GEI Consultants

Consulting Engineers and Scientists

Slope Stability Study

Tullamore Employment Lands

Mayfield Road & Torbram Road, Caledon, Ontario

Submitted to:
Tullamore Industrial Limited Partnership
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1. Introduction

GEI Consultants Ltd. (GEI) was retained by Tullamore Industrial Limited Partnership (Client) to complete a visual slope inspection, slope stability analysis, and provide a slope stability study delineating the Long Term Stable Top of Slope (LTSTOS) position for the proposed Tullamore Employment Lands development northeast of Mayfield Road and Torbram Road, in Caledon, Ontario. A site location plan is provided as Figure 1.

GEI was provided with the following drawings and report:

- *"Report on Geotechnical Investigation, 0 & 12245 Torbram Road, Caledon, Ontario,"* Report No. 5552-21-GB, dated June 24, 2021, by Toronto Inspection Ltd.
- *"Draft Plan of Subdivision,"* Drawing No. D2, File Number 10208, dated November 26, 2021, by Weston Consulting.
- *"Topographic Plan of Part of Lots 18, 19 and 20, Concession 6, East of Hurontario Street, Part of Lots The Road Allowance between Lots 17 and 18, Concession 6, East of Hurontario Street,"* Project No. 21-B7601, dated July 22, 2021, by Young & Young Surveying Inc.

The overall site has an area of 149.5 ha and is proposed to be primarily developed with industrial land use. The remaining parts of site will consist of space for future development, a stormwater management pond, new stormwater channels, new roadways, and dedicated greenbelt space associated with the west tributary of West Humber River that generally flows through the southwestern quadrant of the site. There are various headwater drainage features and three small, ephemeral watercourses that drain into the east tributary. Based on site observations, site topography, and detailed cross-sections, these ephemeral watercourses are interpreted to be unconfined systems. There are two existing ponds online with the east tributary (upper and lower ponds) that were formed by historically filling the channel to create earth embankment dams, which are failing, eroding, and showing signs of distress. The ponds are drained through culverts beneath the embankment dams.

The site is in the Humber River Watershed, within the jurisdiction of the Toronto and Region Conservation Authority (TRCA). A review of TRCA mapping shows that both the eastern and western tributaries are Regulated Areas. The TRCA requested a slope stability study for the site to determine the Long Term Stable Top of Slope (LTSTOS) position (slope stability setback) as part of the permitting process, per the comments provided in the document, *"Comment Response Matrix,"* Dated January 17, 2022, from the Town of Caledon. This slope stability study provides the results of a visual slope inspection, summarizes the existing borehole information from the site, carries out detailed slope stability analysis, and calculates the LTSTOS for the site. A preliminary assessment of the embankment dams is also provided.

2. Visual Slope Inspections

The site and slopes within the Tullamore Employment Lands were inspected on January 11, 2022, by Bo Hwang, a Senior Field Technician at GEI. The weather was sunny, clear, and cold with an estimated air temperature of -25°C at the time of the inspection. The site is within the jurisdiction of the Toronto and Region Conservation Authority (TRCA) in the Humber River Watershed. Due to the large size and the changing slope conditions within the site, separate slope inspections were conducted for the following areas:

- West Tributary – Northern Slope of the Main Tributary Valley Wall (note: the southern slope of the main western tributary is within the greenbelt and development will not occur on the tableland, so the area was not inspected).
- West Tributary – Southern Slope of the Southern Drainage Feature.
- East Tributary – Southern Slope of the Main Tributary Valley Wall.
- East Tributary – Embankment Dams.

Photographs taken during the inspection are included in Appendix B and photograph and site features plans are provided as Figures 2A and 2B. The field records of the inspection, including the Ministry of Natural Resources (MNR) Slope Rating and Slope Inspection Forms are provided in Appendix F.

2.1 West Tributary – Northern Slope of the Main Valley Wall

The greenbelt area at the site contains a tributary watercourse of the West Humber River (called the west tributary) along with a confined valley system including floodplain areas and a slope extending generally east to west between Torbram Road and Mayfield Road.

The eastern third of this slope (extending from Mayfield Road to the existing barns and structures on the tableland) ranges from about 8 to 10 metres in height with inclinations of 3 horizontal to 1 vertical or flatter. The slope is separated from the watercourse by a floodplain that is greater than 15 metres wide. The slope is lightly vegetated with grasses and some small shrubs and trees. There are more trees along the watercourse. A driveway extends from Mayfield Road to the existing farm house, barns and other structures on the tableland near the slope. There are some localized drainage gullies that extend down the slope near the barns, conveying concentrated runoff down the slope. A weeping tile also outlets partway down the slope in one of the erosion gullies. Otherwise, sheet drainage is expected.

The western two-thirds of this slope (extending from the barns to Torbram Road) ranges from about 6 to 12 metres in height with typical inclinations flatter than 2 horizontal to 1 vertical. There are some localized areas where the slope is as steep as 1.4 horizontal to 1 vertical. The

watercourse is generally adjacent to the slope toe and active erosion was observed along the banks (undercutting, exposed roots, small scarps). There are localized marshy areas in the floodplain. The top of slope consists of farmland, but the slope is generally well vegetated with large trees (vertical to slightly leaning) and some undergrowth. There are two locations west of the barns that appear to be historic drainage features (large, shallow gullies) that likely convey concentrated runoff from the tableland to the north.

Overall, there were no signs of slope instability. Some of the trees were leaning but this is likely from long-term creep of the slope. Active erosion was observed along the watercourse and the drainage gullies on the slope indicate there are areas of concentrated runoff flowing down the slope.

The Rating Value obtained from the MNR Slope Rating Form was 21 for the section of slope between Mayfield Road and the barns (with the wide floodplain), which indicates a low potential for slope instability. The Rating Value obtained from the MNR Slope Rating Form was 43 for the slope between the barns and Torbram Road, which indicates a moderate potential for slope instability.

2.2 Western Tributary – South Drainage Feature

The south drainage feature is located in the west tributary but in the southern corner of the site near the intersection of Torbram Road and Mayfield Road. This is a confined system but it is assumed that it only conveys runoff during or after precipitation and snowmelt events. No flowing water was observed during the inspection but marshy vegetation was observe at the bottom of the slope. The slope height ranges from about 2 to 4 metres and the inclinations are typically 4 horizontal to 1 vertical or flatter. No structures were observed near the slope crest.

The area consists of farmland divided by the drainage feature. A small embankment path bisects the channel to connect the divided farmland, but no culvert was observed beneath the embankment. It is expected sheet drainage will occur into the channel from the surrounding farmland, and there is some evidence of concentrated runoff due to rilling or gullies in localized areas.

The surrounding site and slopes are lightly vegetated with grasses and weeds. Some shrubs were seen along the face of the slopes, with tall grass and some small trees seen within the marshy grounds at the bottom. Based on the borehole findings and visual observations, stratigraphy consists of topsoil underlain by earth fill consisting of reworked sandy silt to clayey silt glacial till, followed by undisturbed glacial till.

No signs of slope instability were observed along the slopes. Some localized rills and gullies were observed from the top extending down the face of the slope due to concentrated runoff.

The Rating Value obtained from the MNR Slope Rating Form was 25, which indicates a slight potential for slope instability.

2.3 East Tributary

The east tributary on site consists primarily of a confined watercourse system with a valley slope. The slope heights typically range from 3 to 5 metres with inclinations of 4 horizontal to 1 vertical or flatter. There are two artificial ponds (upper and lower) created by historically filling the channel to create earth embankment dams (more details on the dams in Section 2.4). The ponds are online with the tributary. Flowing water was not observed within the eastern tributary during the inspection but the channel between the ponds contained marshy vegetation and the ponds were surrounded by marshy vegetation. The slopes were vegetated with grasses, shrubs and some trees.

There are two ephemeral watercourses near the headwaters of the tributary that drain into the northern pond. There is another smaller drainage feature that outlets into the lower pond. Based on visual observations, these drainage features are unconfined systems as there is not a discernable slope crest position and the topography is gradual / undulating. No water or defined watercourse channel was observed within the drainage features but they contained marshy vegetation throughout.

The tableland typically contains farmland within the property limits, but there is an industrial development on the opposite side of the east tributary on an adjacent property.

It is expected that some sheet drainage will runoff into the east tributary but it is mainly fed by runoff from the intermittent drainage features. No signs of localized, concentrated runoff were observed along the slope crest and no active erosion at the bottom of the slope was observed. No signs of slope instability were observed along the southern slope of the east tributary.

The Rating Value obtained from the MNR Slope Rating Form was 27 for the southern slope of the east tributary, which indicates a slight potential for slope instability.

2.4 Embankment Dams

There are two existing ponds online with the east tributary (upper and lower ponds) that were formed by historically filling the channel to create earth embankment dams. The upper embankment dam is about 3.5 to 4.5 metres in height with side slope inclinations of 3.5 horizontal to 1 vertical or flatter. The lower embankment dam is about 4 to 4.5 metres in height with side slope inclinations of typically 2.5 horizontal to 1 vertical or flatter, but there is a localized area near the culvert inlet with inclinations of 1.1 horizontal to 1 vertical due to erosion. The embankment dams are failing, eroding, and showing signs of distress.

The ponds are drained through culverts that extend beneath the dams. The culvert inlet at the upper pond is partially damaged or destroyed and the exact inlet location / configuration is unknown. Broken sections of CSP culverts are scattered near the assumed inlet location, along with some boulders and a metal tank. Erosion is occurring around the culvert inlet, and slope failures are occurring up to the embankment crest (slumping / sloughing of soil from the exposed face). It is possible the culvert was partially exposed due to piping erosion from water flowing along the outside of the culvert within the berm. The CSP culvert outlets into the tributary on the south side of the embankment dam, and erosion scarps and slumping were observed surrounding the outlet.

There is also significant erosion at the culvert inlet for the southern embankment dam. The erosion has resulted in slope failures including slumping and sloughing of soil from the over-steepened slope face. A broken piece of CSP culvert and a pile of boulders are located at the assumed inlet location, however the culvert was not observed extending beneath the embankment. The assumed outlet location is eroding and the actual CSP was not observed.

The embankments are vegetated mostly with grass but sporadically contain some small trees and shrubs. Concrete and metal debris were observed along the face of the slope of the northern dam, with metal debris along the slope of the southern dam.

It is understood that seepage was observed from the downstream slope of the embankments by GEI staff during previous site inspections, which indicates water also seeps through the embankment (not just through the culverts).

3. Subsurface Conditions

3.1 General Overview

Toronto Inspection advanced thirty-eight (38) boreholes across the site as part of a geotechnical investigation at the site in 2021. Fourteen (14) of the boreholes were advanced near the slopes under investigation, including 21BH-1 to 21BH-5, 21BH-7 to 21BH-10, 21BH-17, 21BH-33, and 21BH-36.

The detailed soil profiles encountered in the boreholes are indicated on the attached borehole logs from Toronto Inspection (2021) in Appendix A. The borehole logs were provided within a geotechnical engineering report signed and stamped by a Professional Engineer, and GEI has relied on the boreholes as factual information.

The borehole locations are shown on Figures 3A and 3B. Interpreted subsurface stratigraphy is also shown on the subsurface profiles included as Figures XS1 to XS26. It should be noted that the conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the borehole locations. It should be noted that the soil boundaries indicated on the borehole logs and cross sections are inferred from non-continuous or continuous (but disturbed) sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

3.2 Stratigraphy

3.2.1 Topsoil and Earth Fill

Boreholes 21BH-1 to 21BH-5, 21BH-7 to 21BH-10, 21BH-17, 21BH-33, and 21BH-36 to 21BH-38 encountered approximately 10 to 300 mm of topsoil or compost at the ground surface.

Underlying the topsoil or compost, all boreholes encountered a zone of earth fill consisting of clayey silt to sandy silt (reworked glacial till), with some rootlets and topsoil, trace to some gravel and trace to some sand. Pockets of organics were encountered from 4.5 to 6.0 metres below grade in 21BH-8. The earth fill typically extended to depths of approximately 0.4 to 1.0 metres below grade (Elev. 232.4 to 242.8 metres), but extended to 3.1 metres below grade (Elev. 236.9 metres) in 21BH-37 and extended beyond the depth of investigation at 6.5 metres below grade (Elev. 231.8 metres) in 21BH-8, which was drilled through the embankment dam at the upper pond. The earth fill was typically brown and moist. The Standard Penetration Test (SPT) results ("N" Values) ranged from 3 to 29 blows per 300 mm of penetration, indicating a very loose to compact (but typically loose) relative density, or a soft to very stiff consistency.

3.2.2 Native Soils

Underlying the earth fill, Boreholes 21BH-1 to 21BH-5, 21BH-7, 21BH-17 and 21BH-33 encountered native deposits with a cohesive matrix consisting of clayey silt to clayey silt glacial till, with trace to some sand and trace to some gravel. Occasional sand seams were noted in the deposits. The clayey silt to clayey silt glacial till deposits extended to a depth of approximately 5.8 metres below grade (Elev. 232.7 metres) in 21BH-33 and extended beyond the vertical depth of investigation in the other boreholes at 6.5 metres below grade (Elev. 226.4 to 233.6 metres). The SPT "N" Values measured in the cohesive deposits ranged from 10 to 35 blows per 300 mm of penetration, indicating a stiff to hard consistency. The cohesive deposits were moist and brown, turning grey with depth.

Underlying the earth fill in Boreholes 21BH-9, 21BH-10, and 21BH-36 to 21BH-38, and underlying the clayey silt glacial till in 21BH-33 at 5.8 metres below grade (Elev. 232.7 metres), deposits of glacial till were encountered with a mostly cohesionless matrix consisting of sandy silt, some clay to clayey, and trace to some gravel. The sandy silt glacial till was brown and moist, turning grey with depth. The deposits extended beyond the vertical depth of exploration at 6.2 to 6.5 metres below grade (Elev. 231.9 to 236.8 metres). SPT "N" Values measured in the sandy silt glacial till ranged from 11 to greater than 50 blows per 300 mm of penetration, indicating a compact to very dense (but generally compact to dense) relative density.

3.3 Groundwater

Toronto Inspection Boreholes 21BH-2, 21BH-3, 21BH-7, 21BH-10, 21BH-33, 21BH-36 and 21BH-37 were instrumented with monitoring wells with 3-metre-long screens, as shown in the borehole logs in Appendix A. The diameter of the wells is unknown. The results summarized below are taken from the most recent measurements provided in the report, *"Preliminary, Hydrogeological Investigation, Tullamore Lands, 0 & 12245 Torbram Road, Caledon, Ontario,"* Report No. 5552-21-HC, dated June 30, 2021, by Toronto Inspection Ltd.

Monitoring Well Location	Depth / Elev. (m) of Well Screen Location	Strata Screened	Depth / Elev. (m) of Groundwater Level on June 14, 2021
21BH-2	3.1 to 6.1 / 229.9 to 226.9	Clayey Silt Glacial Till	5.36 / 227.63
21BH-3	3.1 to 6.1 / 232.5 to 229.4	Clayey Silt Glacial Till	Dry
21BH-7	3.1 to 6.1 / 237.1 to 234.1	Clayey Silt Glacial Till	4.52 / 235.65
21BH-10	3.1 to 6.1 / 240.3 to 237.3	Sandy Silt Glacial Till	3.19 / 240.19
21BH-33	3.1 to 6.1 / 235.4 to 232.4	Clayey Silt to Sandy Silt Glacial Till	2.46 / 236.02

Monitoring Well Location	Depth / Elev. (m) of Well Screen Location	Strata Screened	Depth / Elev. (m) of Groundwater Level on June 14, 2021
21BH-36	3.1 to 6.1 / 239.2 to 236.1	Sandy Silt Glacial Till	4.58 / 237.64
21BH-37	3.1 to 6.1 / 237.1 to 234.0	Sandy Silt Glacial Till	5.61 / 234.52

Based on the above groundwater measurements from Toronto Inspection, the groundwater table is approximately 2.5 metres below grade or deeper across the site (as measured from the tableland areas).

It is typical for groundwater to loosely mimic the topography of the ground surface of a slope before daylighting as base flow into a watercourse at or beyond the bottom of the slope. The slope stability models in Appendices C and D reflect this assumption.

Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions.

4. Slope Stability Analysis

4.1 Slope Stability Setbacks and Policies

The Toronto and Region Conservation Authority (TRCA) provides policy requirements and technical guidance for developments within slope and erosion hazard zones based on the following documents:

- *"The Living City Policies for Planning and Development in the Watersheds of the Toronto and Region Conservation Authority,"* by TRCA, dated November 28, 2014.
- *"Technical Guide on River and Stream Systems: Erosion Hazard Limit,"* by the Ministry of Natural Resources (MNR), dated 2002.

The subject tributaries are within mapped TRCA Regulated Areas and are therefore subject to these policy guidelines. Included in these policy guidelines are setbacks in which all new development must be set behind. The following allowances are applicable for the confined valley systems at the site:

- Toe Erosion Allowance: This setback is an estimate of the distance the toe of slope will move over the next 100 years. This can be based on a site-specific fluvial geomorphology study, average annual recession rate based on 25 years of data or based on set values provided by the MNR depending on the soil type encountered. If the watercourse is greater than 15 metres away from the slope toe, no toe erosion allowance is required.
- Stable Slope Allowance: This setback is associated with determining the inclination of the slope that achieves a minimum factor of safety of 1.5. In some cases, the existing slope inclination may meet this minimum requirement. In lieu of detailed geotechnical engineering analysis, a conservative estimate for the stable slope inclination of 3H : 1V can typically be applied.
- Erosion Access Allowance: An additional 6 metre setback (for ancillary structures) or 10 metre setback (for buildings) is applied to allow for emergency access, routine maintenance of the slope and potential erosion areas, and to create an additional buffer between the development and the potential erosion hazard. The TRCA may allow for a reduction of this access allowance on a case-by-case basis.

The toe erosion allowance and stable slope allowance combine to form the Long Term Stable Top of Slope (LTSTOS). When the LTSTOS is combined with the erosion access allowance, this total setback line is the Erosion Hazard Limit from which all new development or redevelopment must be set behind, per TRCA guidelines. The above setbacks are applicable to sites where there is a confined valley system, and an LTSTOS model is shown on Figure 5.

These policies are not applicable for unconfined systems, where the Erosion Hazard Limit is defined by the meander belt allowance or flooding hazard limit, plus the erosion access allowance (beyond the scope of work in this report).

4.2 Soil Strength Design Parameters

Soil strength parameters for the soil strata were determined by GEI based on the Toronto Inspection 2021 borehole findings, published information, empirical correlations relating Standard Penetration Test (SPT) results ("N" Values) with soil type, unit weight and friction angle, and our experience on other slope evaluation projects in the area.

The site is underlain by typically 0.5 to 1.0 metres of earth fill, followed by compact to dense sandy silt glacial till deposits or stiff to hard clayey silt to clayey silt glacial till deposits. The values used in the slope stability analysis for this project are summarized below.

Stratum	γ - Bulk Unit Weight (kN/m^3)	Φ - Friction Angle (degrees)	c' – Effective Cohesion (kPa)
Earth Fill	19.0	29	0
Sandy Silt Glacial Till (Compact to Dense)	20.0	33	2
Clayey Silt to Clayey Silt Glacial Till (Very Stiff to Hard)	19.5	30	5

The soil strength parameters are also indicated on the results of the slope stability analysis within Appendices C to E. The soil strength parameters are based on effective stress analysis for long-term slope stability, and are likely conservative values. Furthermore, other effects which can increase the stability of the slope, such as negative pore water pressures within unsaturated soils (matric suction), and root mat reinforcement, have not been modelled. No existing retaining walls or toe erosion protection measures were encountered at the site.

4.3 Slope Geometry, Material Boundaries and Groundwater

GEI was provided with the following topographic plan of the site, which included 0.25 metre contour spacing: *"Topographic Plan of Part of Lots 18, 19 and 20, Concession 6, East of Hurontario Street, Part of Lots The Road Allowance between Lots 17 and 18, Concession 6, East of Hurontario Street,"* Project No. 21-B7601, dated July 22, 2021, by Young & Young Surveying Inc.

To assess the stability of the existing slopes at the site, twenty-six (26) cross-sections were created, typically from areas that were considered more critical (e.g. steepest portions of the

slope) using the survey. The cross-section locations are shown on Figures 3A and 3B and the detailed slope profiles are included as Figures XS1 to XS26.

An AutoCAD file was received from TRCA with the staked top of slope for the northern valley wall of the west tributary and for parts of the southern valley wall for the east tributary. The staked top of slope line is shown as a solid purple line in the enclosed figures. GEI notes that in some locations (e.g. between Cross-Sections 4 to 7), the staked top of slope position provided from TRCA in the CAD file appears to extend partially over the top of slope location that would be established based on the topographic plan and profile views.

The top of slope positions for the confined valley slopes were established by GEI along the southern drainage feature in the western tributary, and along additional sections of the eastern tributary for slope analysis purposes based on interpretation of the slope profiles and on-site observations in relation to the methodology as described in TRCA's field staking protocol. This protocol states that the top of slope should be determined by "*the point where there is a break in slope or grade which distinguishes the valley corridor landform from its surrounding landscape*", and "*based on … professional judgment and can generally be described as the first main point of inflection or start of downward valley slope as observed from the adjacent tableland and does not include plateaus within the valley corridor with secondary points of inflection*". It must be noted that only TRCA Planning and Development staff can stake the physical top of slope that must be used by others for future planning and development purposes. The top of slope position established by GEI is shown with a dashed magenta line on the enclosed figures.

Cross-Sections 21 and 23 to 26 were cut through the unassessed drainage feature extending west from the lower pond, and through the ephemeral watercourses extending west to northwest from the upper pond. No flowing water was observed in these features during the visual inspection, and a neither a distinct / defined top of slope position nor a bankfull width / channel were observed on site or from the topographic plan or cross-sections. These gently rolling and undulating features near the headwaters of the tributary are considered to be unconfined systems, where there is no discernable top of slope or bank. Slope stability analysis is not required for the unconfined systems per the MNR provincial technical guideline and TRCA's *Living City Policies*. Cross-Sections 21 and 23 to 26 are appended to illustrate the gently rolling / undulating nature of the ephemeral watercourses or drainage features with average inclinations of 11 to 14 horizontal to 1 vertical.

The slope and embankment dam stratigraphy were determined based on the 2021 Toronto Inspection borehole results as discussed in Section 3.2. The groundwater was modelled in the analysis to reflect the conditions discussed in Section 3.3.

4.4 Slope Stability Analysis for Existing Conditions

Stability analysis was carried out using the commercially available computer program *Slide2* (Version 9.020) by RocScience Inc. The slope stability analysis was based on a force and moment limit equilibrium analysis using the Spencer method. This method of analysis calculates the minimum factor of safety (resisting versus driving forces) for numerous circular surfaces. The circular surfaces are centered on points on a grid with a set number of radius distances to be calculated for each centre. A factor of safety of 1.0 indicates the slope is at a point of pending failure since the resisting forces are equal to the driving forces.

Slope stability analysis was performed on various cross-sections and calculated the existing factor of safety (FOS) for the section using existing slope geometry, stratigraphy and groundwater conditions. The results are included in Appendix C and are summarized in the table below:

Location on Site	Cross-Section	Approximate Slope Height (m)	Maximum Existing Slope Inclination (Horizontal to Vertical)	Minimum Factor of Safety (FOS) for Existing Conditions
West Tributary, South Slope of Southern Drainage Feature	1	4	4.0:1	3.2
	2	2.2	5.2:1	4.5
	3	3.1	4.8:1	3.9
North Slope of West Tributary Valley Wall	4	11.5	4.3:1	3.4
	5	10.5	3.7:1	2.4
	6	8.6	1.9:1	1.6
	7	6.0	1.4:1	1.3
	8	10.5	6.6:1	4.5
	9	10.2	7.6:1	4.7
	10	9.5	3.4:1	2.4
	11	8.4	2.9:1	2.3
	12	7.8	4.2:1	2.5
	13	9.0	4.2:1	2.6
	14	9.1	4.1:1	2.4
South Slope of East Tributary Valley Wall	15	4.5	5.6:1	4.1
	18	4.0	4.1:1	3.2
	19	3.0	4.0:1	3.5
	22	3.5	6.2:1	3.8

The minimum factor of safety (FOS) calculated for existing slopes across the site were typically greater than 2. The average inclination of the slopes was typically 3 horizontal to 1 vertical or flatter. The analysis is consistent with the conditions observed during the visual slope inspection; no signs of historic or recent slope instability were observed.

An exception is an approximately 100-metre-long section of the west tributary northern slope near Sections 6 and 7, where the watercourse is typically adjacent to the bottom of the slope, and the slope has inclinations as steep as 1.4 horizontal to 1 vertical. The existing FOS is this area ranged from 1.3 to 1.6.

Although the existing FOS of the slopes are typically greater than 1.5, a toe erosion allowance must be considered for long-term setbacks when a watercourse is within 15 metres of the slope toe as discussed below.

4.5 Long Term Stable Top of Slope Determination

The method used to determine the Long Term Stable Top of Slope (LTSTOS) is discussed in Section 4.1 and follows the *Living City Policies* (TRCA, 2014) and the MNR technical guideline.

4.5.1 Toe Erosion Allowance

The toe erosion allowance is a horizontal distance typically measured out from the bankfull width of a watercourse, existing water level of the watercourse, or bottom of the watercourse channel as deemed appropriate based on site specific conditions. The toe erosion allowance applied is based on numerous considerations such as: proximity of the watercourse to the slope toe, the presence of existing erosion, average and peak velocity within the watercourse, susceptibility of the soils at the slope toe to erosion, extent of vegetation, fluvial geomorphological processes, etc. Due to the varied and complex nature of determining toe erosion, multiple simplified methods are available for determining this toe erosion allowance, including:

- Using a value of 15 metres if no information is available;
- Use of an average annual recession rate based on a minimum of 25 years data, and extrapolated to a 100-year planning horizon;
- A fluvial geomorphological study based on a minimum of 25 years of record;
- Use of the table "*Determination of Toe Erosion Allowance*" provided within MNR technical guidelines (2002) as provided below.

For the purposes of determining the toe erosion allowance at this site, the MNR table provided below was used:

Minimum Toe Erosion Allowance – River within 15 Metres of Slope Toe				
Native Soil Structure at Slope Toe	**Evidence of Active Erosion or Bankfull Flow Velocity > Competent Flow Velocity**	**No evidence of Active Erosion or Flow Velocity << Competent Flow Velocity, Bankfull Width**		
		< 5 metres	**5 to 30 metres**	**> 30 metres**
Hard Rock	0 to 2 metres	0 metres	0 metres	1 metre
Soft Rock or Cobbles/Boulders	2 to 5 metres	0 metres	1 metre	3 metres
Stiff to Hard Cohesive Soil, Coarse Granulars or Glacial Tills	5 to 8 metres	1 metre	2 metres	4 metres
Soft/Firm Cohesive Soil, Fine Granular or Fill	8 to 15 metres	1 to 2 metres	5 metres	7 metres

The boreholes results suggest that the slope toe will consist of compact to dense or very stiff to hard glacial till deposits. The toe erosion allowances selected for the three different confined valley systems at the site are summarized in the following table:

Confined Valley System Location	**Soil Structure at Slope Toe**	**Active Toe Erosion Observed?**	**Estimated Bankfull Width (m)**	**Selected Toe Erosion Allowance (m)**
West Tributary, South Slope of Southern Drainage Feature	Clayey Silt to Sandy Silt Glacial Till (Compact to Dense / Very Stiff to Hard)	No	5 to 30	2
North Slope of West Tributary Valley Wall		Yes	N/A	5
South Slope of East Tributary Valley Wall		No	5 to > 30	4

The toe erosion allowance was applied from the edge of the watercourse for the eastern and western tributary slopes, and from the estimated bankfull width in the southern drainage feature which does not contain a permanent watercourse.

4.5.2 Stable Slope Inclination

It is noted that MNR guidelines allow a factor of safety between 1.3 to 1.5 for active land use (e.g. commercial and industrial buildings), which is applicable to this site. The minimum factors of safety recommended for design by the MNR are summarized below.

Land Uses	Design Minimum Factor of Safety
Passive: no buildings near slope; farm field, bush, forest, timberland, woods, wasteland, badlands, tundra.	1.10
Light: no habitable structures near slope; recreational parks, golf courses, buried small utilities, tile beds, barns, garages, swimming pools, sheds, satellite dishes, dog houses.	1.20 to 1.30
Active: habitable or occupied structures near slope; residential, commercial, and industrial buildings, retaining walls, storage/warehousing of non-hazardous substances.	1.30 to 1.50
Infrastructure and Public Use: public use structures or buildings (i.e. hospitals, schools, stadiums), cemeteries, bridges, high voltage power transmission lines, towers, storage/warehousing of hazardous materials, waste management areas.	1.40 to 1.50

TRCA policy guidelines require a factor of safety (FOS) of 1.5 for new developments, and therefore an FOS of 1.5 is applicable for the stable slope inclination at this site.

The existing FOS at Section 7 was 1.3, but the existing FOS for all other sections was greater than 1.5. Where a watercourse is within 15 metres of the slope toe, the toe erosion allowance must be considered. A toe erosion allowance is not required for Sections 11 to 14 as the existing floodplain is wider than 15 metres.

Trial slope models were created which decreased the slope inclination by increments of 0.1H:1V until a minimum FOS of 1.5 was obtained, after the toe erosion allowance was applied. A minimum factor of safety of 1.5 is achieved in the compact to dense sandy silt glacial till and the very stiff to hard clayey silt / clayey silt glacial till deposits with a stable slope inclination of 1.9 horizontal to 1 vertical. Example *Slide2* trial models from Sections 5, 6, 7, 18 and 19 are included in Appendix D illustrating the stable slope inclination of 1.9H:1V achieves a minimum factor of safety of 1.5 after the toe erosion allowance is applied.

Where applicable, the stable slope inclinations are shown on Figures XS1 to XS26. It is noted that apart from Sections 6 and 7, the toe erosion allowance has a negligible impact on the slopes because the existing inclinations are typically 3 horizontal to 1 vertical or flatter.

4.5.3 Long-Term Stable Top of Slope Position

The Long Term Stable Top of Slope (LTSTOS) position for a factor of safety (FOS) of 1.5 is determined by the combination of both the stable slope inclination of the slope profile that achieves the requisite minimum factor of safety, combined with the toe erosion allowance. A schematic sketch visually illustrating how the LTSTOS is determined is provided as Figure 5.

Based on the detailed slope stability analysis, the LTSTOS for an FOS of 1.5 coincides with the existing top of slope (as established by GEI in some locations and staked by TRCA in other locations) for the slopes included within the study area with only one minor exception. The LTSTOS is shown in plan view on Figures 3A and 3B, and in profile view on Figures XS1 to XS26 (where applicable). Between Cross-Sections 6 and 7, the TRCA staked top of bank provided in the CAD file appears to extend partially over the upper slope face. The LTSTOS will extend back to the assumed top of slope position in this area as shown on Figure 3A.

The average inclination of the slopes was typically 3 horizontal to 1 vertical or flatter. Even with the toe erosion allowance, the stable slope inclination has a negligible impact on most of the slopes due to the gentle existing slope inclinations (refer to the enclosed Cross-Sections). Sections 6 and 7 have steeper existing inclinations and active erosion at the toe of the slope, but the LTSTOS does not extend beyond the existing top of slope as staked by TRCA (see Figures XS6 and XS7).

The LTSTOS positions described above are applicable only for the location of the cross-sections. Interpolation of the LTSTOS positions for the remaining areas of the study area was completed based on engineering judgement to address a variety of factors including (but not limited to): location of top of slope, slope inclination and height, structures present, nearby analysis, erosion scarps, etc. The LTSTOS mostly coincides with the existing top of slope across the site, with the exception of the slope between Sections 6 and 7 previously discussed.

It should be noted that the LTSTOS is related to riverine erosion and slope stability processes. The LTSTOS does not account for gully erosion caused by concentrated runoff from the tableland flowing down the slope, which can change over time based on grading or drainage patterns of the tableland. Site grading and stormwater control must be carried out to ensure concentrated runoff will not flow uncontrolled down the slopes after the site has been developed. In addition, the LTSTOS does not apply in unconfined systems that exist to the west of the East Tributary as previously noted.

4.5.4 Erosion Access Allowance

TRCA guidelines require that new developments be setback an additional 10 metres (for commercial or industrial buildings, etc.) from the LTSTOS position. The erosion access allowance is a regulatory setback and not a technically derived setback like the toe erosion allowance and stable slope allowance. As the erosion access allowance is not a technically derived setback, it has not been included on Figures 3A and 3B.

4.6 General Considerations for Construction Near Slopes

For any work conducted in near proximity to the valley slopes, the following recommendations should be followed during construction:

- Construction and restoration activities should be conducted in a manner which does not result in surface erosion of the slope;
- Site grading and drainage should be designed to prevent direct concentrated or channelized surface runoff from flowing directly over the slope;
- Water drainage from down-spouts, sumps, road drainage, and the like should not be permitted to flow over the slope, but be directed towards stormwater sewers or extended down the slope to areas where the erosive energy can be dissipated (e.g. rip-rap splash pads);
- A healthy vegetative cover should be maintained on the slope. Any slope areas disturbed by construction should be restored with suitable native vegetation as soon as possible;
- The slope should not be further steepened and fill materials (including landscape debris, soil, stone slabs, etc.) should not be placed on the slope or within 3 metres of the slope crest.; and
- A sedimentation control fence (silt fence) should be erected around work areas prior to the commencement of site works.

4.7 Embankment Dam Geotechnical Analysis

There are two existing ponds online with the east tributary (upper and lower ponds) that were formed by historically filling the channel to create earth embankment dams. The embankment dams are failing, eroding, and showing signs of distress. The ponds are drained through culverts beneath the embankment dams. Erosion is occurring at the inlets and outlets of the culverts and the culverts are typically damaged or broken. The extent of culvert damage or internal piping erosion is unknown. Seepage was observed from the downstream slope of the embankments by GEI staff during previous site inspections, which indicates water is also seeping through the embankment (not just through the culverts).

4.7.1 Policy and Technical Guidelines

The *Lakes and Rivers Improvement Act* (LRIA) provides the Minister of Natural Resources and Forestry (MNRF) with the legislative authority to govern the design, construction, operation, maintenance and safety of dams in Ontario.

The LRIA defines a dam as *"…a structure or work forwarding, holding back or diverting water and includes a dam, tailings dam, dike, diversion, channel alteration, artificial channel,*

culvert or causeway." The two embankments are holding water within the upper and lower ponds and are considered to be embankment dams as defined in the LRIA. There are various technical bulletins available from MNRF that govern the design, construction, operation, decommissioning, etc. of dams under the LRIA, including *"Geotechnical Design and Factors of Safety, Technical Bulletin,"* dated August 2011.

This technical bulletin provides direction and design guidance on the geotechnical engineering factors of safety for design of dams under the LRIA. The guidelines require stability analysis to be assessed under the following six (6) loading conditions:

- Long-term conditions – steady-state seepage, maximum normal reservoir water level, upstream and downstream faces;
- End of construction – before filling the reservoir, upstream and downstream faces;
- Inflow design flood (IDF) – inflow flooded reservoir level, steady-state phreatic surfaces through the dam, upstream and downstream faces;
- Earthquake (pseudo-static) loading – Maximum Design Earthquake (MDE), maximum normal reservoir water level, long-term steady state phreatic surfaces through the dam, upstream and downstream faces.
- Post earthquake loading, upstream and downstream faces.
- Full rapid drawdown from the maximum normal reservoir water level, upstream face.

The design factors of safety for these loading conditions are summarized in the table below:

Loading Condition	Minimum Factor of Safety	Slope	Was Loading Condition Analysed in This Report?
End of construction before reservoir filling	1.3	Upstream and Downstream	No [1]
Long-term (steady state seepage, normal reservoir level)	1.5	Upstream and Downstream	Yes
IDF loading condition	1.3	Upstream and Downstream	No [2]
Full or partial rapid drawdown	1.2 to 1.3	Upstream	No [2]
Pseudo-static	> 1.0	Upstream and Downstream	Yes
Post earthquake	1.1	Upstream and Downstream	No [3]

1. The embankments are already constructed, so the end of construction condition does not apply at this site.
2. Inflow design floods for the ponds are unknown, so the IDF and rapid drawdown conditions were not analyzed.
3. Post-earthquake condition not included in the preliminary assessment.

GEI carried out a preliminary assessment on the geotechnical stability of the embankment dams to provide preliminary commentary if the dams are suitable to remain in place. Long-term conditions with steady-state seepage and pseudo-static loading were checked for this preliminary assessment.

4.7.2 Preliminary Stability Analysis

The seismic (pseudo-static) loading condition, or Maximum Design Earthquake (MDE) required for the site was determined following, *"Seismic Hazard Criteria, Assessment and Considerations, Technical Bulletin,"* dated August 2011, by Ontario Ministry of Natural Resources. The dams were assumed to have a "low" Hazard Potential Classification, and therefore must use the 500-year earthquake design ground motion for the MDE loading in the stability analysis. This is equivalent to a 0.002 per annum probability of exceedance. The assumed Hazard Potential Classification must be confirmed by a civil engineer, water resources engineer, or dam design engineer.

Natural Resources Canada has online seismic design tools for engineers, including a seismic hazard value calculator from the 2015 National Building Code of Canada. The calculator determines the seismic hazard values based on user-defined latitude and longitude. The peak ground acceleration (PGA) appropriate for the site is 0.033g based on a 0.002 per annum probability of exceedance.

Toronto Inspection advanced a borehole through the upper berm in 2021 during their geotechnical investigation at the site. Borehole 21BH-8 encountered clayey silt to sandy silt earth fill (reworked glacial till) that extended beyond the depth of investigation at 6.5 metres below grade. Trace rootlets, gravel and topsoil were encountered in the fill, and organic pockets were noted at 4.5 and 6.0 metres below grade. The borehole encountered a 19 mm diameter pipe about 2.3 metres below grade, which yielded free-flowing water (potentially a weeping tile). It is assumed that the lower embankment dam consists entirely of earth fill (reworked glacial till), consistent with the upper dam though no borehole was specifically advanced within this dam.

The side slopes of the lower and upper embankment dams typically ranged from 2.9 to 4.0 horizontal to 2 vertical, as shown on Cross-Sections 17 and 20 that were cut through the lower and upper dams, respectively. There is a portion of the lower dam that is over-steepened at the upstream face due to erosion at the culvert inlet, with an inclination of 1.1 horizontal to 1 vertical as shown on Cross-Section 16. Active slope failures (slumping / sloughing of soil from the exposed face) were observed near the culvert inlets of both dams during the visual inspection.

The table below summarizes the results of the analysis for the two loading cases at the upper embankment dam, and the models are included in Appendix E:

Upper Pond Embankment Dam - Preliminary Slope Stability Analysis Results

Loading Condition	Minimum Factor of Safety Required per MNRF Guidelines	Cross-Section Location	Minimum Calculated Factor of Safety for Embankment		Meets Guidelines?
			Upstream	Downstream	
Long-Term (steady state seepage, normal reservoir level)	1.5	20	2.2	1.9	See notes [1,2]
Pseudo-Static Loading	Greater than 1.0		1.9	1.7	See notes [1,2]

1. Based on the assumption that the current pond level is the normal operating level.
2. Erosion and localized slope failures observed on site, therefore considered to not meet the guidelines.

Although the analysis shows the upper embankment dam exceeds the required FOS for the two loading cases, the dam is eroding and there are localized slope failures that are not reflected in the topographic information available for the cross-sections. Based on this, the upper embankment dam does not meet the guidelines as the factor of safety will be less than 1.0 in the localized areas.

