.
2) There were no slip surfaces encountered during the modelling of this section where the factor of safety was less than 1.5 during static conditions.

The figures in the Appendix show the minimum factors of safety and the location of the slip surface resulting in the minimum factor of safety. The figures also provide a slip surface colour map. The colour contours indicate the origin and location of every slip surface calculated during the stability modeling that result in a factor of safety within the range indicated by the respective colour. If a colour indicated on the factor of safety colour legend does not appear on the section, the factor of safety either does not occur (the lowest factor of safety is greater than the range indicated by the colour) or is greater than that indicated by the preceding colour shown.

The analysis was completed assuming near saturated slope conditions. Near saturated slope conditions represent a conservative estimation of the groundwater. The near saturated conditions will take into account any seasonal fluctuations in the ground water level. The near saturated conditions will also account for any potential saturated portion of the slope.

The slope stability analysis completed on the critical sections indicated that the slope is stable, having factors of safety greater than 1.5 under static conditions and 1.1 under seismic conditions, except for section 2. There are no conditions at which the defined slope on the property in the area of the proposed development are less than stable. As such, there is no requirement for a stable slope setback and the construction of a multi-unit residential building in the proposed location will have no effect on the stability of the slope.

Any runoff generated during or following the construction of the proposed development should be directed towards the rear portion of the property as per the existing grading conditions. It is noted that concentrated flow should be dispersed along the face of the slope by means of landscaping and appropriately placed vegetation to avoid erosion along the slope faces. It is noted that should erosion occur along the faces of the slopes as a result of concentrated flow, it will not significantly affect the slope stability. It is considered that vegetated areas disturbed during construction should be re-vegetated as soon as reasonably possible.

**Setback Requirements**

For unstable slopes, the distance from the unstable slope to the safe setback line is called the 'Erosion Hazard Limit' (or Limit of Hazard Lands Setback) In accordance with the Ontario Ministry of Natural Resources Technical Guide - River & Stream Systems: Erosion Hazard Limit 2002 [MNR Technical Guide], the Erosion Hazard Limit consists of three components: (1) Toe Erosion Allowance ( applicable when the toe of valley slope is less than or equal to 15m from the water course), (2) Stable Slope Allowance and (3) Erosion Access Allowance as illustrated in the following 115b copied below from the MNR Technical Guide.

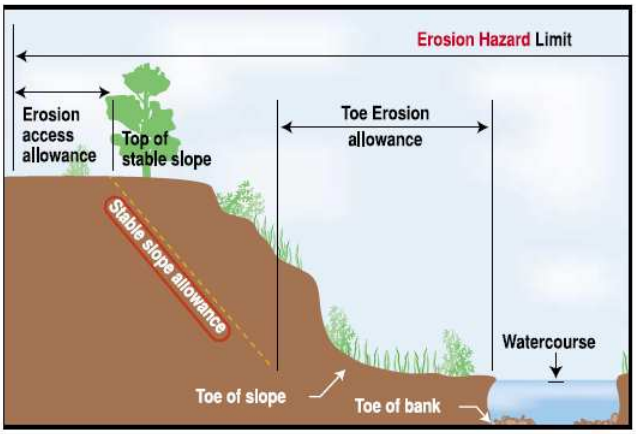



**Figure 115 b - Stable Slope Allowance**
(toe of valley slope ≤15m from watercourse)

Component 1) Toe Erosion Allowance

As previously indicated, the toe of the slope at the site is not within 15 metres of a watercourse. As such, the toe erosion allowance is not applicable for the site.

Component 2) Stable Slope Allowance

The stable slope allowance corresponds to the minimum set back distance such that the minimum factor of safety originating for any slip surface originating at or beyond the setback distance is greater than 1.5 under static conditions and 1.1 under seismic conditions.

The slope stability analysis completed on the sections indicates that the slope can be considered stable having factors of safety of greater than 1.90 under static conditions and greater than 1.50 under seismic conditions. Therefore, there is no stable slope setback.

Component 3) Erosion Access Allowance

The MNR technical Guide suggests that the erosion access allowance for river and stream systems be 6 metres. From the MNR Technical Guide, three main principles support the inclusion of the erosion access allowance:

- Providing for emergency access to erosion prone areas;

- Providing for construction access for regular maintenance and access to the site in the event of an erosion event or failure of a structure;
- Providing protection against unforeseen or predicted external conditions which could have an adverse effect on the natural conditions or processes acting on or within an erosion prone area of provincial interest.

**Erosion Hazard Limit**

Based on the results of the slope stability assessment and the considerations above with respect to the toe erosion allowance and the erosion access allowance at the site, the maximum Erosion Hazard Limit for the site is as follows:

Erosion Hazard Limit = Toe Erosion Allowance + Stable Slope Allowance + Erosion Access Allowance

For slope section 1 – Erosion Hazard Limit = 0 + 0 + 6 = 6 metres from the top of the stable slope.

For slope section 2 – Erosion Hazard Limit = 0 + 3.3 + 6 = 9.3 metres from the top of the stable slope.

For slope section 3 – Erosion Hazard Limit = 0 + 0 + 6 = 6 metres from the top of the stable slope.

A setback distance of 6 to 9.3 metres from the top of the slope has been overlain on Kollaard Associates DWG 240798-SLP. This setback has been based on the scope of work mandated for a slope with slight potential for instability.

**Conclusions / Recommendations**

- It is the professional opinion of the undersigned geotechnical engineer that the slope at the site is stable from a long term perspective and that there are no slope conditions which would prevent the construction of a long term care facility addition at the proposed location.
- The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed development do not materially differ from those given in this letter and that the construction activities do not adversely affect the intent of the design.
- The construction of a long term care facility addition on the site outside of the Limit of Hazard Land Setback will have no detrimental impact to the stability of the slopes at the site.

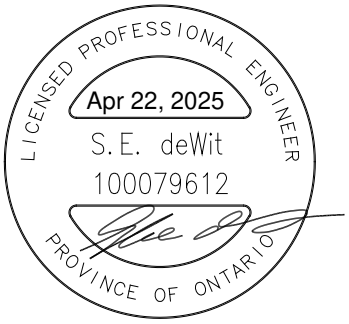
We trust this letter provides sufficient information for your present purposes. If you have any questions concerning this letter please do not hesitate to contact our office.

Best Regards,
Kollaard Associates Inc.

Prepared by:


Isaac Bacon, P.Eng.

Reviewed by:




Steven deWit, P.Eng.

Kollaard Associates
Engineers

# BOREHOLE BH1

**PROJECT:** Proposed Additional Long Term Care Facility
**CLIENT:** Sienna Senior Living
**LOCATION:** 1541 St. Joseph Boulevard, Orleans
**PENETRATION TEST HAMMER:** 63.5 kg, Drop, 0.76m

**PROJECT NUMBER:** 240798
**DATE OF BORING:** 2024-09-12
**SHEET:** 1 of 1
**DATUM:**

| DEPTH SCALE (meters) | SOIL PROFILE: DESCRIPTION | DEPTH (m) | STRATA PLOT | ELEV. (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | UNDIST SHEAR STRENGTH x Cu. kPa x / REM SHEAR STRENGTH o Cu. kPa o (0 20 40 60 80 100) | DYNAMIC CONE PENETRATION TEST blows/300 mm (0 20 40 60 80 100) | MOISTURE CONTENT (%) | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grey crushed stone (FILL) | 0.00 | | 78.11 | | | | | | | |
| 1.0 | | | | | 1 | SS | 78 | | | 3 | |
| | Yellow brown to grey brown silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL) | 1.82 | | 76.29 | 2 | SS | 16 | | | 7 | |
| 2.0 | | | | | | | | | | | |
| | | | | | 3 | SS | 10 | | | 14 | |
| 3.0 | | | | | | | | | | | |
| | | | | | 4 | SS | 62 | | | | |
| | Possibly Weather Shale | 3.27 | | 74.84 | | | | | | | |
| | Practical refusal on bedrock or large boulder | 3.35 | | 74.76 | | | | | | | Borehole dry at time of drilling (Sept 12, 2024) |

