Stability Risk Assessment: MG1001/SRA Rev1
May 2022

STABILITY RISK ASSESSMENT
for
ENVIRONMENT PERMIT APPLICATION
at
HUSBANDS BOSWORTH QUARRY

Prepared
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Project Quality Assurance
Information Sheet

Stability Risk Assessment – ENVIRONMENTAL PERMIT APPLICATION
HUSBANDS BOSWORTH QUARRY

Stability Risk Assessment	:	MG1001/SRA Rev1	**Report Status**	:	For Approval
Report Date	:	May 2022			
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1 INTRODUCTION

1.1 Report Context

Sirius Environmental Limited (Sirius) were commissioned by **Mick George Limited** (Mick George) to prepare a Stability Risk Assessment (SRA) for Husbands Bosworth Quarry, to support the CL:AIRE and environmental permit applications for the site, to allow for infilling of the quarry with imported materials.

This Stability Risk Assessment (SRA) considers the different components of the containment system, and assesses how they may be affected by the proposals, to ensure the stability is maintained.

This SRA has been prepared using guidance contained within the **Environment Agency R&D Technical Report P1-385/TR2** (hereinafter referred to as 'The Guidance').

1.1.1 Outline of the Installation

Husbands Bosworth Quarry is located approximately 10km east of the town of Lutterworth, and approximately 10km west of the town of Market Harborough. The site entrance is at Ordnance Survey National Grid Reference **SP 641 835**. The address of the site is:

Husbands Bosworth Quarry,
Welford Road,
Husbands Bosworth,
Market Harborough,
LE17 6JH.

1.1.2 Summary of Previous Work

There has been limited information of previous works. However, the information contained within the planning application dated **March 2021** has been utilised as part of this Stability Risk Assessment.

1.1.2.1 Tarmac Borehole Drill Logs (2015)

Tarmac undertook a number of borehole investigations within the vicinity of the site in **October 2015**. These borehole investigations were fully logged with detailed lithological descriptions of the geological units encountered.

1.2 Conceptual Stability Site Model

The following sub-sections present a summary of the natural geological, fill materials (including engineered fill and un-engineered infill) used in the model, relating specifically to the components identified in **Form IPPC Landfill Part B**, and from the guidance contained within the **Environment Agency R&D Technical Report P1385/TR2**.

1.2.1 Geology and Ground Conditions

The geology at Husbands Bosworth Quarry consists of both superficial and bedrock geology. The borehole logs indicate there is approximately 300mm of topsoil which overlies silt/clayey overburden. The overburden overlies sand and gravel deposits which overlie the in-situ mudstone bedrock.

The superficial geology consists of quaternary glaciofluvial deposits formed up to 2 million years ago. The bedrock geology is Jurassic in age and is overlain by the quaternary glaciofluvial deposits. The bedrock geology consists of the Dyrham Formation which comprises interbedded siltstones and mudstones.

1.2.2 Hydrogeology and Groundwater

A number of groundwater monitoring boreholes have been installed around the perimeter of the site to provide detailed data on the groundwater level which surrounds the site.

The recorded groundwater levels vary around the perimeter of the site but generally flow from north to south towards the River Welland. The section selected for this SRA is located near Borehole 3 (BH3) and, therefore, the groundwater level for the purposes of this SRA has been set at **127.00mAOD**.

The groundwater level has been lowered at the edge of engineered buttress for each lift to be level with the top of the previous lift, as if this is encountered on site during the works an informal system shall be required, not for stability reasons, but for construction purposes to allow for construction works to be undertaken easily.

1.2.3 Stability Section Selection

The stability section utilised within this SRA has been selected as it represents a worst-case scenario, and allows for analysis to be undertaken on all aspects associated with the infilling process at Husbands Bosworth Quarry.

The section selected as part of this assessment is through the area with the greatest height of fill for the 1 in 3 buttress and associated engineered containment system. The maximum height of any slope for the proposed buttress shall be approximately 21.5m. Analysis of this section shall allow for the worst case stability issues to be assessed and ensure the stability of all slopes on the site remain stable, both during construction and once the infilling operation have been completed. Any slopes with a vertical height of less than 21.5m shall report greater factors of safety than those presented in this report.

A drawing showing the section position is presented in **Appendix SRA1**.

1.2.4 Basal Subgrade Model

The proposed basal subgrade shall comprise mudstone from the Dyrham Formation.

1.2.5 Side Slope Subgrade Model

The side-slope subgrade is proposed to comprise mainly glaciofluvial deposits which shall mostly be made up of sands and gravel. There may be small areas (within the side-slope subgrade towards the top of slope) that comprise silts and clays.

1.2.6 Side Slope Lining System Model

The proposed side-slope engineering detail shall consist of the following:

- 1000mm compacted clay liner (CCL) with a maximum permeability of $k=1 \times 10^{-7}$ m/s, to comply with the inert landfill guidance.

The side-slope lining system is to be constructed above an engineered fill buttress which is to be constructed against the side of the quarry with a side-slope gradient of 1 in 3.

1.2.7 Inert Waste Mass Model

The inert soil waste mass for the proposed infill has been modelled as part of this stability risk assessment to achieve (fill up to) the approved restoration contours proposed as part of the planning application for the site.

The construction and in-filling timeframes have been modelled in accordance with **Table SRA1** below. As the exact timings are unknown, a best estimate has been utilised within this SRA.

The inert waste mass, engineered clay sidewall lining system and the underlying engineered fill buttress have been split into 2m lifts, as shown in **Table SRA1** below. In order to maintain stability throughout the construction / infilling process, following the construction of each lift of the buttress and lining system, the corresponding inert waste lift is to be placed against the lining system, rather than building the buttress / lining system to full height before confining with the inert waste. This allows for this to be constructed without the use of preferential drainage pathways (higher permeability material) in the engineered fill buttress.

TABLE SRA1: CONSTRUCTION TIMEFRAMES USED IN THE MODEL	
Construction Description	**Timescale (Days)**
Buttress Construction Lift 1	10
Engineered Clay Liner Lift 1	5
Inert Waste Lift 1	45
Buttress Construction Lift 2	10
Engineered Clay Liner Lift 2	5
Inert Waste Lift 2	90
Buttress Construction Lift 3	10
Engineered Clay Liner Lift 3	5
Inert Waste Lift 3	182
Buttress Construction Lift 4	10
Engineered Clay Liner Lift 4	5
Inert Waste Lift 4	182.5
Buttress Construction Lift 5	10
Engineered Clay Liner Lift 5	5
Inert Waste Lift 5	182.5
Buttress Construction Lift 6	10
Engineered Clay Liner Lift 6	5
Inert Waste Lift 6	182.5
Buttress Construction Lift 7	10
Engineered Clay Liner Lift 7	5
Inert Waste Lift 7	182.5
Buttress Construction Lift 8	10
Engineered Clay Liner Lift 8	5
Inert Waste Lift 8	182.5
Buttress Construction Lift 9	10
Engineered Clay Liner Lift 9	5
Inert Waste Lift 9	182.5
Buttress Construction Lift 10	10
Engineered Clay Liner Lift 10	5
Inert Waste Lift 10	70
Buttress Construction Lift 11	5
Engineered Clay Liner Lift 11	2
Inert Waste Lift 11	90

1.2.8 Capping System Model

There is proposed to be no formal engineered capping system above the inert soil waste infill and, therefore, this has not been assessed further in this stability risk assessment.

2 STABILITY RISK ASSESSMENT

The five principal components of the conceptual stability site model have been considered and the various elements of that component have been assessed with regard to stability, and integrity.

The principal components considered are the:

- basal sub-grade;
- side-slope sub-grade;
- basal lining system;
- side-slope lining system; and
- inert waste.

2.1 Risk Screening

Issues relating to the stability and integrity of each principal component of the landfill have been subject to a preliminary review ('screening') to determine the need to undertake further detailed geotechnical analyses. The following sections present the results of this screening exercise.