The table below summarizes the results of the analysis for the two loading cases at the lower embankment dam, and the models are included in Appendix E:

Lower Pond Embankment Dam - Preliminary Slope Stability Analysis Results

Loading Condition	Minimum Factor of Safety Required per MNRF Guidelines	Cross-Section Location	Minimum Calculated Factor of Safety for Embankment		Meets Guidelines?
			Upstream	Downstream	
Long-Term (steady state seepage, normal reservoir level)	1.5	16	0.7	N/A	**No**
		17	1.8	1.9	Yes[1]
Pseudo-Static Loading	Greater than 1.0	17	1.6	1.7	Yes[1]

1. Based on the assumption that the current pond level is the normal operating level.

The lower pond does not meet the MNRF design factors of safety for the two loading conditions.

It must also be noted that only two of the six geotechnical loading conditions were assessed based on the information available at this time, to provide a preliminary assessment and commentary. Additional boreholes must be advanced through the embankments, and the civil or water resources engineer must provide the normal operating levels and the inflow design floods for both ponds for detailed geotechnical analysis to be completed. However, both embankment dams are failing and do not meet the MNRF geotechnical design factors of safety based on the two loading conditions reviewed.

4.7.3 Preliminary Commentary

The scope of work did not include a comprehensive review and detailed inspection of the dams which would be completed by others. There are additional factors included in earthen dam design such as bearing, erosion control (e.g. piping), operating levels, flood control / outflow structures, and dam material composition that are not evaluated in this report. High-level commentary is provided below:

- It is expected that the embankment dams were not designed by an engineer or constructed following MNRF guidelines or industry standards. This includes the design and installation of the culverts (e.g. were they sized appropriately, do they have adequate bedding or anti-seepage collars, etc.).
- The embankments are showing signs of distress and are eroding / failing in some locations (see Cross-Section 16 at the lower dam and the photos of the culvert inlets and outlets at both locations).
- The dams do not meet MNRF geotechnical design guidelines for two loading cases.
- No clay core was encountered in 21BH-8 advanced through the upper embankment. Impermeable lining was not observed on the upstream face of the ponds. This increases the risk of long-term piping erosion caused by seepage through the embankment. Signs of seepage were observed by GEI staff on the downstream face of the dams during previous field visits.
- Based on visual observations, the culverts beneath the dams are damaged or destroyed. The extent of damage is unknown, but it is expected there is an increased risk of piping erosion underneath the entire embankment.

The owner of the property should be aware of the potential liabilities related to owning, operating and maintaining the embankment dams in their current state. The risk to the public and environment downstream of the embankment dams must not be overlooked. It is strongly recommended that additional work be carried out such as a detailed dam inspections, dam safety reviews and dam break analysis to determine potential impacts and risk of dam failure to the public and environment downstream. Additional boreholes must be drilled through the embankments if detailed geotechnical analysis will be completed following MNRF guidelines. The normal operating levels and inflow design floods must also be determined by the civil or

water resources engineer. It is understood that drainage patterns may change at the site as part of the proposed development, and the potential increased flows into the ponds and their effect onto the embankment dams must be analyzed.

5. Limitations and Conclusions

5.1 Limitations

The recommendations and comments provided are necessarily on-going as new information of underground conditions becomes available. The analysis was completed using boreholes advanced at the site in 2021 by Toronto Inspection Ltd. The borehole logs were provided within a geotechnical engineering report signed and stamped by a Professional Engineer, and GEI has relied on the boreholes as factual information. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, conditions not observed during the investigation may become apparent. Should this occur, GEI Consultants should be contacted to assess the situation and additional testing and reporting may be required.

GEI Consultants should be retained for a general review of the final design drawings and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, GEI Consultants will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was prepared by GEI Consultants for the account of Tullamore Industrial Limited Partnership. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. GEI Consultants accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

5.2 Conclusion

It is recognized that municipal/regional governing bodies, in their capacity as the planning and building authority under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both as are expressed and implied.

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to contact our office.

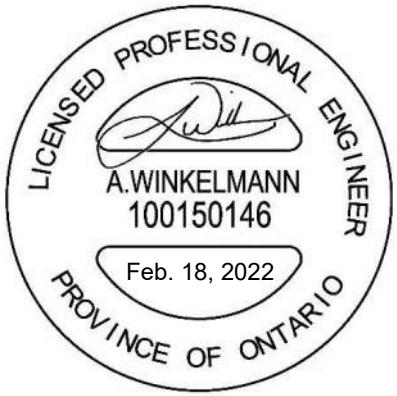
Yours Truly,

GEI Consultants

Prepared By:

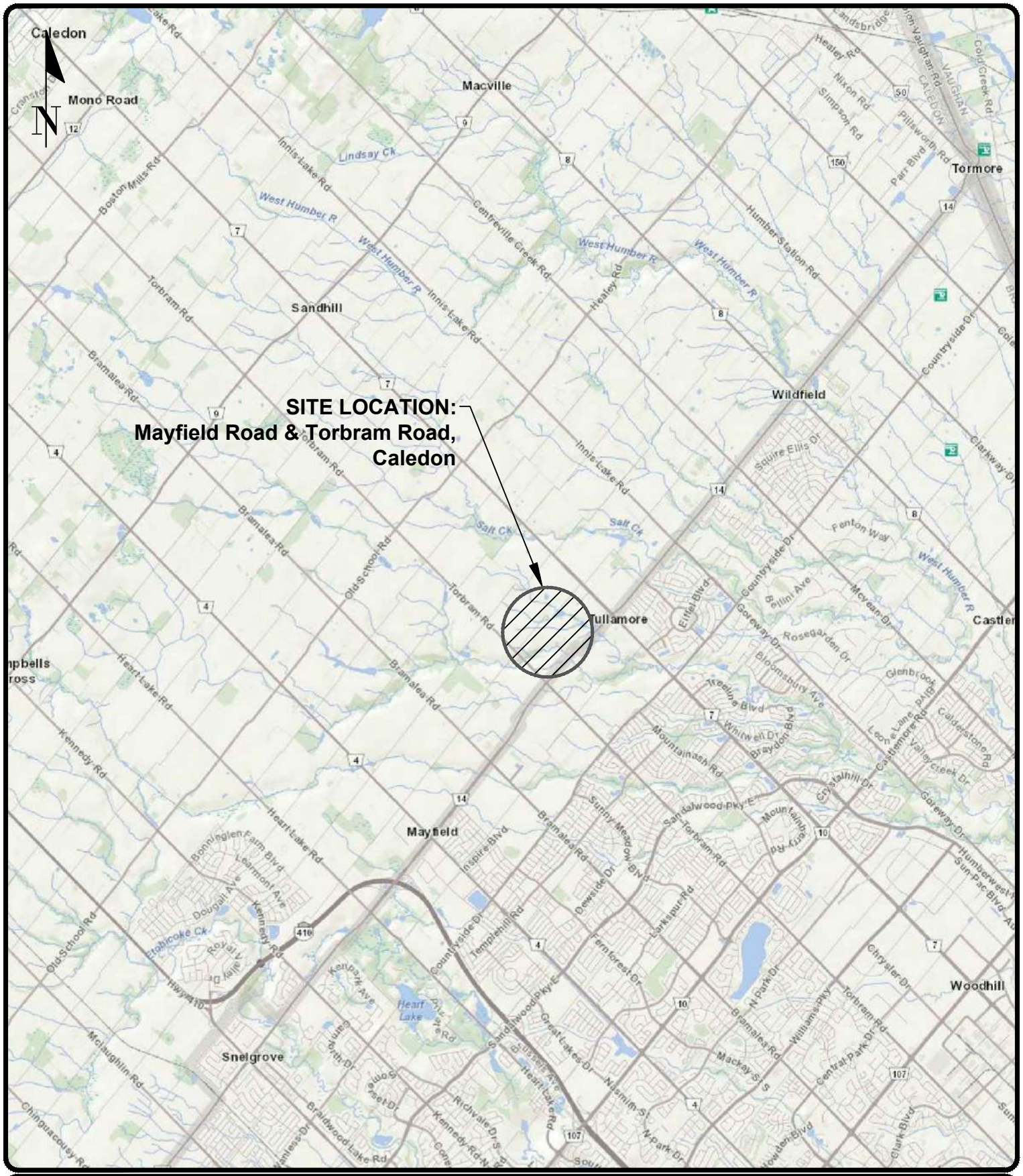
Russell Wiginton, P.Eng.
Senior Geotechnical Engineer

Reviewed By:



Alexander Winkelmann, P.Eng.
Geotechnical and Earth Sciences Manager

Figures

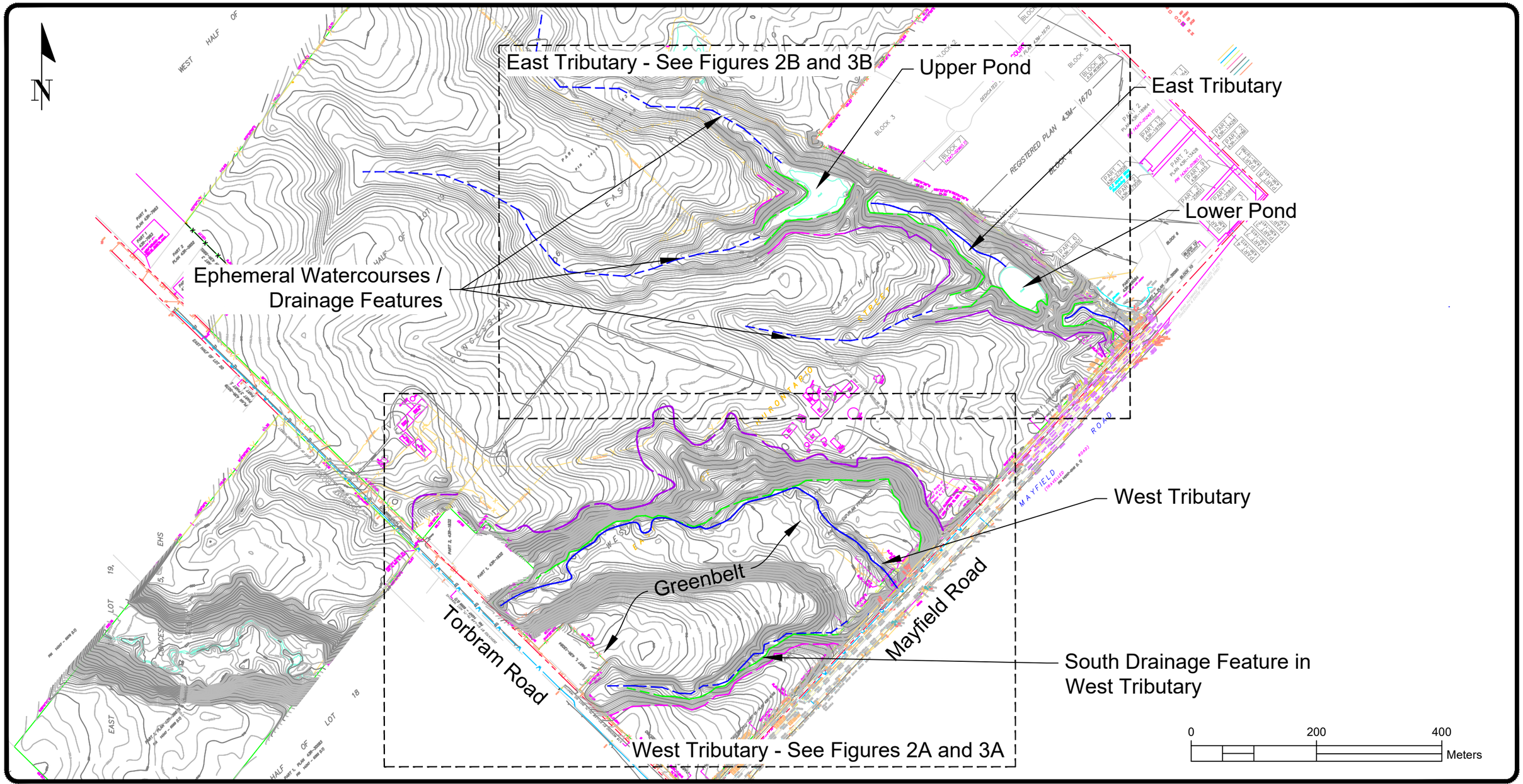


GEI Consultants

647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project:	Tullamore Employment Lands
Title:	Site Location Plan

Approved by:	A.W.	Date:	February 2022	Project No.:	2100975
Drawn by:	R.W.	Scale:	N.T.S	Figure No.:	1A



Legend:

- Bottom of Slope
- Top of Slope (Staked by TRCA)
- Top of Slope (Est. by GEI)
- Approx. C/L of Watercourse
- Approx. C/L of Intermittent Drainage Feature

Reference:
21-B7601_TOPO 2021-07-22.dwg
"Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
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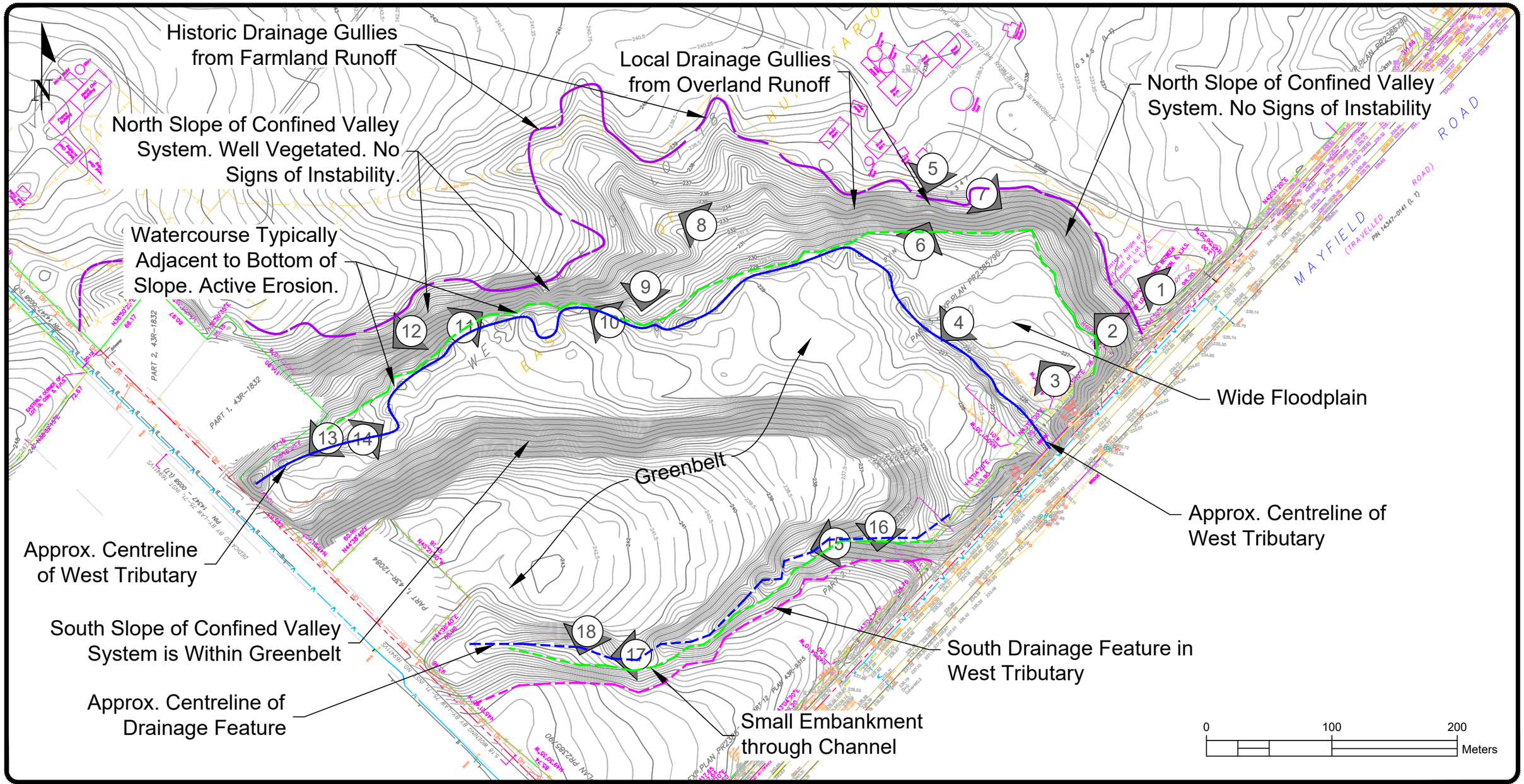
Project: Tullamore Employment Lands			
Title: Site Context Plan			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:6000	Figure No.: 1B	



Legend:

- Photo Direction & Location
- Bottom of Slope
- Top of Slope (Staked by TRCA)
- Top of Slope (Est. by GEI)
- Approx. C/L of Watercourse
- Approx. C/L of Intermittent Drainage Feature

Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, dated July 22, 2021, by Young & Young Surveying Inc.

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647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
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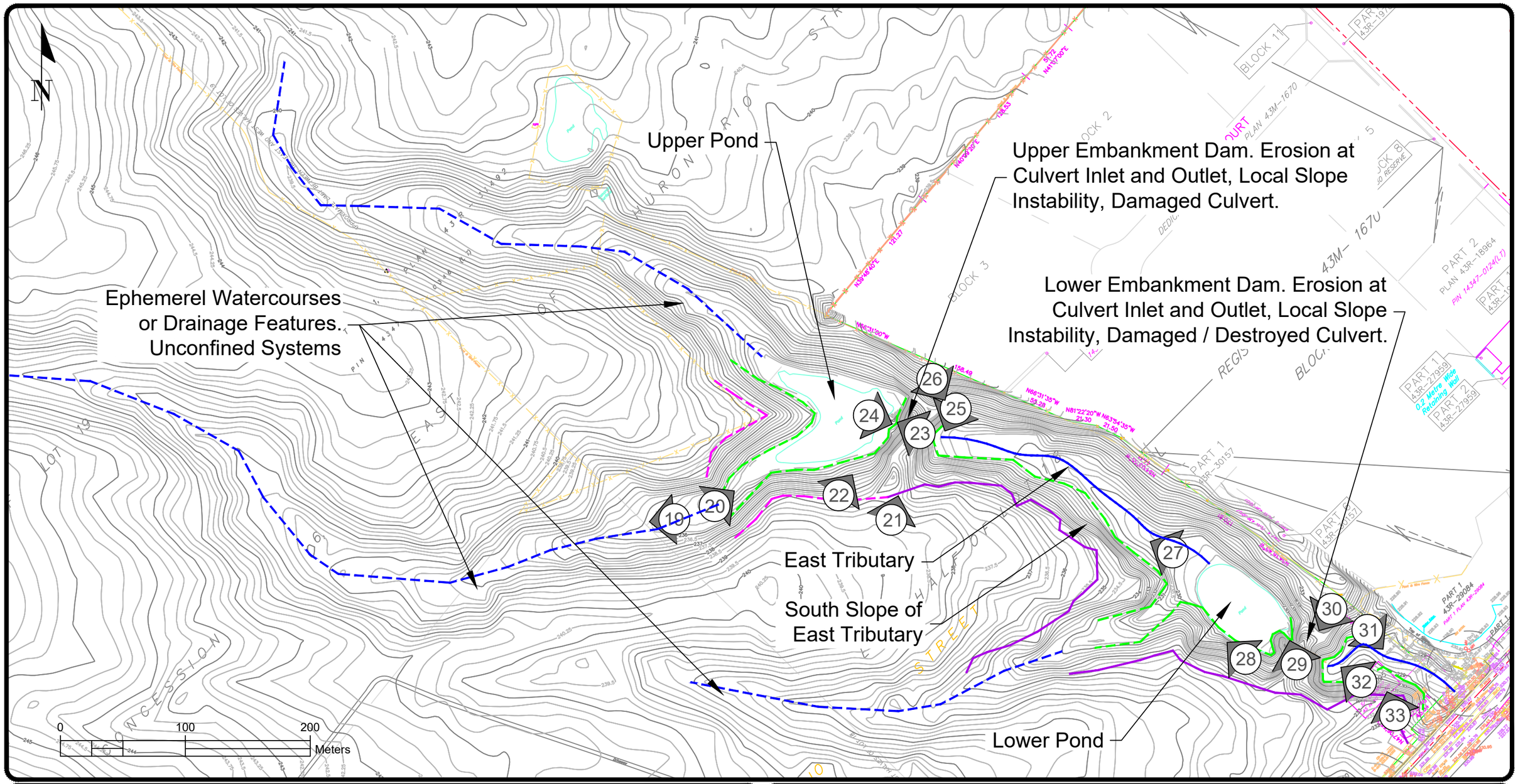
Project: Tullamore Employment Lands			
Title: Photograph & Site Features Location Plan			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:3000	Figure No.: 2A	



Legend:

- Photo Direction & Location
- Bottom of Slope
- Top of Slope (Staked by TRCA)
- Top of Slope (Est. by GEI)
- Approx. C/L of Watercourse
- Approx. C/L of Intermittent Drainage Feature

Reference:
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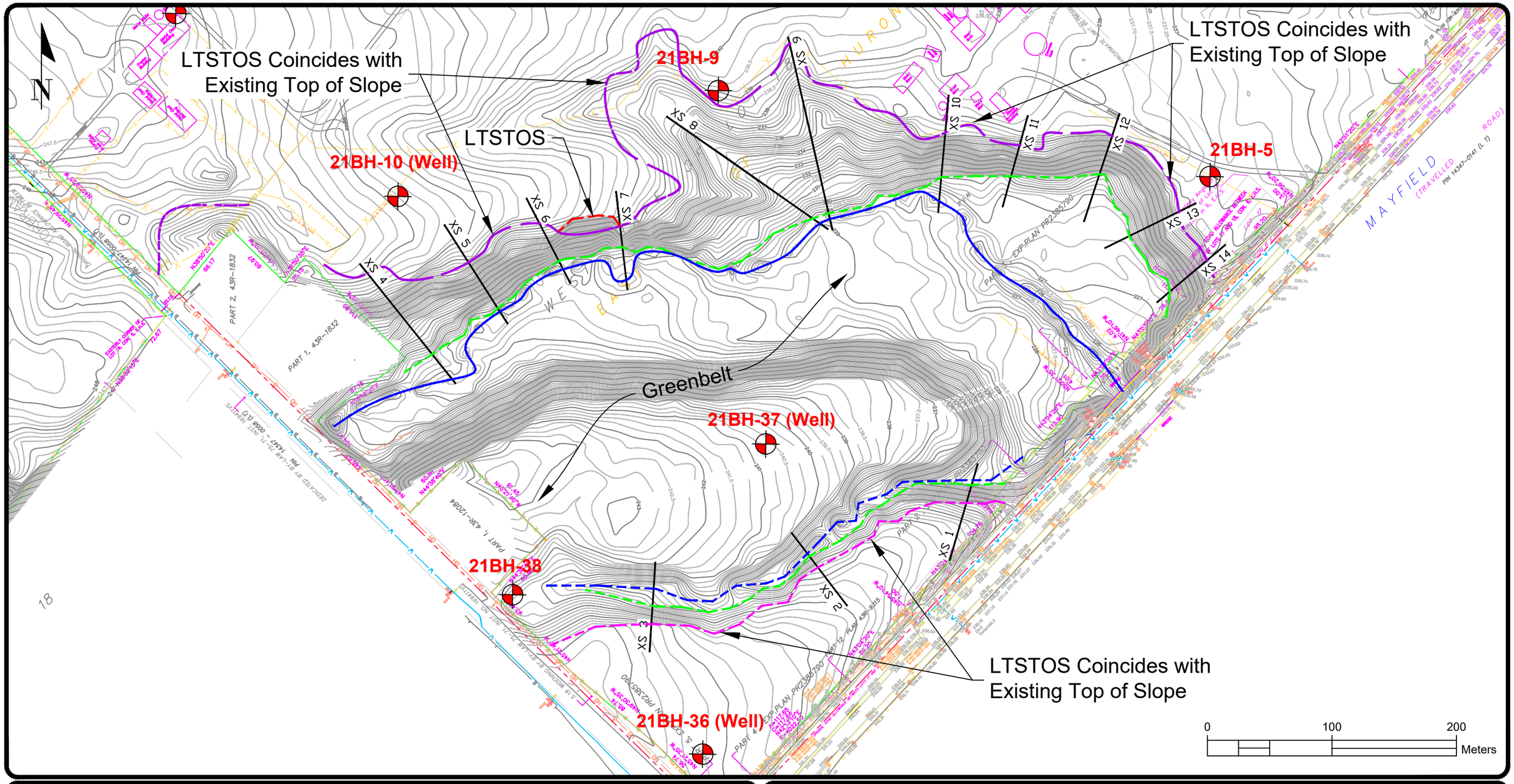
Project: Tullamore Employment Lands			
Title: Photograph & Site Features Location Plan			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:3000	Figure No.: 2B	



Legend:

- XS 1 — Cross - Section Location
- Approx. Borehole Location (Toronto Inspection 2021)
- Bottom of Slope
- Top of Slope (Staked by TRCA)
- Top of Slope (Est. by GEI)
- LTSTOS Position for FOS of 1.5
- Approx. C/L of Watercourse
- Approx. C/L of Intermittent Drainage Feature

Reference:
21-B7601_TOPO 2021-07-22.dwg
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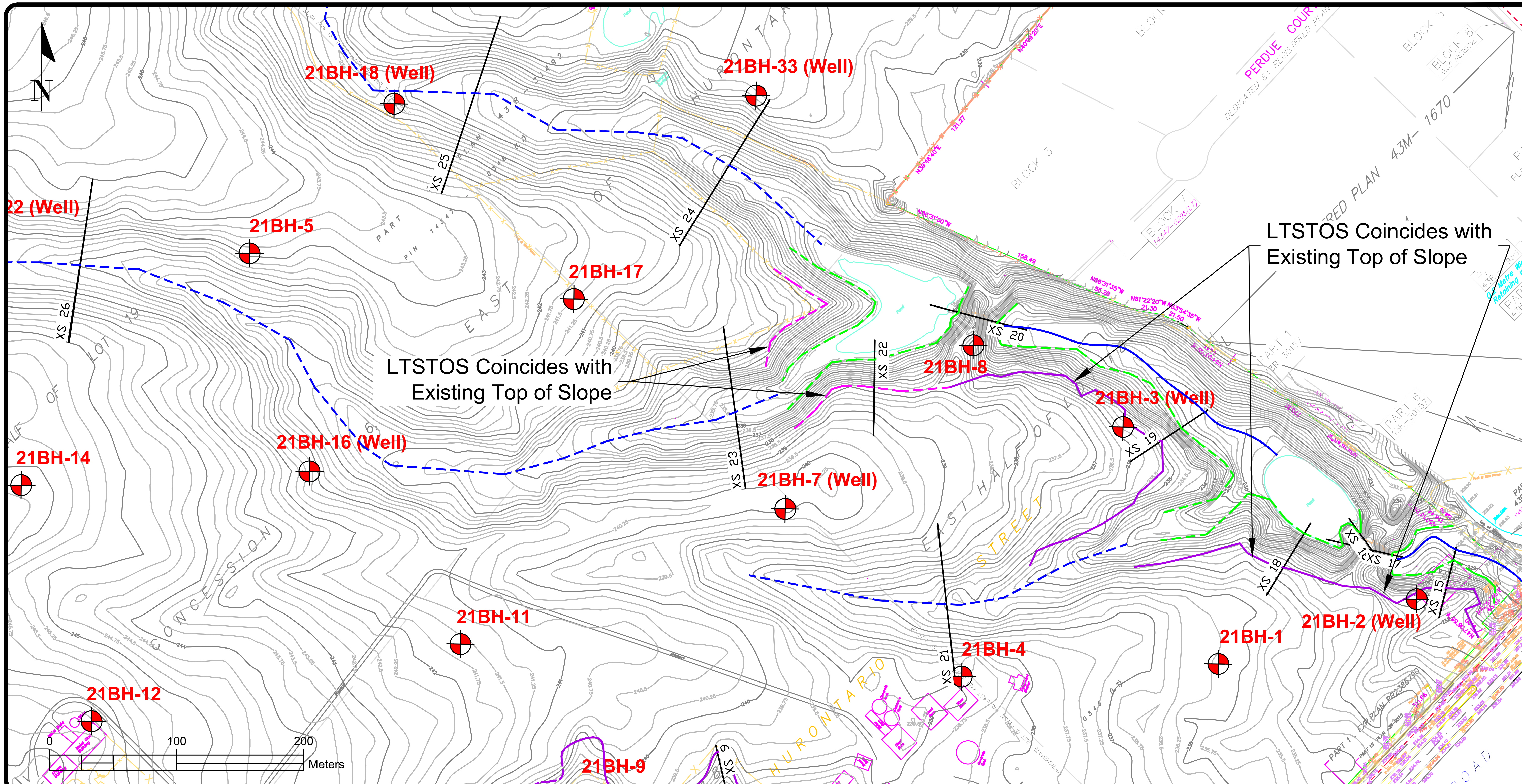
Project: Tullamore Employment Lands			
Title: Borehole, Cross-Section and LTSTOS Location Plan			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:3000	Figure No.: 3A	



Legend:

XS 1	Cross - Section Location
	Approx. Borehole Location (Toronto Inspection 2021)
	Bottom of Slope
	Top of Slope (Staked by TRCA)
	Top of Slope (Est. by GEI)
	LTSTOS Position for FOS of 1.5
	Approx. C/L of Watercourse
	Approx. C/L of Intermittent Drainage Feature

Reference:
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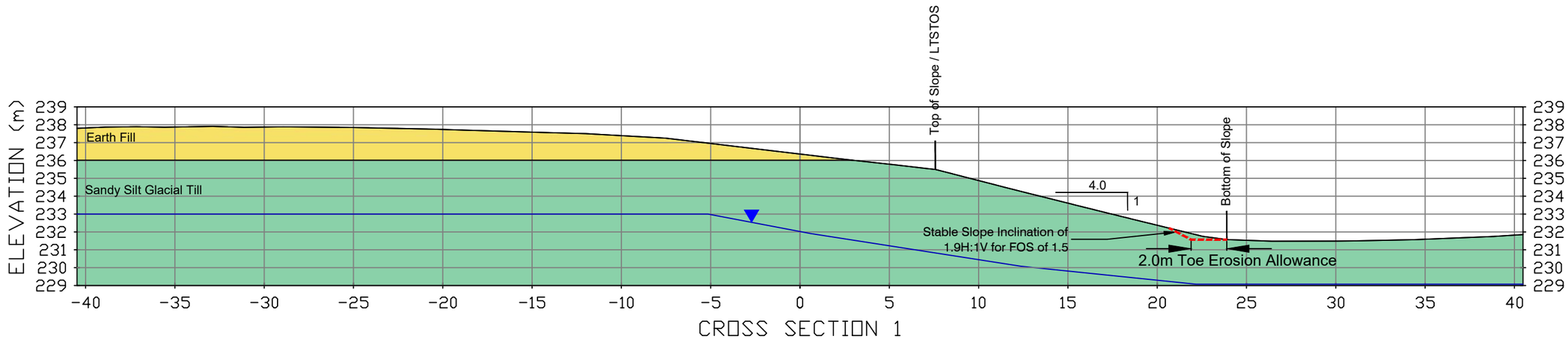
Project:	Tullamore Employment Lands				
Title:	Borehole, Cross-Section and LTSTOS Location Plan				
Approved by:	A.W.	Date:	February 2022	Project No.:	2100975
Drawn by:	R.W.	Scale:	1:3000	Figure No.:	3B



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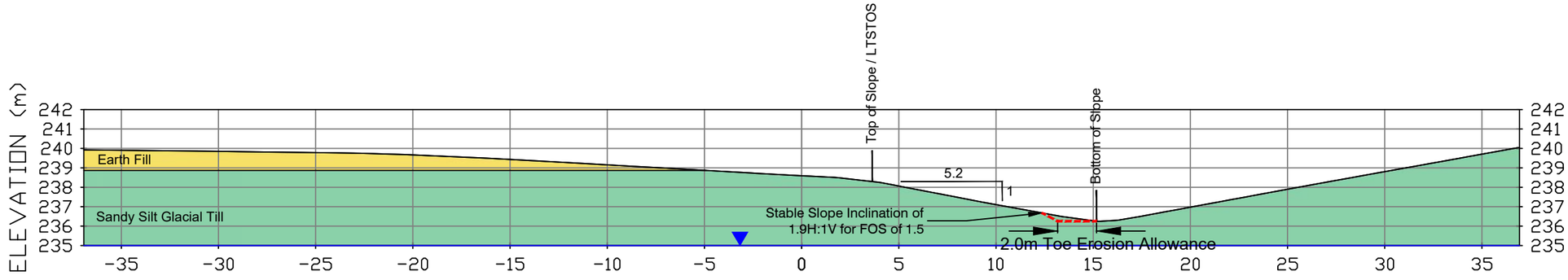

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21-B7601_TOPO 2021-07-22.dwg
"Sketch Showing Topographic Details on Tullamore Employment Lands,"
Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
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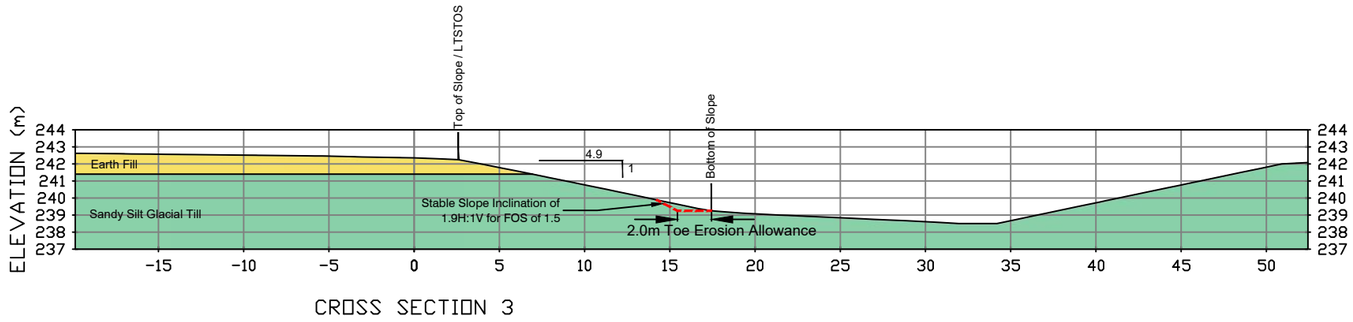
Project: Tullamore Employment Lands			
Title: Detailed Cross-Section 1 & 2			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:250	Figure No.: XS 1-2	



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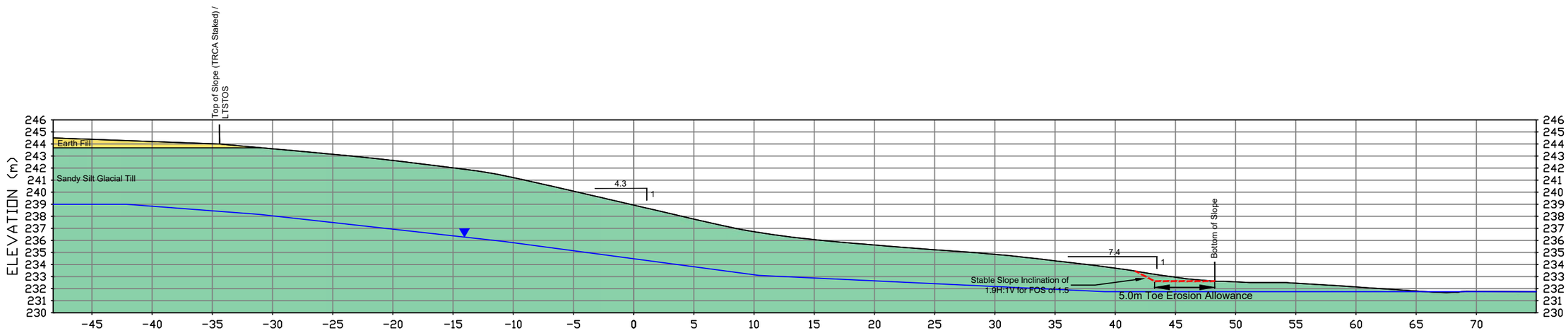

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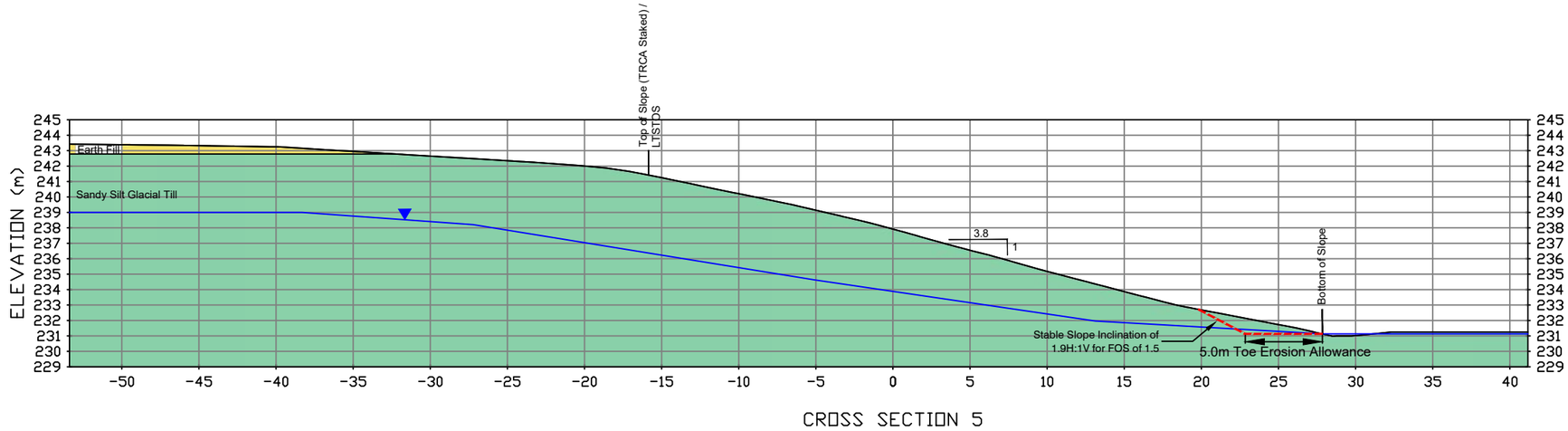
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project: Tullamore Employment Lands			
Title: Detailed Cross-Section 3 & 4			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:350	Figure No.: XS 3-4	



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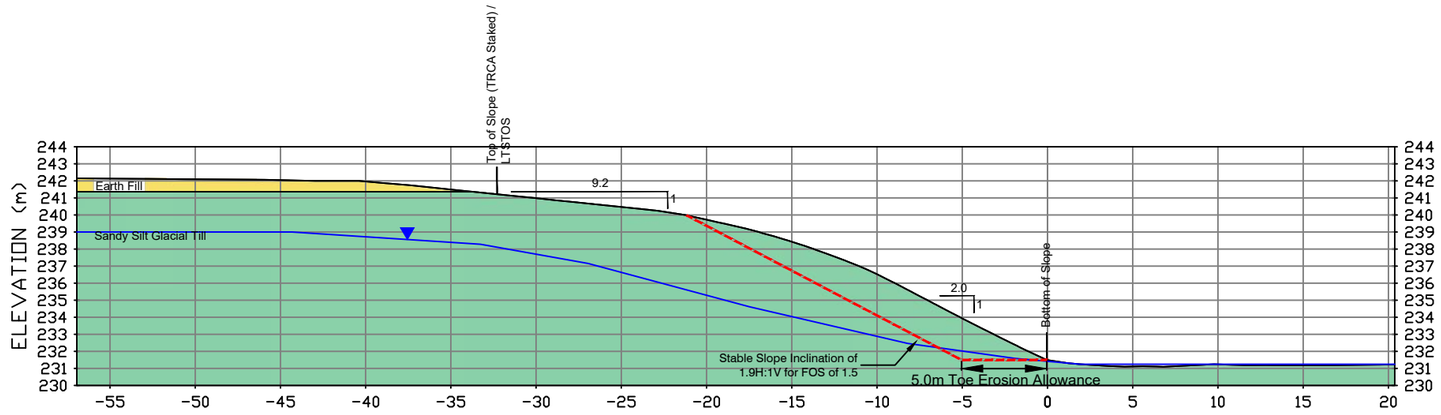