**DEPTH SCALE:** 1 to 31.25
**LOGGED:** KH
**BORING METHOD:** Power Auger
**AUGER TYPE:** Hollow Stem
**CHECKED:** SD

Kollaard Associates
Engineers

# BOREHOLE BH2

**PROJECT:** Proposed Additional Long Term Care Facility
**CLIENT:** Sienna Senior Living
**LOCATION:** 1541 St. Joseph Boulevard, Orleans
**PENETRATION TEST HAMMER:** 63.5 kg, Drop, 0.76m

**PROJECT NUMBER:** 240798
**DATE OF BORING:** 2024-09-12
**SHEET:** 1 of 1
**DATUM:**

| DEPTH SCALE (meters) | SOIL PROFILE: DESCRIPTION | DEPTH (m) | STRATA PLOT | ELEV. (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | UNDIST SHEAR STRENGTH x Cu. kPa x / REM SHEAR STRENGTH o Cu. kPa o (0 20 40 60 80 100) | DYNAMIC CONE PENETRATION TEST blows/300 mm (0 20 40 60 80 100) | MOISTURE CONTENT (%) | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grey crushed stone (FILL) | 0.00 | | 78.78 | | | | | | | |
| 1.0 | | | | | 1 | SS | 16 | | | 2 | |
| | | | | | 2 | SS | 18 | | | 7 | |
| 2.0 | Yellow brown to grey brown silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL) | 2.05 | | 76.73 | 3 | SS | 30 | | | 9 | |
| | Practical refusal on bedrock or large boulder | 2.92 | | 75.86 | | | | | | | |

Borehole dry at time of drilling (Sept 12, 2024)

**DEPTH SCALE:** 1 to 31.25
**LOGGED:** KH

**BORING METHOD:** Power Auger
**AUGER TYPE:** Hollow Stem
**CHECKED:** SD

Kollaard Associates
Engineers

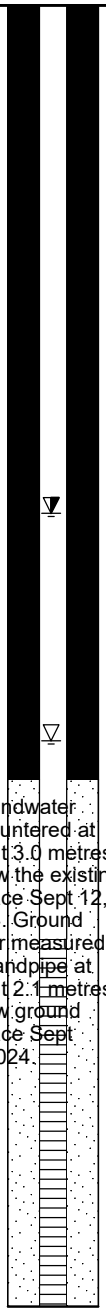
# BOREHOLE BH3

**PROJECT:** Proposed Additional Long Term Care Facility
**CLIENT:** Sienna Senior Living
**LOCATION:** 1541 St. Joseph Boulevard, Orleans
**PENETRATION TEST HAMMER:** 63.5 kg, Drop, 0.76m

**PROJECT NUMBER:** 240798
**DATE OF BORING:** 2024-09-12
**SHEET:** 1 of 1
**DATUM:**

| DEPTH SCALE (meters) | DESCRIPTION | DEPTH (m) | ELEV. (m) | NUMBER | TYPE | BLOWS/0.3m | UNDIST SHEAR STRENGTH x Cu. kPa x / REM SHEAR STRENGTH o Cu. kPa o (0 20 40 60 80 100) | DYNAMIC CONE PENETRATION TEST blows/300 mm (0 20 40 60 80 100) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Grey crushed stone (FILL) | 0.00 | 80.09 | | | | | | |
| | Yellow brown sand and gravel (FILL) | 0.03 | 80.06 | 1 | SS | 10 | | | 5 |
| | Grey brown silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL) | 0.55 | 79.54 | | | | | | |
| 1.0 | | | | 2 | SS | 23 | | | 8 |
| | | | | 3 | SS | 24 | | | |
| 2.0 | | | | 4 | SS | 26 | | | 9 |
| 3.0 | | | | 5 | SS | 25 | | | 10 |
| | Grey silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL) | 3.04 | 77.05 | 6 | SS | 24 | | | 9 |
| 4.0 | | | | 7 | SS | 15 | | | 8 |
| | | | | 8 | SS | 22 | | | 12 |
| 5.0 | | | | 9 | SS | 100 | | | |
| | Practical refusal on bedrock or large boulder | 5.38 | 74.71 | | | | | | 11 |

**PIEZOMETER OR STANDPIPE INSTALLATION**



Groundwater encountered at about 3.0 metres below the existing surface Sept 12, 2024. Ground water measured in standpipe at about 2.1 metres, below ground surface Sept 19,2024.

**DEPTH SCALE:** 1 to 31.25
**LOGGED:** KH

**BORING METHOD:** Power Auger
**AUGER TYPE:** Hollow Stem
**CHECKED:** SD

Kollaard Associates
Engineers

# BOREHOLE BH4

**PROJECT:** Proposed Additional Long Term Care Facility
**CLIENT:** Sienna Senior Living
**LOCATION:** 1541 St. Joseph Boulevard, Orleans
**PENETRATION TEST HAMMER:** 63.5 kg, Drop, 0.76m

**PROJECT NUMBER:** 240798
**DATE OF BORING:** 2024-09-12
**SHEET:** 1 of 1
**DATUM:**

| DEPTH SCALE (meters) | SOIL PROFILE: DESCRIPTION | DEPTH (m) | STRATA PLOT | ELEV. (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | UNDIST SHEAR STRENGTH x Cu. kPa x / REM SHEAR STRENGTH o Cu. kPa o (0 20 40 60 80 100) | DYNAMIC CONE PENETRATION TEST blows/300 mm (0 20 40 60 80 100) | MOISTURE CONTENT (%) | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grey crushed stone (FILL) | 0.00 | | 79.31 | | | | | | | |
| 1.0 | Grey brown silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL) | 0.90 | | 78.41 | 1 | SS | 6 | | | 8 | |
| | | | | | 2 | SS | 100 | | | | |
| | Practical refusal on bedrock or large boulder | 1.52 | | 77.79 | | | | | | 14 | |

Borehole dry at time of drilling (Sept 12, 2024)

**DEPTH SCALE:** 1 to 31.25
**LOGGED:** KH

**BORING METHOD:** Power Auger
**AUGER TYPE:** Hollow Stem
**CHECKED:** SD

Kollaard Associates
Engineers

# BOREHOLE BH5

**PROJECT:** Proposed Additional Long Term Care Facility
**CLIENT:** Sienna Senior Living
**LOCATION:** 1541 St. Joseph Boulevard, Orleans
**PENETRATION TEST HAMMER:** 63.5 kg, Drop, 0.76m

**PROJECT NUMBER:** 240798
**DATE OF BORING:** 2024-09-12
**SHEET:** 1 of 1
**DATUM:**

| DEPTH SCALE (meters) | SOIL PROFILE: DESCRIPTION | DEPTH (m) | STRATA PLOT | ELEV. (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | UNDIST SHEAR STRENGTH x Cu. kPa x / REM SHEAR STRENGTH o Cu. kPa o (0 20 40 60 80 100) | DYNAMIC CONE PENETRATION TEST blows/300 mm (0 20 40 60 80 100) | MOISTURE CONTENT (%) | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yellow brown silty sand, trace gravel, wire and concrete debris (FILL) | 0.00 | | 79.68 | | | | | | | |
| 1.0 | | | | | 1 | SS | 19 | | | | |
| | Yellow brown silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL) | 1.37 | | 78.31 | | | | | | | |
| 2.0 | | | | | 2 | SS | 22 | | | 10 | |
| | | | | | 3 | SS | 25 | | | | |
| | | | | | 4 | SS | 100 | | | | |
| | Practical refusal on bedrock or large boulder | 2.94 | | 76.74 | | | | | | | |

Borehole dry at time of drilling (Sept 12, 2024)