2.1.1 Basal Subgrade Screening

The basal subgrade for the proposed inert infilling operation shall comprise in-situ mudstone of the Dyrham Formation. The key considerations for the basal subgrade and the implications for stability and integrity are presented in **Table SRA2** below.

<table>
<tr><th colspan="3">TABLE SRA2: STABILITY COMPONENTS FOR BASAL SUBGRADE</th></tr>
<tr><td rowspan="3">Excessive Deformation</td><td>Compressible subgrade</td><td>The basal subgrade shall comprise in-situ material. This shall generally be considered to be relatively stiff, and with the unloading that shall take place due the quarrying activities at the site, there shall be a further increase in the stiffness of the material as a result. An appropriate stiffness has been assigned to the basal subgrade within the models to ensure it is representative of the site conditions;</td></tr>
<tr><td>Heave</td><td>The local groundwater contained within the sand and gravels is found above the basal subgrade. Therefore, basal heave due to groundwater uplift pressure is not considered to be an issue. As the basal subgrade shall be subjected to unloading from the removal of the mineral above, there is the potential for heave to occur within the basal subgrade due to the reduction in vertical stress. Therefore, this shall be assessed further in this report;</td></tr>
<tr><td>Cavities in subgrade</td><td>None anticipated;</td></tr>
<tr><td rowspan="2">Filling on Waste</td><td>Compressible Waste</td><td>Not applicable;</td></tr>
<tr><td>Cavities in Waste</td><td>Not applicable;</td></tr>
</table>

2.1.2 Side-Slope Subgrade Screening

The side-slope subgrade shall comprise mainly glaciofluvial deposits which shall mostly be made up of sands and gravel. There may be small areas within the side-slope subgrade towards the top of slope that comprise silts and clays. The key considerations for the side slope subgrade and the implications for stability and integrity are presented in **Table SRA3** below.

TABLE SRA3: STABILITY COMPONENTS FOR SIDE-SLOPE SUBGRADE		
Excessive Deformation	Compressible subgrade	The side-slope subgrade shall comprise in-situ material. This shall generally be considered to relatively stiff and with the unloading that shall take place due the quarrying activities, there shall be an increase in the stiffness of the material as a result. An appropriate stiffness has been assigned to the side-slope subgrade within the models to ensure it is representative of the site conditions;
	Heave	The reported groundwater level from the monitoring boreholes varies around the perimeter of the site. A groundwater level from the nearby borehole has been included within the model. The groundwater level sits in the middle of the sand and gravel deposits and therefore there is a potential for heave in the side-slope subgrade. However, the weight of the engineered fill buttress will counteract any upwards / lateral groundwater pressure in the sidewall subgrade; heave is unlikely to occur in the side-slope subgrade beneath the buttress. Consequently, displacements in the engineered fill buttress and overlying side-slope lining system due to heave are unlikely to occur. Therefore, heave of the side-slope subgrade has not been assessed further in this report.
	Cavities in subgrade	None anticipate;
Filling on Waste	Compressible Waste	Not applicable;
	Cavities in Waste	Not applicable;

The stability of the quarry faces during the excavation of the mineral has not been assessed as part of this report. If deemed necessary by the quarry operator, a further stability assessment on the proposed quarry flanks should be undertaken to ensure these remain stable for the duration of the quarrying process prior to placement of the buttress.

The subgrade prior to the placement of the buttress material shall be inspected to ensure that there are no signs of instability. Any necessary remedial works shall be undertaken prior to buttress placement.

2.1.3 Basal Lining System Screening

No basal lining construction works are planned as part of these works. Therefore, this has not been assessed further.

2.1.4 Side-Slope Lining System Screening

The key considerations for the side-slope lining system (AEGB) and the implications for stability, and integrity, are presented in **Table SRA4** below.

TABLE SRA4: STABILITY COMPONENTS FOR SIDE-SLOPE LINING SYSTEM		
Un-confined	Stability	The side-slope liner (AEGB) and the underlying engineered fill buttress will be least stable when each lift of the slope is un-confined, and no inert waste has been placed against it. As each lift of the inert waste is placed against the corresponding side-slope lift, the factor of safety will increase as the inert waste provides a passive resistance wedge (confinement) at base of the slope. This will be assessed in this report;
Confined	Stability	Confinement of the side-slope lining system (AEGB) and engineered fill buttress as the inert waste lifts are placed will increase the factor of safety from that of an un-confined slope, as the inert waste will provide passive resistance, and added stability to the system. The confined slope will be assessed in this report;
	Integrity	Due to the nature of the inert waste, there is considered to be minimal movement within the lining system to cause integrity issues. If there were to be any small movements, it is likely that the material used to construct the side slope lining system shall have a permeability much lower than the required value of k=1E-7m/s. Therefore, even if strains did appear, the permeability would still be greater than the minimum requirement, ensuring that the integrity of the liner is maintained. Therefore, this has not been assessed further in this report;

2.1.5 Inert Waste Mass Screening

The controlling factors that influence the stability of the inert waste mass are presented in **Table SRA5** below.

TABLE SRA5: STABILITY COMPONENTS OF WASTE SLOPES			
Failure wholly in waste	Stability		The inert soil waste will be deposited in horizontal layers, to mitigate stability risks associated with plant movements parallel to the slope, as well as improving compaction. These will also minimise unconfined slopes during construction. The stability of the inert waste flanks shall be assessed in this report;
Failure involving liner and waste	Mineral Clay	Stability	Loading of the waste against the side-slope liner (AEGB) may increase the risk of a translational slope failure adjacent to the lining system, which has the potential to damage the liner. This will be assessed further in this report;
		Integrity	Due to the nature of the inert soil waste, there is anticipated to be minimal movement within the lining system to cause integrity issues. If there were to be any small movements, it is likely that the material used to construct the side-slope lining system (AEGB) would have a permeability much lower than the required value of k=1E-7m/s. Therefore, even if small movements did take place, the permeability would still be greater than the requirement, ensuring the integrity of the liner is maintained. Therefore, this has not been assessed further in this report.

2.2 Justification for Modelling Approach and Software

In order to perform a comprehensive stability risk assessment (SRA), the components of the landfill containment systems have to be considered not only individually, but also in conjunction with one another, where relevant. Any analytical techniques adopted for such an assessment should adequately represent all of the considered scenarios for both the un-confined and confined conditions (where appropriate). The methodology and the software should also achieve the desired output parameters for the assessment. This equates to the determination of factors of safety for stability assessments.

The analytical methods used in this stability risk assessment include:

(a) **Finite element analyses** for the determination of the stability of the landfill, for the different stages of the landfill construction and subsequent inert waste placement, and the **calculation of factors of safety**.

2.2.1 Finite Element Analyses

The proprietary software **PLAXIS 2D** (V21) has been used for this stability risk assessment. This is a two-dimensional finite element programme intended for the analysis of deformation and stability in geotechnical engineering. It is equipped for the simulation of non-linear, time dependent and anisotropic behaviour of soils and rock. In addition, since soil is multi-phase material, special procedures are required to deal with hydrostatic and non-hydrostatic pore pressures in the soil. **PLAXIS 2D** was originally developed for geotechnical engineers studying river embankments on the soft soils of the lowlands of Holland. In subsequent years, **PLAXIS 2D** has been extended to cover most other areas of geotechnical engineering. It is therefore well suited for application to the environmental permit application stability risk assessment at Husbands Bosworth Quarry.

2.2.2 Phi-C Reduction

A safety analysis in PLAXIS is undertaken by reducing the strength parameters of the soils. This process is termed 'Phi-C reduction' and is carried out as a separate calculation mode. Phi-C reduction is used when it is required to calculate a factor of safety, for the situation under consideration.

In the Phi-C reduction approach, the strength parameters $\tan\varphi$ and c of the soils (and interface shear strengths) are incrementally reduced until failure of the system occurs. The strengths of interfaces, if used, are reduced in the same way. The strength of structural objects like plates and anchors are not influenced by the Phi-C reduction.