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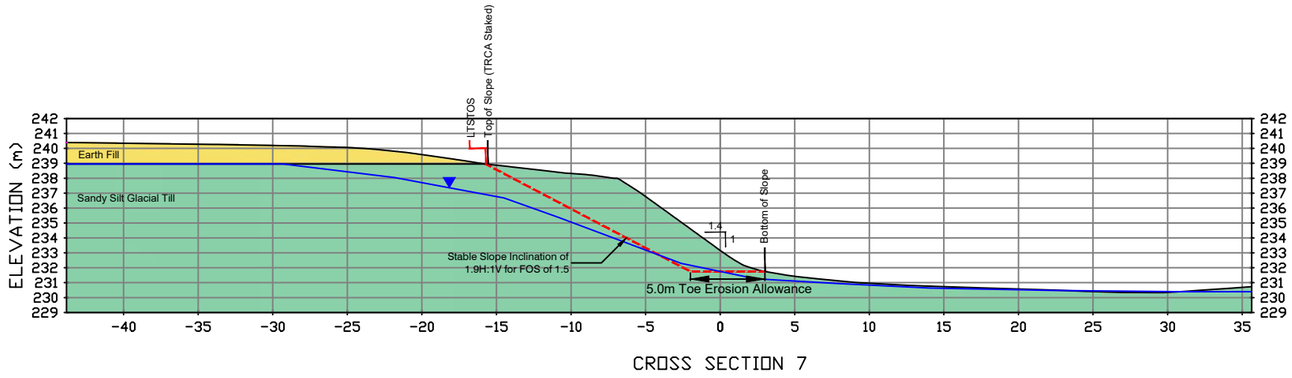
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project:	Tullamore Employment Lands		
Title:	Detailed Cross-Section 5 & 6		
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:350	Figure No.: XS 5-6	



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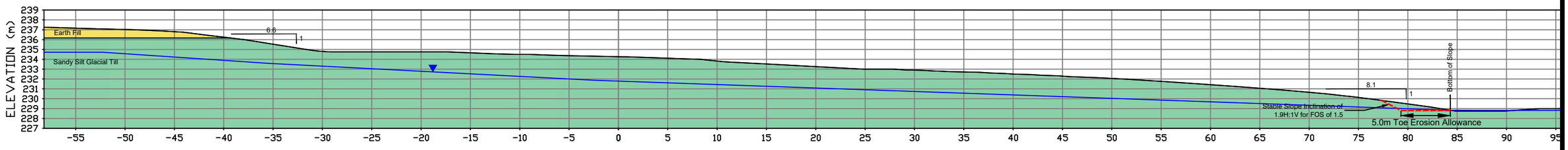
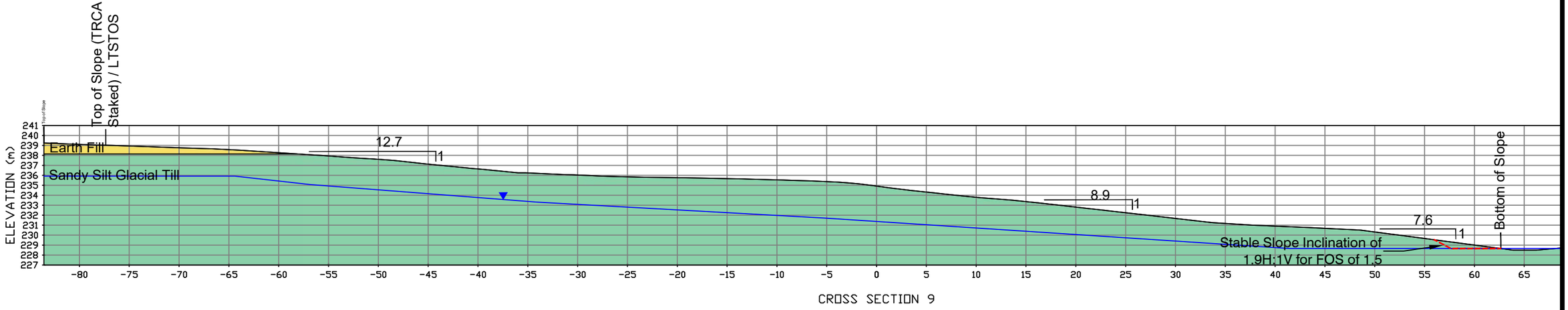


CROSS SECTION 8

Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project:	Tullamore Employment Lands		
Title:	Detailed Cross-Section 7 & 8		
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:400	Figure No.: XS 7-8	



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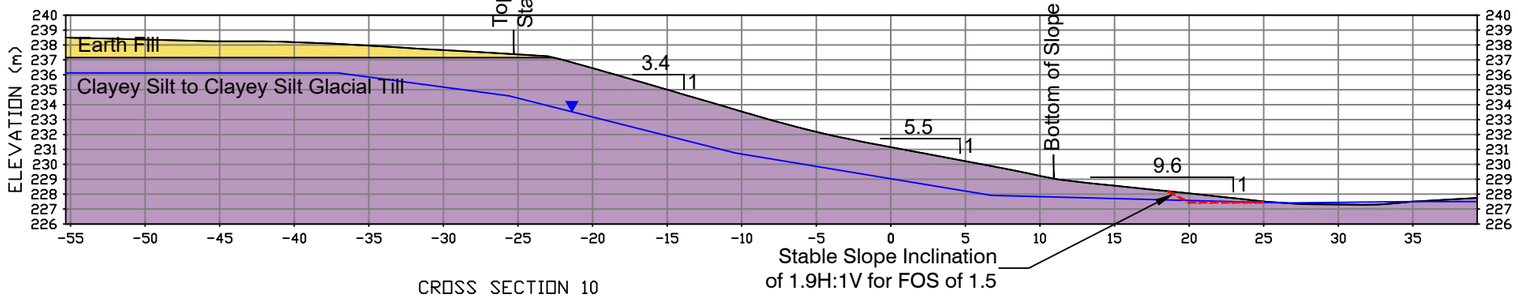
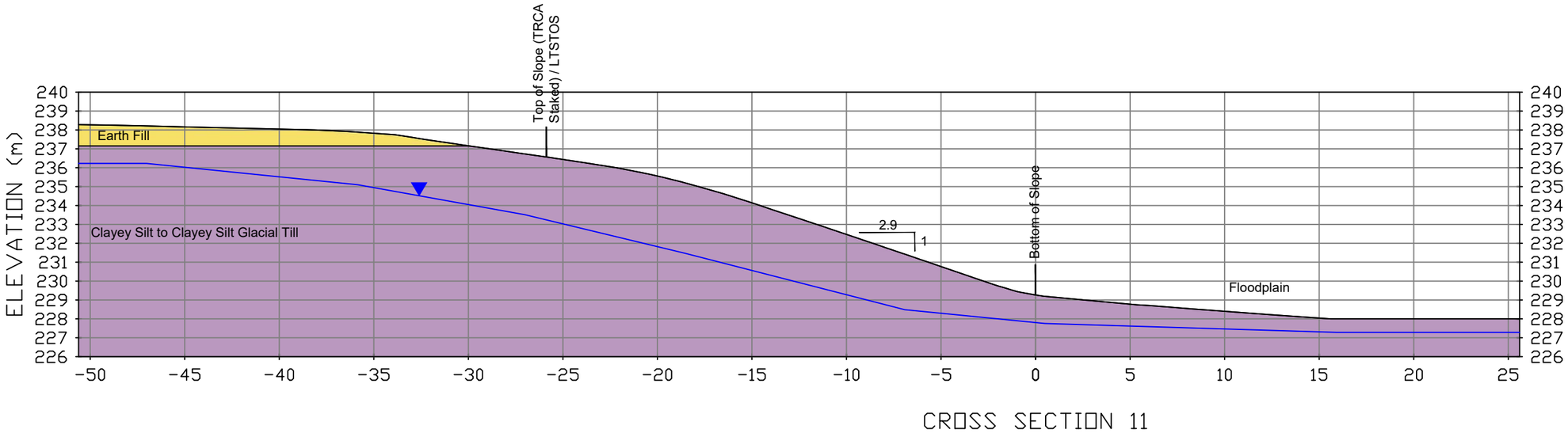


CROSS SECTION 10

Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project: Tullamore Employment Lands			
Title: Detailed Cross-Section 9 & 10			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:400	Figure No.: XS 9-10	



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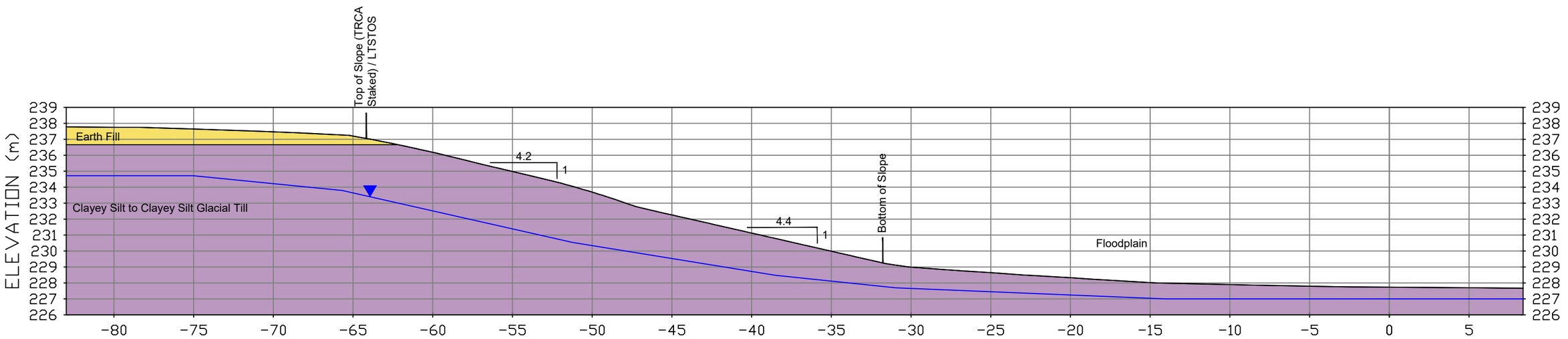

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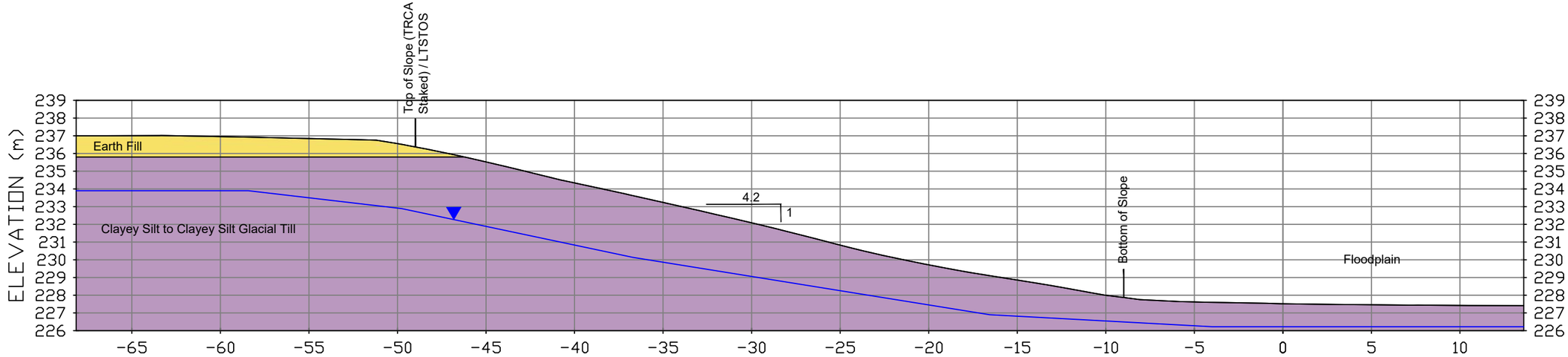
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project:	Tullamore Employment Lands		
Title:	Detailed Cross-Section 11 & 12		
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:250	Figure No.: XS 11-12	



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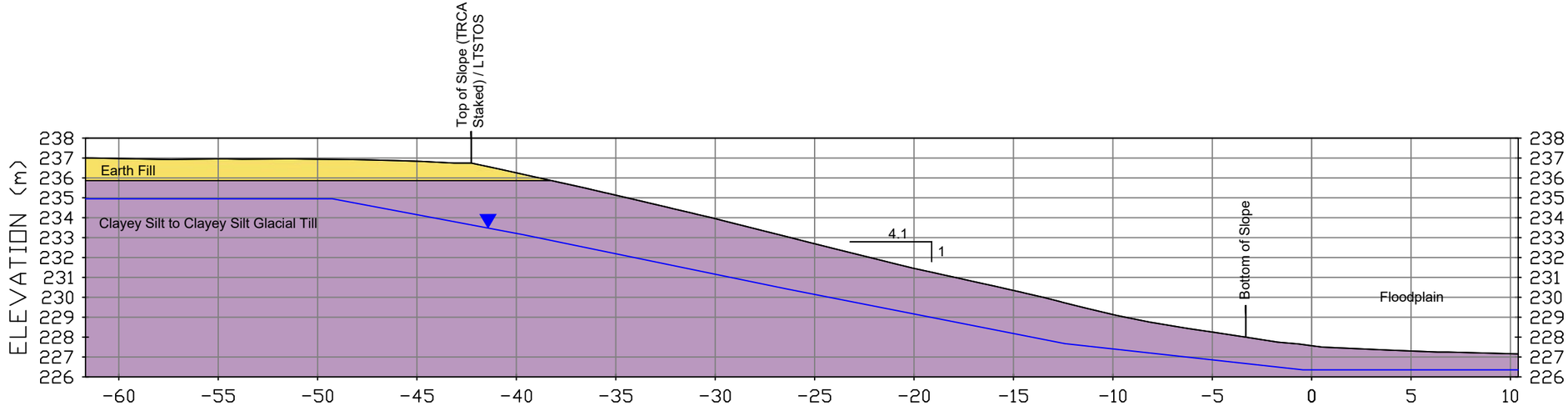

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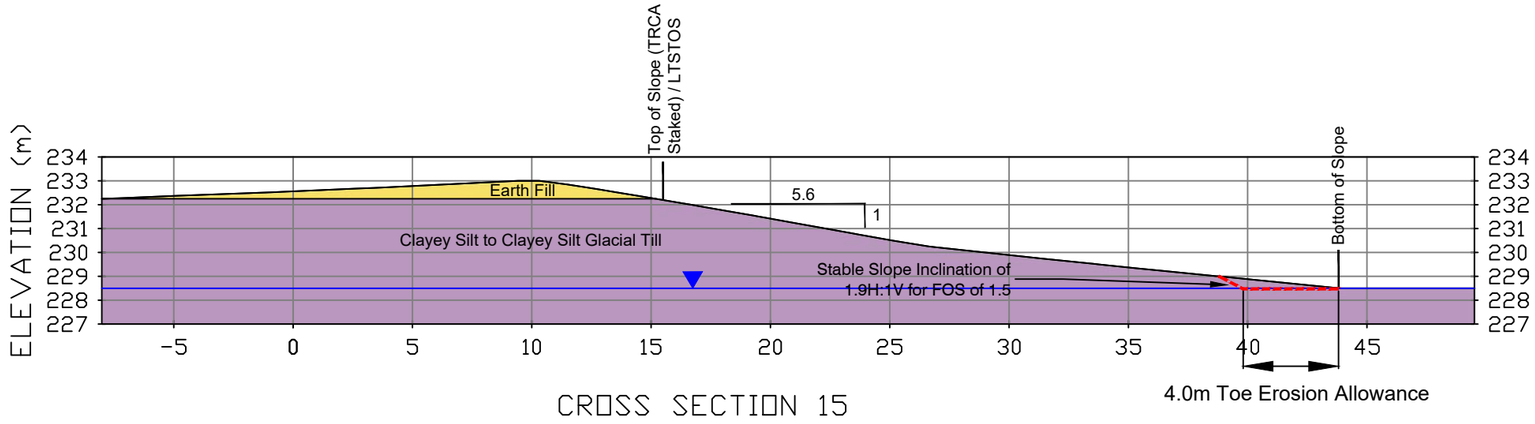
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project:	Tullamore Employment Lands		
Title:	Detailed Cross-Section 13 & 14		
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:250	Figure No.: XS 13-14	



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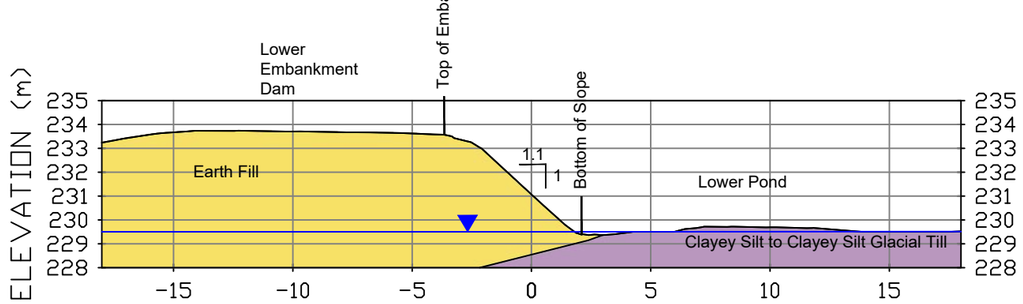

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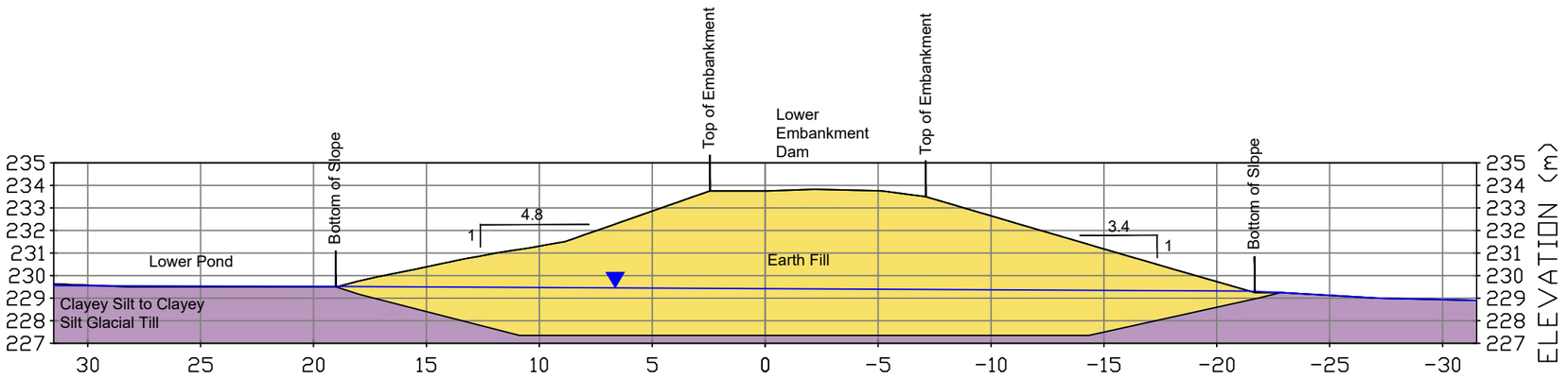
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project:	Tullamore Employment Lands				
Title:	Detailed Cross-Section 15 & 16				
Approved by:	A.W.	Date:	February 2022	Project No.:	2100975
Drawn by:	R.W.	Scale:	1:250	Figure No.:	XS 15-16



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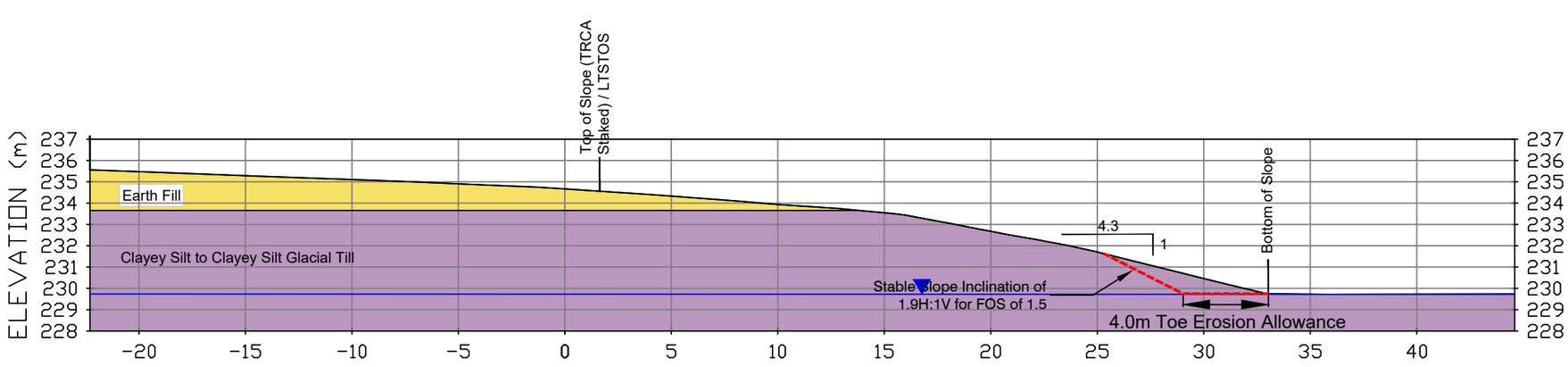

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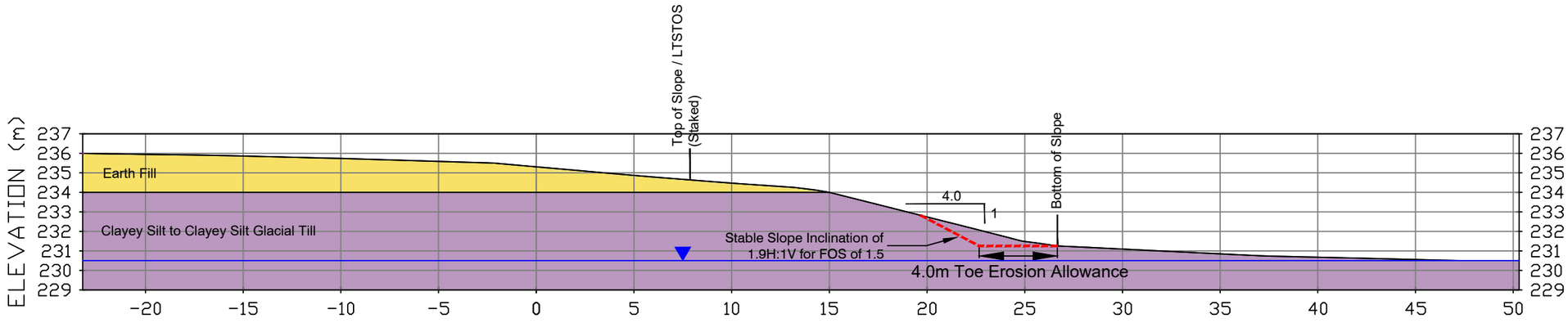
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project:	Tullamore Employment Lands		
Title:	Detailed Cross-Section 17 & 18		
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:250	Figure No.: XS 17-18	



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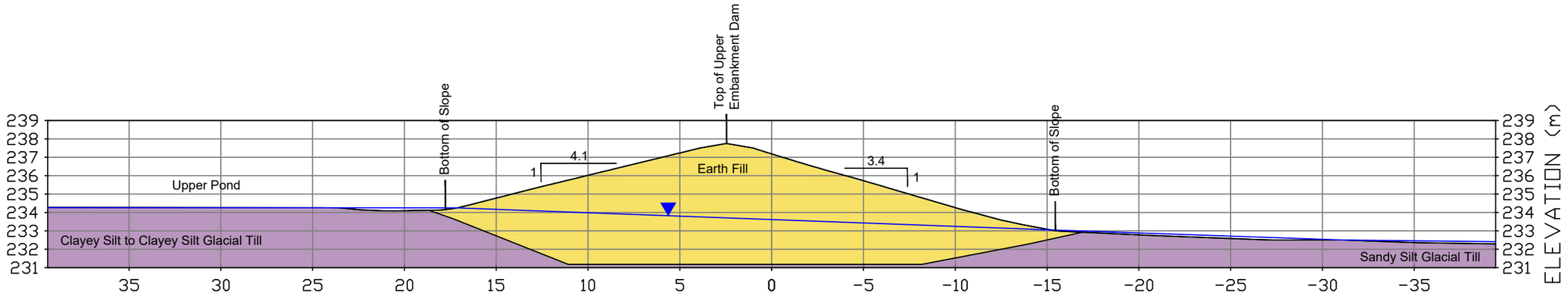

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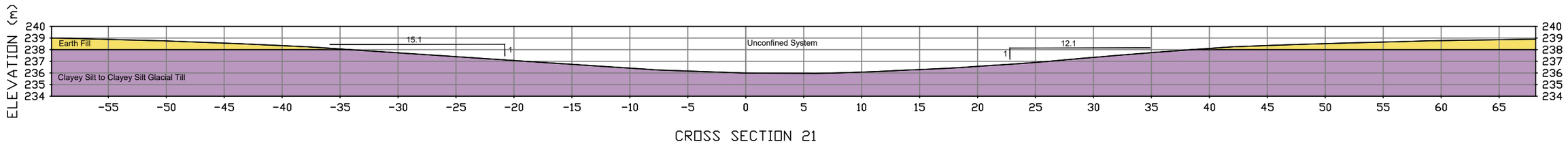
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project: Tullamore Employment Lands			
Title: Detailed Cross-Section 19 & 20			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:250	Figure No.: XS 19-20	



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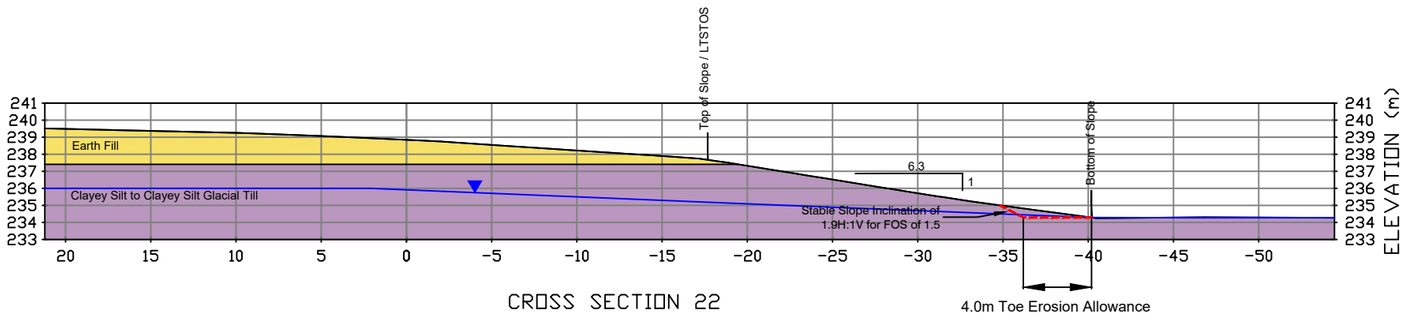

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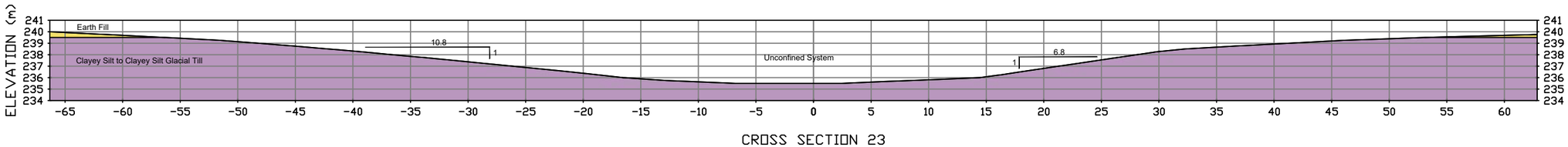
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project: Tullamore Employment Lands			
Title: Detailed Cross-Section 21 & 22			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:350	Figure No.: XS 21-22	



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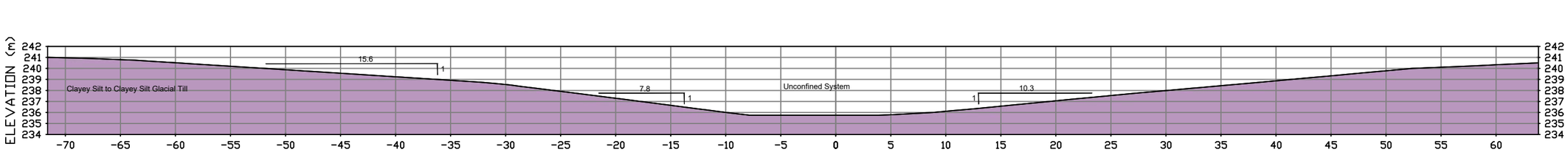

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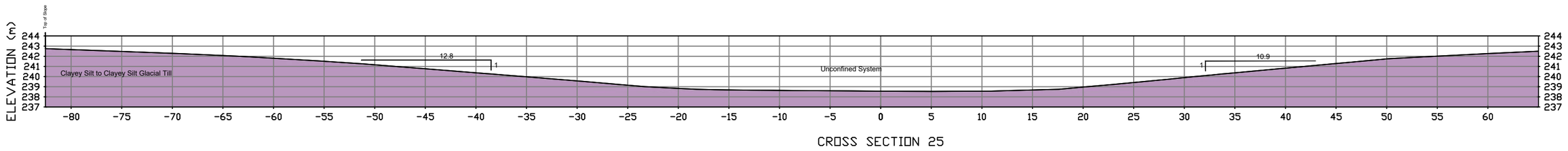
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project: Tullamore Employment Lands			
Title: Detailed Cross-Section 23 & 24			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:400	Figure No.: XS 23-24	



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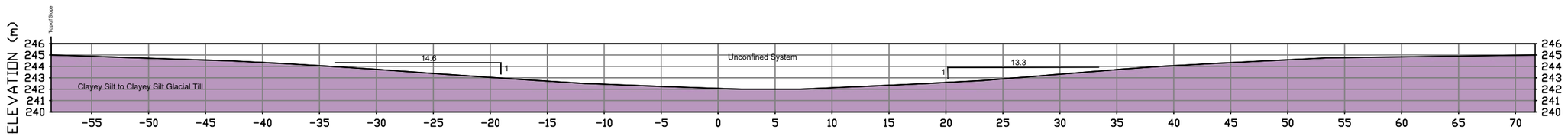

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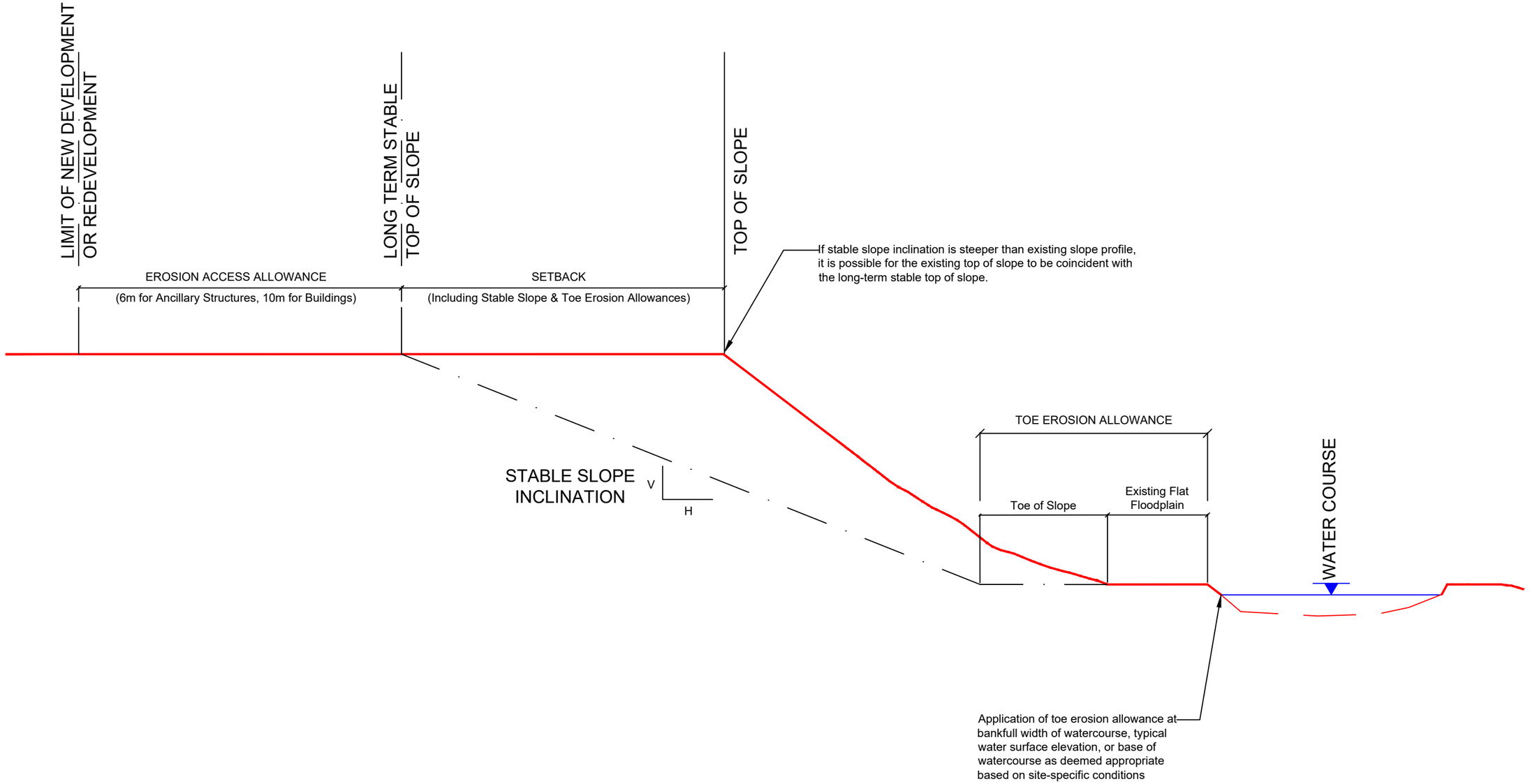
Reference:
21-B7601_TOPO 2021-07-22.dwg "Sketch Showing Topographic Details on Tullamore Employment Lands," Project No. 21-00975, Dated July 22, 2021, by Young & Young Surveying Inc.

GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project: Tullamore Employment Lands			
Title: Detailed Cross-Section 25 & 26			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: 1:400	Figure No.: XS 25-26	



GEI Consultants
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7
P: (705) 719-7994

Project: Tullamore Employment Lands			
Title: Long Term Stable Top of Slope Model			
Approved by: A.W.	Date: February 2022	Project No.: 2100975	
Drawn by: R.W.	Scale: N.T.S	Figure No.: 5	

Appendix A

Borehole Logs (Toronto Inspection, 2021)

Project No. 5552-21-GB

Log of Borehole 21BH-01

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

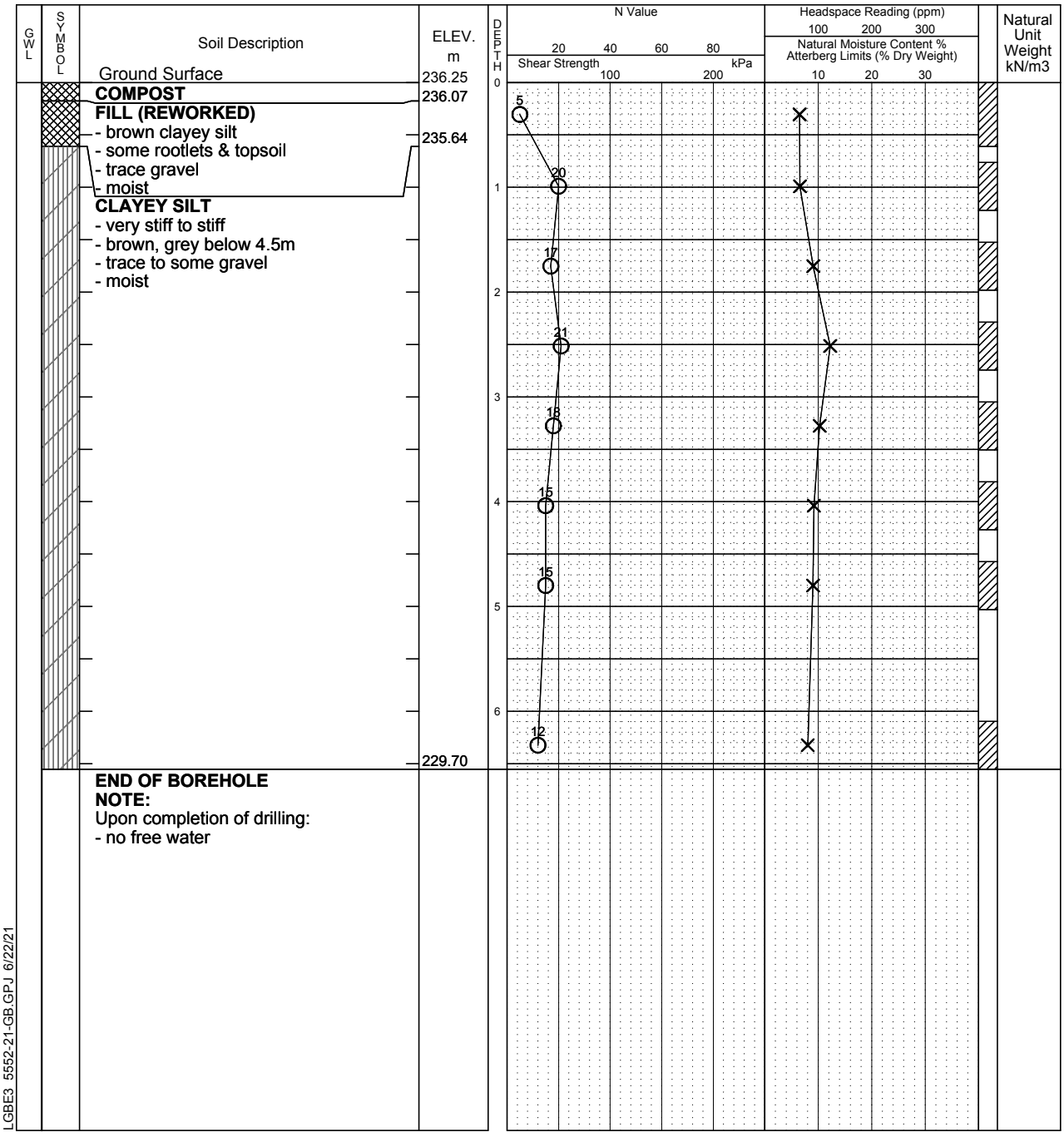
Date Drilled: 5/21/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5552-21-GB

Log of Borehole 21BH-02 (MW)

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

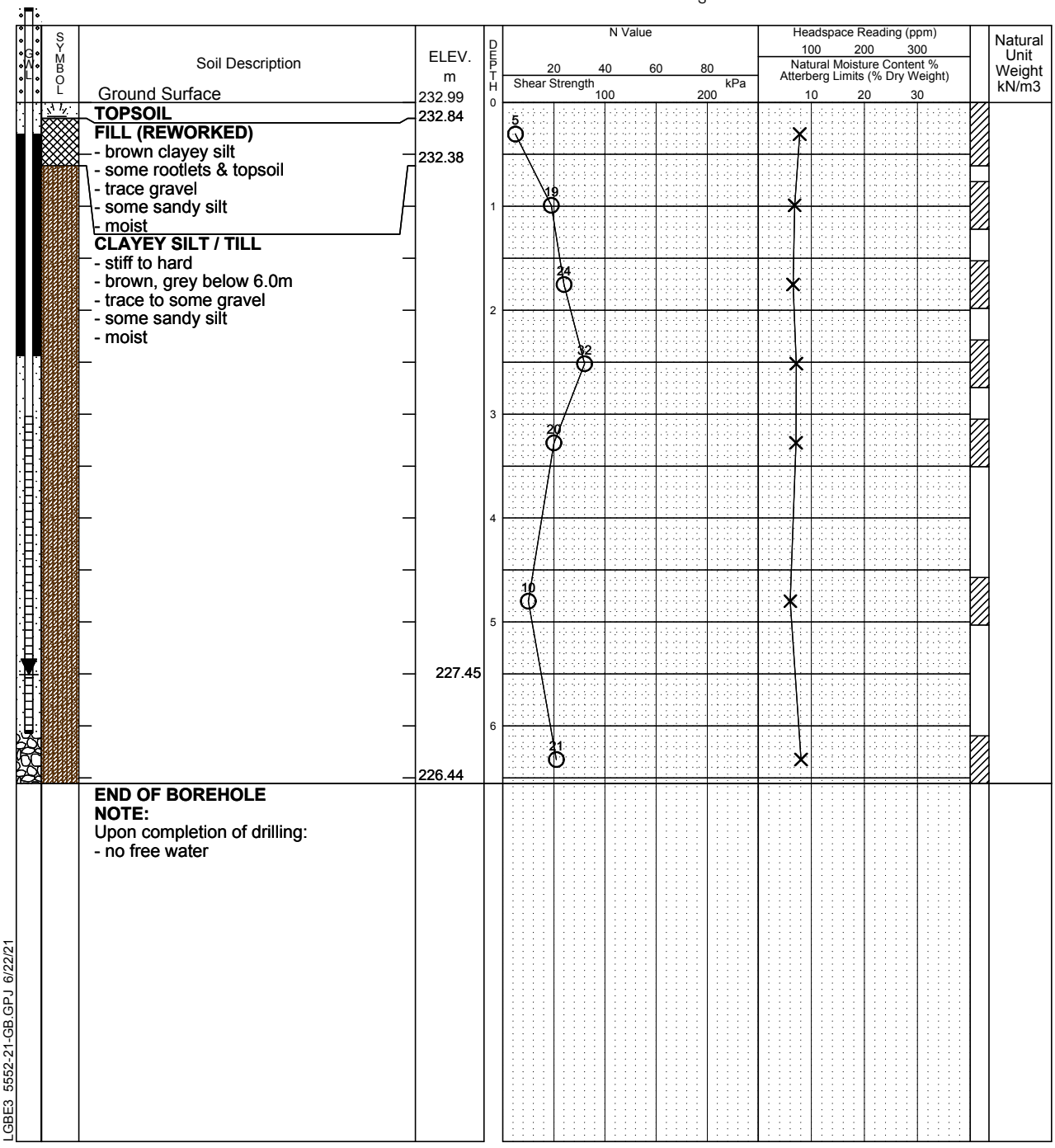
Date Drilled: 5/21/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
June 3, 2021	5.54m	

Project No. 5552-21-GB

Log of Borehole 21BH-03 (MW)

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

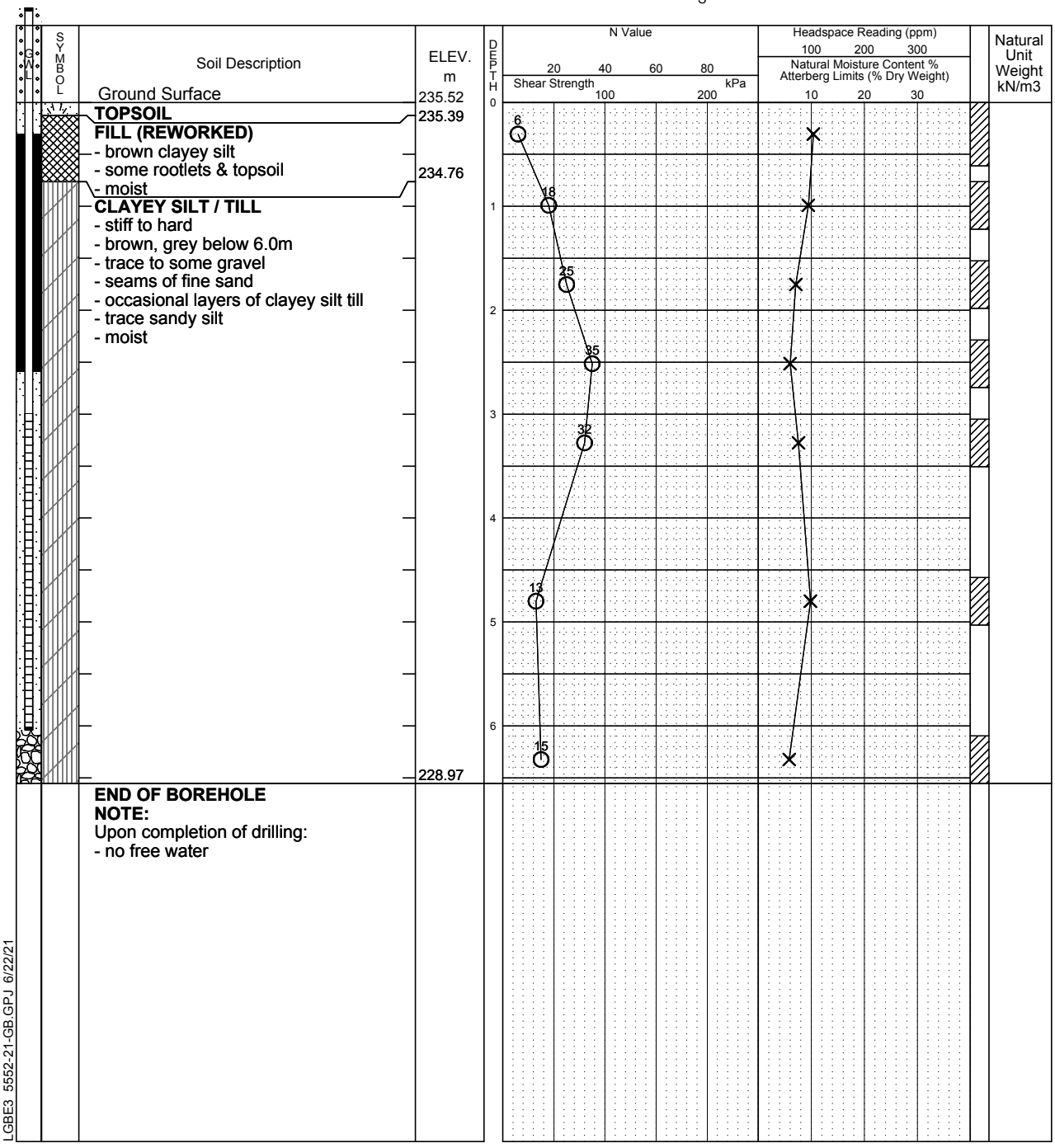
Date Drilled: 5/21/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
June 3, 2021	Dry	

Project No. 5552-21-GB

Log of Borehole 21BH-04

Dwg No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

Date Drilled: 5/21/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	238.67	0
		TOPSOIL	238.62	
		FILL (REWORKED) - brown clayey silt - trace to some rootlets & topsoil - moist to very moist	238.06	
		CLAYEY SILT / TILL - stiff to very stiff - brown, grey below 6.0m - trace gravel, trace sand - seams of fine sand - moist		1 2 3 4 5 6
			232.11	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - no free water		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa

Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3

LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5552-21-GB

Log of Borehole 21BH-05

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

Date Drilled: 5/25/21

Drill Type: Track Mounted Drill Rig

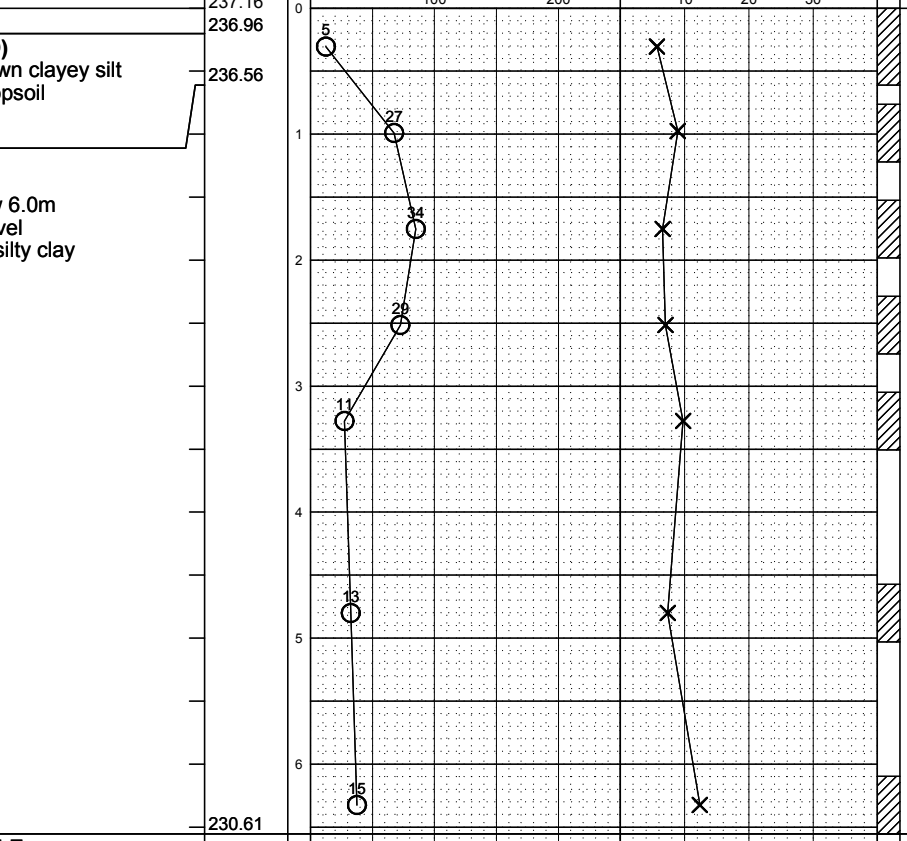
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	237.16	0
		TOPSOIL	236.96	
		FILL (REWORKED) - dark brown to brown clayey silt - some rootlets & topsoil - some sandy silt - moist	236.56	
		CLAYEY SILT - stiff to hard - brown, grey below 6.0m - trace to some gravel - trace sand, trace silty clay - moist		1
				2
				3
				4
				5
				6
			230.61	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - no free water		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Natural Unit Weight kN/m3



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5552-21-GB

Log of Borehole 21BH-07 (MW)

Dwg No. 8

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

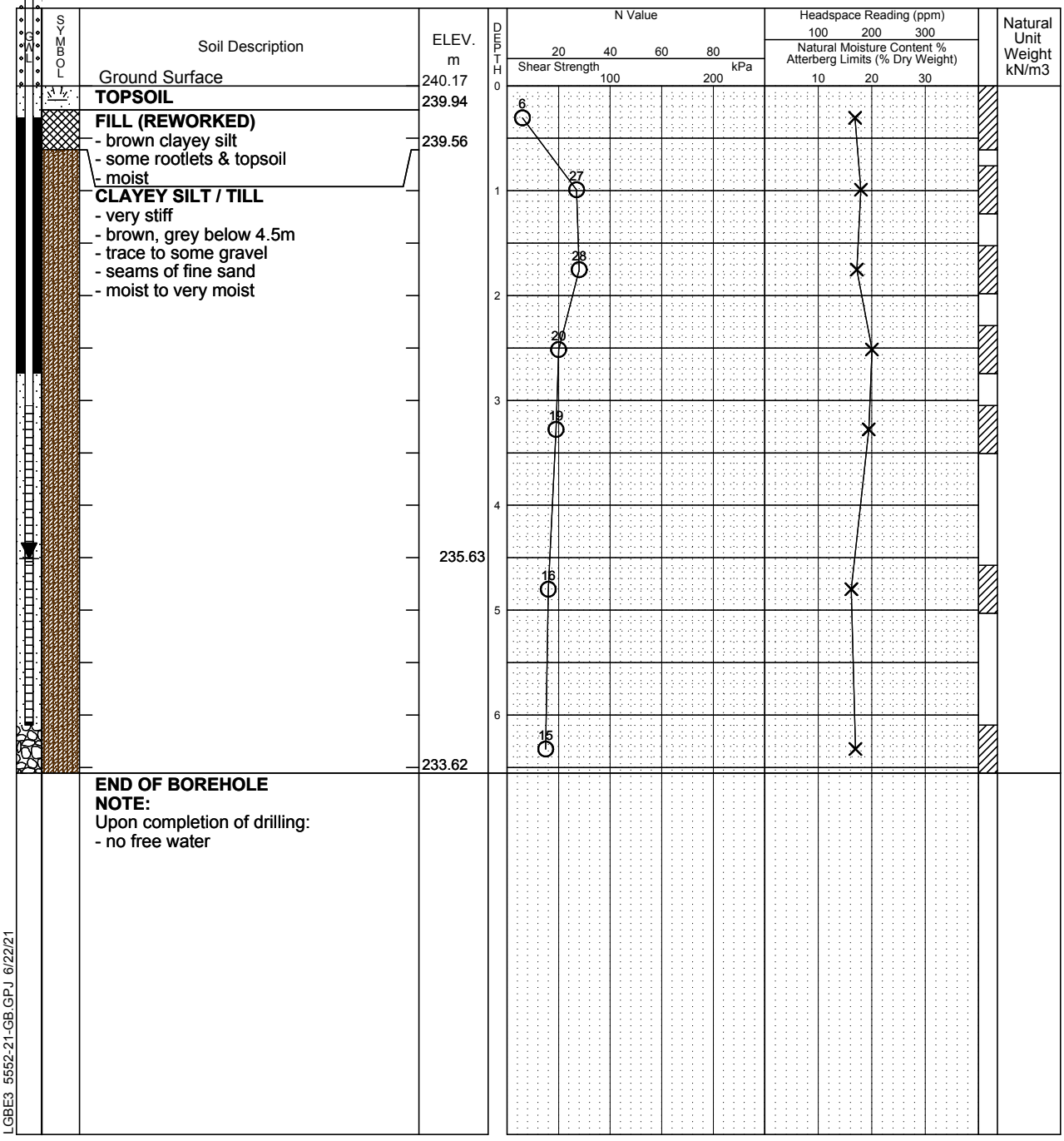
Date Drilled: 5/25/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
June 3, 2021	4.54m	

Project No. 5552-21-GB

Log of Borehole 21BH-08

Dwg No. 9

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

Date Drilled: 5/25/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	238.39	0
		TOPSOIL	238.39	
		FILL (REWORKED) - brown clayey silt - trace rootlets & topsoil - some sandy silt - trace gravel - pockets of organics at 4.5m & 6.0m - moist to very moist, wet layers		1 2 3 4 5 6
			231.84	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - hit a 3/4" pipe at 2.3m from top of the berm - water level at 0.0m (flowing out)		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Natural Unit Weight kN/m3

N Value: 7, 7, 7, 29, 13, 7, 10

LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5552-21-GB

Log of Borehole 21BH-09

Dwg No. 10

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

Date Drilled: 5/25/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

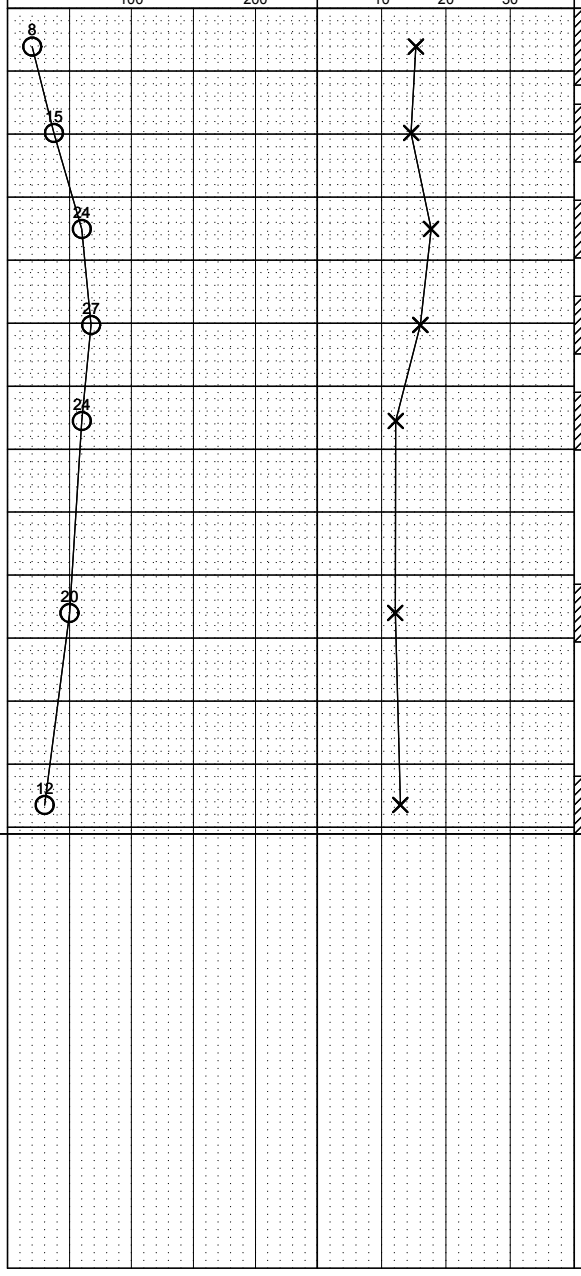
Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	239.51	0
		TOPSOIL	239.28	
		FILL (REWORKED) - brown sandy silt to clayey silt - some rootlets & topsoil - moist	238.74	
		CLAYEY / SANDY SILT TILL - soft to very stiff / compact - brown, grey below 6.0m - some gravel - seams of fine sand - moist to very moist		1 2 3 4 5 6
			232.95	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - no free water		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa

Headspace Reading (ppm): 100 200 300
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5552-21-GB

Log of Borehole 21BH-10 (MW)

Dwg No. 11

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

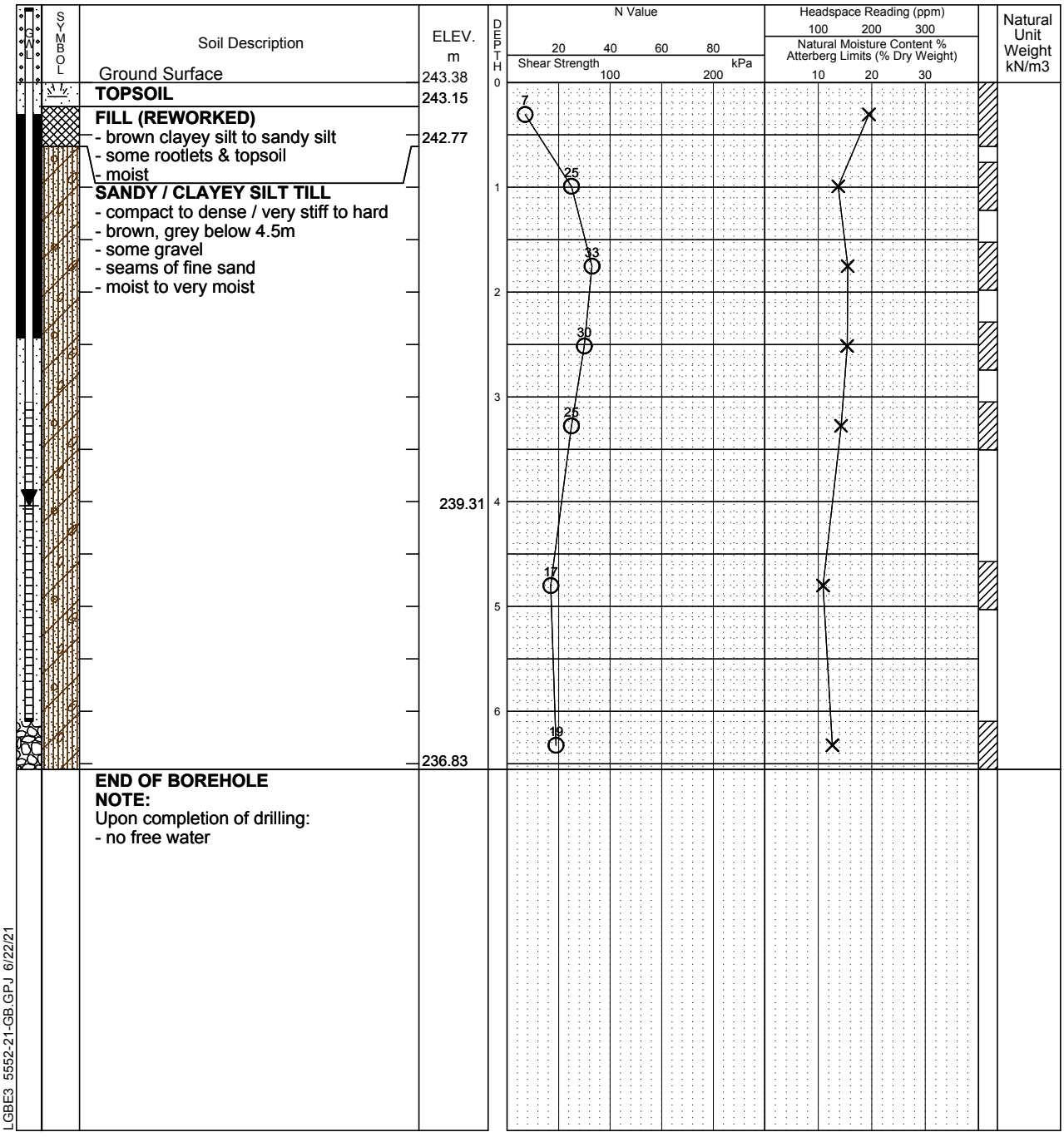
Date Drilled: 5/26/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
June 3, 2021	4.07m	

Project No. 5552-21-GB

Log of Borehole 21BH-17

Dwg No. 18

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

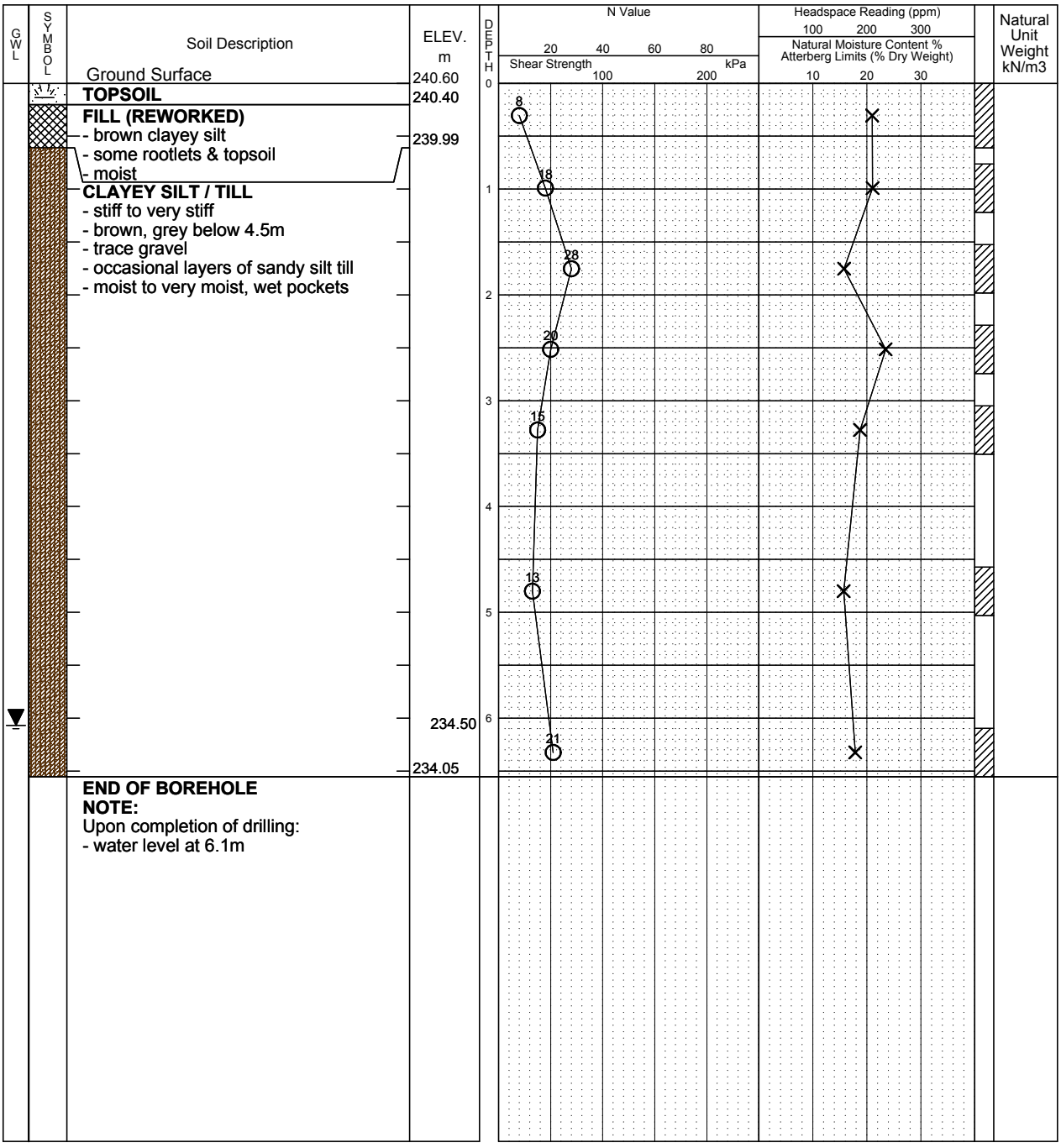
Date Drilled: 5/27/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5552-21-GB

Log of Borehole 21BH-33 (MW)

Dwg No. 34

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

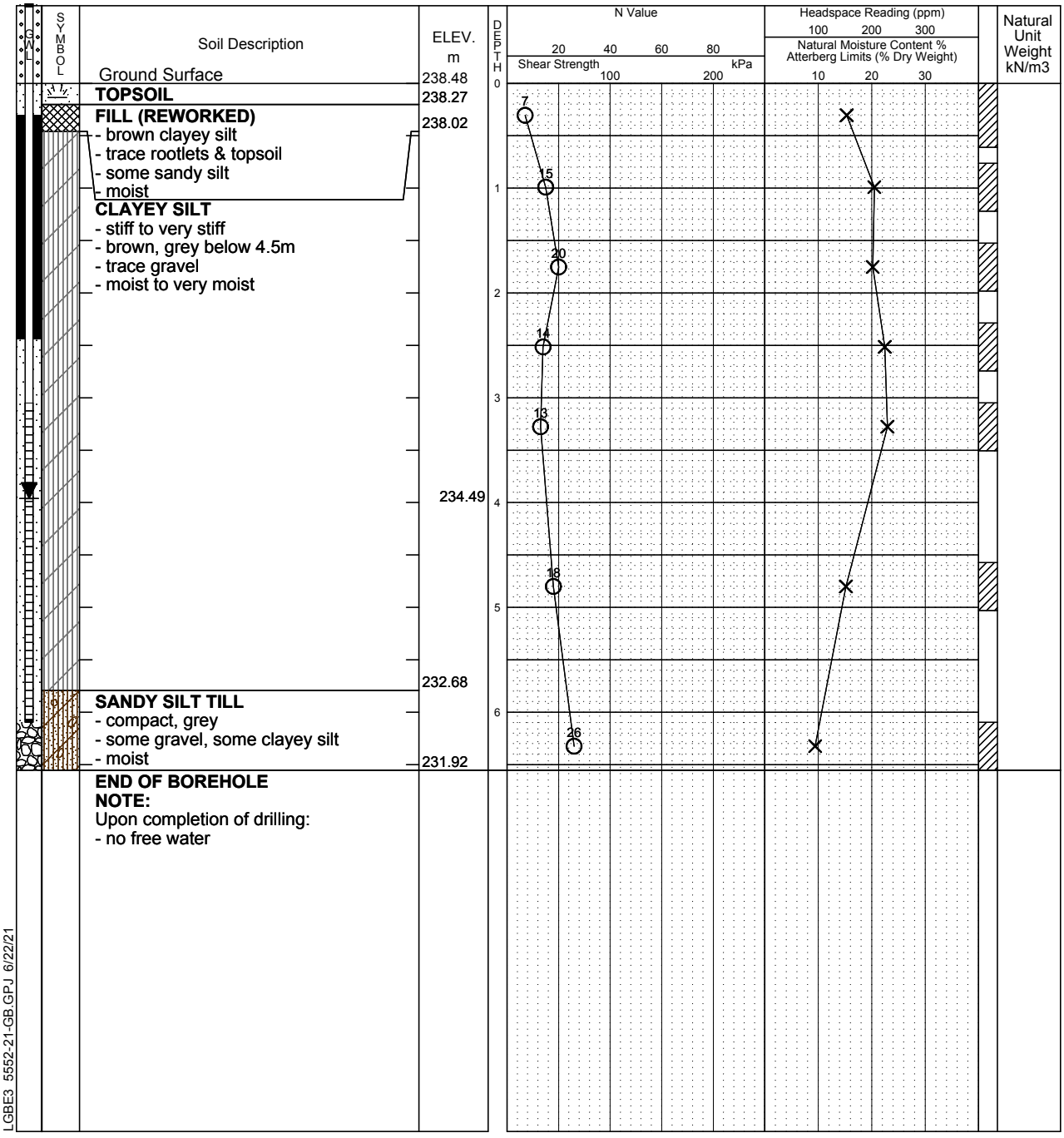
Date Drilled: 6/2/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
June 3, 2021	3.99m	

Project No. 5552-21-GB

Log of Borehole 21BH-36 (MW)

Dwg No. 37

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

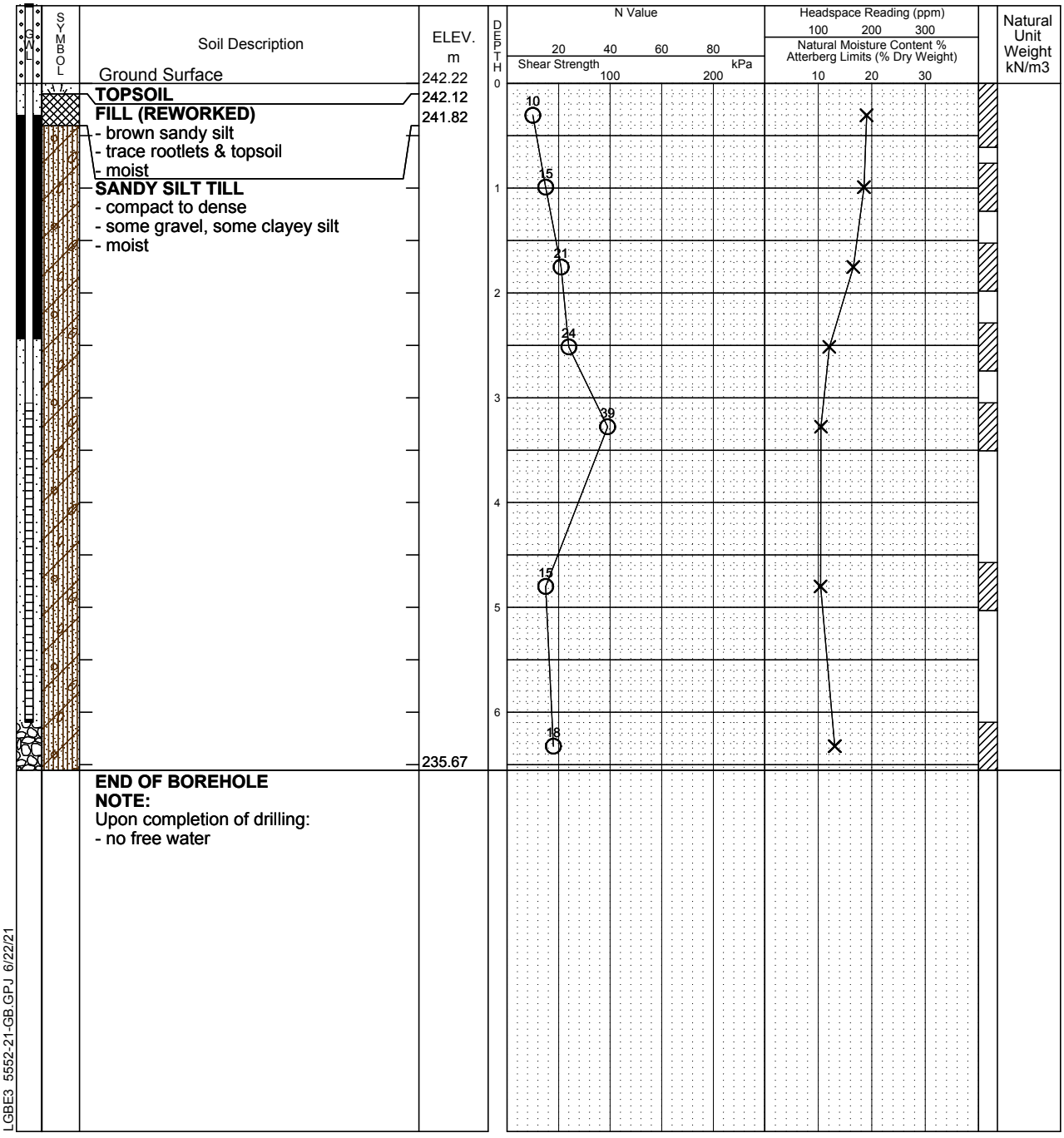
Date Drilled: 6/3/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
June 7, 2021	Dry	

Project No. 5552-21-GB

Log of Borehole 21BH-37 (MW)

Dwg No. 38

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

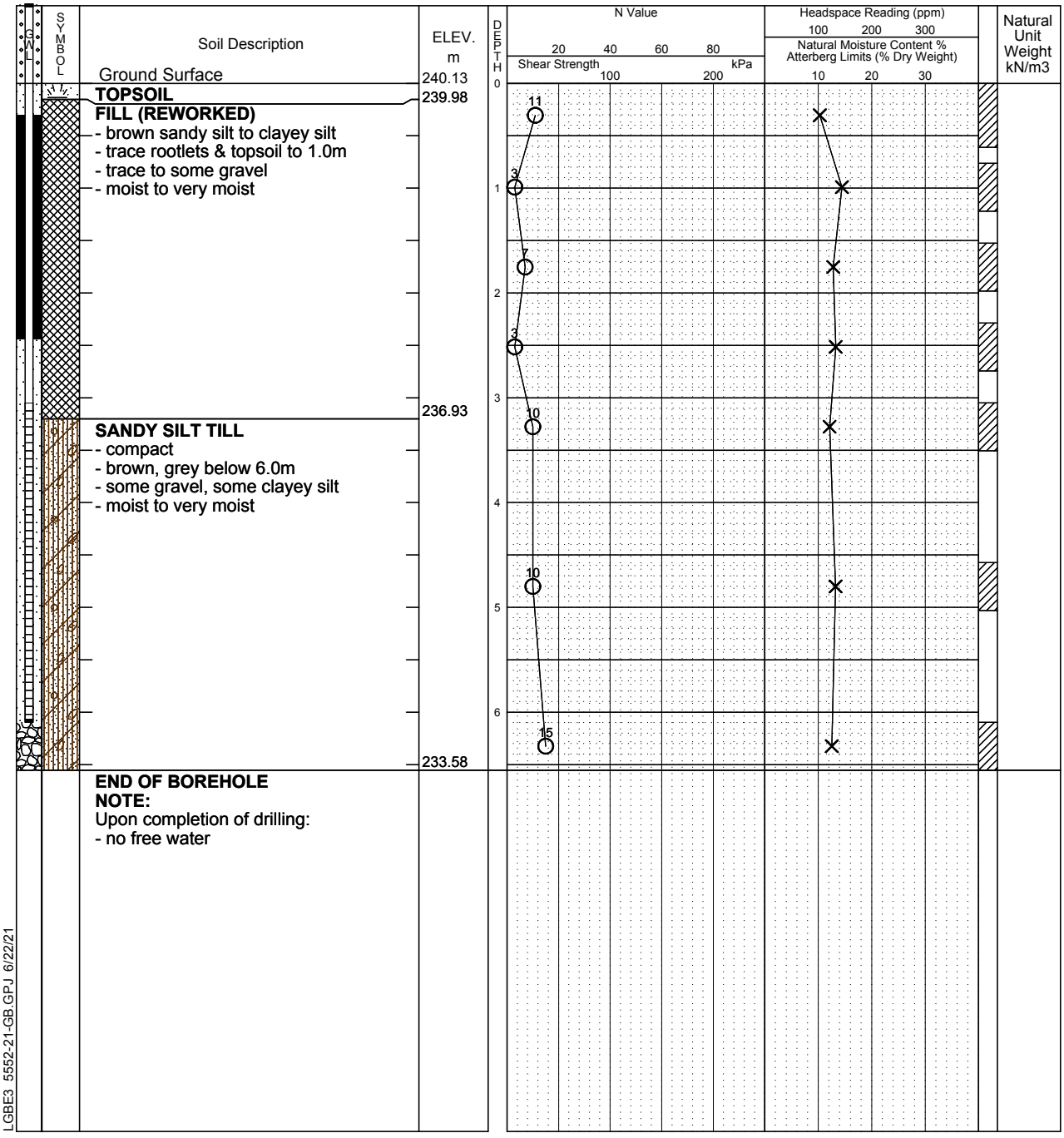
Date Drilled: 6/3/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
June 7, 2021	Dry	

Project No. 5552-21-GB

Log of Borehole 21BH-38

Dwg No. 39

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Airport Road and Mayfield Road, Caledon, Ontario

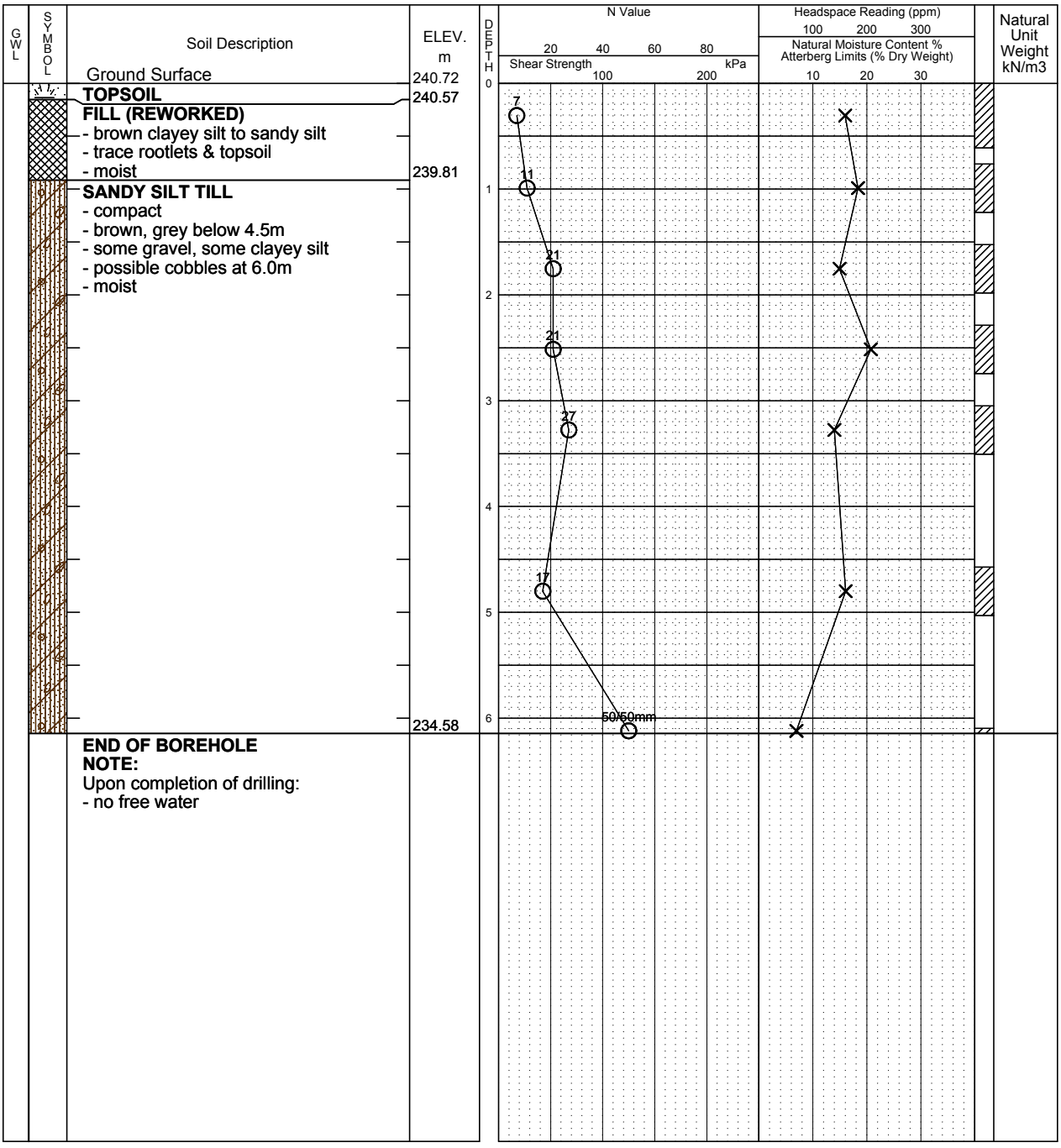
Date Drilled: 6/3/21

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 5552-21-GB.GPJ 6/22/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Appendix B

Site and Slope Photographs

PHOTOGRAPH 1

GEI (2022)

Description:
A view of the west tributary northern slope crest near the driveway from Mayfield Road (confined valley system).