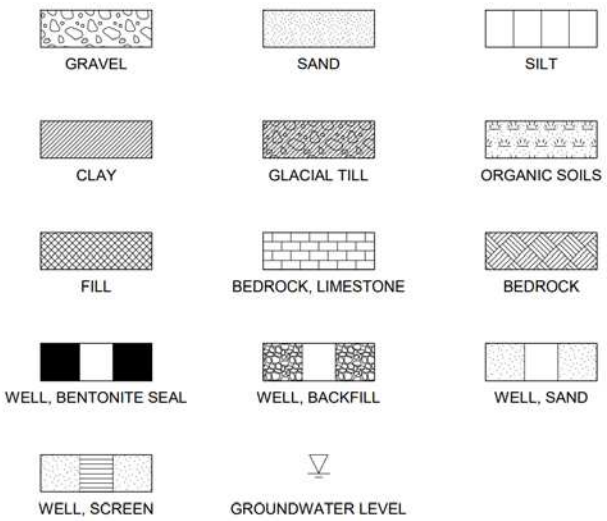
**DEPTH SCALE:** 1 to 31.25
**LOGGED:** KH

**BORING METHOD:** Power Auger
**AUGER TYPE:** Hollow Stem
**CHECKED:** SD

## LIST OF ABBREVIATIONS AND TERMINOLOGY

| SAMPLE TYPES | |
|---|---|
| AS | Auger Sample |
| CS | Chunk Sample |
| DO | Drive Open |
| MS | Manual Sample |
| RC | Rock Core |
| SS | Split Spoon Sample |
| TO | Thin-Walled Open Shelby Tube |
| WS | Wash Sample |

| PENETRATION RESISTANCE | |
|---|---|
| **Standard Penetration Resistance (N)**<br>The number of blows by a 63.5 kg hammer dropped 760 millimeters required to drive a 50 mm drive open sampler for a distance of 300 mm. | |
| **Dynamic Penetration Resistance**<br>The number of blows by a 63.5 kg hammer dropped 760 mm to drive a 50 mm diameter, 60° cone attached to 'A' size drill rods for a distance of 300 mm. | |
| **WH** | Sampler advanced by static weight of hammer and drill rods. |
| **WR** | Sampler advanced by static weight of drill rods. |
| **PH** | Sampler advanced by hydraulic pressure from drill rig. |
| **PM** | Sampler advanced by manual pressure. |




## SOIL DESCRIPTIONS

| Relative Density | 'N' Value |
|---|---|
| Very Loose | 0 – 4 |
| Loose | 4 – 10 |
| Compact | 10 – 30 |
| Dense | 30 – 50 |
| Very Dense | >50 |

| Consistency | Cu, kPa |
|---|---|
| Very Soft | 0 – 12 |
| Soft | 12 – 25 |
| Firm | 25 – 50 |
| Stiff | 50 – 100 |
| Very Stiff | >100 |

| LIST OF COMMON SYMBOLS | |
|---|---|
| Cu | Undrained Shear Strength |
| e | Void Ratio |
| Cc | Compression Index |
| Cv | Coefficient of Consolidation |
| k | Coefficient of Permeability |
| PI | Plasticity Index |
| n | Porosity |
| u | Pore Pressure |
| W | Moisture Content |
| LL | Liquid Limit |
| PL | Plastic Limit |
| r | Unit Weight of Soil |
| y | Unit Weight of Submerged Soil |
| cr | Normal Stress |

| SOIL TESTS | |
|---|---|
| C | Consolidation Test |
| H | Hydrometer Analysis |
| M | Sieve Analysis |
| MH | Sieve and Hydrometer Analysis |
| U | Unconfined Compression Test |
| Q | Undrained Triaxial Test |
| VA | Field Vane, Undisturbed and Remolded Shear Strength |

# APPENDIX A: TABLES AND FIGURES

TABLE I

RECORD OF TEST PITS
1541 ST. JOSEPH OULEVARD, ORLEANS
CITY OF OTTAWA, ONTARIO

| TEST PIT NUMBER | DEPTH (METRES) | DESCRIPTION |
|---|---|---|
| AH1 | 0.00 – 0.30 | TOPSOIL |
| | 0.30 – 1.10 | Stiff red brown SILTY CLAY, trace to some gravel |
| | 1.10 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |
| AH2 | 0.00 – 0.15 | TOPSOIL |
| | 0.15 – 0.50 | Stiff red brown SILTY CLAY, trace to some gravel |
| | 0.50 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |
| AH3 | 0.00 – 020 | TOPSOIL |
| | 0.20 – 0.40 | Stiff red brown SILTY CLAY, trace to some gravel |
| | 0.40 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |

TABLE I (Continued)

| TEST PIT NUMBER | DEPTH (METRES) | DESCRIPTION |
|---|---|---|
| AH4 | 0.00 – 0.20 | TOPSOIL |
| | 0.20 – 0.45 | Stiff red brown SILTY CLAY, trace to some gravel |
| | 0.45 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |
| AH5 | 0.00 – 0.05 | TOPSOIL |
| | 0.05 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |
| AH6 | 0.00 – 0.05 | TOPSOIL |
| | 0.05 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |
| AH7 | 0.00 – 0.15 | TOPSOIL |
| | 0.15 – 0.45 | Stiff red brown SILTY CLAY, trace to some gravel |
| | 0.45 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |

TABLE I (Continued)

| TEST PIT NUMBER | DEPTH (METRES) | DESCRIPTION |
|---|---|---|
| AH8 | 0.00 – 0.10 | Topsoil (FILL) |
| | 0.10 – 1.35 | Yellow brown silty sand (FILL) |
| | 1.35 – 1.50 | TOPSOIL |
| | 1.50 – 1.65 | Stiff grey brown SILTY CLAY, trace to some gravel |
| | 1.65 | Practical refusal on large boulder or bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |
| AH9 | 0.00 – 0.15 | TOPSOIL |
| | 0.15 – 1.15 | Stiff red brown SILTY CLAY, trace to some gravel |
| | 1.15 | Practical refusal on large boulder or bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |
| AH10 | 0.00 – 0.30 | TOPSOIL |
| | 0.30 – 0.75 | Firm red brown SILTY CLAY, trace to some gravel |
| | 0.75 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |

TABLE I (Continued)

| TEST PIT NUMBER | DEPTH (METRES) | DESCRIPTION |
|---|---|---|
| AH11 | 0.00 – 0.25 | TOPSOIL |
| | 0.25 – 1.00 | Stiff grey brown SILTY CLAY, trace to some gravel |
| | 1.00 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |
| AH12 | 0.00 – 0.25 | TOPSOIL |
| | 0.25 | Practical refusal on bedrock |
| Auger hole dry at time of excavation, April 13, 2025. | | |

# 2015 National Building Code Seismic Hazard Calculation

**INFORMATION:** Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

**Site:** 45.460N 75.560W **User File Reference:** 1541 St. Joesph Boulevard, Orleans 2025-04-15 16:21 UT

**Requested by:** Kollaard Associates Inc.

| Probability of exceedance per annum | 0.000404 | 0.001 | 0.0021 | 0.01 |
|---|---|---|---|---|
| Probability of exceedance in 50 years | 2 % | 5 % | 10 % | 40 % |
| Sa (0.05) | 0.483 | 0.268 | 0.161 | 0.047 |
| Sa (0.1) | 0.561 | 0.322 | 0.200 | 0.065 |
| Sa (0.2) | 0.467 | 0.272 | 0.171 | 0.058 |
| Sa (0.3) | 0.353 | 0.207 | 0.131 | 0.045 |
| Sa (0.5) | 0.249 | 0.145 | 0.092 | 0.032 |
| Sa (1.0) | 0.122 | 0.072 | 0.046 | 0.016 |
| Sa (2.0) | 0.058 | 0.034 | 0.021 | 0.006 |
| Sa (5.0) | 0.015 | 0.008 | 0.005 | 0.001 |
| Sa (10.0) | 0.005 | 0.003 | 0.002 | 0.001 |
| PGA (g) | 0.300 | 0.175 | 0.109 | 0.034 |
| PGV (m/s) | 0.206 | 0.116 | 0.071 | 0.022 |

**Notes:** Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 $m/s^2$). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