The total multiplier ΣMsf is used to define the value of the soil strength parameters as a given stage in the analysis:

$$\sum Msf = \frac{\tan\varphi_{input}}{\tan\varphi_{reduced}} = \frac{c_{input}}{c_{reduced}}$$

A Phi-C reduction calculation is performed using the load advancement number of steps procedure. The incremental multiplier Msf is used to specify the increment of the strength reduction of the first calculation step. The increment is by default set to 0.1, which is generally found to be a good starting value. The strength parameters are successively reduced automatically until all additional steps have been performed. In this case, the factor of safety can be given by:

$$SF = \frac{\textit{available strength}}{\textit{strength at failure}} = \text{value of } \sum Msf \text{ at failure}$$

If a failure mechanism has not fully developed, then the calculation is repeated with a larger number of additional steps.

To capture the failure of the system accurately, the use of arc-length control in the iteration procedure is required. The use of a tolerated error of no more than 3% is also required. Both requirements are complied with when using the Standard setting of the iterative procedure.

When using Phi-C reduction in combination with advanced soil models, these models will actually behave as a standard Mohr-Coulomb model, since stress-dependant stiffness behaviour and hardening effects are excluded. The stress-dependent stiffness modulus (where this is specified in the advanced model) at the end of the previous step is used as a constant stiffness modulus during the Phi-C reduction calculation.

For slopes, the **Phi-C reduction** approach resembles the method of calculating safety factors as conventionally adopted in traditional slip-circle analyses.

2.3 Selection of Appropriate Factors of Safety

The factor of safety is the numerical expression of the degree of confidence that exists for a given set of conditions, against a particular failure mechanism occurring. It is commonly expressed as the ratio of the load or action that would cause failure against the actual load or actions likely to be applied during service. This is readily determined for some types of analysis, for example limit equilibrium slope stability analyses. .

The factor of safety adopted for each component of the model would be related to the consequences of a failure.

BS6031 - Code of Practice for Earthworks (Clause 6.5.1.2 Safety Factors) states that suitable safety factors in a particular case can only be arrived at after careful consideration of all the relevant factors, and the exercise of sound engineering judgement. The factors to be considered include:

a) The complexity of the soil conditions;
b) The adequacy of the site investigation;
c) The certainty with which the design parameters represent the actual in-situ conditions;
d) The length of time over which the stability has to be assured;
e) The likelihood of unfavourable changes in groundwater regime in the future;
f) The likelihood of unfavourable changes in the surface profile in the future;
g) The speed of any movement which might take place; and
h) The consequences of any failure.

A minimum factor of safety of 1.3 is considered acceptable for stability and integrity, if reasonably conservative values are used.

2.4 Justification for Geotechnical Parameters Selected for Analysis

Geotechnical data for the stability analysis has been obtained from several sources. These sources include previous stability risk assessments, published (conservative) data applicable to the analyses, as well as Sirius's recent experience on other similar stability risk assessments.

The parameters for the sands and gravel were determined from a back-analysis utilising the topographical survey (LiDAR data) for the site. From this, the maximum current slope angles were identified as a gradient of 1 in 1. These parameters were adjusted in the PLAXIS model until the factor of safety was close to unity to ensure the parameters selected are a worst-case. It is worth noting that this SRA does not assess the proposed quarry cut slopes (achieved after the quarrying) and is only focused on the landfill construction associated with the infilling process, but this stage has been included within the model for completeness (although the factors of safety are not reported for this stage).

The parameters selected for material properties consider the analyses undertaken to be conservative for the conditions that are proposed to be present on site. Material properties for the soil waste were obtained using guidance from **Environment Agency R&D Technical Report P1385/TR1**.

2.5 Summary of Material Parameters for Finite Element Analyses

Table SRA6A and Table SRA6B below summarises effective stress parameters utilised in the analyses.

TABLE SRA6A: SUMMARY OF EFFECTIVE STRESS MATERIAL PARAMETERS FOR FINITE ELEMENT ANALYSES (HARDENING SOIL)								
Material	Unit Weight	Effective Cohesion	Effective Angle of Friction	Permeability	E_{50}	E_{oed}	E_{ur}	power
	kN/m³	kN/m²	°	m/s	kN/m²	kN/m²	kN/m²	(m)
Engineered Clay Liner	19.0-20.0	5.0	25.0	k=1E-9	7,000	7,000	21,000	0.750
Inert Waste	19.0-20.0	5.0	25.0	k=5E-9	4,000	4,000	12,000	0.750
Engineered Fill	19.0-20.0	5.0	25.0	k=5E-9	7,000	7,000	21,000	0.750
Mudstone	23.0-24.0	12.0	28.0	k=1E-8	10,000	10,000	30,000	0.750

TABLE SRA6B: SUMMARY OF EFFECTIVE STRESS MATERIAL PARAMETERS FOR FINITE ELEMENT ANALYSES (MOHR COLUMB)						
Material	Unit Weight	Effective Cohesion	Effective Angle of Friction	Permeability	E′	V′
	kN/m³	kN/m²	°	m/s	kN/m²	(nu)
Sands and Gravels	20.0-21.0	0.5	40.0	k=1E-4	10,000	0.2

A PLAXIS printout of the material parameters can be found in **Appendix SRA2** of this report.

3 ANALYSIS

3.1 Introduction

The key areas of the infilling operational and associated containment system at Husbands Bosworth Quarry which require analysis are:

- **Stability Analysis**: The stability of the proposed engineered fill buttress, side-slope lining system (AEGB) and inert soil waste profile for all stages of the landfill construction and infilling.

3.2 Effective Stress Stability Analysis

A summary of the factors of safety from the PLAXIS Phi-C reduction runs for the stability models are presented in **Table SRA7** below.

TABLE SRA7: SUMMARY OF PHI-C REDUCTION RUNS FOR CONSTRUCTION AND WASTE MODEL STABILITY		
Description	**Critical slope identified during analysis**	**Factor of Safety**
Buttress Lift 1	Circular Failure through excavated quarry face of sands and gravels, and mudstone bedrock	1.360
Engineered Clay Liner Lift 1	Circular Failure through excavated quarry face of sands and gravels, mudstone bedrock	1.366
Waste Lift 1	Circular Failure through excavated quarry face of sands and gravels, and mudstone bedrock	1.359
Buttress Lift 2	Circular Failure through excavated quarry face of sands and gravels, mudstone bedrock and buttress fill material	1.437
Engineered Clay Liner Lift 2	Circular Failure through excavated quarry face of sands and gravels, mudstone bedrock and buttress fill material	1.441
Waste Lift 2	Circular Failure through excavated quarry face of sands and gravels, mudstone bedrock and buttress fill material	1.429
Buttress Lift 3	Circular Failure through excavated quarry face of sands and gravels, mudstone bedrock and buttress fill material	1.551
Engineered Clay Liner Lift 3	Circular Failure through engineered clay liner and buttress fill material	1.489
Waste Lift 3	Circular Failure through excavated quarry face of sands and gravels, mudstone bedrock and buttress fill material	1.543
Buttress Lift 4	Circular Failure through buttress fill material	1.728
Engineered Clay Liner Lift 4	Circular Failure through engineered clay liner and buttress fill material	1.513
Waste Lift 4	Circular Failure through excavated quarry face of sands and gravels, mudstone bedrock and buttress fill material	1.722
Buttress Lift 5	Circular Failure through buttress fill material	1.598