PHOTOGRAPH 2

GEI (2022)

Description:
A view of the west tributary northern slope profile.

PHOTOGRAPH 3

GEI (2021)

Description:
A view of the wide floodplain between the slope and west tributary watercourse between Mayfield Road and the barns.

PHOTOGRAPH 4

GEI (2022)

Description:
A view of the west tributary watercourse near Mayfield Road.

PHOTOGRAPH 5

GEI (2022)

Description:
A view of gully erosion extending down the slope face due to concentrated runoff from the barns and other structures.

PHOTOGRAPH 6

GEI (2022)

Description:
Another view of gully erosion extending down the slope face due to concentrated runoff from the barns and other structures. Weeping pipes outlet partway down the slope.

PHOTOGRAPH 7

GEI (2022)

Description:
Another general view of the northern slope of the western tributary confined valley system.

PHOTOGRAPH 8

GEI (2022)

Description:
A view of the tableland (farmland) north of the northern slope of the western tributary.

PHOTOGRAPH 9

GEI (2022)

Description:
Another view of the west tributary watercourse.

PHOTOGRAPH 10

GEI (2022)

Description:
Another view of the west tributary watercourse. The watercourse is typically adjacent to the northern slope toe between the barns and Torbram Road.

PHOTOGRAPH 11

GEI (2022)

Description:
A view of the well vegetated northern slope profile.

PHOTOGRAPH 12

GEI (2022)

Description:
Another view of the well vegetated northern slope profile. Some trees are partially tilting, likely due to long term slope creep.

PHOTOGRAPH 13

GEI (2022)

Description:
Active erosion is occurring along the west tributary watercourse.

PHOTOGRAPH 14

GEI (2022)

Description:
Active erosion is occurring along the west tributary watercourse.

PHOTOGRAPH 15

GEI (2022)

Description:
A view of the southern drainage feature (confined valley system) that is expected to only contain intermittent flows during or after runoff events.

PHOTOGRAPH 16

GEI (2022)

Description:
A view of the south slope of the southern drainage feature. Some rilling was observed on the slope face, due to concentrated runoff.

PHOTOGRAPH 17

GEI (2022)

Description:
Another view of the southern drainage feature (confined valley system) that is expected to only contain intermittent flows during or after runoff events.

PHOTOGRAPH 18

GEI (2022)

Description:
Another view of the southern drainage feature (confined valley system) that is expected to only contain intermittent flows during or after runoff events.

PHOTOGRAPH 19

GEI (2022)

Description:
A view of the unconfined feature that drains into the upper pond of the eastern tributary.

PHOTOGRAPH 20

GEI (2022)

Description:
Another view of the unconfined feature that drains into the upper pond of the eastern tributary.

PHOTOGRAPH 21

GEI (2022)

Description:
A view of the northern embankment dam crest, at the upper pond location.

PHOTOGRAPH 22

GEI (2022)

Description:
A view of the side slope of the upper pond / embankment dam, containing some concrete and other debris.

PHOTOGRAPH 23

GEI (2022)

Description:
A view of the upper pond and damaged / destroyed culvert intlet that extends below the berm (upstream side of the upper pond).

PHOTOGRAPH 24

GEI (2022)

Description:
A view of the damaged culvert and active erosion and slope failures (slumping) at the upstream face of the northern embankment dam (upper pond).

PHOTOGRAPH 25

GEI (2022)

Description:
A view of the culvert outlet downstream at the northern embankment dam.

PHOTOGRAPH 26

GEI (2022)

Description:
A general view of the eastern tributary, looking south / downstream of the upper pond.

PHOTOGRAPH 27

GEI (2022)

Description:
A general view looking north along the eastern tributary.

PHOTOGRAPH 28

GEI (2022)

Description:
A view of the western slope along the lower pond.

PHOTOGRAPH 29

GEI (2022)

Description:
A view of the damaged / destroyed culvert inlet at the upstream face of the lower pond embankment dam. There is erosion and slope failures around the inlet.

PHOTOGRAPH 30

GEI (2022)

Description:
A view of the crest of the lower pond embankment dam.

PHOTOGRAPH 31

GEI (2022)

Description:
A view looking south of the remaining section of the eastern tributary before it flows beneath Mayfield Road through a concrete box culvert.

PHOTOGRAPH 32

GEI (2022)

Description:
A view of the assumed outlet (downstream side) for the culvert that passes beneath the lower pond embankment dam. There is erosion in the area.

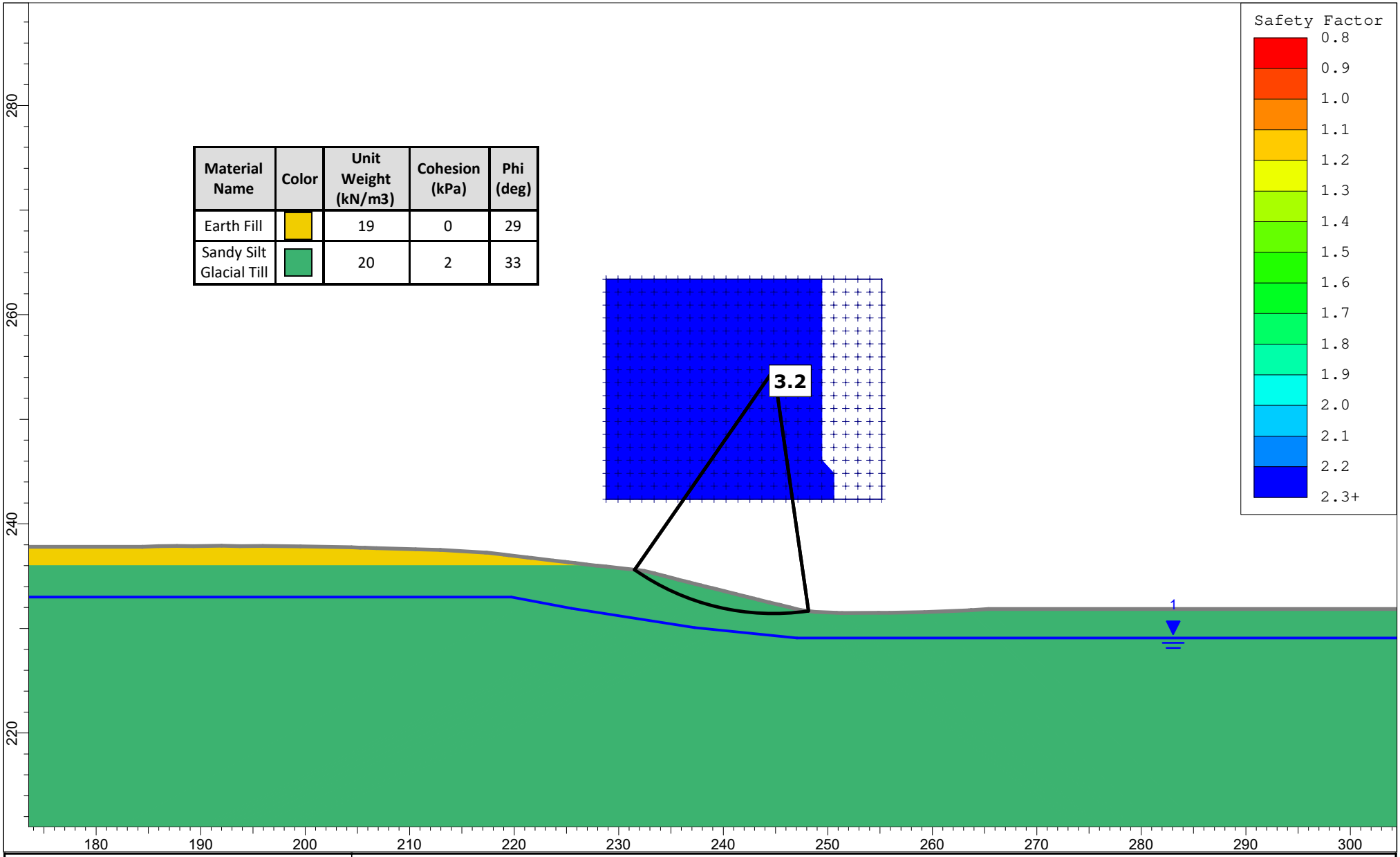
PHOTOGRAPH 33

GEI (2022)

Description:
A general view of the lower pond embankment dam.

Appendix C

Slope Stability Analysis – Existing Conditions



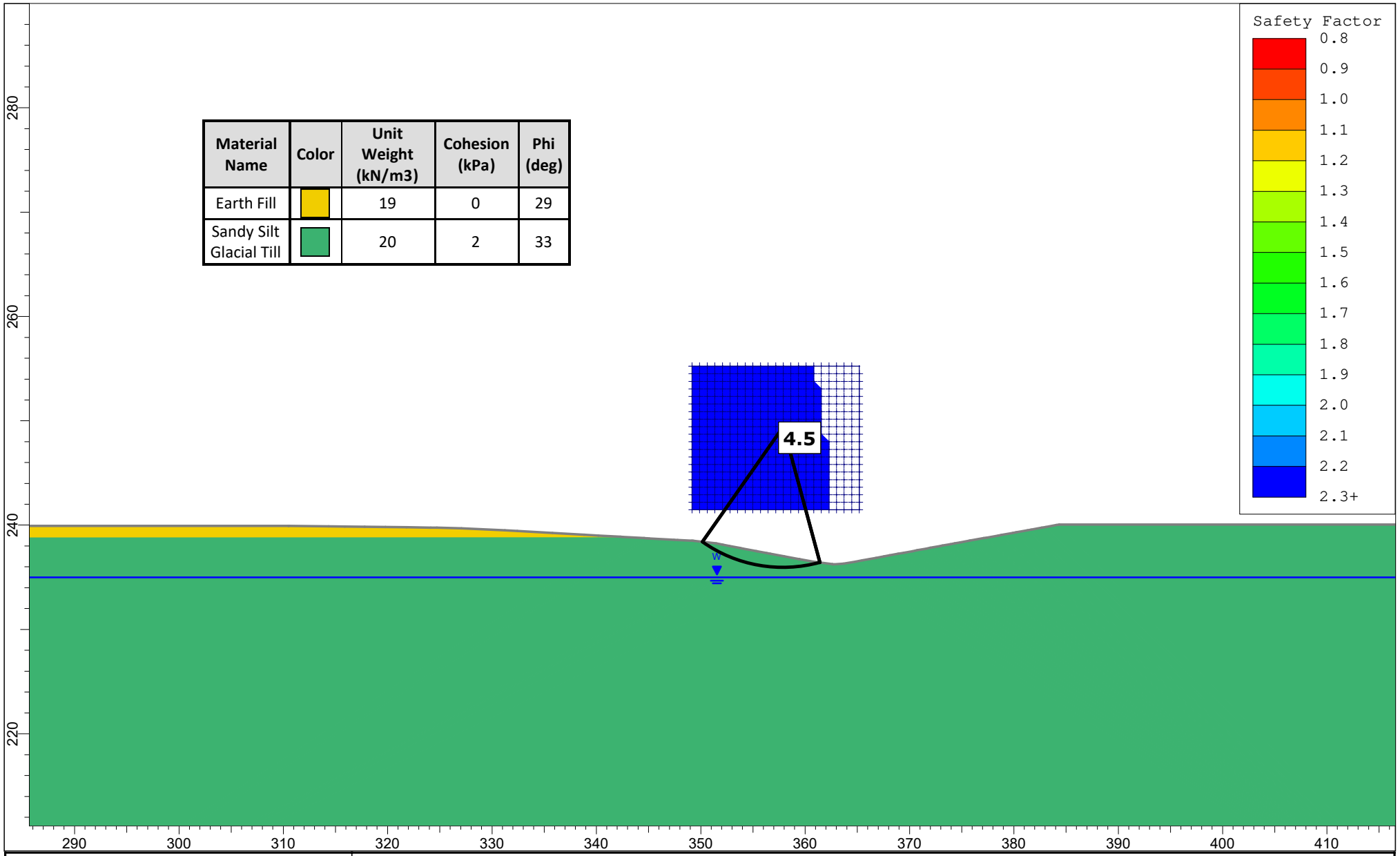
Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Sandy Silt Glacial Till		20	2	33

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 1 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	

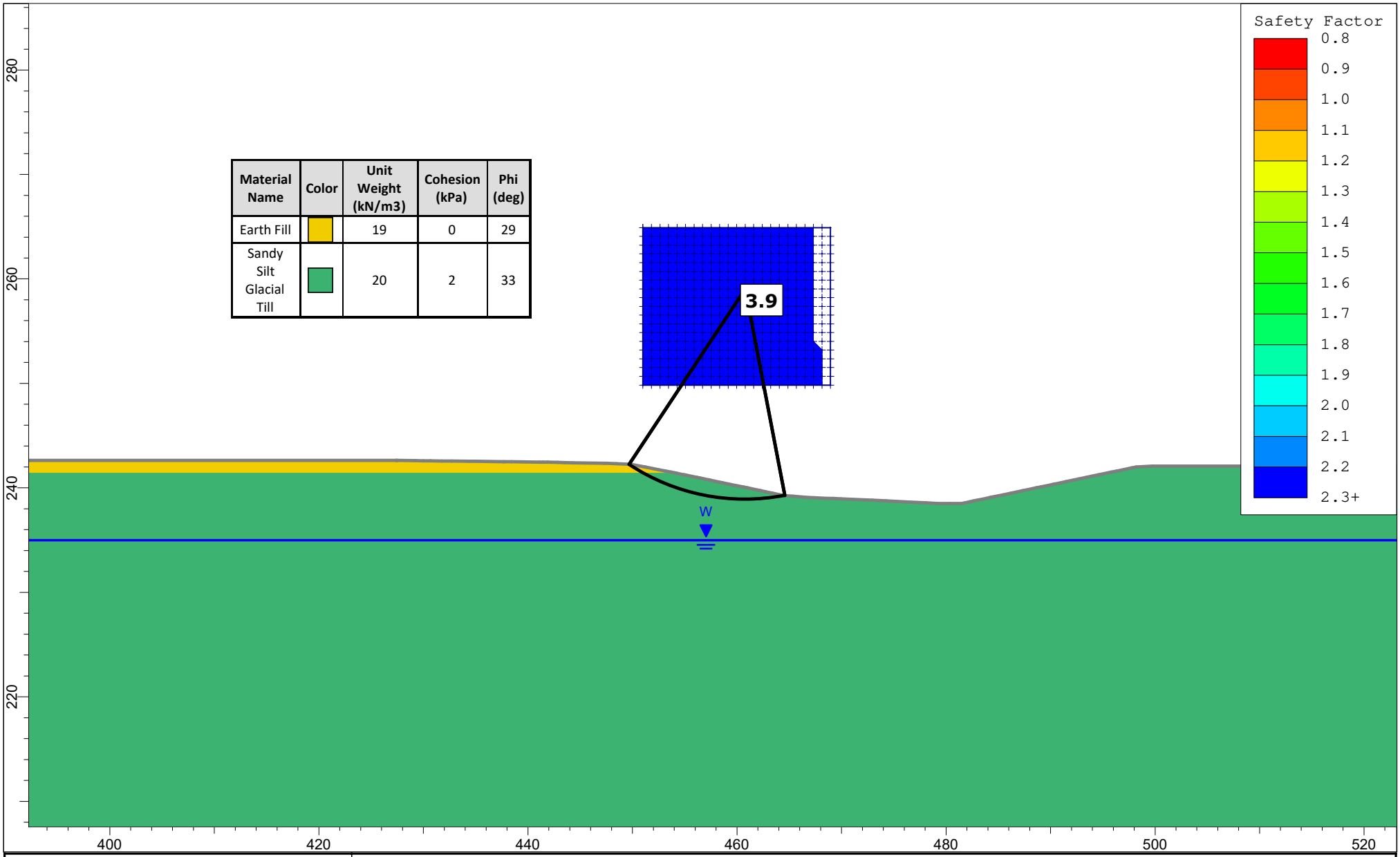
Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Sandy Silt Glacial Till		20	2	33



GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 2 - Existing Conditions		
Drawn By	RW	Scale	1:500
Company	GEI		
Date	2/15/2022	Project No.	2100975

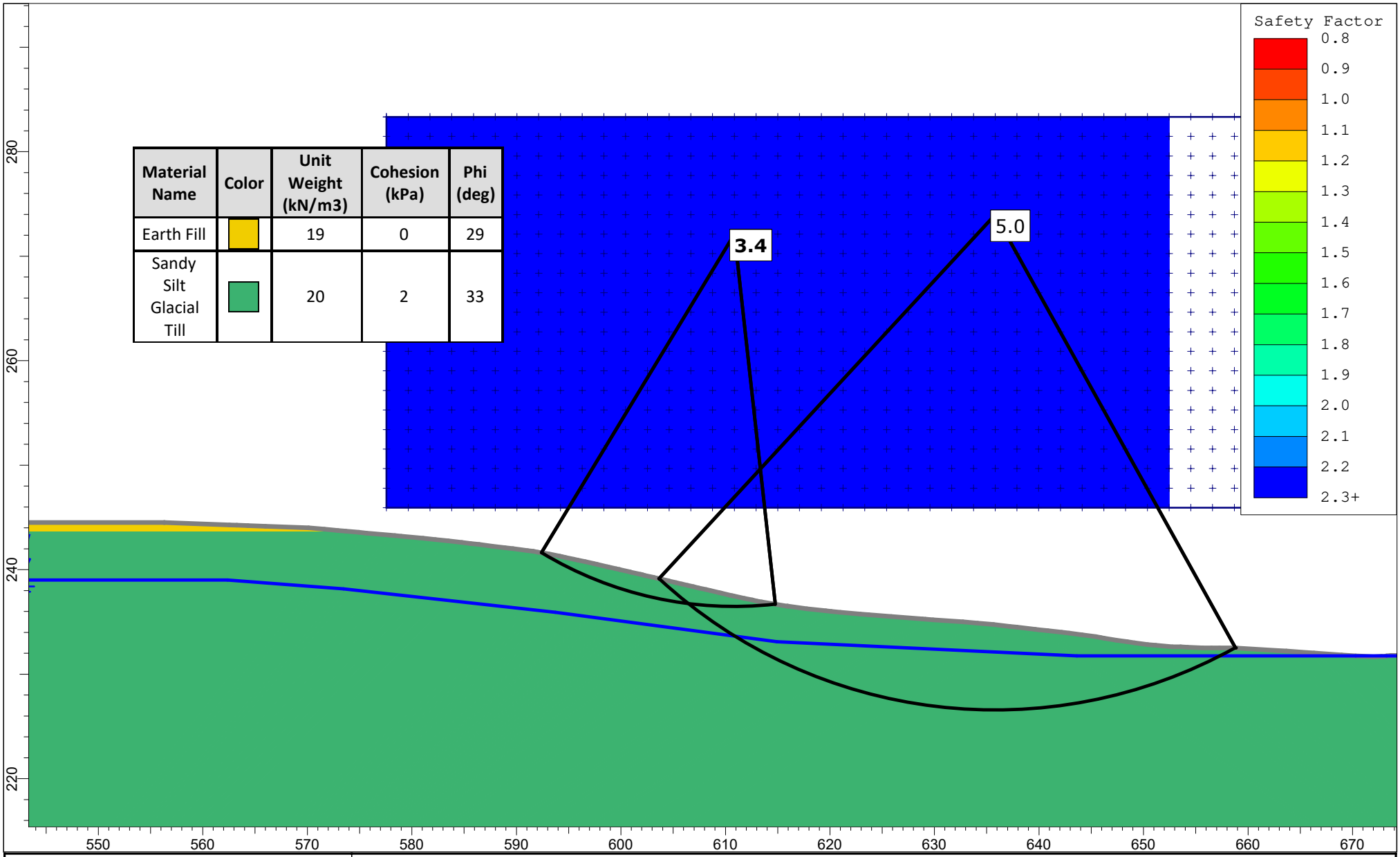


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Sandy Silt Glacial Till		20	2	33

GEI Consultants

SLIDEINTERPRET 9.020

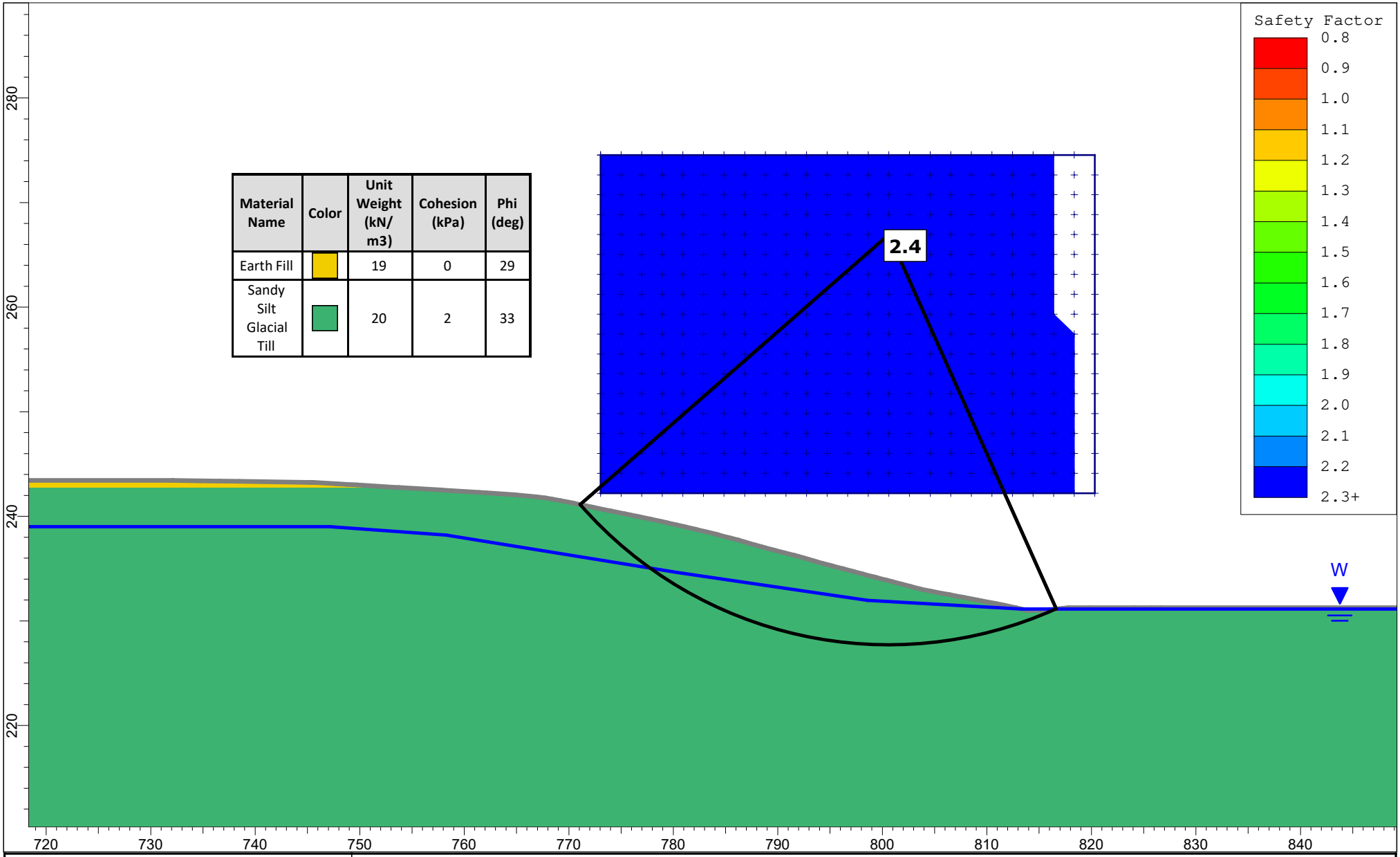
Project	Tullamore Employment Lands		
Analysis Description	Section 3 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	



GEI Consultants

SLIDEINTERPRET 9.020

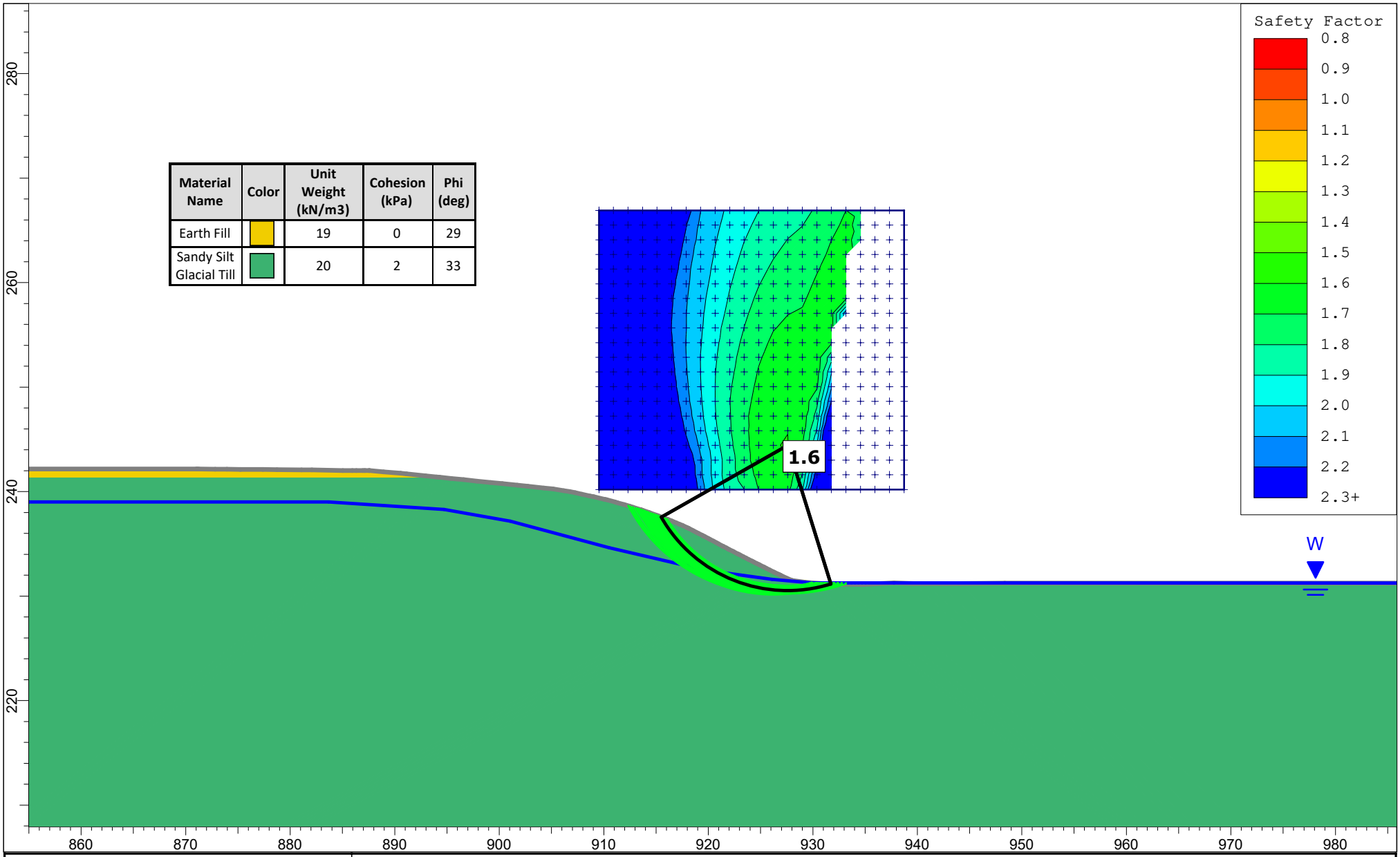
Project	Tullamore Employment Lands		
Analysis Description	Section 4 - Existing Conditions		
Drawn By	RW	Scale	1:500
Company	GEI		
Date	2/15/2022	Project No.	2100975



GEI Consultants

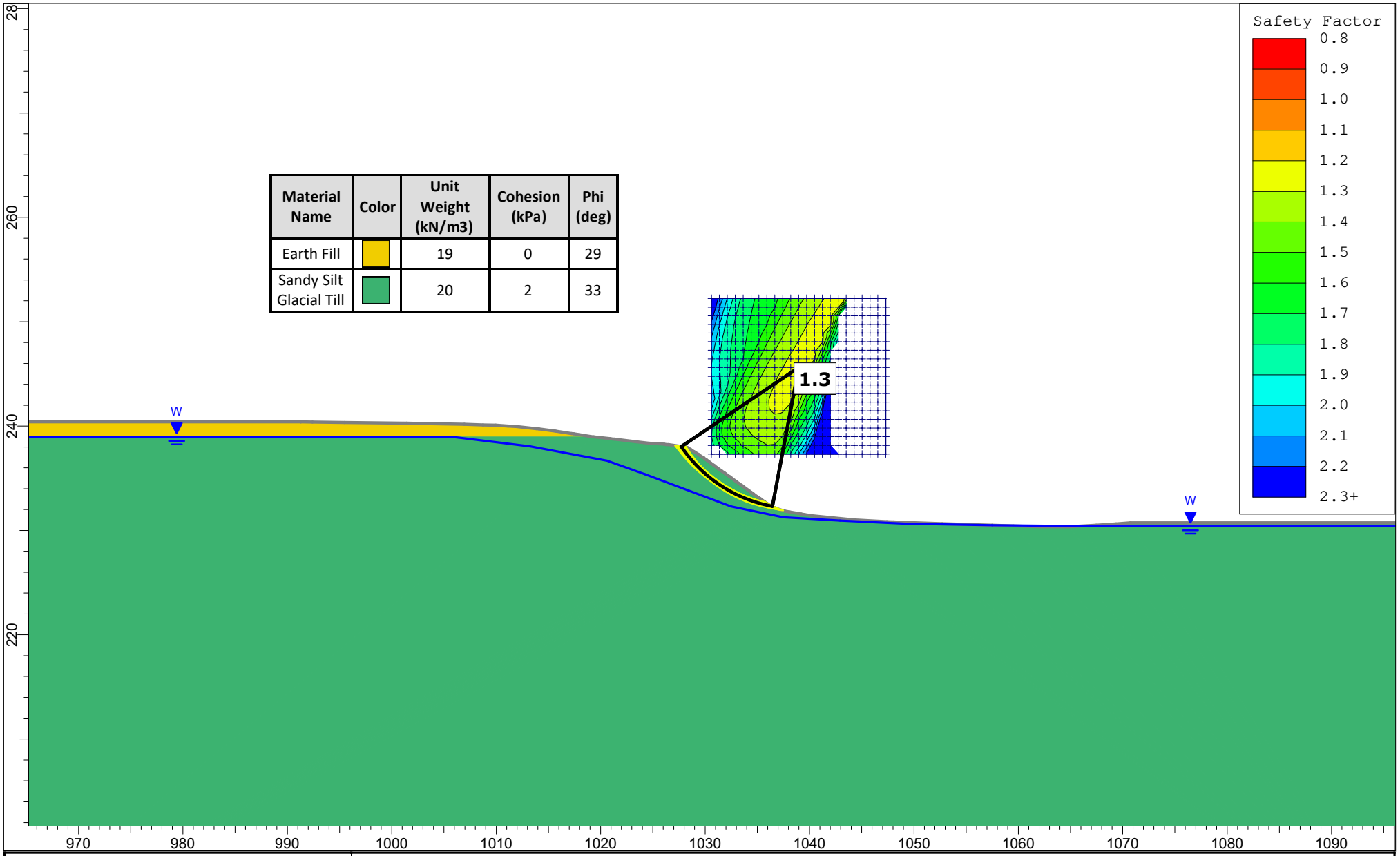
SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 5 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	



GEI Consultants	*Project*	Tullamore Employment Lands	
	Analysis Description	Section 6 - Existing Conditions	
	Drawn By RW	*Scale* 1:500	*Company* GEI
	Date 2/15/2022		*Project No.* 2100975

SLIDEINTERPRET 9.020

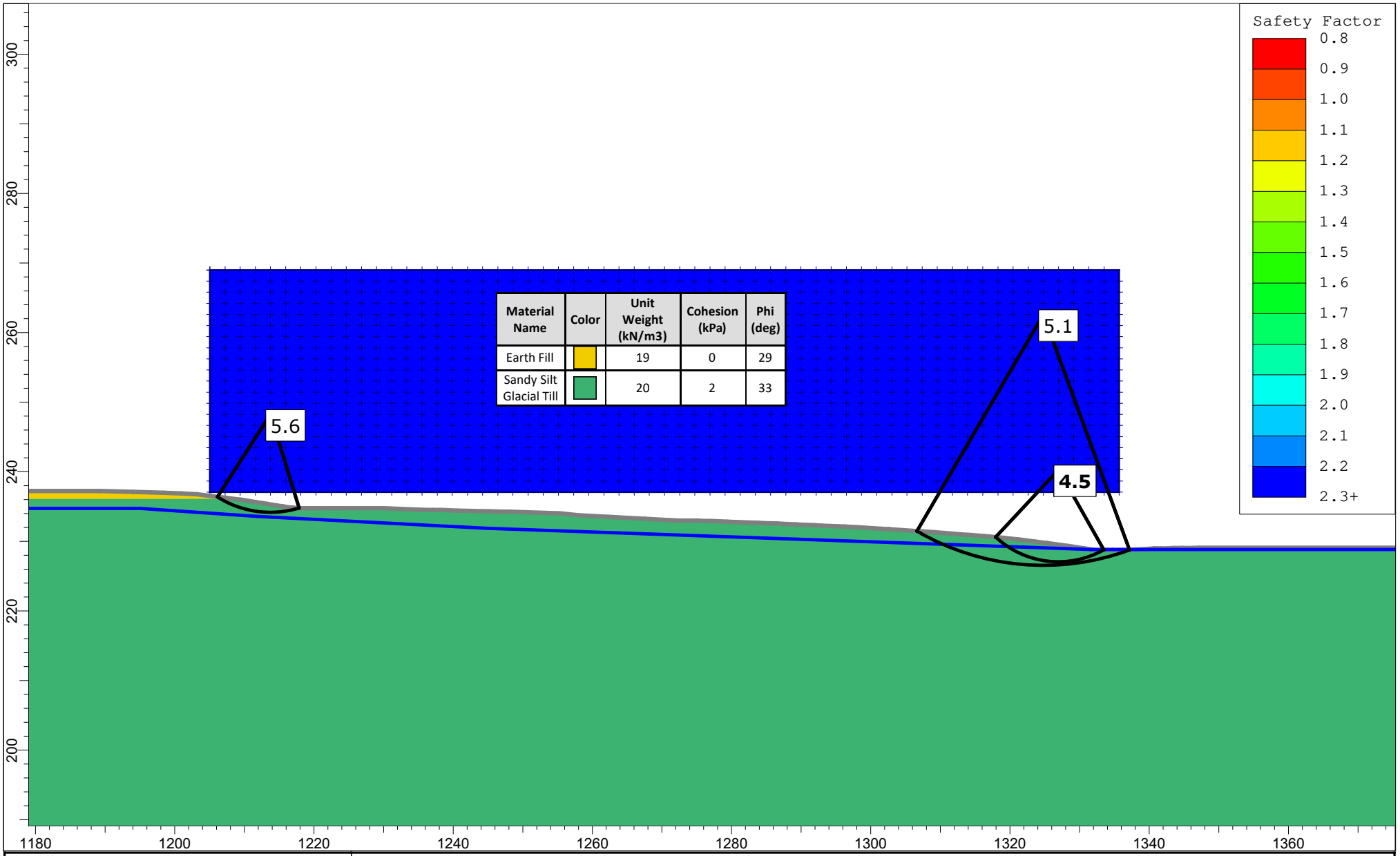


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Sandy Silt Glacial Till		20	2	33