## References

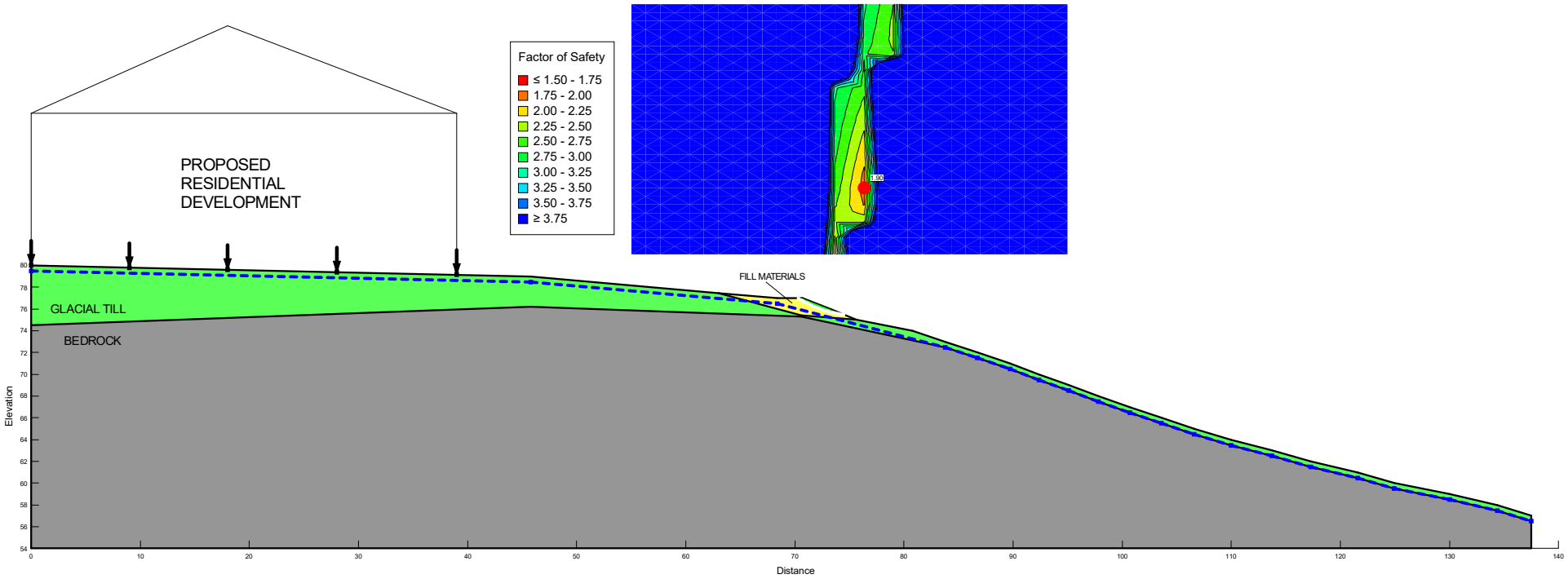
**National Building Code of Canada 2015 NRCC no. 56190;** Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

**Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)**
**Commentary J**: Design for Seismic Effects

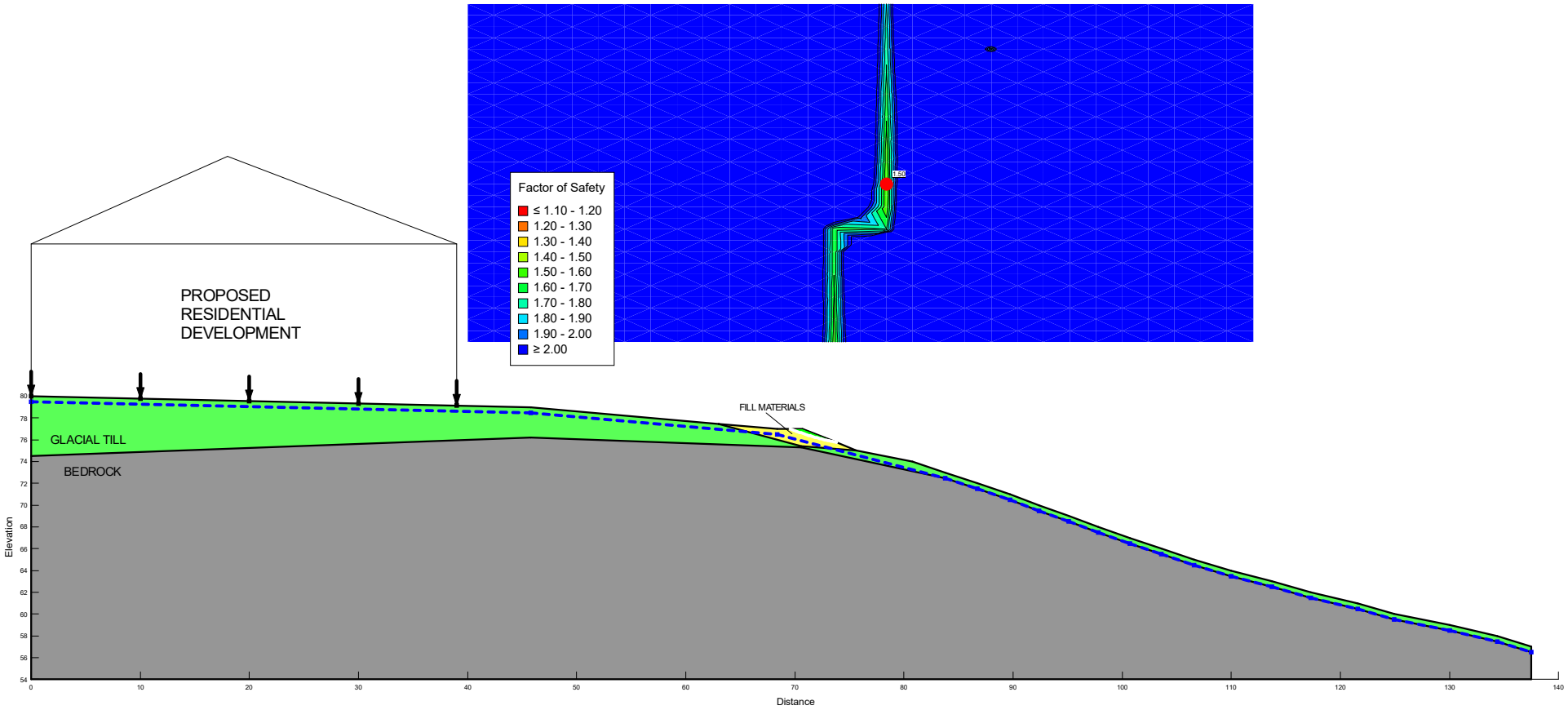
**Geological Survey of Canada Open File 7893** Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