TABLE SRA7: SUMMARY OF PHI-C REDUCTION RUNS FOR CONSTRUCTION AND WASTE MODEL STABILITY

Engineered Clay Liner Lift 5	Circular Failure through engineered clay liner and buttress fill material	1.517
Waste Lift 5	Circular Failure through excavated quarry face of sands and gravels, mudstone bedrock and buttress fill material	1.987
Buttress Lift 6	Circular Failure through buttress fill material	1.640
Engineered Clay Liner Lift 6	Circular Failure through engineered clay liner and buttress fill material	1.514
Waste Lift 6	Circular Failure through excavated quarry face of sands and gravels, and buttress fill material	2.321
Buttress Lift 7	Circular Failure through buttress fill material	1.670
Engineered Clay Liner Lift 7	Circular Failure through engineered clay liner and buttress fill material	1.531
Waste Lift 7	Circular Failure through excavated quarry face of sands and gravels, and buttress fill material	2.618
Buttress Lift 8	Circular Failure through buttress fill material	1.690
Engineered Clay Liner Lift 8	Circular Failure through engineered clay liner and buttress fill material	1.567
Waste Lift 8	Circular Failure through excavated quarry face of sands and gravels, and buttress fill material	3.154
Buttress Lift 9	Circular Failure through buttress fill material	1.705
Engineered Clay Liner Lift 9	Circular Failure through engineered clay liner and buttress fill material	1.569
Waste Lift 9	Circular Failure through excavated quarry face of sands and gravels, and buttress fill material	4.167
Buttress Lift 10	Circular Failure through buttress fill material	1.863
Engineered Clay Liner Lift 10	Circular Failure through engineered clay liner and buttress fill material	1.612
Waste Lift 10	Circular Failure through inert waste slope	4.103
Buttress Lift 11	Circular Failure through buttress fill material	2.823
Engineered Clay Liner Lift 11	Circular Failure through engineered clay liner and buttress fill material	1.990
Waste Lift 11	Circular Failure through inert waste slope	4.484

Graphical representations of the analyses (including failure modes) are shown in **Appendix SRA3**.

4 ASSESSMENT

The assessments outlined above are presented in the order described.

4.1 Buttress, Engineered Side-Slope (AEGB) and Inert Waste Stability Assessment

Table SRA7 above outlines the factors of safety for the various stages of construction and infilling for the stability model assessed as part of this stability risk assessment (SRA) for Husbands Bosworth Quarry.

As part of the design, a **1 in 3 buttress** is proposed to be constructed from imported material under CL:AIRE, to reduce the gradient of the 1 in 1 quarried side-slope subgrade slopes to allow for construction of the engineered clay side-slope liner (AEGB) to take place. As the characteristics of this material is unknown, a worst-case scenario has been assessed, with the proposed soil material being cohesive (low permeability). The engineered clay liner will also consist of low permeability material.

The low permeability nature of the buttress engineered fill and the engineered clay liner shall result in a build-up of excess positive pore-water pressures within the buttress material and the lining system, as construction takes place. The excess pore water pressures that build-up mean that there is no increase in the effective stress within the soils, and (consequently) no increase in the effective shear strength of the material, resulting in reduced factors of safety for the unconfined slopes, until the excess pore-water pressures begin to dissipate.

Due to the potential instability of the unconfined buttress and engineered clay liner slope, due to the build-up of excess pore water pressures, as described above, the side slope shall be constructed in 2m lifts which shall be subsequently confined with inert waste prior to the next lift of engineering being undertaken. Constructing in lifts shall improve the factor of safety (and hence the stability) of the engineered fill / engineered clay liner slopes, as the inert waste provides passive resistance to the base of the unconfined slope. The speed at which the buttress and side-slope lining system may be constructed is therefore controlled by the speed of the adjacent inert waste placement.

The critical failure mode identified from the analysis associated with the construction of the engineered fill buttress, side-slope lining system, and the subsequent infilling with inert waste, is a circular failure through the buttress fill material and the engineered clay liner, which occurs following each lift of the side-slope lining system. The lowest reported factor of safety from the analysis for the side slope lining system was **FOS=1.489**, which occurs following the 3rd lift of the buttress and engineered clay liner. All the factors of safety reported from the analysis, for each stage of the construction and infilling at Husband Bosworth are above the minimum required 1.3. Therefore, the stability of the proposed engineered fill buttress, side-slope lining system and inert waste mass is deemed to be acceptable, provided that the construction / infilling strategy and the timings outlined in this SRA are followed.

The lowest factors of safety from the analysis occurred for failure modes passing through the side-slope of the quarry (cut into the sands and gravels at a gradient of 1 in 1). These failure modes occur due to the excavation of the quarry face. As explained in Section 2.1.2 above, stability of the quarry faces have not been assessed as part of this report, but may required further SRA work if deemed necessary by the quarry operator.

Once the sidewall has been constructed to full height and confined with inert waste, the reported factor of safety is **FOS = 4.484** and therefore is greater then 1.3 and deemed acceptable, and there shall be no instabilities associated with the final profile for the site.

4.1.1 Heave Assessment

In areas where extraction of the sands and gravel mineral is yet to commence, the removal of the sands and gravel during the proposed quarrying activities would result in a reduction in the vertical stress which is being applied to the underlying mudstone of the Dyrham Formation. This reduction in vertical stress allows the ground below to relax which causes unloading expansion of the material, in a upwards direction, giving rise to heave. The magnitude of heave is generally governed by soil stiffness and the stress history, whilst the rate of heave is generally governed by the permeability of the soils. This phenomenon has been modelled in PLAXIS as part of this assessment and the maximum potential heave within the basal subgrade following removal of the sand and gravel is estimated to be approximately ~200mm. As there is no formal engineered clay liner being constructed on the base, and the fact that there is a significant thickness of in-situ clay below the site, the predicted heave within the basal subgrade is not considered to have any detrimental impact to the stability of the containment system for the site.

5 CONCLUSIONS

This stability risk assessment (SRA) has addressed the stability of the proposed buttress, the proposed side-slope lining system (AEGB), and the subsequent inert waste infill, at Husbands Bosworth Quarry.

Analyses have been based on the available site investigation information, site monitoring, conservative materials parameters, and a worst-case interpretation.

This SRA has shown that constructing the engineered buttress and engineered clay liner in 2m lifts, and then subsequently confining this with inert waste prior to constructing the next lift of engineered buttress and clay liner, reports factors of safety greater than **FOS=1.3** for all the aspects and options considered. The stability of the proposed construction and infilling works is therefore deemed to be acceptable, provided that the construction / infilling strategy and the timings outlined in this SRA are followed.

Should the in-filling rate increase from that modelled in this SRA, or the characteristics of the CL:AIRE material vary significantly from the worst-case values assumed, or the waste fill heights increase, or there is a change in the waste types being accepted, then the model in this SRA should be revisited with the new timeframe/s and waste parameter/s, to ensure that acceptable factors of safety are still maintained.

Stability of the excavated quarry faces during and following their excavation has not been assessed in detail as part of this report. If deemed necessary by the quarry operator, a further stability assessment on the proposed quarry flanks should be undertaken to ensure these remain stable for the duration of the quarrying process and prior to the placement of the buttress.

In conclusion, the stability of the proposed buttress, the proposed side-slope lining system (AEGB), and the subsequent inert waste placement at Husbands Bosworth shall remain stable.