GEI Consultants

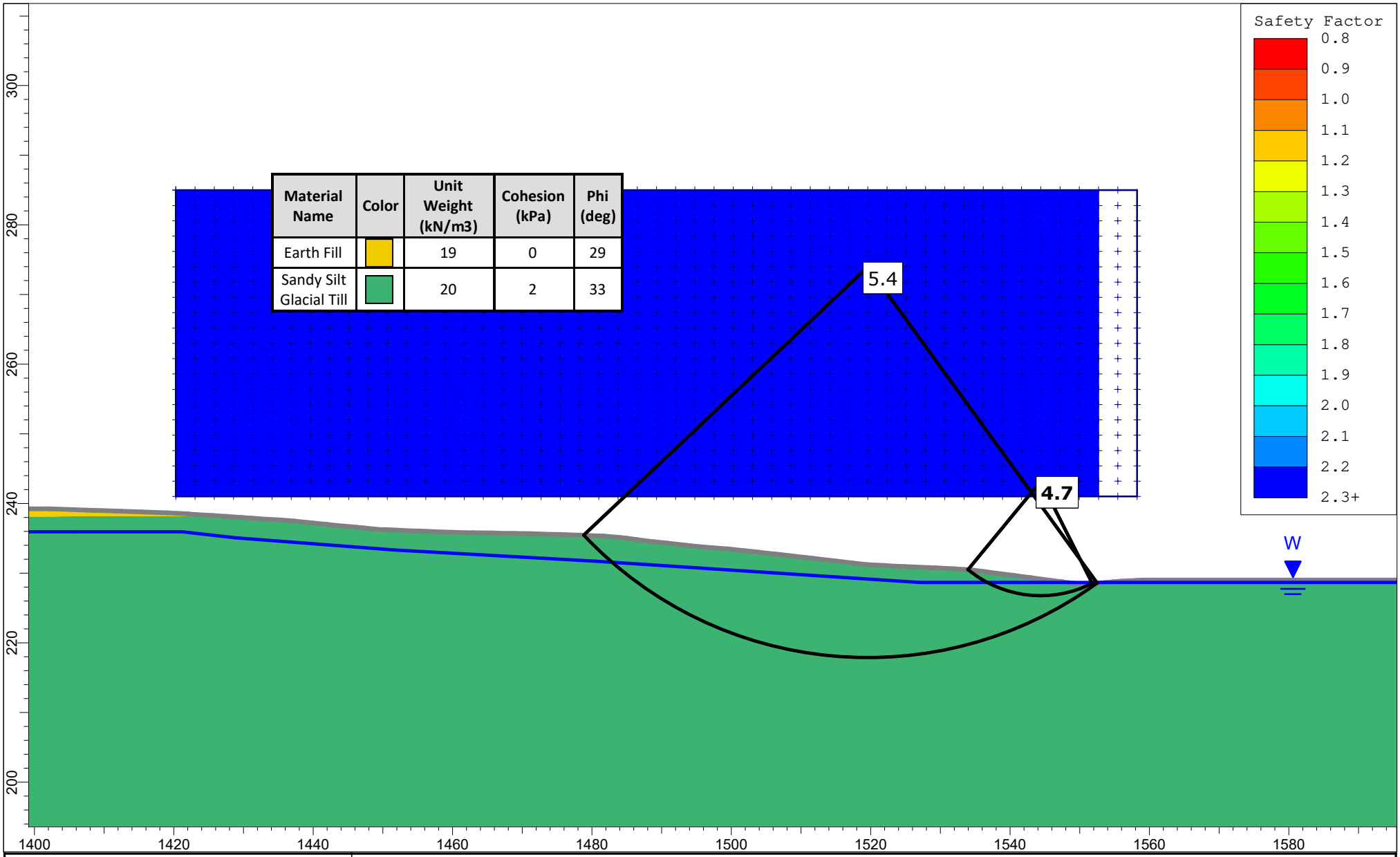
SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 7 - Existing Conditions		
Drawn By	RW	*Scale* 1:500	*Company* GEI
Date	2/15/2022		*Project No.* 2100975



GEI Consultants	Project: Tullamore Employment Lands		
	Analysis Description: Section 8 - Existing Conditions		
	Drawn By: RW	Scale: 1:750	Company: GEI
	Date: 2/15/2022		Project No.: 2100975

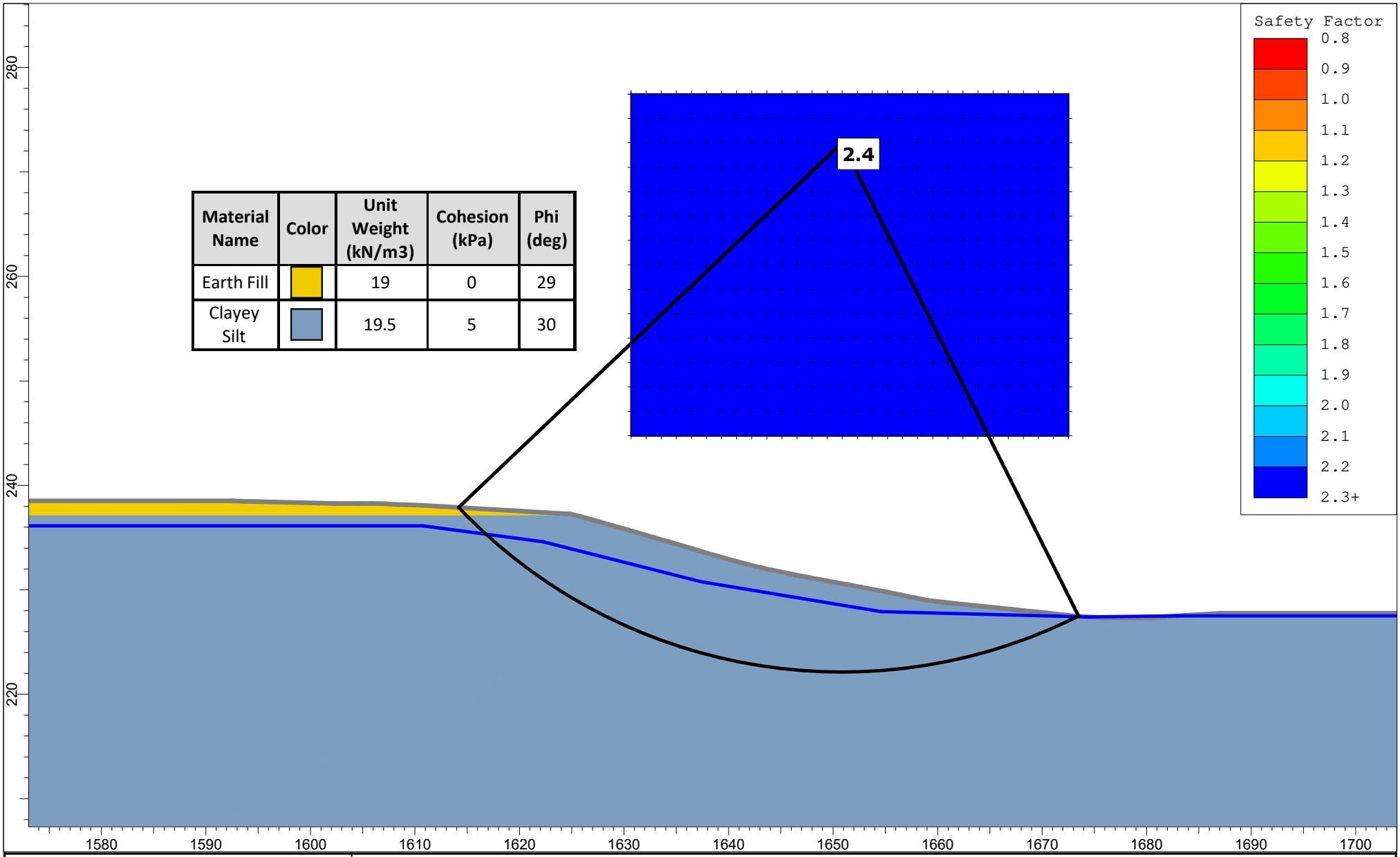
SLIDEINTERPRET 9.020



GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 9 - Existing Conditions		
Drawn By	RW	Scale	1:750
Company	GEI		
Date	2/15/2022	Project No.	2100975

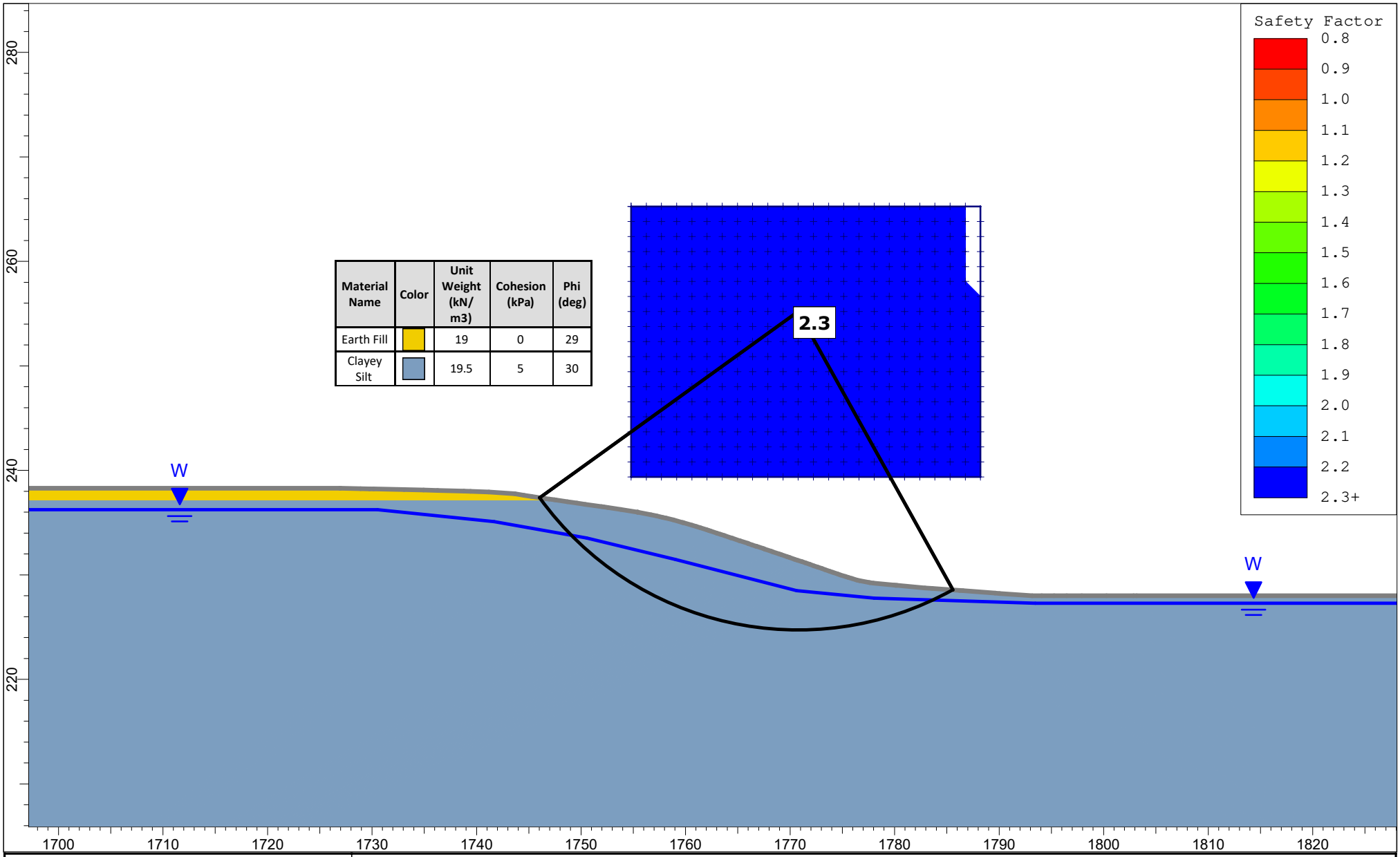


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt		19.5	5	30

GEI Consultants

Project	Tullamore Employment Lands		
Analysis Description	Section 10 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	

SLIDEINTERPRET 9.020

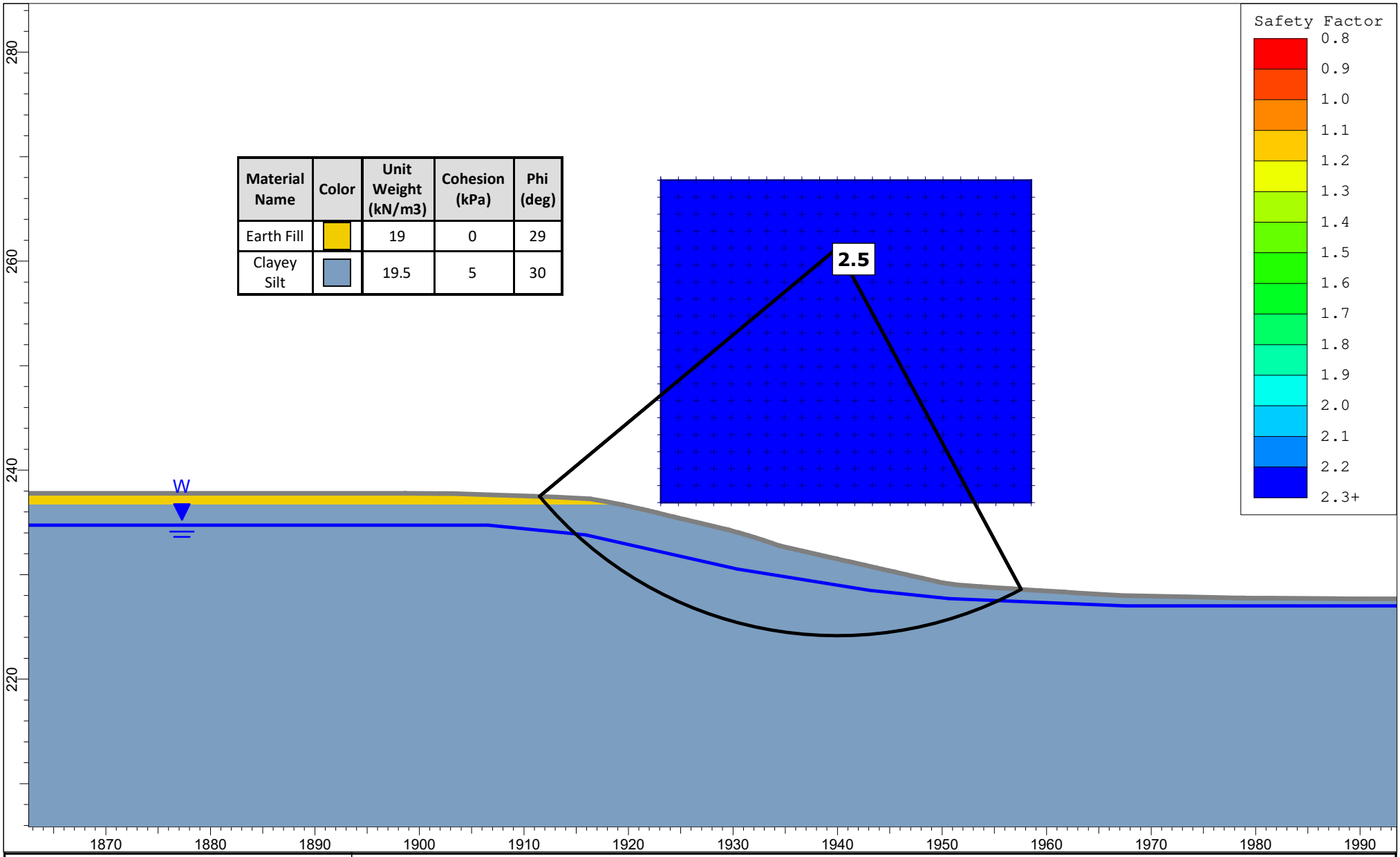


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 11 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	

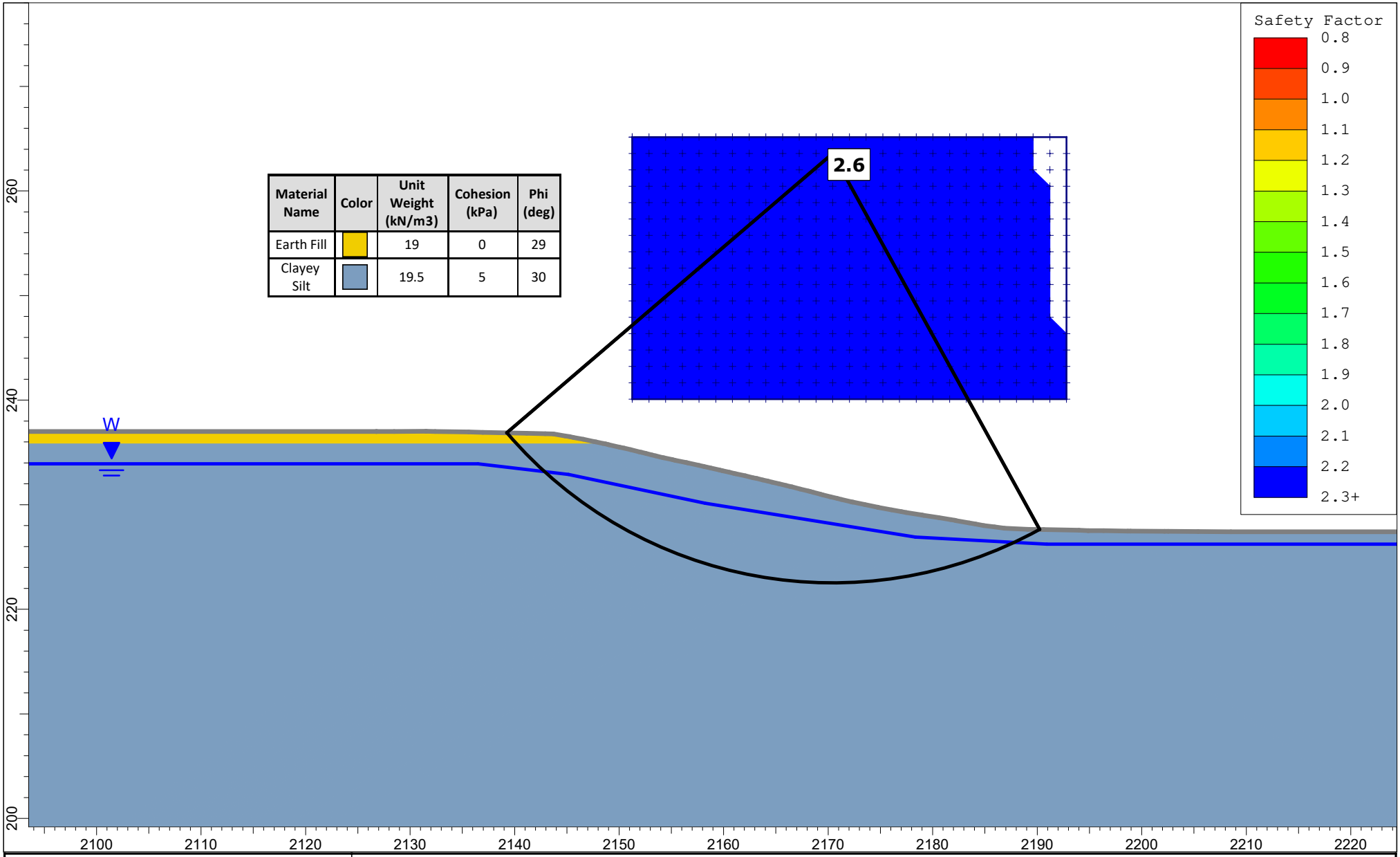


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 12 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	

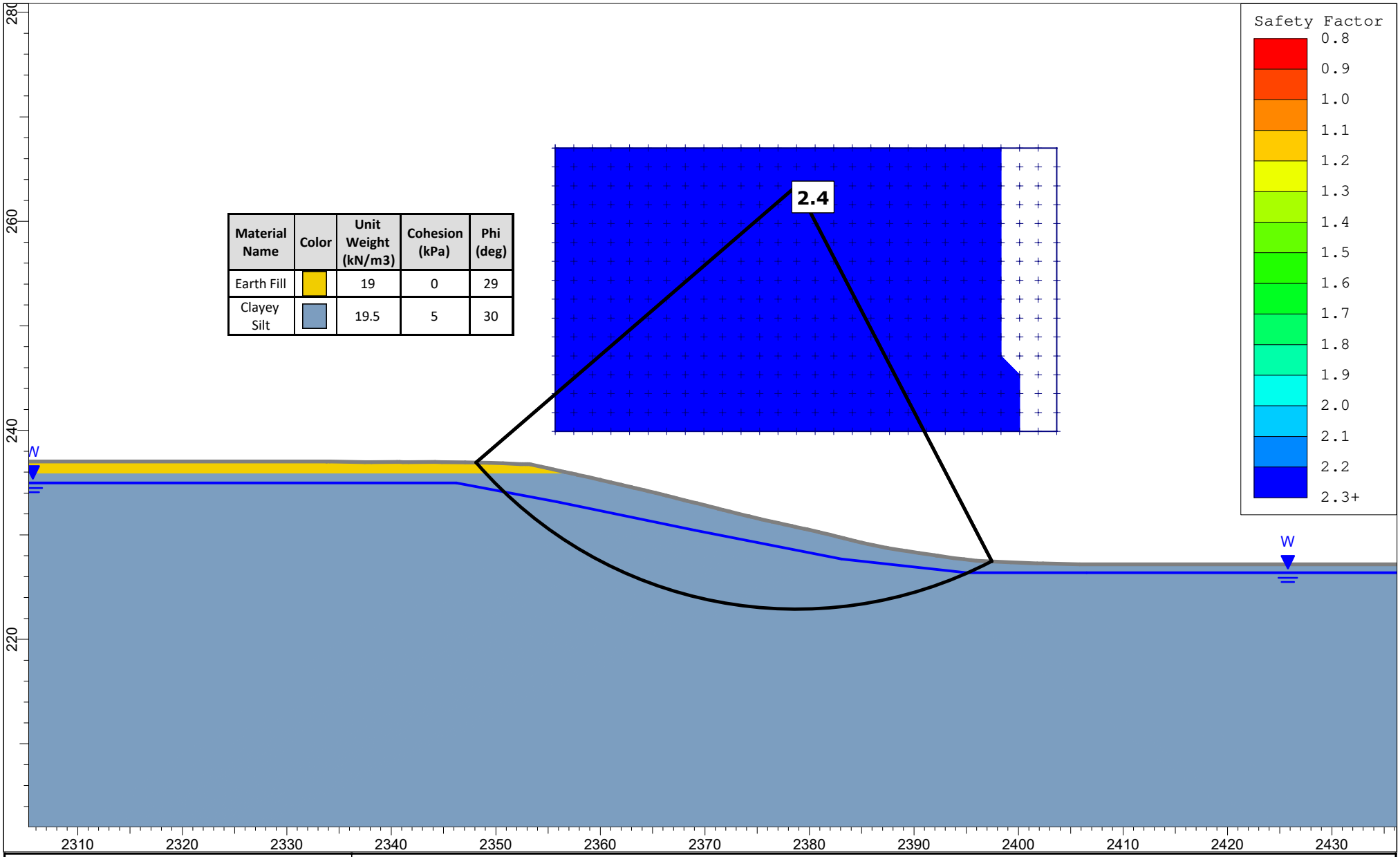


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 13 - Existing Conditions		
Drawn By	RW	*Scale*	1:500
Company	GEI		
Date	2/15/2022	*Project No.*	2100975

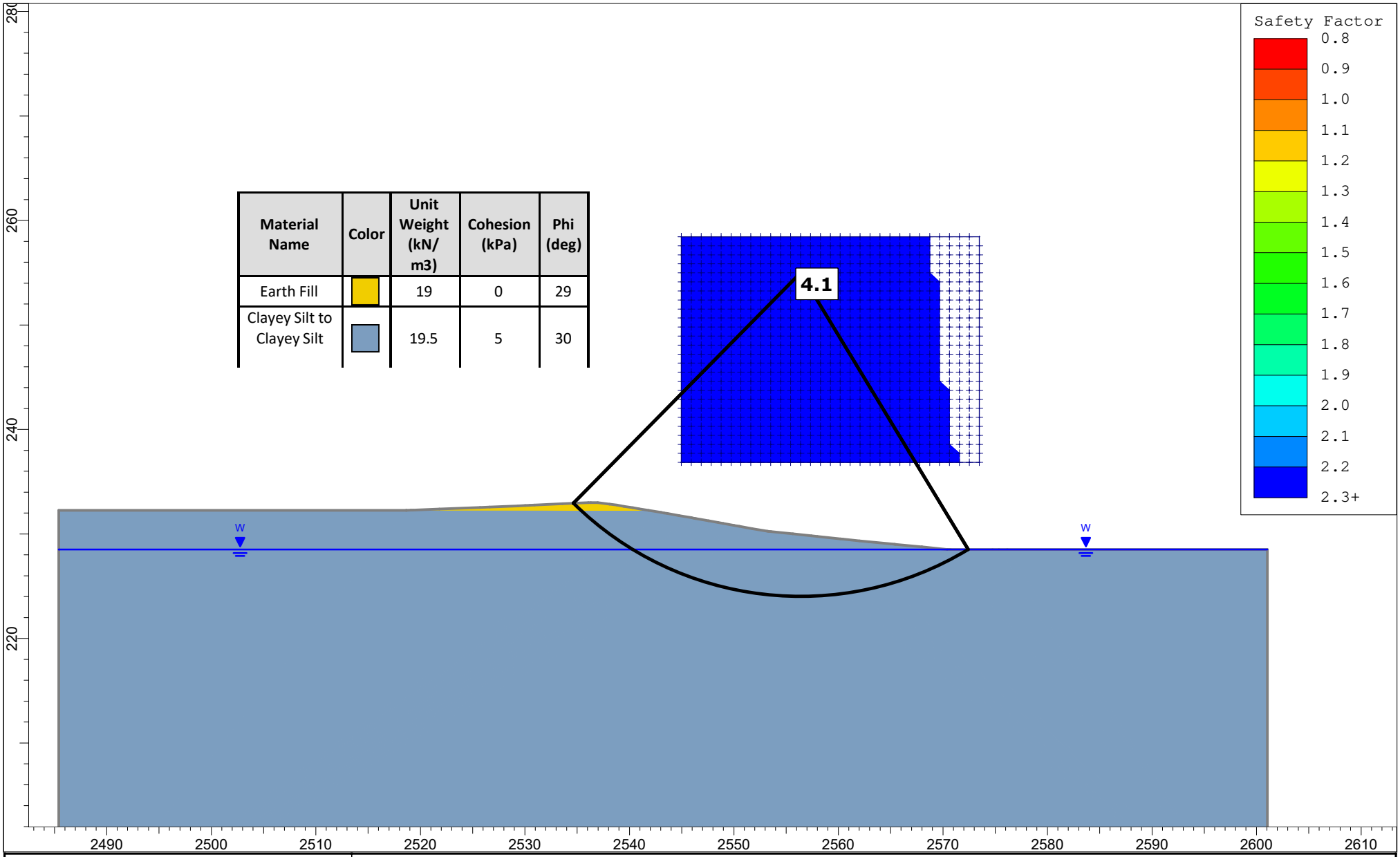


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 14 - Existing Conditions		
Drawn By	RW	*Scale*	1:500
Company	GEI		
Date	2/15/2022	*Project No.*	2100975

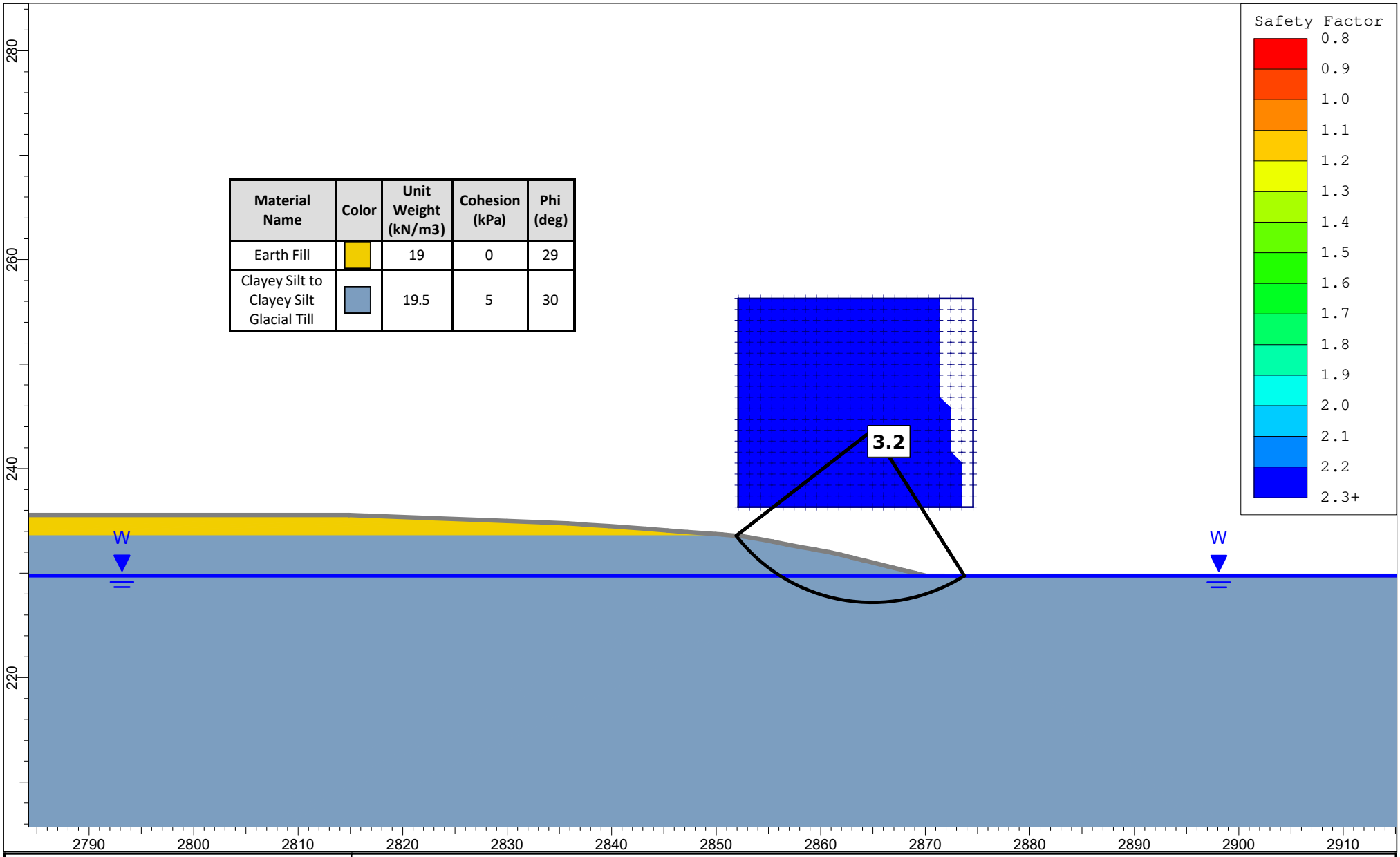


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 15 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	

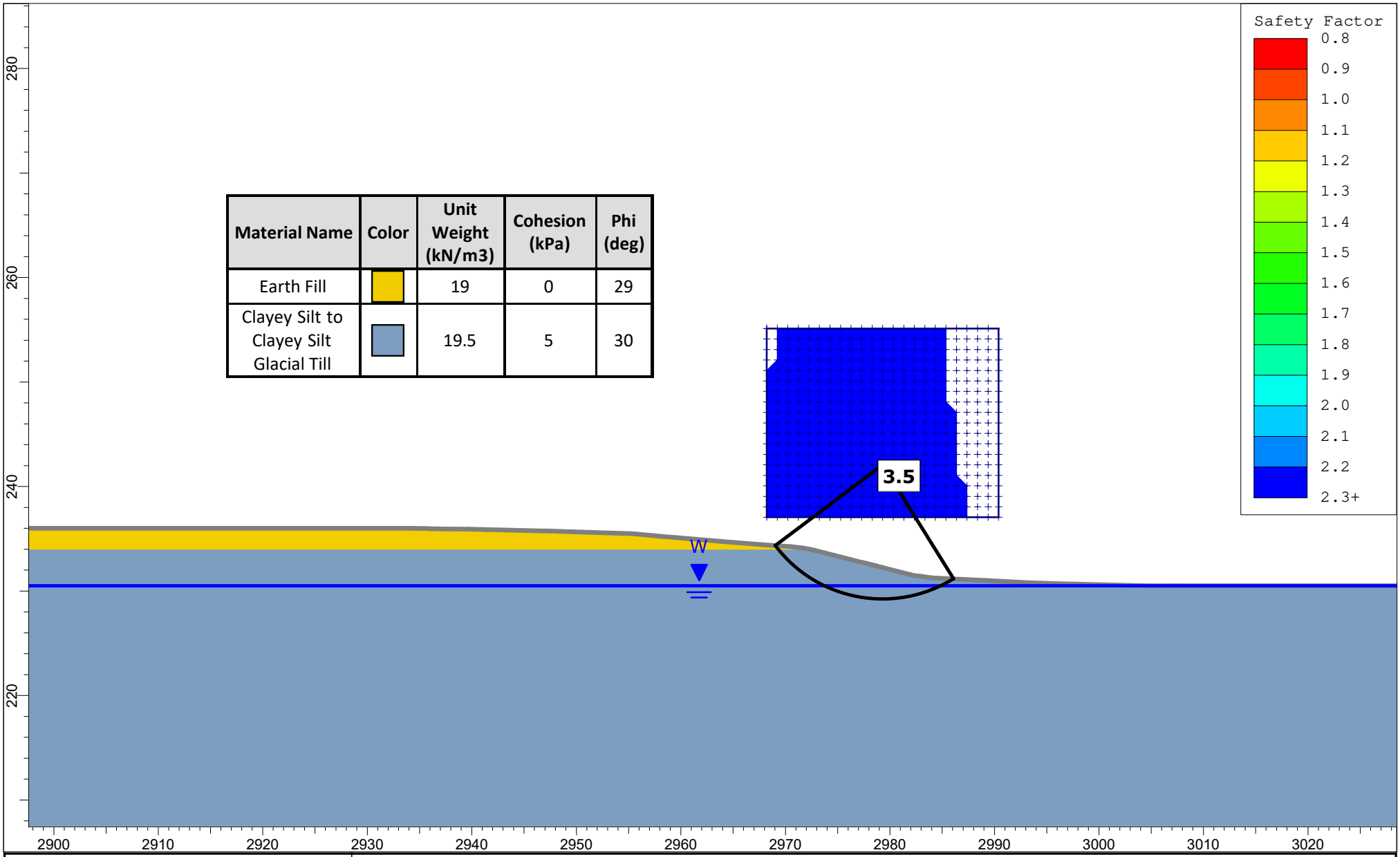


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt Glacial Till		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 18 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	

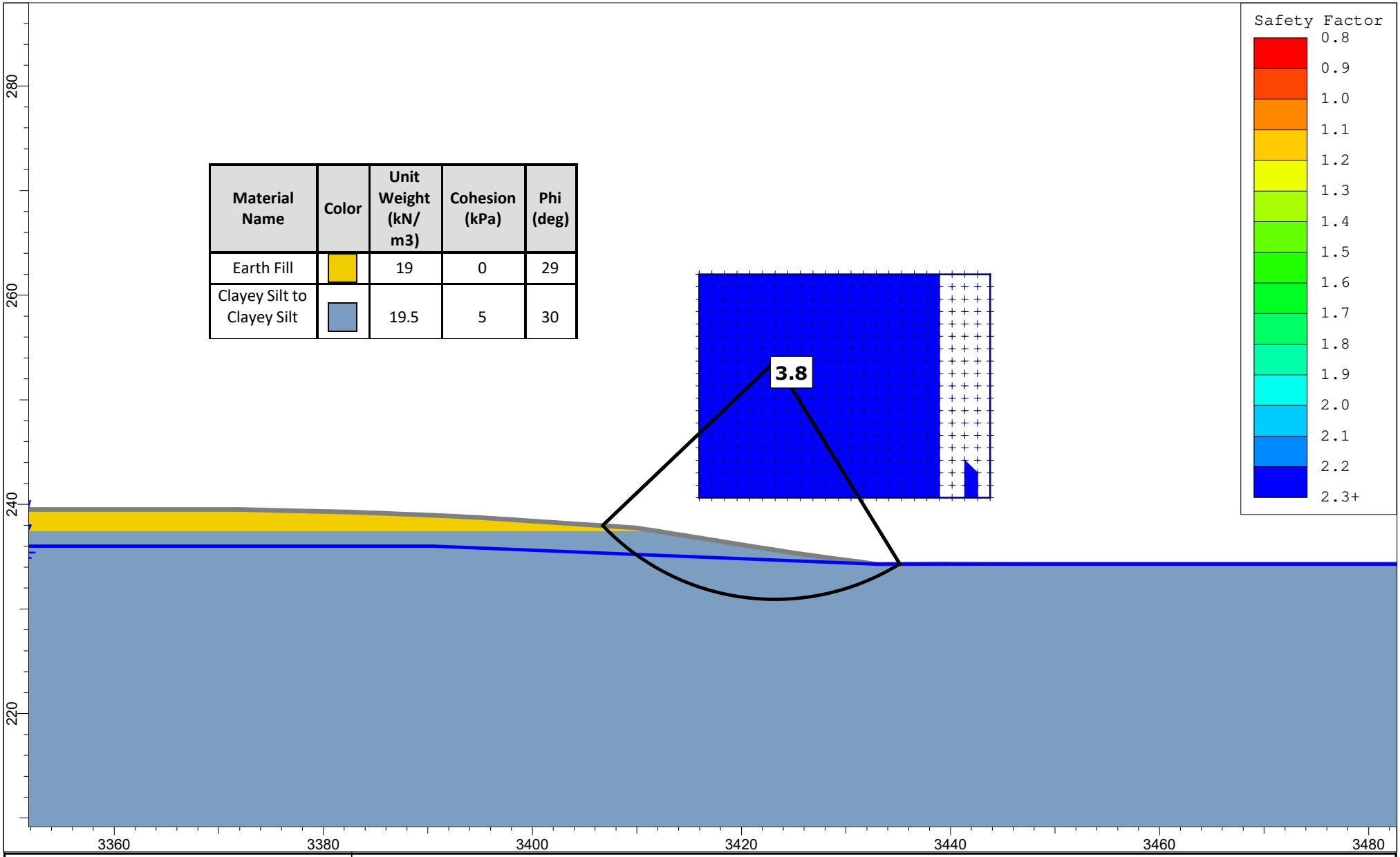


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt Glacial Till		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 19 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	



Material Name	Color	Unit Weight (kN/ m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt		19.5	5	30

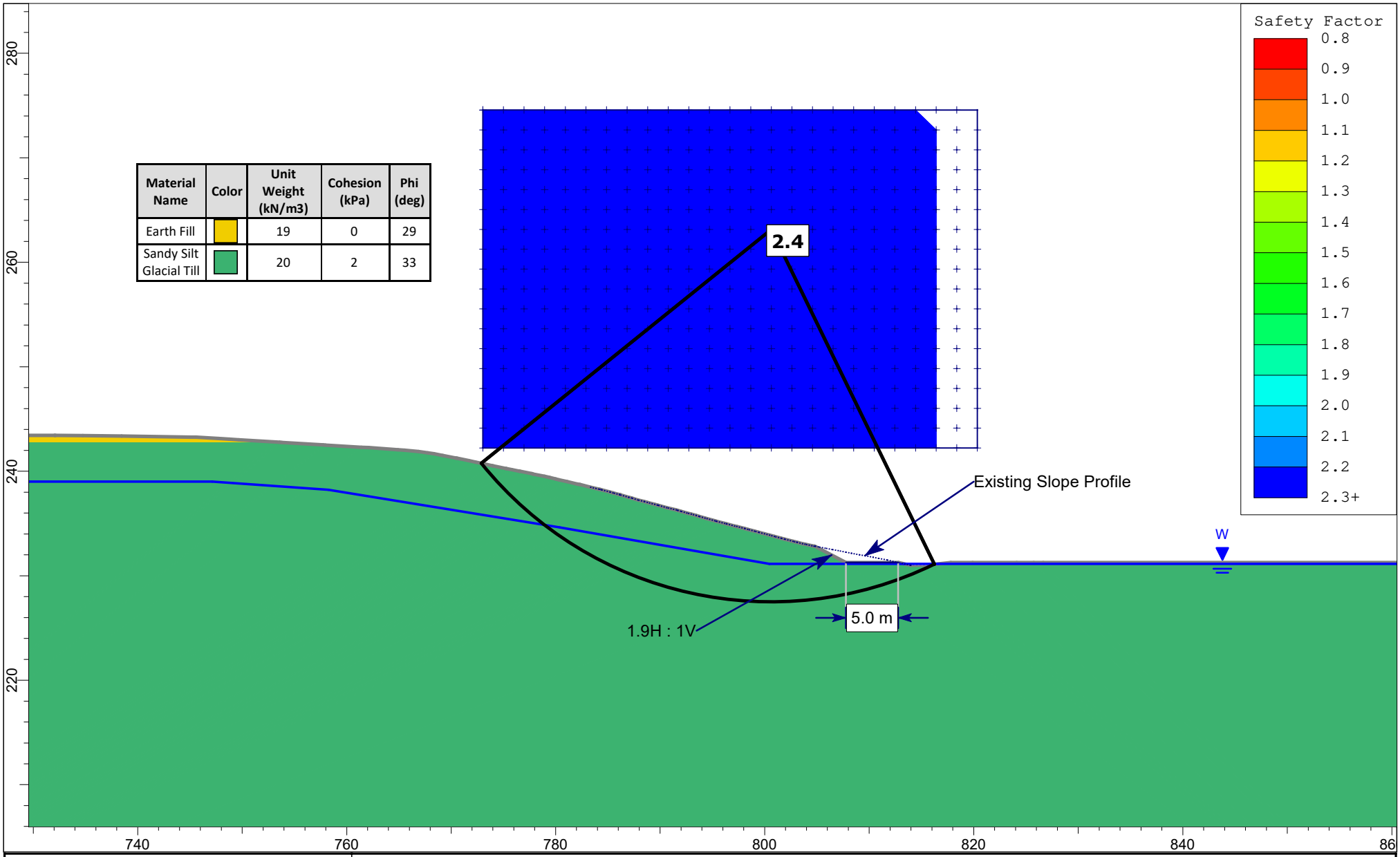
GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 22 - Existing Conditions		
Drawn By RW	*Scale* 1:500	*Company* GEI	
Date 2/15/2022		*Project No.* 2100975	