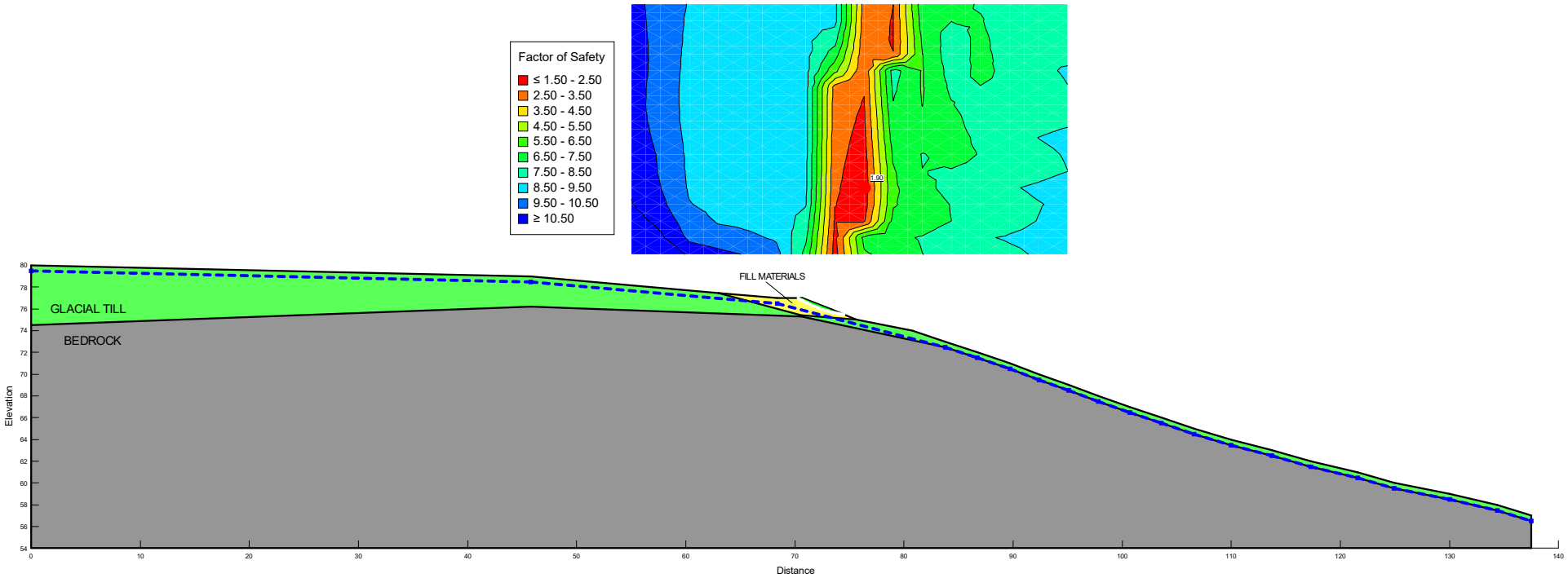
# SLOPE SECTION 1 - POST DEVELOPMENT (STATIC CONDITIONS)



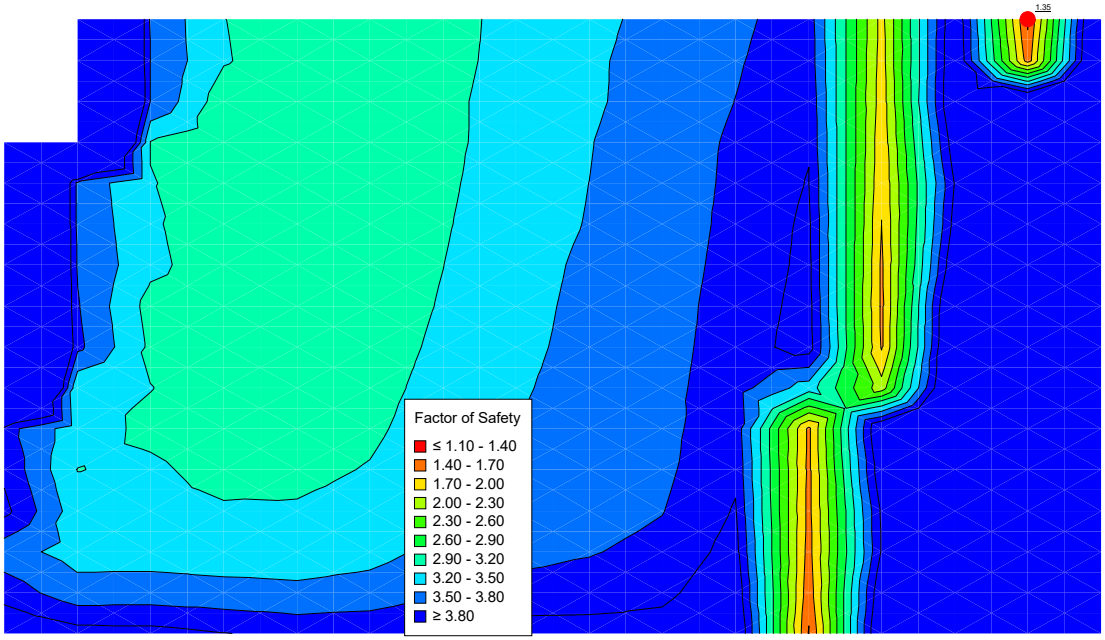
# SLOPE SECTION 1 - POST DEVELOPMENT (SEISMIC CONDITIONS)