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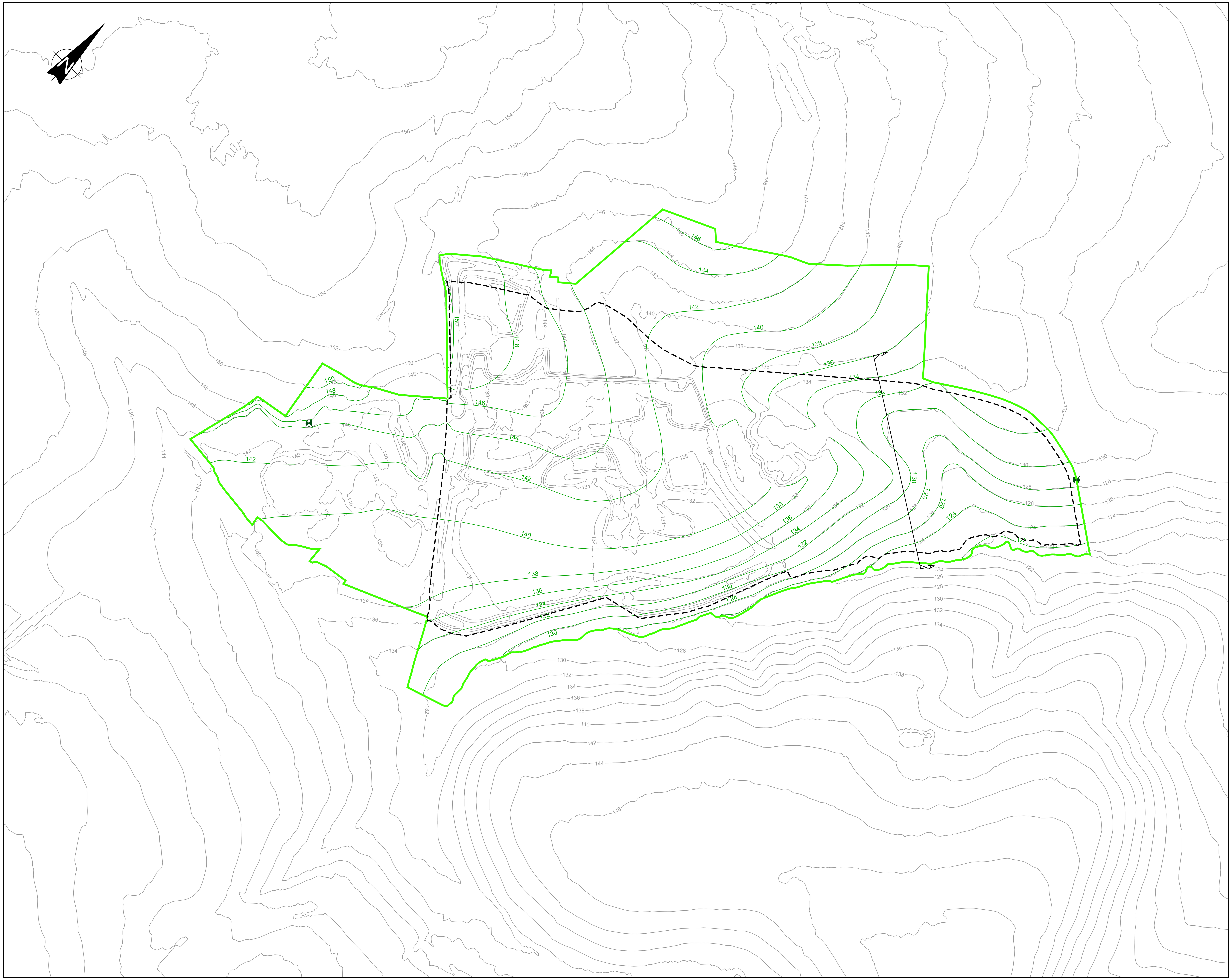
APPENDIX SRA1

DRAWINGS



NOTES

1. ALL LEVELS IN METRES ABOVE ORDNANCE DATUM.
2. DO NOT SCALE FROM THIS DRAWING.

LEGEND

- 18.5 SITE SURVEY
- 19.0 PROPOSED RESTORATION CONTOURS
- QUARRY BOUNDARY

REV	DESCRIPTION	DATE	BY

CLIENT

MICK GEORGE

sirius Environmental

Office Suite 2, The Beacon Centre for Enterprise, Dafen, Llanelli. SA14 8LQ. 01554 780 544

JOB TITLE

HUSBANDS BOSWORTH QUARRY
Environmental Permit Application

DRAWING TITLE

SRA Section Locations

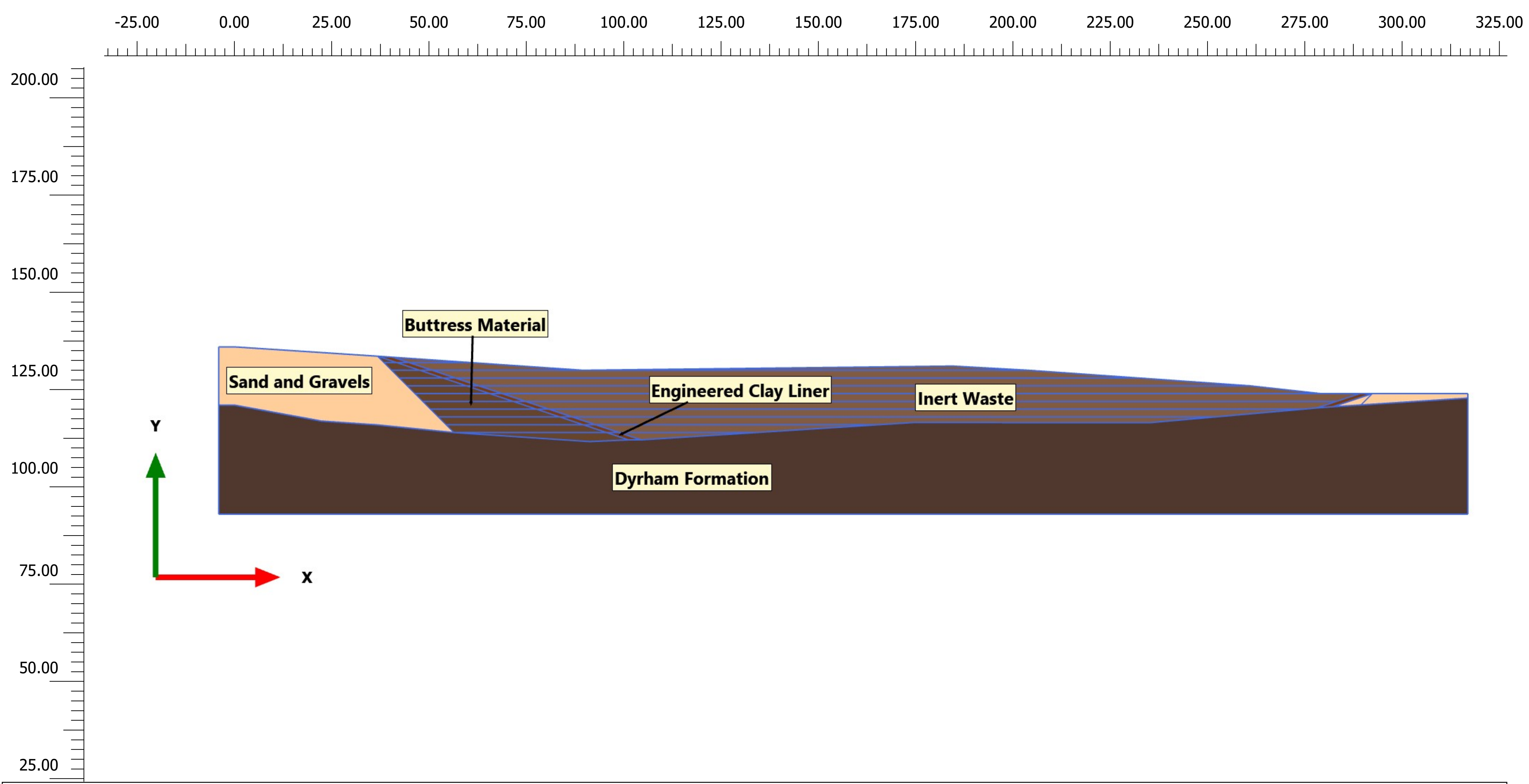
DRAWN	DATE	APPROVED	DATE
M.C	24/01/2022	J.D	24/01/2022