Appendix D

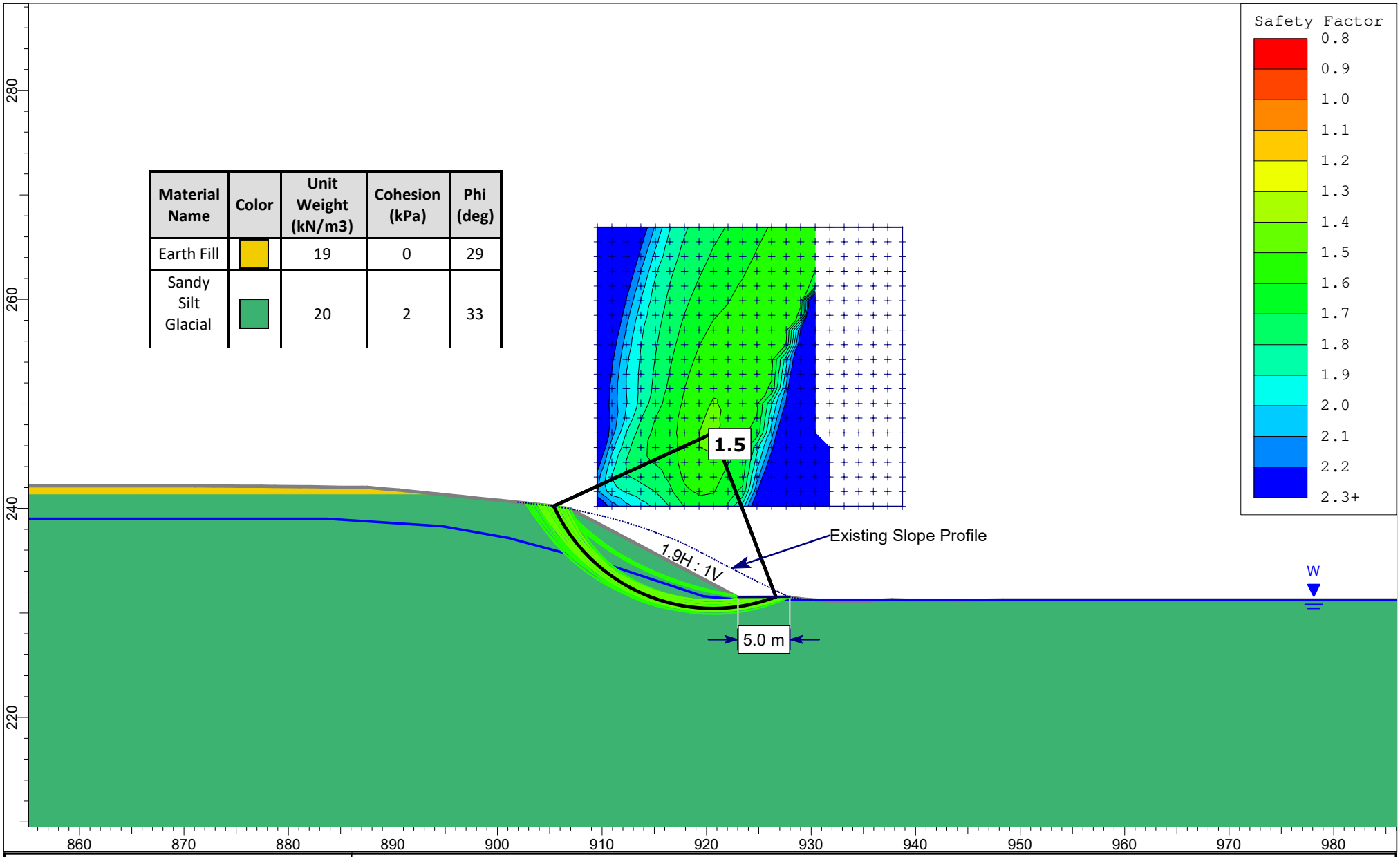
Slope Stability Analysis – LTSTOS Position



Project	Tullamore Employment Lands		
Analysis Description	Section 5 - LTSTOS Position		
Drawn By: RW	Scale: 1:500	Company: GEI	
Date: 2/15/2022		Project No.: 2100975	

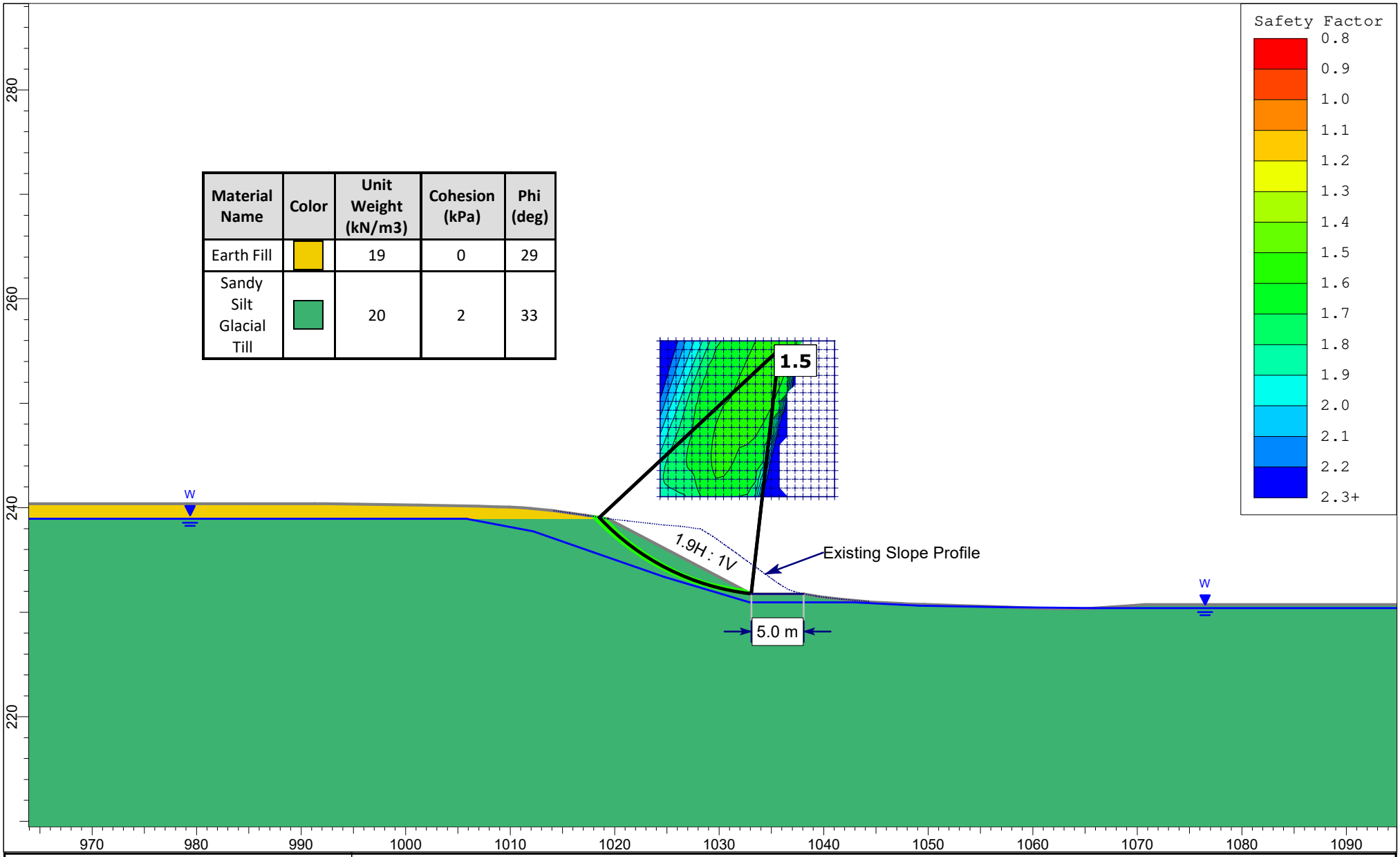
GEI Consultants

SLIDEINTERPRET 9.020



GEI Consultants	Project	Tullamore Employment Lands	
	Analysis Description	Section 6 - LTSTOS Position	
	Drawn By: RW	Scale: 1:500	Company: GEI
	Date: 2/15/2022		Project No.: 2100975

SLIDEINTERPRET 9.020

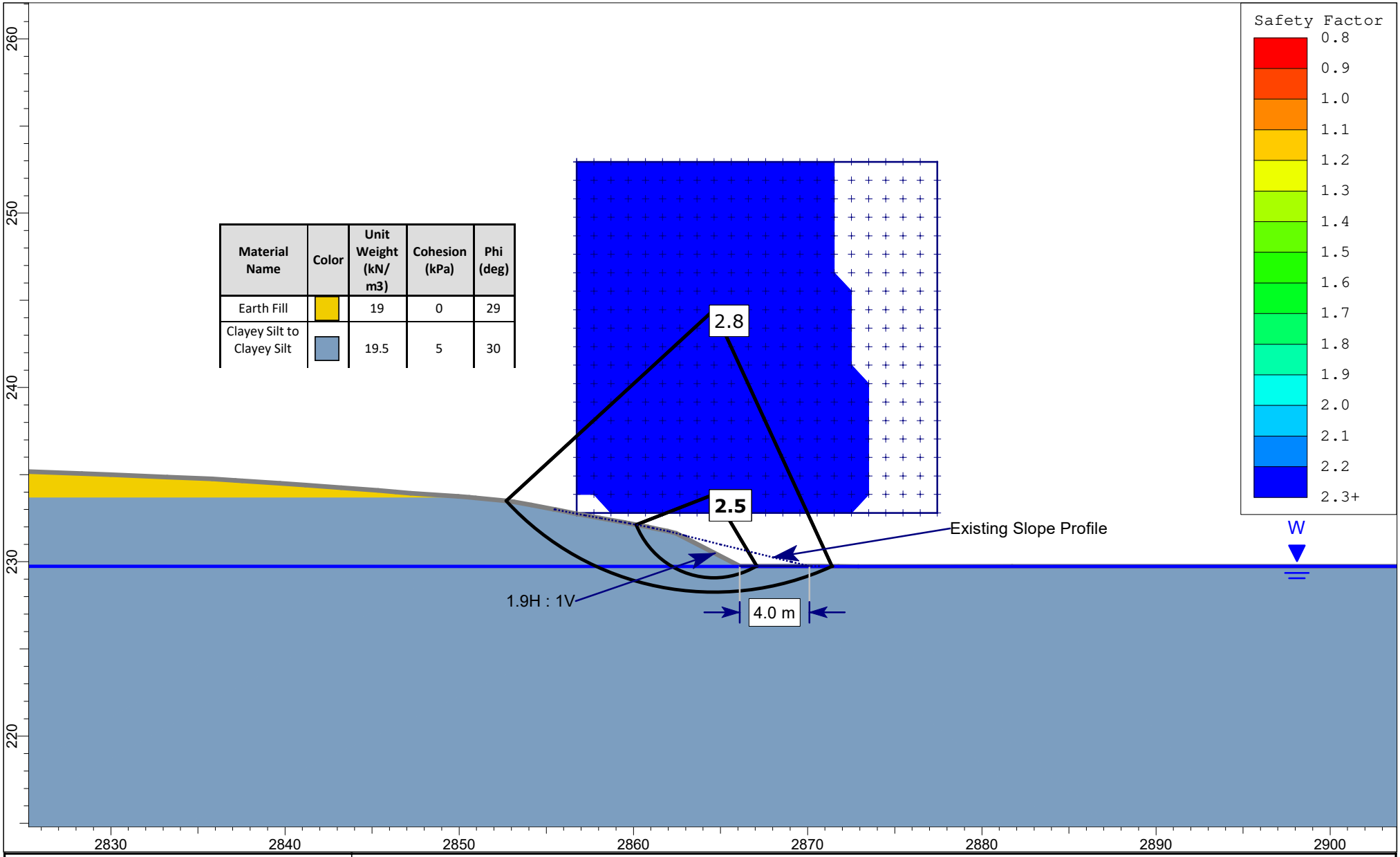


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Sandy Silt Glacial Till		20	2	33

GEI Consultants

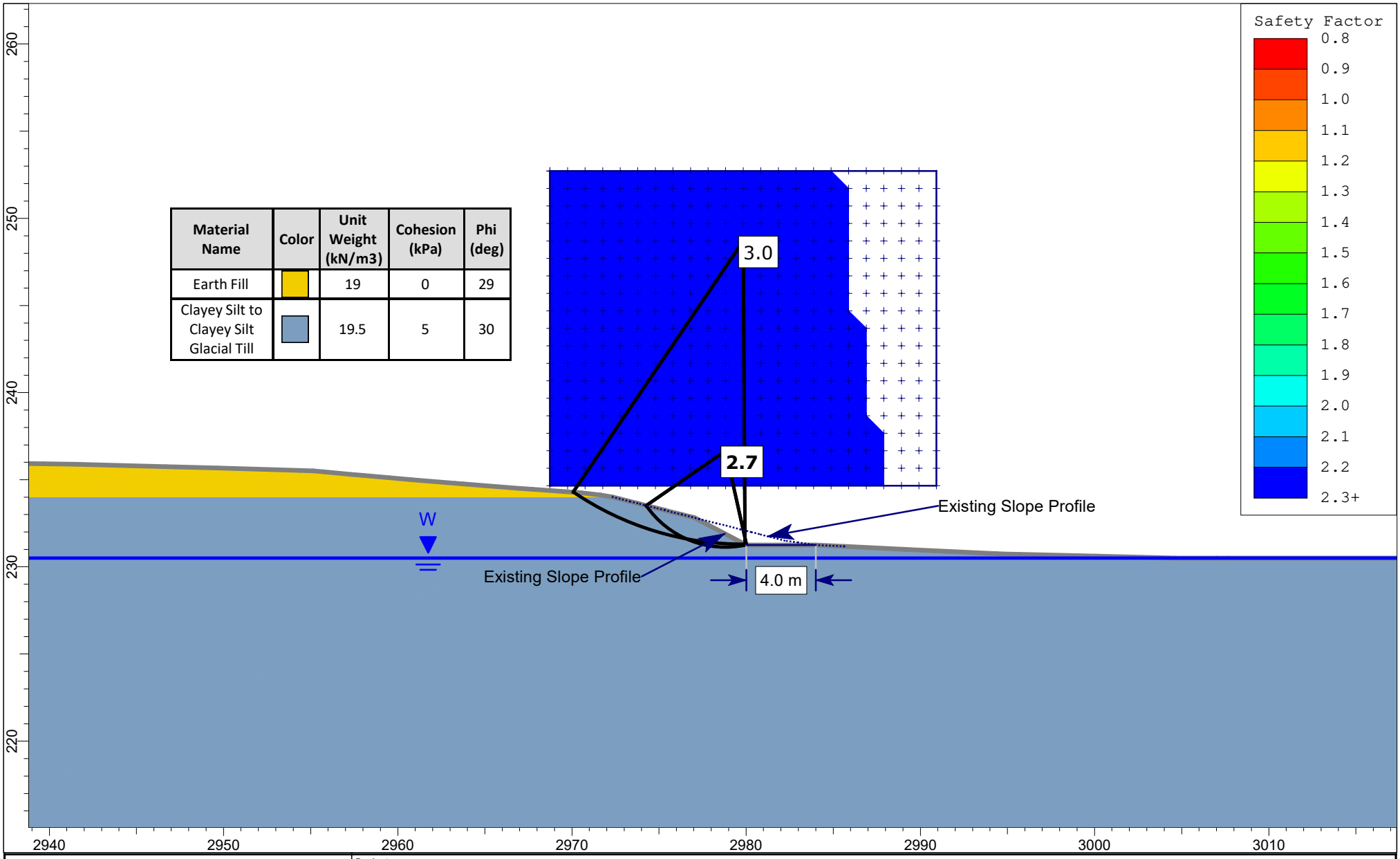
SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 7 - LTSTOS Position		
Drawn By	RW	Scale	1:500
Company	GEI		
Date	2/15/2022	Project No.	2100975



GEI Consultants	Project: Tullamore Employment Lands		
	Analysis Description: Section 18 - LTSTOS Position		
	Drawn By: RW	Scale: 1:300	Company: GEI
	Date: 2/15/2022		Project No.: 2100975

SLIDEINTERPRET 9.020



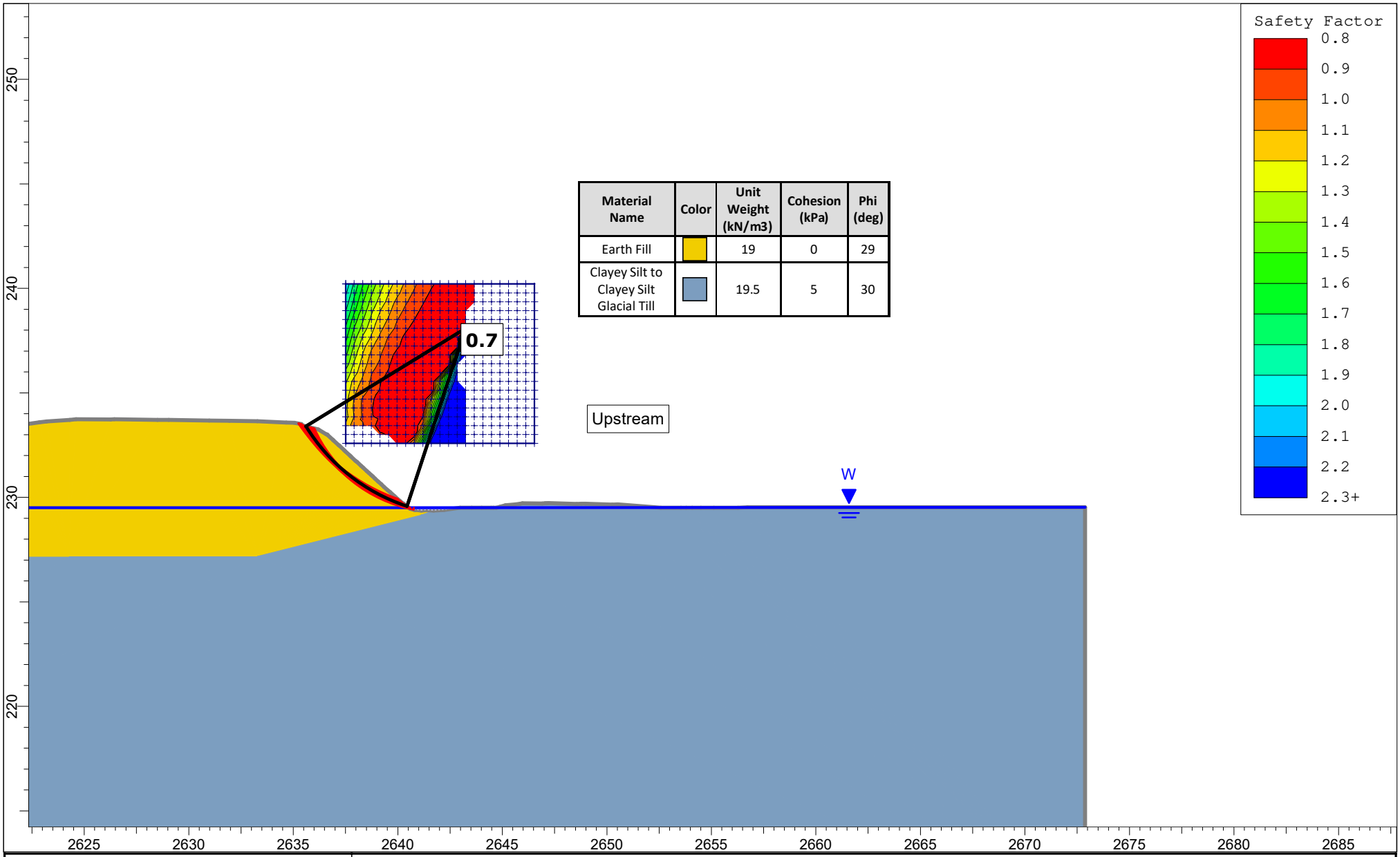
GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 19 - LTSTOS Position		
Drawn By	RW	Scale	1:300
Company	GEI		
Date	2/15/2022	Project No.	2100975

Appendix E

Slope Stability Analysis – Embankment Dams

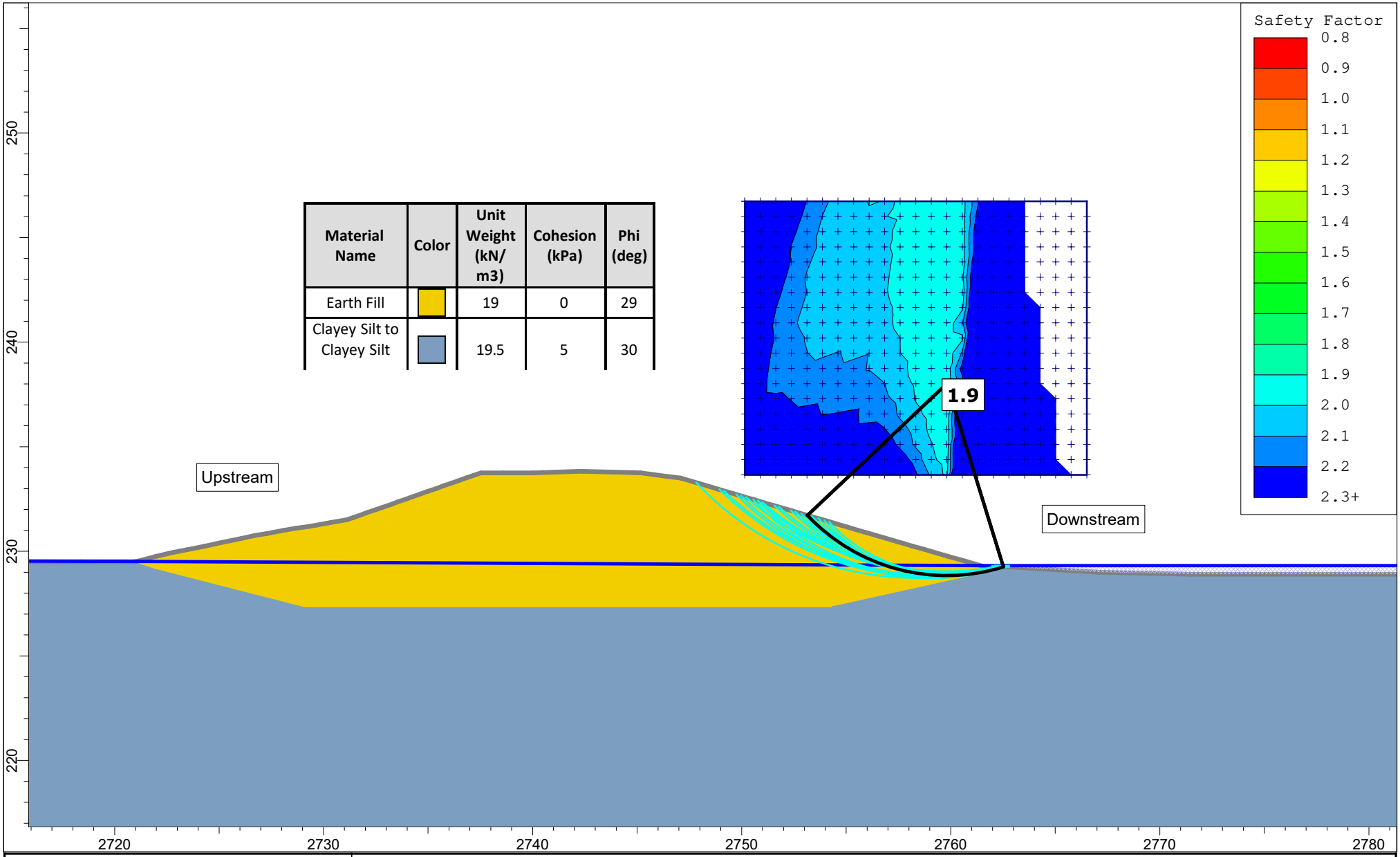


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt Glacial Till		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 16 - Lower Pond, Embankment Dam at Culvert Inlet - Long-Term		
Drawn By	RW	*Scale* 1:250	*Company* GEI
Date	2/17/2022		*Project No.* 2100975

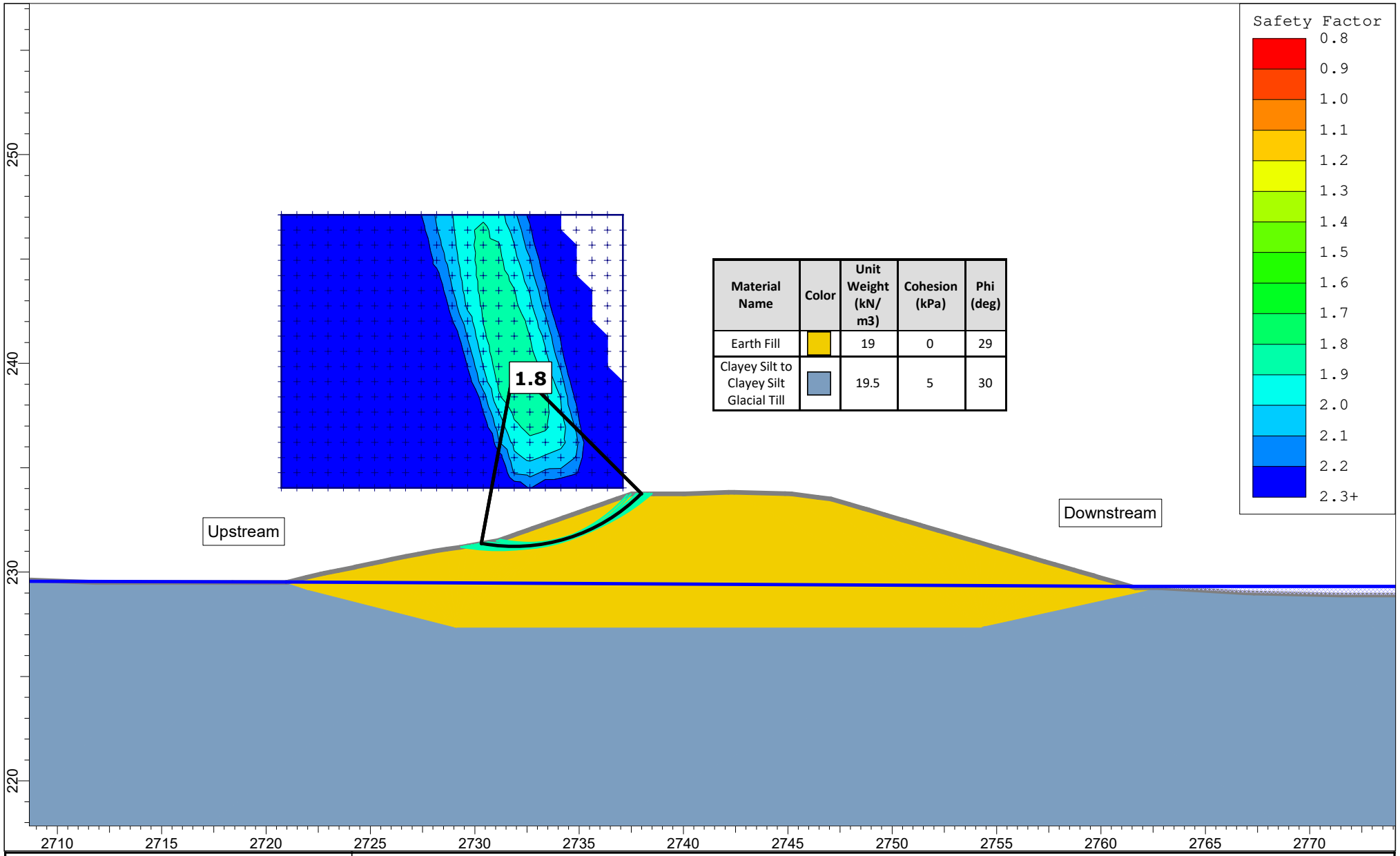


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 17 - Lower Pond Embankment Dam, Downstream - Long-Term		
Drawn By	RW	*Scale* 1:250	*Company* GEI
Date	2/17/2022		*Project No.* 2100975

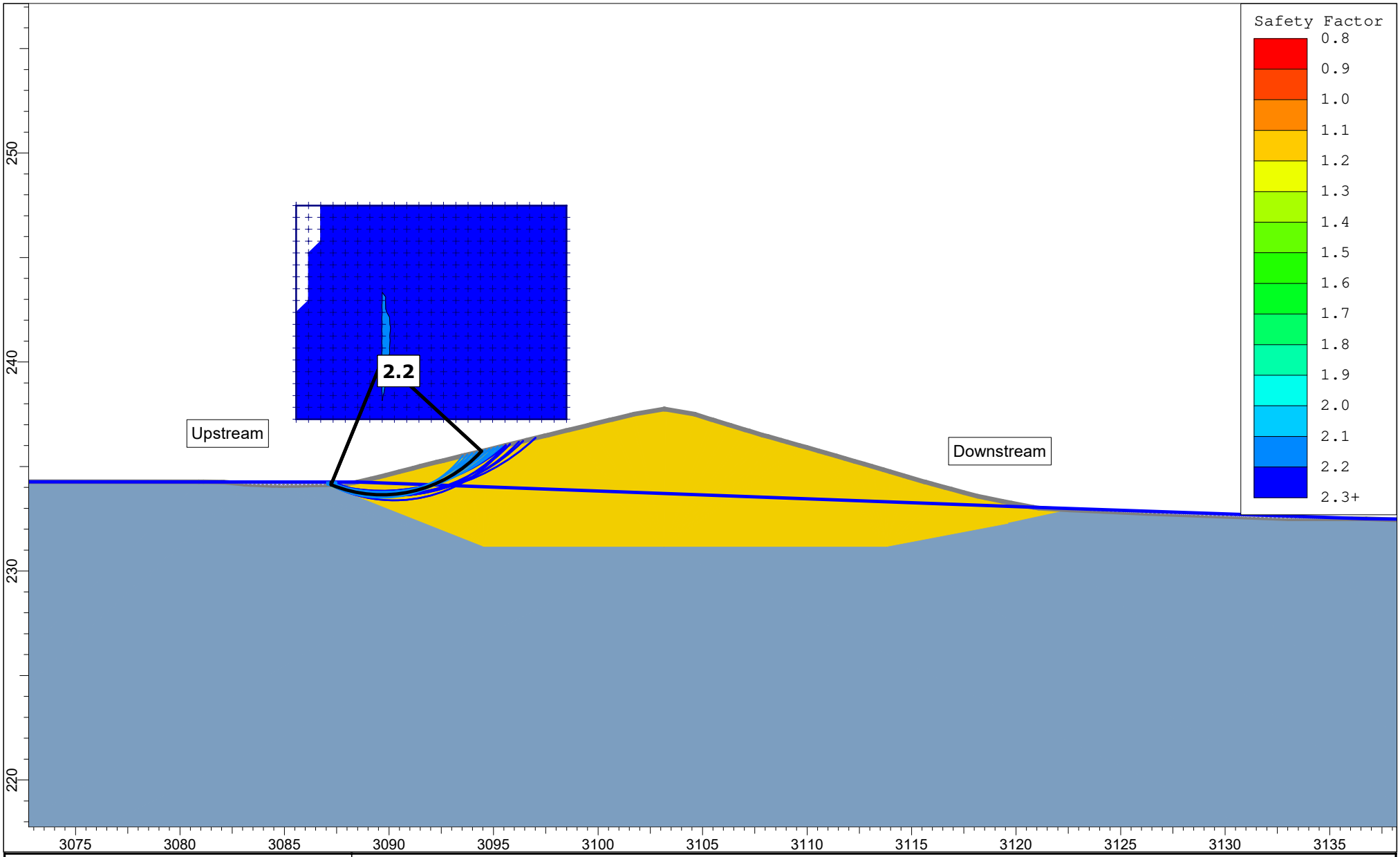


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt Glacial Till		19.5	5	30

GEI Consultants

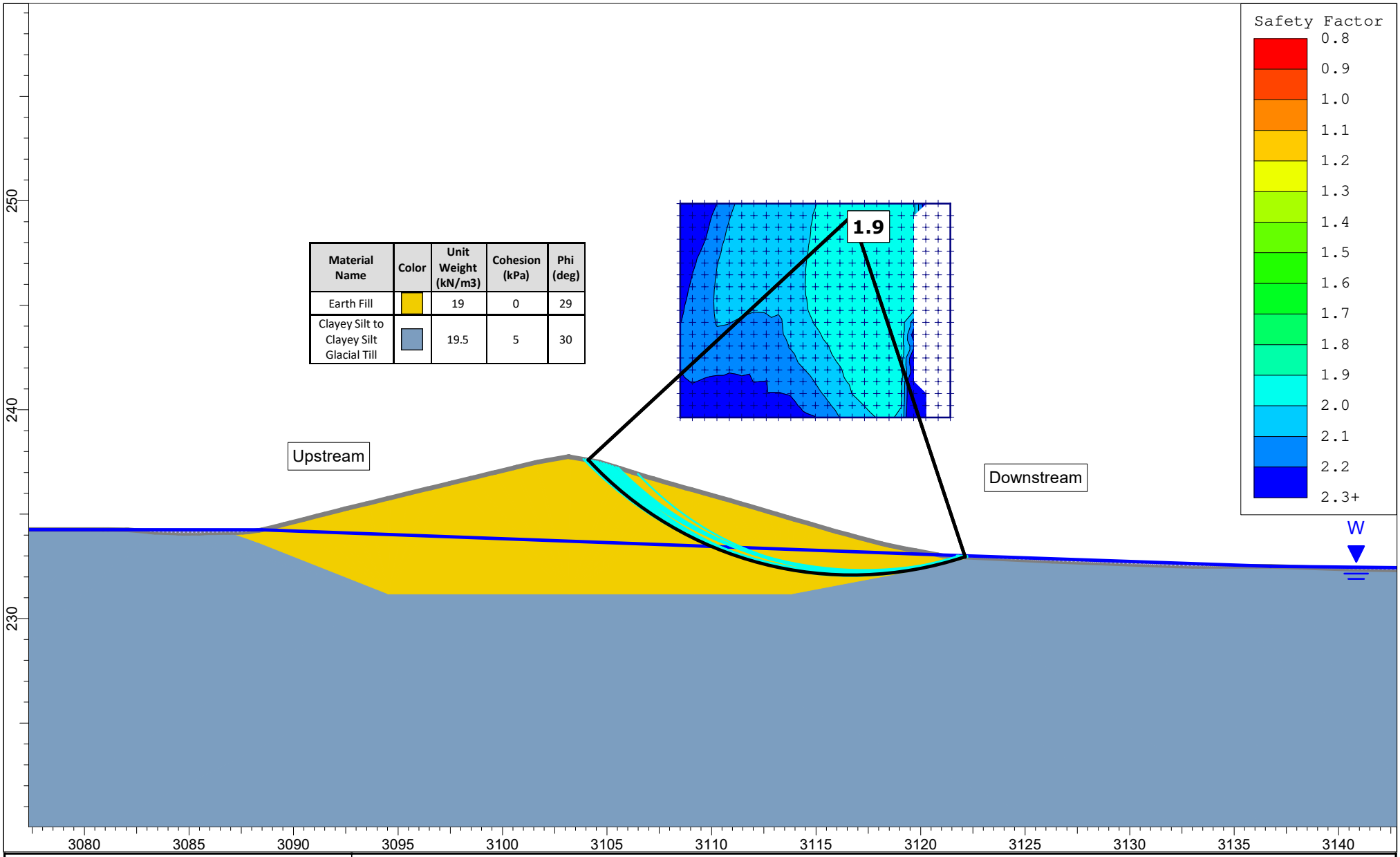
SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 17 - Lower Pond, Embankment Dam, Upstream - Long-Term		
Drawn By	RW	Scale	1:250
Company	GEI		
Date	2/17/2022	Project No.	2100975



GEI Consultants	Project: Tullamore Employment Lands		
	Analysis Description: Section 20 - Upper Pond, Embankment Dam, Upstream - Long-Term		
	Drawn By: RW	Scale: 1:250	Company: GEI
	Date: 2/17/2022		Project No.: 2100975

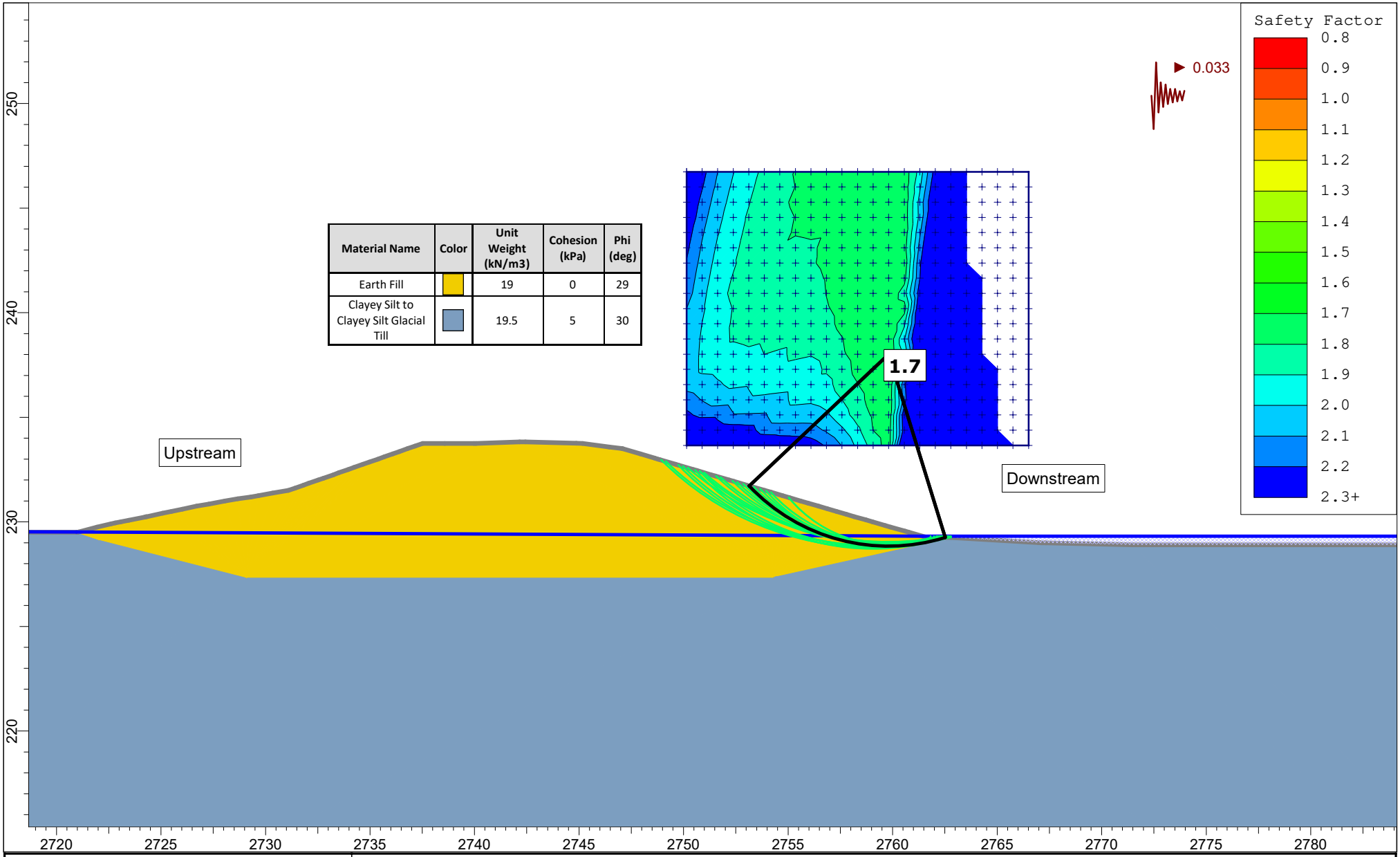
SLIDEINTERPRET 9.020



GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 20 - Upper Pond, Embankment Dam, Downstream - Long-Term		
Drawn By	RW	*Scale* 1:250	*Company* GEI
Date	2/17/2022		*Project No.* 2100975