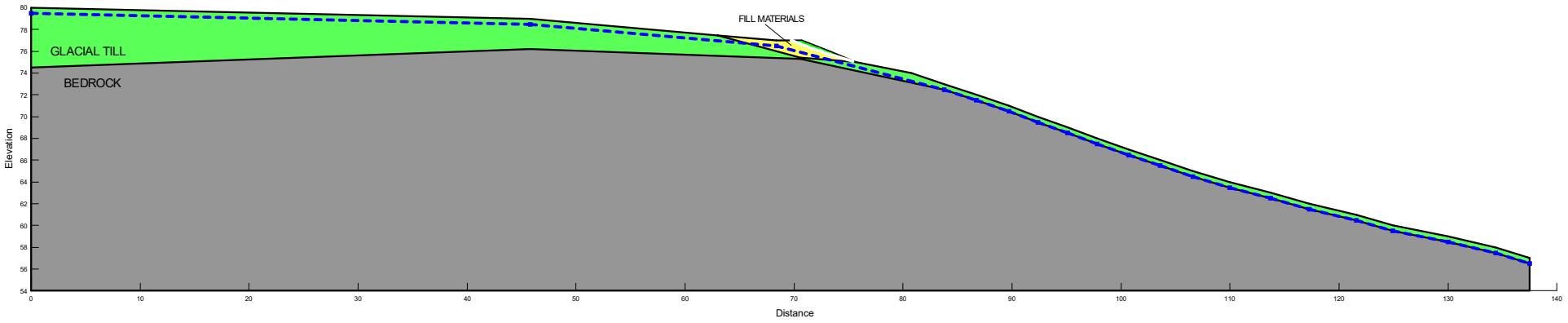


# SLOPE SECTION 1 - PRE DEVELOPMENT (STATIC CONDITIONS)

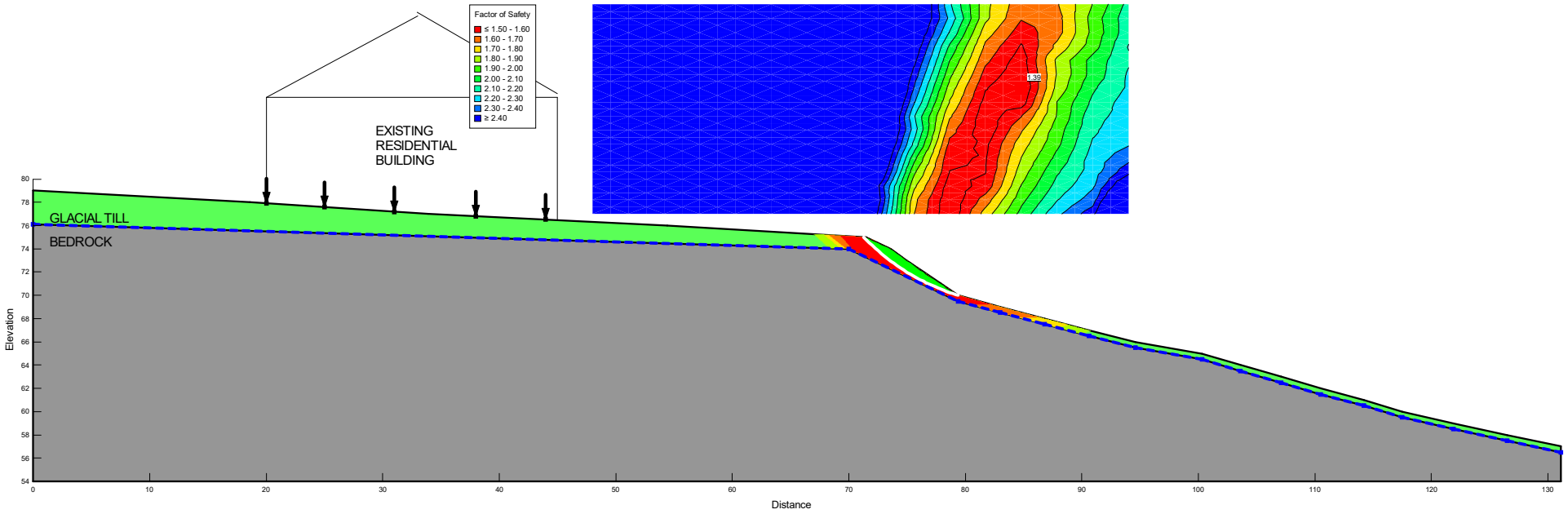


# SLOPE SECTION 1 - PRE DEVELOPMENT (SEISMIC CONDITIONS)

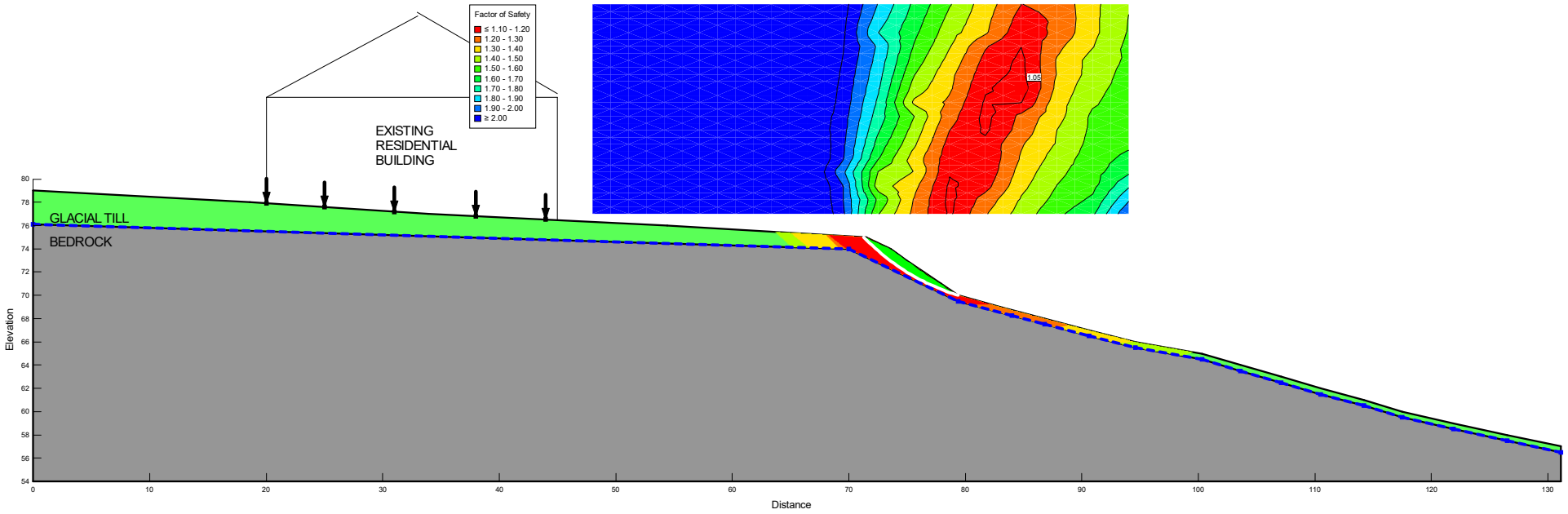


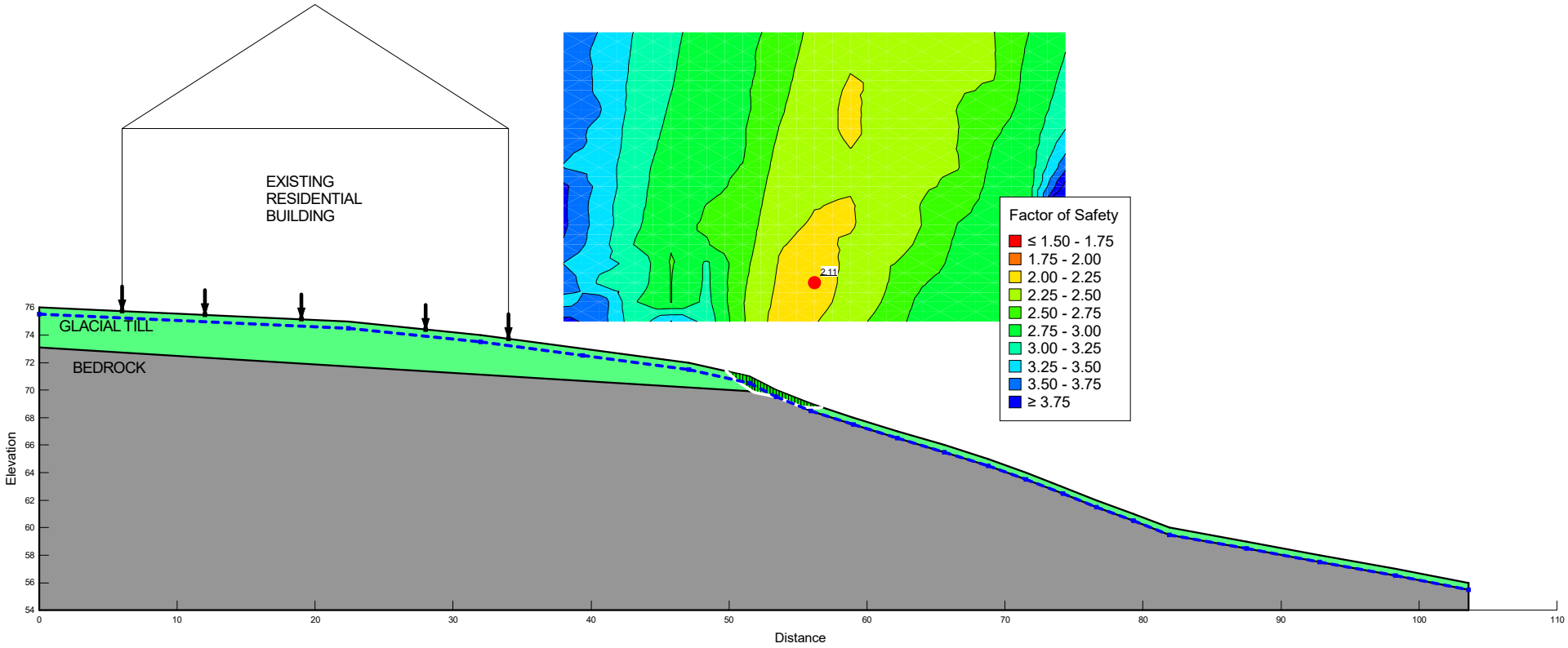
# SLOPE SECTION 2 - STATIC CONDITIONS



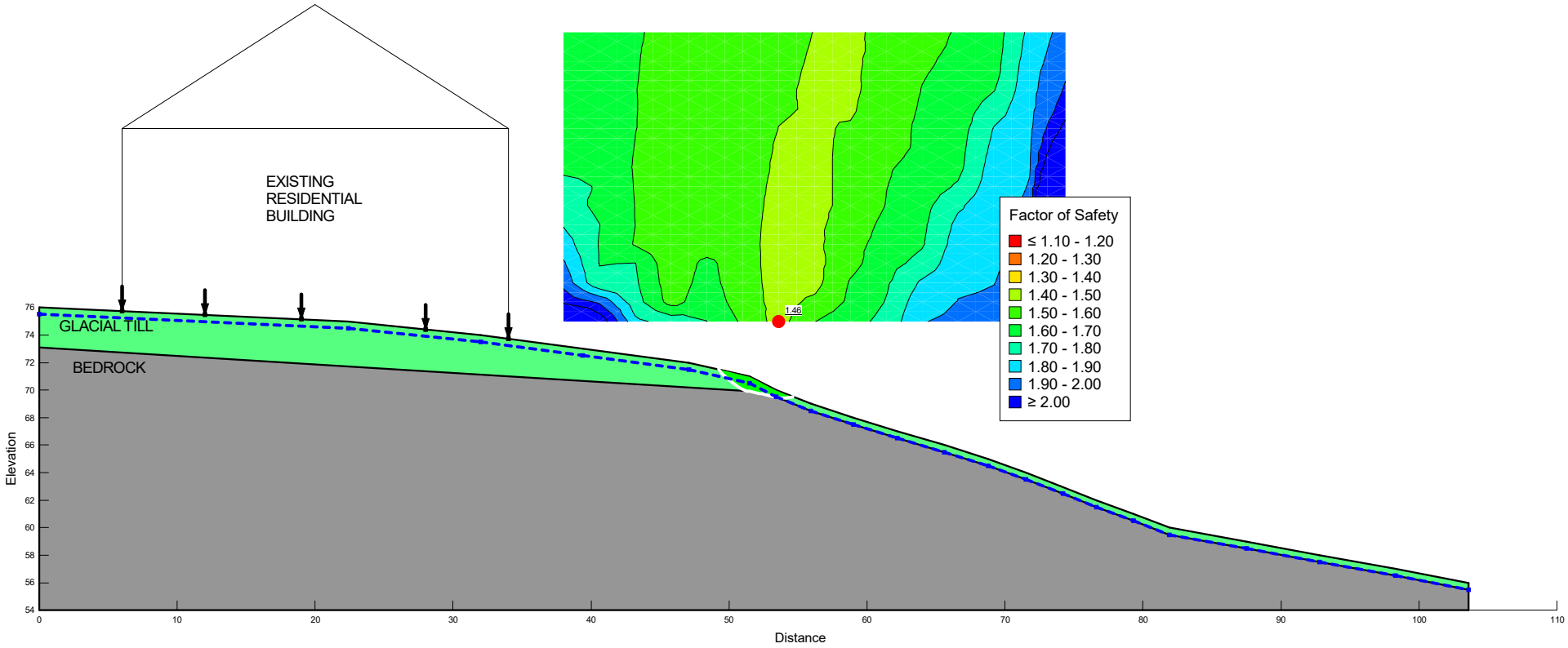
# SLOPE SECTION 2 - SEISMIC CONDITIONS

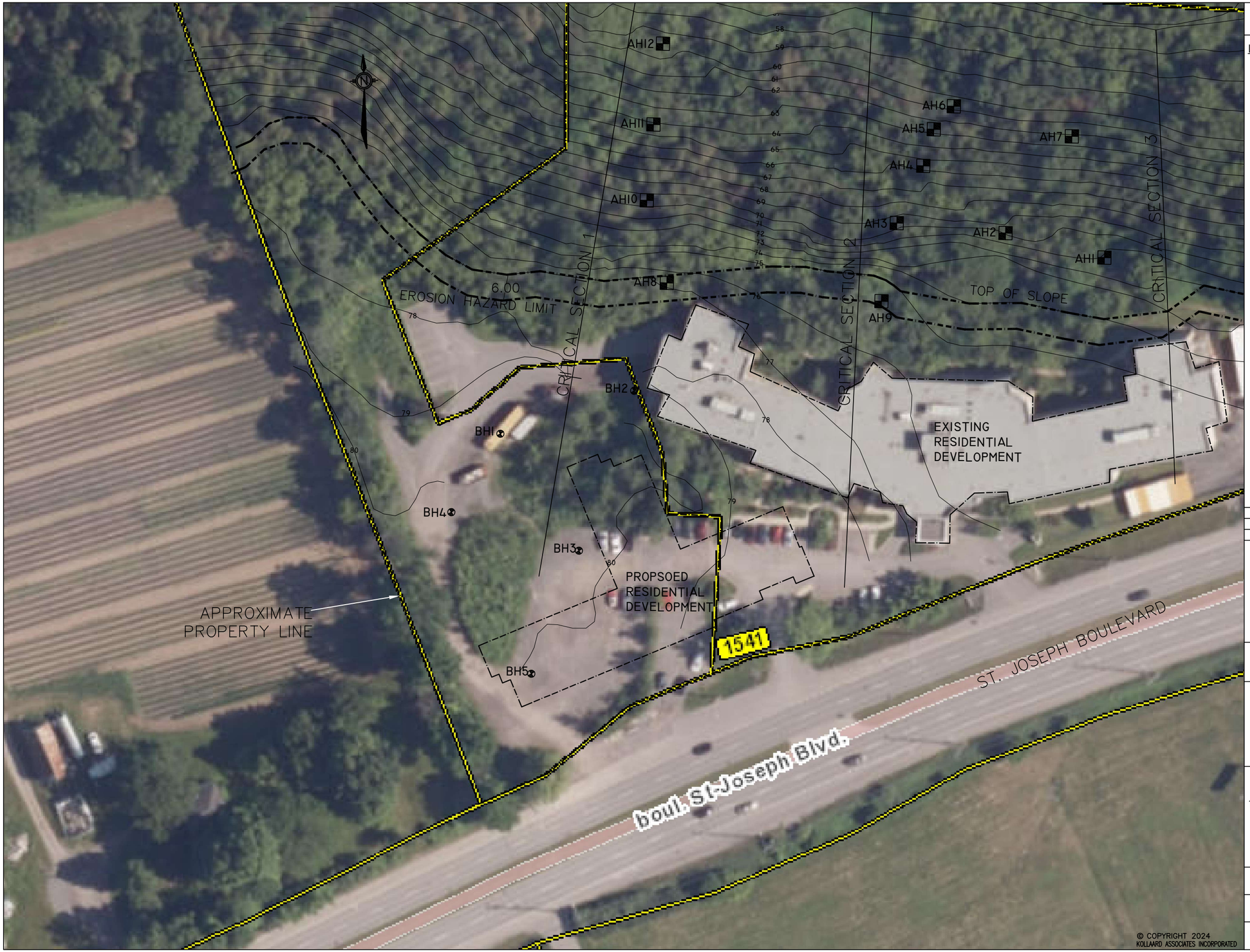


# SLOPE SECTION 3 - STATIC CONDITIONS



# SLOPE SECTION 3 - SEISMIC CONDITIONS






*DRAWING NUMBER:*

# SITE PLAN, FIGURE 2

LEGEND:

BH1 APPROXIMATE BOREHOLE LOCATION

TP1 APPROXIMATE TEST PIT LOCATION

REFERENCE: PLAN SUPPLIED BY CITY OF OTTAWA EMAPS

SPECIAL NOTE: THIS DRAWING TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING REPORT.

| REV. | NAME | DATE | DESCRIPTION |
|---|---|---|---|
| | | | |

Kollaard Associates Engineers

PO, BOX 189, 210 PRESCOTT ST
KEMPTVILLE ONTARIO
K0G 1J0 FAX (613) 258-0475
http://www.kollaard.ca

(613) 860-0923
info@kollaard.ca