SCALE	SHEET	DRAWING NUMBER	REVISION
1:2500	A1L	MG1001 /SRA/01	0

APPENDIX SRA2

MODEL GEOMETRY AND MODEL PARAMETERS

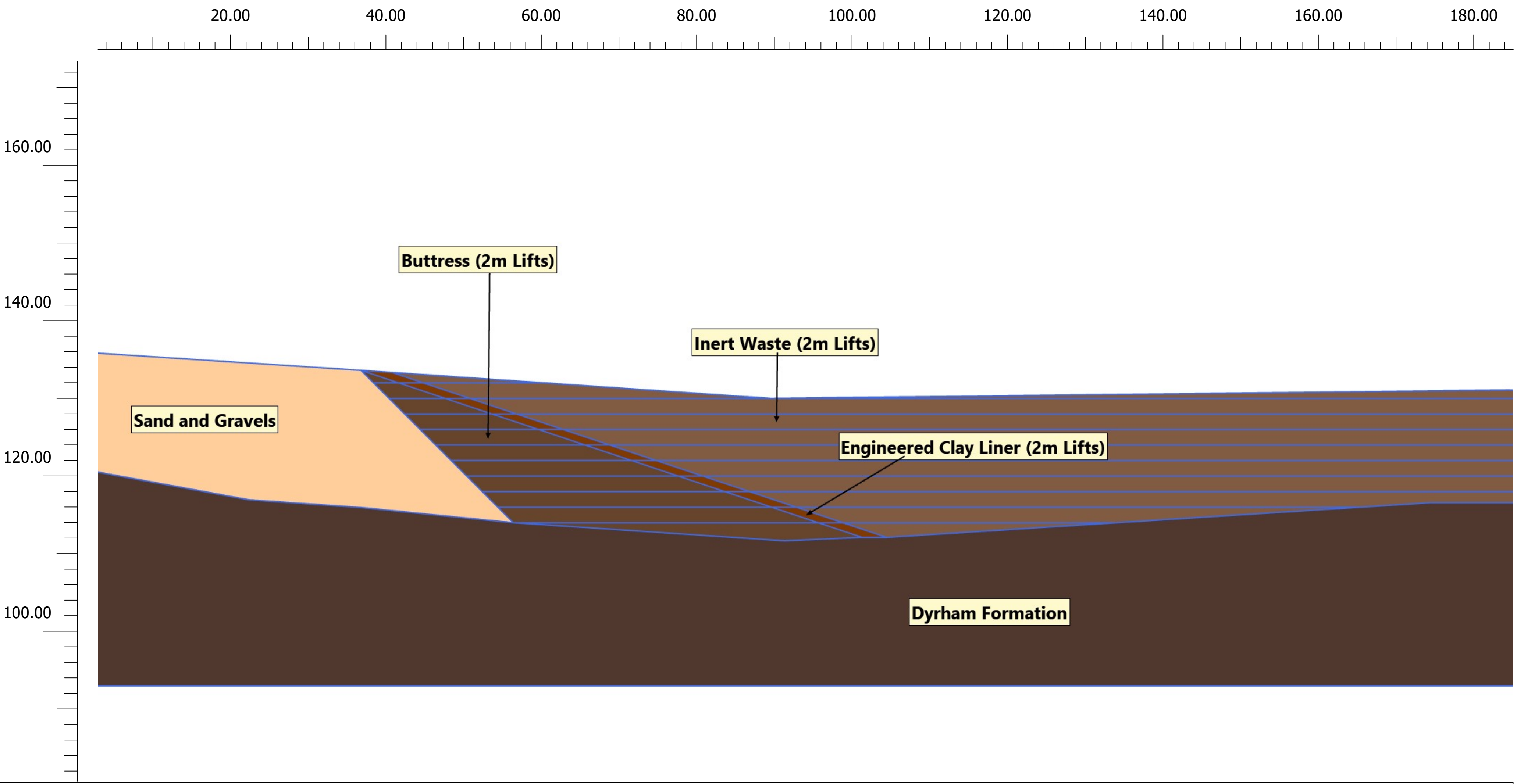
Output Version 21.1.0.479



Connectivity plot

Sirius Environmental	*Project description* Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 351	*Company* Sirius Environmental Ltd

Output Version 21.1.0.479



Connectivity plot

Project description Husbands Bosworth			*Date* 28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 351	*Company* Sirius Environmental Ltd	

sirius Environmental

Material set				
Identification number		1	2	3
Identification		Engineered Clay Liner	Imported Material	Mudstone HS
Material model		Hardening soil	Hardening soil	Hardening soil
Drainage type		Undrained (A)	Undrained (A)	Undrained (A)
Colour		RGB 123, 56, 4	RGB 125, 88, 64	RGB 77, 54, 45
Comments				
General properties				
γ_{unsat}	kN/m³	19.00	19.00	23.00
γ_{sat}	kN/m³	20.00	20.00	24.00
Advanced				
Void ratio				
Dilatancy cut-off		No	No	No
e_{init}		0.5000	0.5000	0.5000
e_{min}		0.000	0.000	0.000
e_{max}		999.0	999.0	999.0
Damping				
Rayleigh α		0.000	0.000	0.000
Rayleigh β		0.000	0.000	0.000
Stiffness				
E_{50}^{ref}	kN/m²	7000	4000	10.00E3
E_{oed}^{ref}	kN/m²	7000	4000	10.00E3
E_{ur}^{ref}	kN/m²	21.00E3	12.00E3	30.00E3
power (m)		0.7500	0.7500	0.7500
Alternatives				
Use alternatives		No	No	No
C_c		0.04929	0.08625	0.03450
C_s		0.01479	0.02587	0.01035
e_{init}		0.5000	0.5000	0.5000
Strength				
c_{ref}	kN/m²	5.000	5.000	12.00
φ (phi)	°	25.00	25.00	28.00
ψ (psi)	°	0.000	0.000	0.000

Identification		Engineered Clay Liner	Imported Material	Mudstone HS
Advanced				
Set to default values		Yes	Yes	Yes
Stiffness				
ν_{ur}		0.2000	0.2000	0.2000
p_{ref}	kN/m²	100.0	100.0	100.0
K_0^{nc}		0.5774	0.5774	0.5305
Strength				
c_{inc}	kN/m²/m	0.000	0.000	0.000
y_{ref}	m	0.000	0.000	0.000
R_f		0.9000	0.9000	0.9000
Tension cut-off		Yes	Yes	Yes
Tensile strength	kN/m²	0.000	0.000	0.000
Undrained behaviour				
Undrained behaviour		Standard	Standard	Standard
Skempton-B		0.9866	0.9866	0.9866
ν_u		0.4950	0.4950	0.4950
$K_{w,ref}$ / n	kN/m²	860.4E3	491.7E3	1.229E6
Stiffness				
Stiffness		Standard	Standard	Standard
Strength				
Strength		Rigid	Rigid	Rigid
R_{inter}		1.000	1.000	1.000
Consider gap closure		Yes	Yes	Yes
Real interface thickness				
δ_{inter}		0.000	0.000	0.000
Groundwater				
Cross permeability		Impermeable	Impermeable	Impermeable
Drainage conductivity, dk	m³/day/m	0.000	0.000	0.000
Thermal				
R	m² K/kW	0.000	0.000	0.000

Identification		Engineered Clay Liner	Imported Material	Mudstone HS
K0 settings				
K_0 determination		Automatic	Automatic	Automatic
$K_{0,x} = K_{0,z}$		Yes	Yes	Yes
$K_{0,x}$		0.5774	0.5774	0.5305
$K_{0,z}$		0.5774	0.5774	0.5305
Overconsolidation				
OCR		1.000	1.000	1.000
POP	kN/m²	0.000	0.000	0.000
Model				
Data set		Standard	Standard	Standard
Soil				
Type		Coarse	Coarse	Coarse
< 2 µm	%	10.00	10.00	10.00
2 µm - 50 µm	%	13.00	13.00	13.00
50 µm - 2 mm	%	77.00	77.00	77.00
Flow parameters				
Use defaults		None	None	None
k_x	m/day	0.08640E-3	0.4320E-3	0.8640E-3
k_y	m/day	0.08640E-3	0.4320E-3	0.8640E-3
$-\psi_{unsat}$	m	10.00E3	10.00E3	10.00E3
e_{init}		0.5000	0.5000	0.5000
S_s	1/m	0.000	0.000	0.000
Change of permeability				
c_k		1000E12	1000E12	1000E12

Identification		Engineered Clay Liner	Imported Material	Mudstone HS
Parameters				
c_s	kJ/t/K	0.000	0.000	0.000
λ_s	kW/m/K	0.000	0.000	0.000
ρ_s	t/m³	0.000	0.000	0.000
Solid thermal expansion		Volumetric	Volumetric	Volumetric
α_s	1/K	0.000	0.000	0.000
D_v	m²/day	0.000	0.000	0.000
f_{Tv}		0.000	0.000	0.000
Unfrozen water content		None	None	None