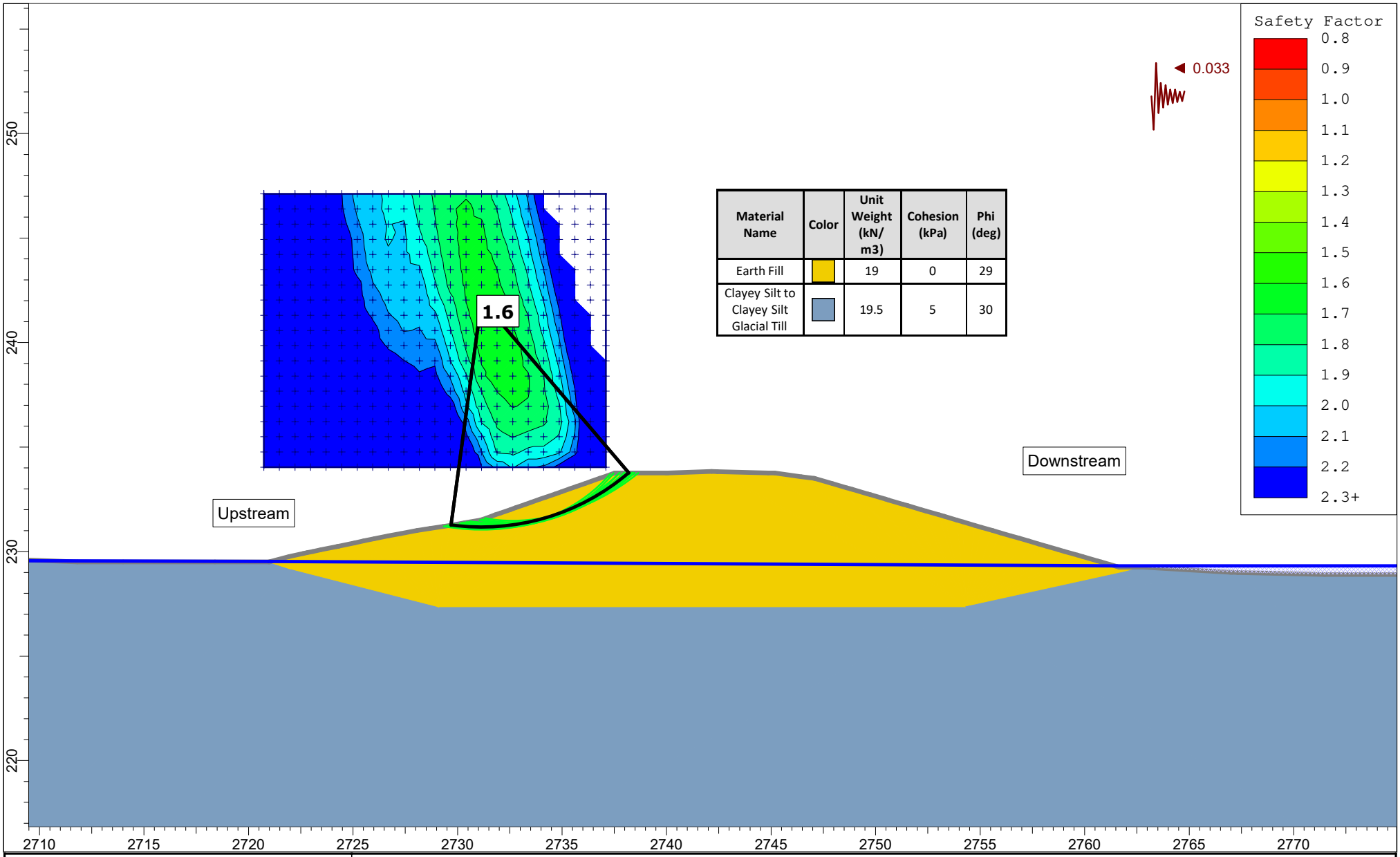


Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt Glacial Till		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 17 - Lower Pond Embankment Dam, Downstream - Seismic Loading		
Drawn By	RW	*Scale* 1:250	*Company* GEI
Date	2/17/2022		*Project No.* 2100975

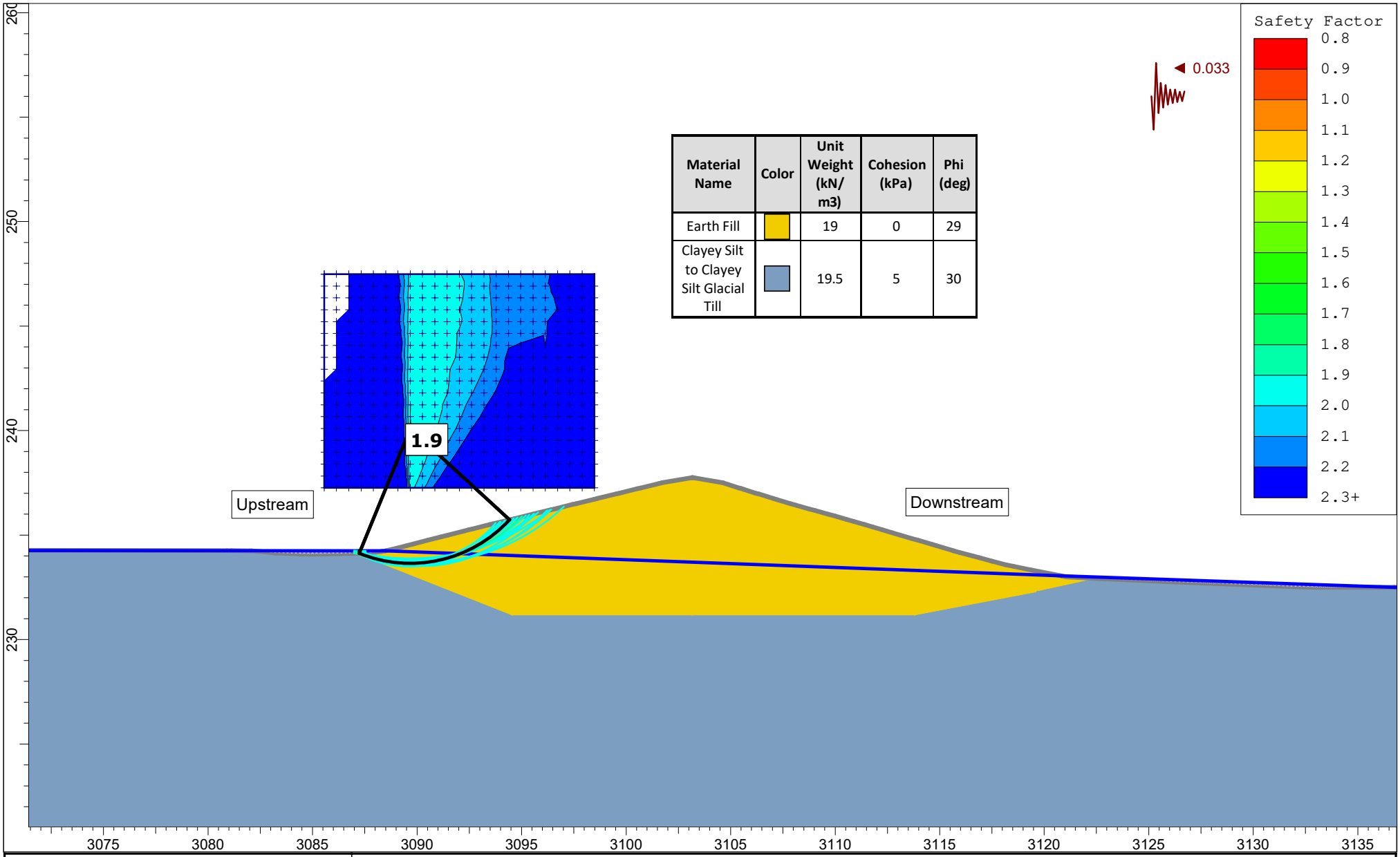


Material Name	Color	Unit Weight (kN/ m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt Glacial Till		19.5	5	30

GEI Consultants

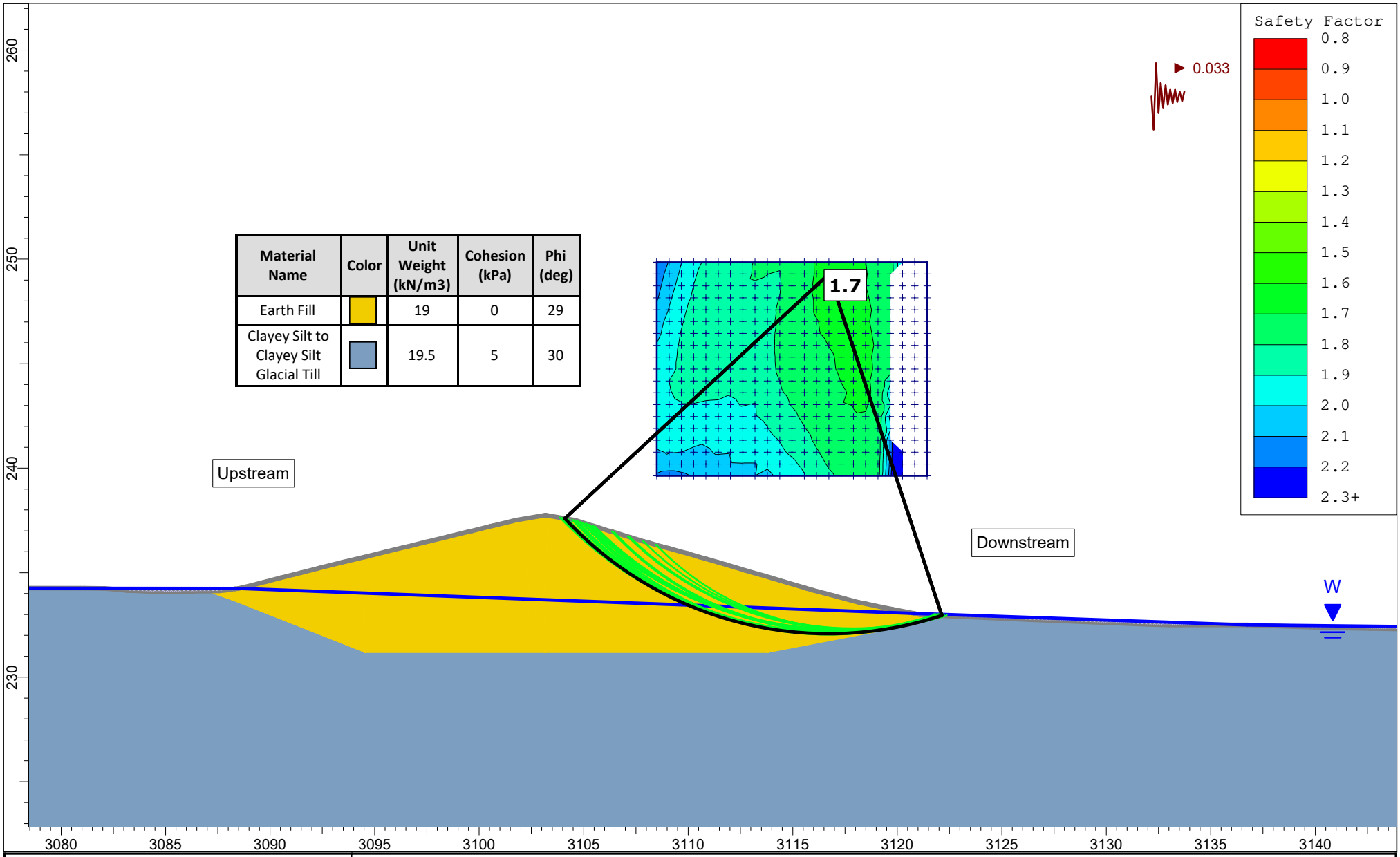
SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 17 - Lower Pond, Embankment Dam, Upstream - Seismic Loading		
Drawn By	RW	*Scale*	1:250
Company	GEI		
Date	2/17/2022	*Project No.*	2100975



GEI Consultants	Project	Tullamore Employment Lands	
	Analysis Description	Section 20 - Upper Pond, Embankment Dam, Upstream - Seismic Loading	
	Drawn By: RW	Scale: 1:250	Company: GEI
	Date: 2/17/2022		Project No.: 2100975

SLIDEINTERPRET 9.020



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Earth Fill		19	0	29
Clayey Silt to Clayey Silt Glacial Till		19.5	5	30

GEI Consultants

SLIDEINTERPRET 9.020

Project	Tullamore Employment Lands		
Analysis Description	Section 20 - Upper Pond, Embankment Dam, Downstream - Seismic Loading		
Drawn By	RW	Scale	1:250
Company	GEI		
Date	2/17/2022	Project No.	2100975

Appendix F

MNR Slope Inspection and Slope Rating Forms

SLOPE INSPECTION FORM

File No: 2100975
File Name: Tullamore Employment Lands
Inspection Date: Jan 11/22
Inspected By (name)**:** Bo Hwang
Weather (circle)**:** ☒ sunny ☐ partly cloudy ☐ overcast ☐ calm ☐ breezy ☐ windy
☒ clear ☐ fog ☐ rain ☐ snow ☒ cold ☐ cool ☐ warm ☐ hot
Est. Air Temp. (°C): -25C

Site Location / Directions (describe main roads, features)**:**
Inspection Location - West Tributary, Northern Slope of Valley Wall (From Mayfield Road to Existing Barns)

Site Location Sketch:

Property Ownership (name, address, phone)**:**

Legal Description:
Lot 18
Concession 16 E.H.S (CHING)
Township Caledon
County Peel

Watershed: West Humber River
Governing Regional Body: Town of Caledon
Governing Conservation Authority: TRCA

Current Land Use (circle and describe)**:**
☐ Vacant – Field, bush, woods, forest, wilderness, tundra
☐ Passive – Recreational parks, golf courses, non-habitable structures, buried utilities, swimming pools
☒ Active – Habitable structures, residential, commercial, industrial, warehousing, storage
☐ Infrastructure/Public Use – Stadiums, hospitals, schools, bridges, high voltage power lines, waste management sites

SLOPE DATA

Height ☒ 3 - 6 m ☐ 6 - 10 m ☐ 10 - 15 m ☐ 15 - 20 m
☐ 20 - 25 m ☐ 25 - 30 m ☐ >30 m
Estimated height (m): 8 to 10 m

Inclination / Shape ☐ 4:1 or flatter (25% / 14°) ☒ Up to 3:1 (33% / 18.5°) ☐ Up to 2:1 (50% / 26.5°)
☐ Up to 1:1 (100% / 45°) ☐ Up to 0.5:1 (200% / 63.5°) ☐ Steeper than 0.5:1 (>63.5°)

SLOPE DRAINAGE (describe):

TOP

- Tableland slopes gently towards the slope

FACE

-Gullies/Ditch near house and barn area (concentrated runoff from the barn areas)

BOTTOM

- Sheet drainage

SLOPE SOIL STRATIGRAPHY (describe, positions, thicknesses, types):

TOP

- Topsoil and some Earth Fill over Glacial Till

FACE

- Topsoil over Glacial Till

BOTTOM

- Topsoil over Glacial Till

WATER COURSE FEATURES (circle and describe)**:**

SWALES, GULLIES, DITCHES, CHANNELS

STREAMS, CREEKS, RIVERS

- Tributary of the West Humber River flows past the site, located more than 15 m from the slope toe (wide floodplain in the area).

PONDS, BAYS, LAKES

SPRINGS, SEEPS, MARHSY GROUND

VEGETATION COVER (grasses, weeds, shrubs, saplings, trees):

TOP

- Grasses
- Small shrubs and some mature trees

FACE

- Grasses and some small trees

BOTTOM

- Grass (Floodplain), some trees along the watercourse.

STRUCTURES (buildings, walls, fences, sewers, roads, stairs, decks, towers):

TOP

- Farm house and barns located Northeast of slope

FACE

- Noted some debris on the slope face (concrete, dead tree branch), no other structures observed.

BOTTOM

None observed

EROSION FEATURES (scour, undercutting, bare areas, piping, rills, gully):

TOP

- Some localized gullies located near house and barn area

FACE

- Some localized gullies located near house and barn area

BOTTOM

None observed

SLOPE SLIDE FEATURES (tension cracks, scarps, slumps, bulges, grabens, ridges, bent trees)**:**

TOP

None observed

FACE

- Some trees slightly tilting (likely long-term slope creep). No signs of instability.

BOTTOM

None observed

GEI Consultants

Inspection Location - West Tributary, Northern Slope of Valley Wall (From Mayfield Road to Existing Barns)

SLOPE RATING FORM

Site Location: Tullamore Employment Lands
Property Owner:
Inspected By: Bo Hwang

File No: 2100975
Inspection Date: January 11, 2022
Weather: -22C Clear

				Rating Value	
1.	**SLOPE INSPECTION**				
		Degrees	***Horiz. : Vert.***		
	a)	18 or less	3 : 1 or flatter	0	☒
	b)	18 to 26	2 : 1 to 3 : 1	6	☐
	c)	more than 26	steeper than 2 : 1	16	☐
2.	**SOIL STRATIGRAPHY**				
	a)	Shale, Limestone, Granite (Bedrock)		0	☐
	b)	Sand, Gravel		6	☐
	c)	Glacial Till		9	☒
	d)	Clay, Silt		12	☐
	e)	Fill		16	☐
	f)	Leda Clay		24	☐
3.	**SEEPAGE FROM SLOPE FACE**				
	a)	None or Near bottom only		0	☒
	b)	Near mid-slope only		6	☐
	c)	Near crest only or from several levels		12	☐
4.	**SLOPE HEIGHT**				
	a)	2 metres or less		0	☐
	b)	2.1 to 5 metres		2	☐
	c)	5.1 to 10 metres		4	☒
	d)	Greater than 10 metres		8	☐
5.	**VEGETATION COVER ON SLOPE FACE**				
	a)	Well vegetated; heavy shrubs or forested with mature trees		0	☐
	b)	Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4	☒
	c)	No vegetation; bare		8	☐
6.	**TABLELAND DRAINAGE**				
	a)	Tableland flat, no apparent drainage over slope		0	☐
	b)	Minor drainage over slope, no active erosion		2	☐
	c)	Drainage over slope, active erosion, gullies		4	☒
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**				
	a)	15 metres or more from slope toe		0	☒
	b)	Less than 15 metres from slope toe		6	☐
8.	**PREVIOUS LANDSLIDE ACTIVITY**				
	a)	No		0	☒
	b)	Yes		6	☐
				TOTAL	
				21	

	SLOPE INSTABILITY RATING	**RATING VALUE TOTAL**	**INVESTIGATION REQUIREMENTS**
1.	Low potential	<24	Site inspection only, confirmation, report letter.
2.	Slight potential	25-35	Site inspection and surveying, preliminary study, detailed report.
3.	Moderate potential	>35	Boreholes, piezometers, lab tests, surveying, detailed report.

NOTES:
a) Choose only one from each category; compare total rating value with above requirements.
b) If there is a water body (stream, creek, river, pond, bay, lake) at the slope toe; the potential for toe erosion and undercutting should be evaluated in detail and, protection provided if required.

SLOPE INSPECTION FORM

File No: 2100975
File Name: Tullamore Employment Lands
Inspection Date: Jan 11/22
Inspected By (name)**:** Bo Hwang
Weather (circle)**:** ☒ sunny ☐ partly cloudy ☐ overcast ☐ calm ☐ breezy ☐ windy
☒ clear ☐ fog ☐ rain ☐ snow ☒ cold ☐ cool ☐ warm ☐ hot
Est. Air Temp. (°C): -25C

Site Location / Directions (describe main roads, features)**:**
Inspection Location - West Tributary, Northern Slope of Valley Wall (From Barns to Torbram Road)

Site Location Sketch:

Property Ownership (name, address, phone)**:**

Legal Description:
Lot 18
Concession 16
Township Caledon
County Peel

Watershed: West Humber River
Governing Regional Body: Town of Caledon
Governing Conservation Authority: TRCA

Current Land Use (circle and describe)**:**
☐ Vacant – Field, bush, woods, forest, wilderness, tundra
☐ Passive – Recreational parks, golf courses, non-habitable structures, buried utilities, swimming pools
☒ Active – Habitable structures, residential, commercial, industrial, warehousing, storage
☐ Infrastructure/Public Use – Stadiums, hospitals, schools, bridges, high voltage power lines, waste management sites

SLOPE DATA

Height ☐ 3 - 6 m ☒ 6 - 10 m ☐ 10 - 15 m ☐ 15 - 20 m
☐ 20 - 25 m ☐ 25 - 30 m ☐ >30 m
Estimated height (m): 6 to 11.5 m

Inclination / Shape ☐ 4:1 or flatter (25% / 14°) ☐ Up to 3:1 (33% / 18.5°) ☐ Up to 2:1 (50% / 26.5°)
☒ Up to 1:1 (100% / 45°) ☐ Up to 0.5:1 (200% / 63.5°) ☐ Steeper than 0.5:1 (>63.5°)
Usually flatter than 2:1, but as steep as 1.4:1 in some localized areas.

SLOPE DRAINAGE (describe):

TOP

- Tableland (Farmland) slopes gently towards the slope.

FACE

- Mostly sheet drainage. There are two locations west of the barns that extend from the top to bottom of the slope and appear to be historic drainage features (shallow gullies) from tableland runoff.

BOTTOM

- Creek/Floodplain

SLOPE SOIL STRATIGRAPHY (describe, positions, thicknesses, types):

TOP

- Topsoil and some Earth Fill (Farmland) over Glacial Till.

FACE

- Topsoil over Silty Sand Glacial Till

BOTTOM

- Floodplain (Topsoil, Glacial Till and some Sand)

WATER COURSE FEATURES (circle and describe)**:**

SWALES, GULLIES, DITCHES, CHANNELS

STREAMS, CREEKS, RIVERS

PONDS, BAYS, LAKES

- Tributary of West Humber River flows past the slope, generally adjacent to the slope toe (active erosion observed).

SPRINGS, SEEPS, MARHSY GROUND

- Some localized marshy ground in floodplain

VEGETATION COVER (grasses, weeds, shrubs, saplings, trees):

TOP

- Grasses and weeds (Farm Land)

FACE

- Very well vegetated with large trees (vertical to slightly leaning trees)
- Some undergrowth

BOTTOM

- Well vegetated with trees and shrubs/ some undergrowth

STRUCTURES (buildings, walls, fences, sewers, roads, stairs, decks, towers):

TOP

Generally vacant farmland but some barns and dwellings at the east and west side of the slope.

FACE

None observed

BOTTOM

None observed

EROSION FEATURES (scour, undercutting, bare areas, piping, rills, gully):

TOP

There are two locations west of the barns that extend from the top to bottom of the slope and appear to be historic drainage features (shallow and wide gullies) from tableland runoff. No other signs of concentrated runoff observed along most of the slope.

FACE

- Some exposed roots near bottom of slope

BOTTOM

- Exposed roots and undercutting along the creek bank (active erosion).

SLOPE SLIDE FEATURES (tension cracks, scarps, slumps, bulges, grabens, ridges, bent trees)**:**

TOP

None observed

FACE

None observed

BOTTOM

- Some bent trees along the creek bank (likely from erosion).

GEI Consultants

Inspection Location - West Tributary, Northern Slope of Valley Wall (From Barns to Torbram Road)

SLOPE RATING FORM

Site Location: Tullamore Employment Lands
Property Owner:
Inspected By: Bo Hwang

File No: 2100975
Inspection Date: January 11, 2022
Weather: -22C Clear

				Rating Value	
1.	**SLOPE INSPECTION**				
		Degrees	***Horiz. : Vert.***		
	a)	18 or less	3 : 1 or flatter	0	☐
	b)	18 to 26	2 : 1 to 3 : 1	6	☐
	c)	more than 26	steeper than 2 : 1	16	☒
2.	**SOIL STRATIGRAPHY**				
	a)	Shale, Limestone, Granite (Bedrock)		0	☐
	b)	Sand, Gravel		6	☐
	c)	Glacial Till		9	☒
	d)	Clay, Silt		12	☐
	e)	Fill		16	☐
	f)	Leda Clay		24	☐
3.	**SEEPAGE FROM SLOPE FACE**				
	a)	None or Near bottom only		0	☒
	b)	Near mid-slope only		6	☐
	c)	Near crest only or from several levels		12	☐
4.	**SLOPE HEIGHT**				
	a)	2 metres or less		0	☐
	b)	2.1 to 5 metres		2	☐
	c)	5.1 to 10 metres		4	☐
	d)	Greater than 10 metres		8	☒
5.	**VEGETATION COVER ON SLOPE FACE**				
	a)	Well vegetated; heavy shrubs or forested with mature trees		0	☒
	b)	Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4	☐
	c)	No vegetation; bare		8	☐
6.	**TABLELAND DRAINAGE**				
	a)	Tableland flat, no apparent drainage over slope		0	☐
	b)	Minor drainage over slope, no active erosion		2	☐
	c)	Drainage over slope, active erosion, gullies		4	☒
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**				
	a)	15 metres or more from slope toe		0	☐
	b)	Less than 15 metres from slope toe		6	☒
8.	**PREVIOUS LANDSLIDE ACTIVITY**				
	a)	No		0	☒
	b)	Yes		6	☐
		SLOPE INSTABILITY RATING	**RATING VALUE TOTAL**	**INVESTIGATION REQUIREMENTS**	**TOTAL** 43
1.		Low potential	<24	Site inspection only, confirmation, report letter.	
2.		Slight potential	25-35	Site inspection and surveying, preliminary study, detailed report.	
3.		Moderate potential	>35	Boreholes, piezometers, lab tests, surveying, detailed report.	

NOTES:
a) Choose only one from each category; compare total rating value with above requirements.
b) If there is a water body (stream, creek, river, pond, bay, lake) at the slope toe; the potential for toe erosion and undercutting should be evaluated in detail and, protection provided if required.

SLOPE INSPECTION FORM

GEI Consultants

File No: 2100975
File Name: Tullamore Employment Lands
Inspection Date: Jan 11/22
Inspected By (name)**:** Bo Hwang
Weather (circle)**:** ☒ sunny ☐ partly cloudy ☐ overcast ☐ calm ☐ breezy ☐ windy
☒ clear ☐ fog ☐ rain ☐ snow ☒ cold ☐ cool ☐ warm ☐ hot
Est. Air Temp. (°C): -25C

Site Location / Directions (describe main roads, features)**:**
East Tributary, including the Upper and Lower Ponds

Site Location Sketch:

Property Ownership (name, address, phone)**:**

Legal Description:
Lot 18
Concession 16 E.H.S (CHING)
Township Caledon
County Peel

Watershed: West Humber River
Governing Regional Body: Town of Caledon
Governing Conservation Authority: TRCA

Current Land Use (circle and describe)**:**
☐ Vacant – Field, bush, woods, forest, wilderness, tundra
☒ Passive – Recreational parks, golf courses, non-habitable structures, buried utilities, swimming pools
☐ Active – Habitable structures, residential, commercial, industrial, warehousing, storage
☐ Infrastructure/Public Use – Stadiums, hospitals, schools, bridges, high voltage power lines, waste management sites

SLOPE DATA

Height ☒ 3 - 6 m ☐ 6 - 10 m ☐ 10 - 15 m ☐ 15 - 20 m
☐ 20 - 25 m ☐ 25 - 30 m ☐ >30 m
Estimated height (m): 3 to 5 m

Inclination / Shape ☐ 4:1 or flatter (25% / 14°) ☒ Up to 3:1 (33% / 18.5°) ☐ Up to 2:1 (50% / 26.5°)
☐ Up to 1:1 (100% / 45°) ☐ Up to 0.5:1 (200% / 63.5°) ☐ Steeper than 0.5:1 (>63.5°)

SLOPE DRAINAGE (describe):

TOP

- Tableland slopes gently towards the slope. Drainage features outlet into the tributary.

FACE

- Sheet drainage

BOTTOM

- Wetland/ponds

SLOPE SOIL STRATIGRAPHY (describe, positions, thicknesses, types):

TOP

- Topsoil and some Earth Fill over Glacial Till

FACE

- Topsoil over Glacial Till
- The embankment dams consist entirely of earth fill

BOTTOM

- Marsh/wetland and pond (glacial till)

WATER COURSE FEATURES (circle and describe)**:**

SWALES, GULLIES, DITCHES, CHANNELS

STREAMS, CREEKS, RIVERS

PONDS, BAYS, LAKES

- Upper and lower ponds, on-line with the tributary.

SPRINGS, SEEPS, MARHSY GROUND

Marshy ground within the tributary and surrounding both ponds.

VEGETATION COVER (grasses, weeds, shrubs, saplings, trees):

TOP

- Grasses and weeds

FACE

- Well vegetated with trees and shrubs
- Some undergrowth

BOTTOM

- Dense grasses and weed
- Pond

STRUCTURES (buildings, walls, fences, sewers, roads, stairs, decks, towers):

TOP

None on the tableland within the property limits (industrial lands on the opposite tableland).

FACE

None observed

BOTTOM

- Steel culvert (control overflowing) at dam areas, otherwise no structures.

EROSION FEATURES (scour, undercutting, bare areas, piping, rills, gully):

TOP

None observed

FACE

None observed

BOTTOM

- Bare areas and undercutting noted at inlet culvert areas (washout)

SLOPE SLIDE FEATURES (tension cracks, scarps, slumps, bulges, grabens, ridges, bent trees)**:**

TOP

None observed

FACE

None observed

BOTTOM

- Slumps and scarps noted around culvert inlet of the lower pond.

GEI Consultants

East Tributary and Upper / Lower Ponds

SLOPE RATING FORM

Site Location: Tullamore Employment Lands
Property Owner: _____
Inspected By: Bo Hwang

File No: 2100975
Inspection Date: January 11, 2022
Weather: -22C Clear

				Rating Value	
1.	**SLOPE INSPECTION**				
		Degrees	***Horiz. : Vert.***		
	a)	18 or less	3 : 1 or flatter	0	☐
	b)	18 to 26	2 : 1 to 3 : 1	6	☒
	c)	more than 26	steeper than 2 : 1	16	☐
2.	**SOIL STRATIGRAPHY**				
	a)	Shale, Limestone, Granite (Bedrock)		0	☐
	b)	Sand, Gravel		6	☐
	c)	Glacial Till		9	☒
	d)	Clay, Silt		12	☐
	e)	Fill		16	☐
	f)	Leda Clay		24	☐
3.	**SEEPAGE FROM SLOPE FACE**				
	a)	None or Near bottom only		0	☒
	b)	Near mid-slope only		6	☐
	c)	Near crest only or from several levels		12	☐
4.	**SLOPE HEIGHT**				
	a)	2 metres or less		0	☐
	b)	2.1 to 5 metres		2	☒
	c)	5.1 to 10 metres		4	☐
	d)	Greater than 10 metres		8	☐
5.	**VEGETATION COVER ON SLOPE FACE**				
	a)	Well vegetated; heavy shrubs or forested with mature trees		0	☐
	b)	Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4	☒
	c)	No vegetation; bare		8	☐
6.	**TABLELAND DRAINAGE**				
	a)	Tableland flat, no apparent drainage over slope		0	☒
	b)	Minor drainage over slope, no active erosion		2	☐
	c)	Drainage over slope, active erosion, gullies		4	☐
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**				
	a)	15 metres or more from slope toe		0	☐
	b)	Less than 15 metres from slope toe		6	☒
8.	**PREVIOUS LANDSLIDE ACTIVITY**				
	a)	No		0	☒
	b)	Yes		6	☐

SLOPE INSTABILITY RATING	**RATING VALUE TOTAL**	**INVESTIGATION REQUIREMENTS**	**TOTAL**
1. Low potential	<24	Site inspection only, confirmation, report letter.	27
2. Slight potential	25-35	Site inspection and surveying, preliminary study, detailed report.	
3. Moderate potential	>35	Boreholes, piezometers, lab tests, surveying, detailed report.	

NOTES:
a) Choose only one from each category; compare total rating value with above requirements.
b) If there is a water body (stream, creek, river, pond, bay, lake) at the slope toe; the potential for toe erosion and undercutting should be evaluated in detail and, protection provided if required.

SLOPE INSPECTION FORM

File No: 2100975
File Name: Tullamore Employment Lands
Inspection Date: Jan 11/22
Inspected By (name)**:** Bo Hwang
Weather (circle)**:** ☒ sunny ☐ partly cloudy ☐ overcast ☐ calm ☐ breezy ☐ windy
☒ clear ☐ fog ☐ rain ☐ snow ☒ cold ☐ cool ☐ warm ☐ hot
Est. Air Temp. (°C): -25C

Site Location / Directions (describe main roads, features)**:**
West Tributary - Southern Slope of South Drainage Feature

Site Location Sketch:

Property Ownership (name, address, phone)**:**

Legal Description:

Lot 18
Concession 16
Township Caledon
County Peel

Watershed: West Humber River
Governing Regional Body: Town of Caledon
Governing Conservation Authority: TRCA

Current Land Use (circle and describe)**:**

☒ Vacant – Field, bush, woods, forest, wilderness, tundra

☐ Passive – Recreational parks, golf courses, non-habitable structures, buried utilities, swimming pools

☐ Active – Habitable structures, residential, commercial, industrial, warehousing, storage

☐ Infrastructure/Public Use – Stadiums, hospitals, schools, bridges, high voltage power lines, waste management sites

SLOPE DATA

Height ☒ 3 - 6 m ☐ 6 - 10 m ☐ 10 - 15 m ☐ 15 - 20 m
☐ 20 - 25 m ☐ 25 - 30 m ☐ >30 m
Estimated height (m): 2 to 4 m

Inclination / Shape ☐ 4:1 or flatter (25% / 14°) ☒ Up to 3:1 (33% / 18.5°) ☐ Up to 2:1 (50% / 26.5°)
☐ Up to 1:1 (100% / 45°) ☐ Up to 0.5:1 (200% / 63.5°) ☐ Steeper than 0.5:1 (>63.5°)

SLOPE DRAINAGE (describe):

TOP

- Tableland slopes gently towards the slope. Some rilling observed on the slope face / crest.

FACE

- Sheet drainage

BOTTOM

- Marshy ground/sheet drainage. Assumed to be a drainage feature that only conveys runoff during / after precipitation or snowmelt events.

SLOPE SOIL STRATIGRAPHY (describe, positions, thicknesses, types):

TOP

- Topsoil and some Earth Fill over Silty Sand Glacial Till.

FACE

- Topsoil over Silty Sand Glacial Till

BOTTOM

- Topsoil over Silty Sand Glacial Till

WATER COURSE FEATURES (circle and describe)**:**

SWALES, GULLIES, DITCHES, CHANNELS

Assumed to be a drainage feature that only conveys runoff during / after precipitation or snowmelt events.

STREAMS, CREEKS, RIVERS

PONDS, BAYS, LAKES

SPRINGS, SEEPS, MARHSY GROUND

- Bottom of slope: Tall weeds and grasses (dry), some marshy ground

VEGETATION COVER (grasses, weeds, shrubs, saplings, trees):

TOP

- Grasses and weeds (Farm Land)

FACE

- Well vegetated with tall grasses and some shrubs

BOTTOM

- Well vegetated with tall grasses and small trees

STRUCTURES (buildings, walls, fences, sewers, roads, stairs, decks, towers):

TOP

None observed

FACE

None observed

BOTTOM

None observed

EROSION FEATURES (scour, undercutting, bare areas, piping, rills, gully):

TOP

- Some localized rills and gullies

FACE

- Some localized rills and gullies continuing from top of slope

BOTTOM

None observed

SLOPE SLIDE FEATURES (tension cracks, scarps, slumps, bulges, grabens, ridges, bent trees)**:**

TOP

None observed

FACE

None observed

BOTTOM

None observed

GEI Consultants

West Tributary - Southern Slope of South Drainage Feature

SLOPE RATING FORM

Site Location: Tullamore Employment Lands
Property Owner:
Inspected By: Bo Hwang

File No: 2100975
Inspection Date: January 11, 2022
Weather: -22C Clear

				Rating Value	
1.	**SLOPE INSPECTION**				
		Degrees	***Horiz. : Vert.***		
	a)	18 or less	3 : 1 or flatter	0	☒
	b)	18 to 26	2 : 1 to 3 : 1	6	☐
	c)	more than 26	steeper than 2 : 1	16	☐
2.	**SOIL STRATIGRAPHY**				
	a)	Shale, Limestone, Granite (Bedrock)		0	☐
	b)	Sand, Gravel		6	☐
	c)	Glacial Till		9	☒
	d)	Clay, Silt		12	☐
	e)	Fill		16	☐
	f)	Leda Clay		24	☐
3.	**SEEPAGE FROM SLOPE FACE**				
	a)	None or Near bottom only		0	☒
	b)	Near mid-slope only		6	☐
	c)	Near crest only or from several levels		12	☐
4.	**SLOPE HEIGHT**				
	a)	2 metres or less		0	☐
	b)	2.1 to 5 metres		2	☒
	c)	5.1 to 10 metres		4	☐
	d)	Greater than 10 metres		8	☐
5.	**VEGETATION COVER ON SLOPE FACE**				
	a)	Well vegetated; heavy shrubs or forested with mature trees		0	☐
	b)	Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4	☒
	c)	No vegetation; bare		8	☐
6.	**TABLELAND DRAINAGE**				
	a)	Tableland flat, no apparent drainage over slope		0	☐
	b)	Minor drainage over slope, no active erosion		2	☐
	c)	Drainage over slope, active erosion, gullies		4	☒
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**				
	a)	15 metres or more from slope toe		0	☐
	b)	Less than 15 metres from slope toe		6	☒
8.	**PREVIOUS LANDSLIDE ACTIVITY**				
	a)	No		0	☒
	b)	Yes		6	☐

SLOPE INSTABILITY RATING	**RATING VALUE TOTAL**	**INVESTIGATION REQUIREMENTS**	**TOTAL**
1. Low potential	<24	Site inspection only, confirmation, report letter.	25
2. Slight potential	25-35	Site inspection and surveying, preliminary study, detailed report.	
3. Moderate potential	>35	Boreholes, piezometers, lab tests, surveying, detailed report.	

NOTES:
a) Choose only one from each category; compare total rating value with above requirements.
b) If there is a water body (stream, creek, river, pond, bay, lake) at the slope toe; the potential for toe erosion and undercutting should be evaluated in detail and, protection provided if required.