*CLIENT:*
SIENNA SENIOR LIVING

*PROJECT:*
GEOTECHNICAL INVESTIGATION FOR PROPOSED ADDITIONAL LONG TERM CARE FACILITY

*LOCATION:*
1541 ST. JOSEPH BOULEVARD, ORLEANS
OTTAWA, ONTARIO

| *DESIGNED BY:* | *DATE:* |
|---|---|
| -- | SEPTEMBER 3, 2024 |
| *DRAWN BY:* | *SCALE:* |
| DT | N.T.S |

*KOLLAARD FILE NUMBER:*
240798

# APPENDIX B: WELL RECORDS

316/5h "A"

UTM | 18 Z | 4516320 E
| 5 R | 5013410 4 15 N
Elev. | 4 R | 02410
Basin | 25 | | |

ONTARIO

RECEIVED
JUL 16 1952
GEOLOGICAL BRANCH
DEPARTMENT of MINES

15 No. 716

The Well Drillers Act
Department of Mines, Province of Ontario

# Water Well Record

County or Territorial District [redacted] Township, ~~Village, Town or City~~ [redacted]
[redacted] own or City) Montreal Rd
[redacted] Montreal Rd
Date Completed ... (day) (month) (year) Cost of Well (excluding pump) ...

## Pipe and Casing Record

Casing diameter(s) 4"
Length(s) of casing(s) 20'
Type of screen
Length of screen
Distance from top of screen to ground level
Is well a gravel-wall type?