Material set		
Identification number		5
Identification		Eng Fill
Material model		Hardening soil
Drainage type		Undrained (A)
Colour		RGB 114, 77, 54
Comments		
General properties		
γ_{unsat}	kN/m³	19.00
γ_{sat}	kN/m³	20.00
Advanced		
Void ratio		
Dilatancy cut-off		No
e_{init}		0.5000
e_{min}		0.000
e_{max}		999.0
Damping		
Rayleigh α		0.000
Rayleigh β		0.000
Stiffness		
E_{50}^{ref}	kN/m²	7000
E_{oed}^{ref}	kN/m²	7000
E_{ur}^{ref}	kN/m²	21.00E3
power (m)		0.7500
Alternatives		
Use alternatives		No
C_c		0.04929
C_s		0.01479
e_{init}		0.5000
Strength		
c_{ref}	kN/m²	5.000
φ (phi)	°	25.00
ψ (psi)	°	0.000

Identification		Eng Fill
Advanced		
Set to default values		Yes
Stiffness		
ν_{ur}		0.2000
p_{ref}	kN/m²	100.0
K_0^{nc}		0.5774
Strength		
c_{inc}	kN/m²/m	0.000
y_{ref}	m	0.000
R_f		0.9000
Tension cut-off		Yes
Tensile strength	kN/m²	0.000
Undrained behaviour		
Undrained behaviour		Standard
Skempton-B		0.9866
ν_u		0.4950
$K_{w,ref}$ / n	kN/m²	860.4E3
Stiffness		
Stiffness		Standard
Strength		
Strength		Rigid
R_{inter}		1.000
Consider gap closure		Yes
Real interface thickness		
δ_{inter}		0.000
Groundwater		
Cross permeability		Impermeable
Drainage conductivity, dk	m³/day/m	0.000
Thermal		
R	m² K/kW	0.000

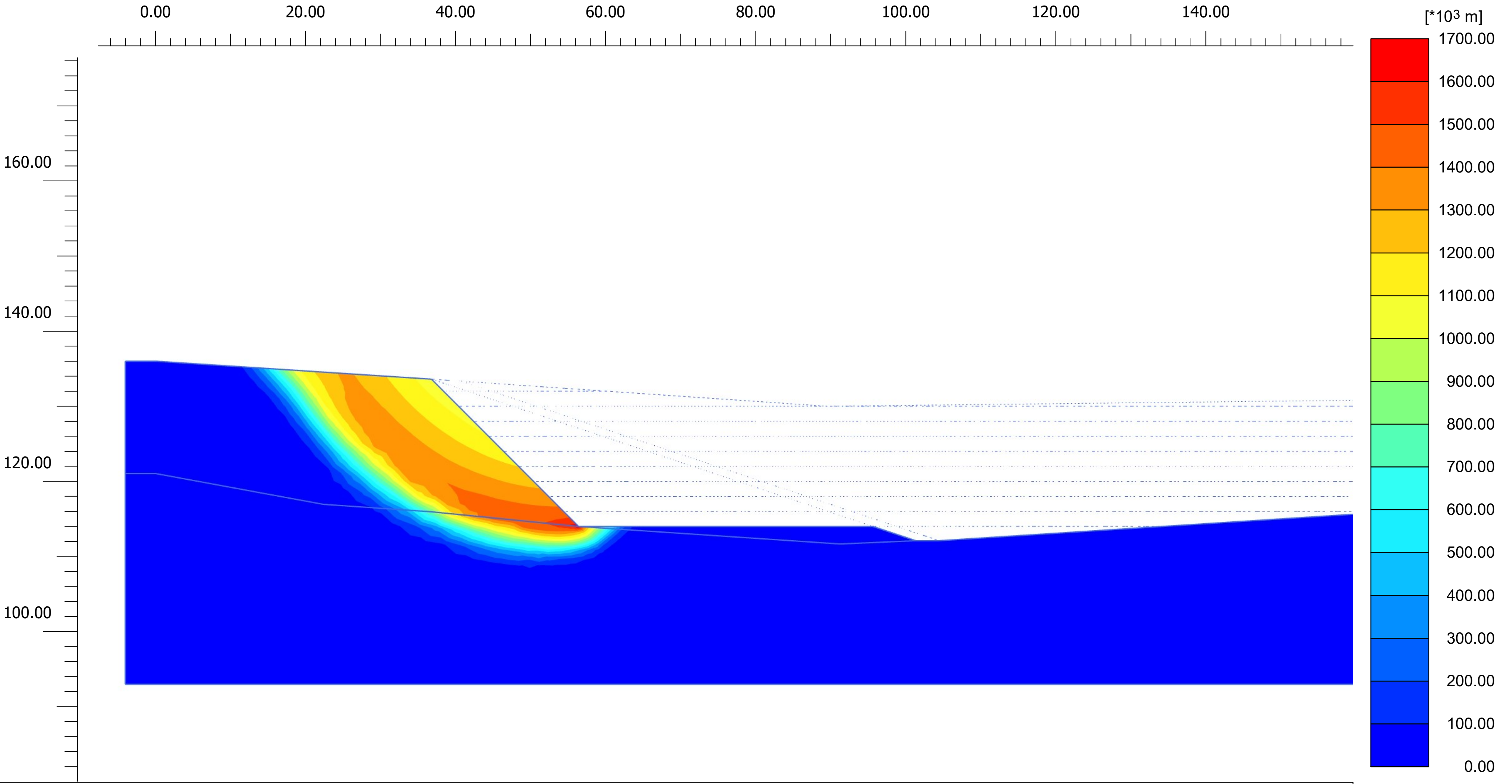
Identification		Eng Fill
K0 settings		
K_0 determination		Automatic
$K_{0,x} = K_{0,z}$		Yes
$K_{0,x}$		0.5774
$K_{0,z}$		0.5774
Overconsolidation		
OCR		1.000
POP	kN/m²	0.000
Model		
Data set		Standard
Soil		
Type		Coarse
< 2 μm	%	10.00
2 μm - 50 μm	%	13.00
50 μm - 2 mm	%	77.00
Flow parameters		
Use defaults		None
k_x	m/day	0.4320E-3
k_y	m/day	0.4320E-3
$-\psi_{unsat}$	m	10.00E3
e_{init}		0.5000
S_s	1/m	0.000
Change of permeability		
c_k		1000E12

Identification		Eng Fill
Parameters		
c_s	kJ/t/K	0.000
λ_s	kW/m/K	0.000
ρ_s	t/m³	0.000
Solid thermal expansion		Volumetric
α_s	1/K	0.000
D_v	m²/day	0.000
f_{Tv}		0.000
Unfrozen water content		None