## Pumping Test

Date April 9, 1952
Static level 45 feet
Pumping level
Pumping rate 200 gals
Duration of test ½ hr
Distance from cylinder or bowls to ground level

## Water Record

Kind (fresh or mineral) mineral
Quality (hard, soft, contains iron, sulphur, etc.) soft - sulphur & salt
Appearance (clear, cloudy, coloured) clear
For what purpose(s) is the water to be used? domestic
How far is well from possible source of contamination? 50
What is the source of contamination? septic tank
Enclose a copy of any mineral analysis that has been made of water

| Depth(s) to Water Horizon(s) | Kind of Water | No. of Feet Water Rises |
|---|---|---|
| 130 feet | mineral | 85 feet |
| 160 | | |

## Well Log

| Overburden and Bedrock Record | From | To |
|---|---|---|
| | 0 ft. | ....ft. |
| 1 to 80 feet Blue clay | 1 | 80 |
| 80 - 180 feet slate rock B. | 80 | 180 |
| | | |
| | | |
| | | |
| Black soil | 1 | 8 |
| limestone | 8 | 180 |

## Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.


Situation: Is well on upland, in valley, or on hillside? hillside
Drilling Firm Gordon S. Mulligan
Address 488 MacLaren st
Name of Driller Moses Renaud Address 427 Clarence st
Date April 9 Licence Number
Gordon S. Mulligan
Signature of Licensee
for Moses Renaud

FORM 5

CSS.58

31G/5h "A"

UTM 18 Z 415621715 E
5 R 5031405 5 N

Elev. [illegible] R [illegible]

Basin 25

lot 10

ONTARIO

The Water-well Drillers Act, 1954
Department of Mines

RECEIVED
DEC - 6 1955
GEOLOGICAL BRANCH
DEPARTMENT of MINES

No. 718

# Water-Well Record

Carleton

County or Territorial District.....[redacted].....Township, Village, Town or City.....Gloucster.....

[redacted] Village, Town or City).....

Address .....213 Nelson St. Ottawa.....

(day) (month) (year)

## Pipe and Casing Record

Casing diameter(s) .....4"
Length(s) .....14'
Type of screen .....
Length of screen .....

## Pumping Test

Static level .....21'
Pumping rate .....8 Gal P M
Pumping level .....35'
Duration of test .....1 hour

## Well Log

| Overburden and Bedrock Record | From ft. | To ft. | Depth(s) at which water(s) found | No. of feet water rises | Kind of water (fresh, salty, or sulphur) |
|---|---|---|---|---|---|
| Dark Sandy Soil | 0 | 3 | 110' | 89' | fresh |
| Course gray sand | 3 | 12 | | | |
| Fine Black sand | 12 | 14 | | | |
| Lime stone rock | 14 | 110 | | | |

## Water Record

For what purpose(s) is the water to be used?
.....Domestic.....
Is water clear or cloudy?.....clear.....
Is well on upland, in valley, or on hillside?.....
.....upland.....

Drilling firm .....T. H. Adams.....
Address .....Hurdman's Bridge Ontario.....
.....

Name of Driller .....T. H. Adams.....
Address .....
.....

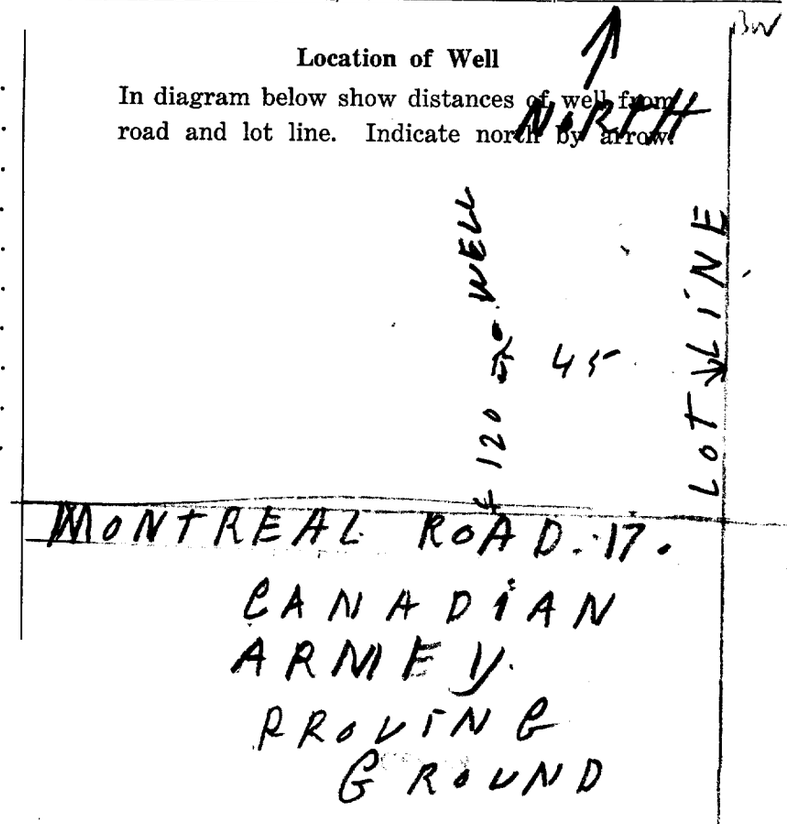
Licence Number.....42.....

I certify that the foregoing statements of fact are true.

Date Dec 2. 55 Thos H Adams
Signature of Licensee

## Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.




Form 5

31G/5h "A"

UTM | 18 | Z | 4 5 6 0 0 5 | E
| 5 | R | 5 0 3 3 9 4 5 | N
Elev. | 4 | R | 0 2 6 1 |
Basin | 2 5 | | |

15 No. 723

The Ontario Water Resources Commission Act, 1957

# WATER WELL RECORD

County or District Carleton — Township, Village, Town or City Gloucester

[redacted] 10 — Date completed 4 (day) Feb. (month) 61 (year)

Address RR No. 1 Orleans, Ont.

## Casing and Screen Record

Inside diameter of casing 6 3/16
Total length of casing 17'
Type of screen
Length of screen
Depth to top of screen
Diameter of finished hole 6"

## Pumping Test

Static level 10'
Test-pumping rate 17 G.P.M.
Pumping level 90'
Duration of test pumping 1 Hour
Water clear or cloudy at end of test Clear
Recommended pumping rate 10 G.P.M.
with pumping level of Jet set at 90'

## Well Log

| Overburden and Bedrock Record | From ft. | To ft. | Depth(s) at which water(s) found | No. of feet water rises | Kind of water (fresh, salty, sulphur) |
|---|---|---|---|---|---|
| Clay Bleu | 0 | 12 | | | |
| Rock Grey limestone | 12 | 230 | 215' | 205' | Fresh |

## Water Record

For what purpose(s) is the water to be used?
Household

Is well on upland, in valley, or on hillside?
Uplands

Drilling Firm J.B. Dufresne & Co. Ltd.

Address 1014 Ma itland Ave. Ottawa Ont.

Licence Number 565

Name of Driller W.. ROY

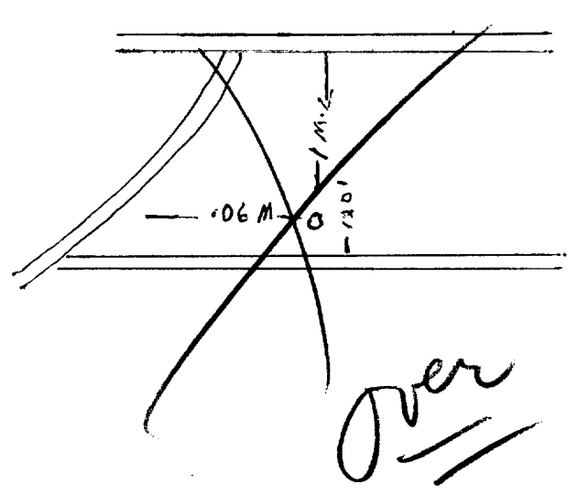
Address Hull

Date 4 Feb. 1961

(Signature of Licensed Drilling Contractor)

## Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.




Over

Form 5

CSS.58