APPENDIX SRA3

PLAXIS STABILITY PRINTOUTS

Output Version 21.1.0.479



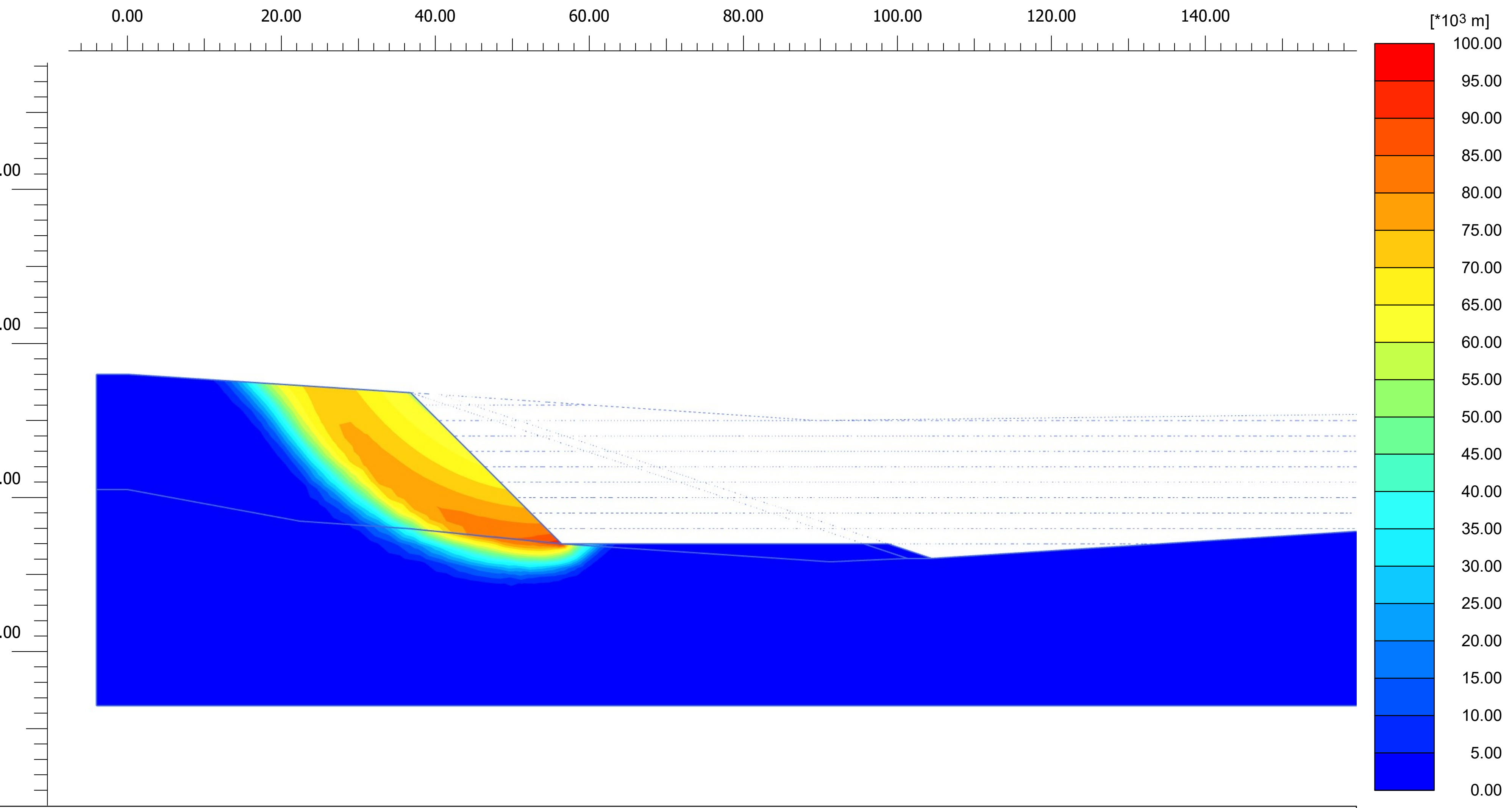
Incremental displacements |Δu| (scaled up $5.00*10^{-6}$ times)

Maximum value = $1.681*10^{6}$ m (Element 635 at Node 17091)

Sirius Environmental	*Project description* Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 3455	*Company* Sirius Environmental Ltd

Step info				
Phase	BL1S [Phase_67]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	0.06570E-12			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.06214E-3	ΣM_{sf}	1.360
Time	Increment	0.000	End time	1835
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7212
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	6201 kN/m^2			

Output Version 21.1.0.479



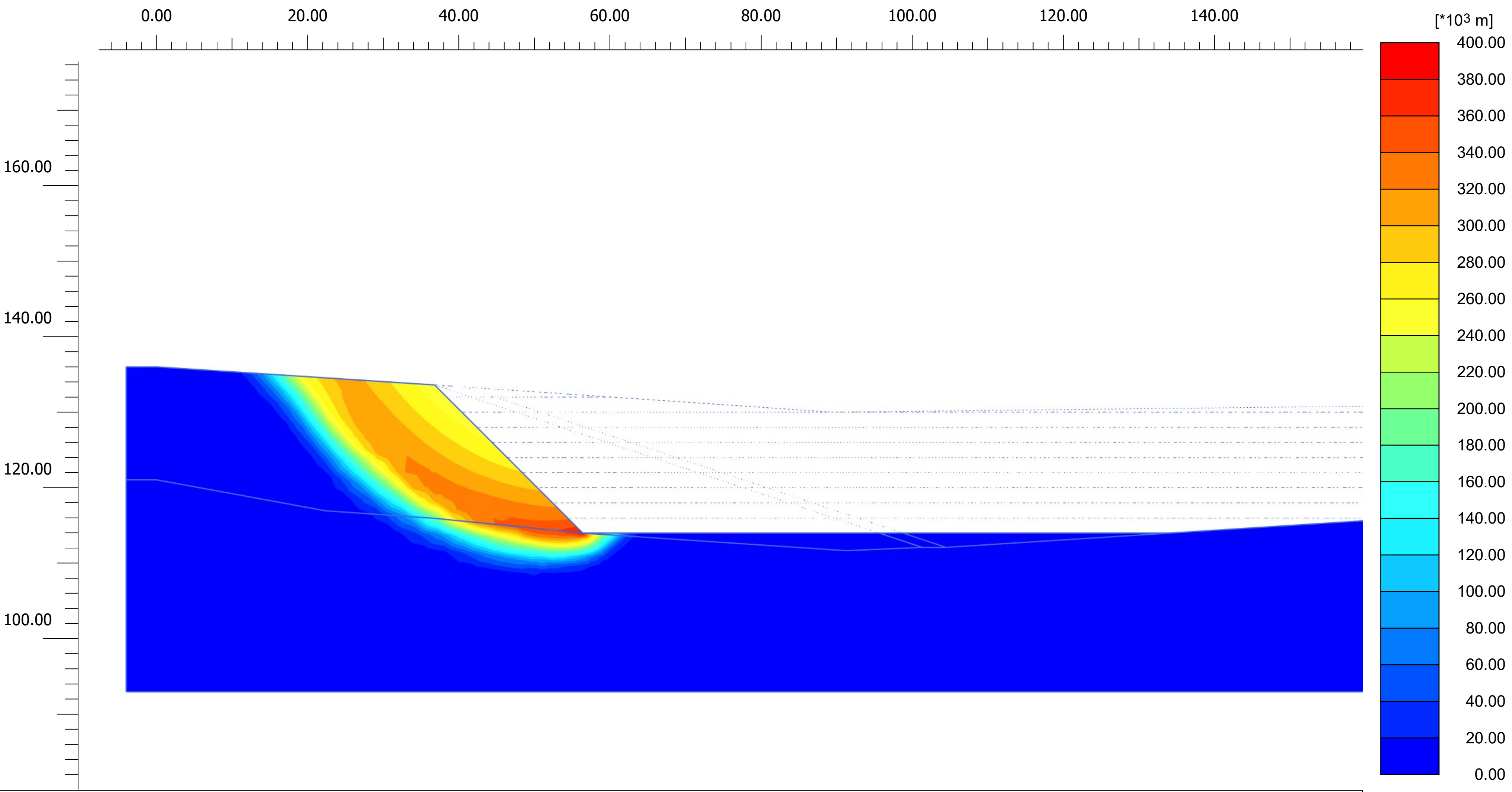
Incremental displacements |Δu| (scaled up 0.100*10⁻³ times)

Maximum value = 95.07*10³ m (Element 635 at Node 17091)

Project description Husbands Bosworth			*Date* 28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 3355	*Company* Sirius Environmental Ltd	

Step info				
Phase	ECLL1S [Phase_66]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	-1.616E-12			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.2060E-3	ΣM_{sf}	1.366
Time	Increment	0.000	End time	1840
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7217
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	17.21E3 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 0.0200*10^{-3} times)

Maximum value = 395.9*10^{3} m (Element 635 at Node 17091)

Project description Husbands Bosworth			*Date* 28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 3255	*Company* Sirius Environmental Ltd	

Step info

Phase	WL1S [Phase_65]
Step	Initial
Calulation mode	Classical mode
Step type	Safety
Updated mesh	False
Solver type	Picos
Kernel type	64 bit
Extrapolation factor	0.5000
Relative stiffness	1.170E-12

Multipliers

Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-4.080E-6	ΣM_{sf}	1.359
Time	Increment	0.000	End time	1885

Staged construction

Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7245
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000

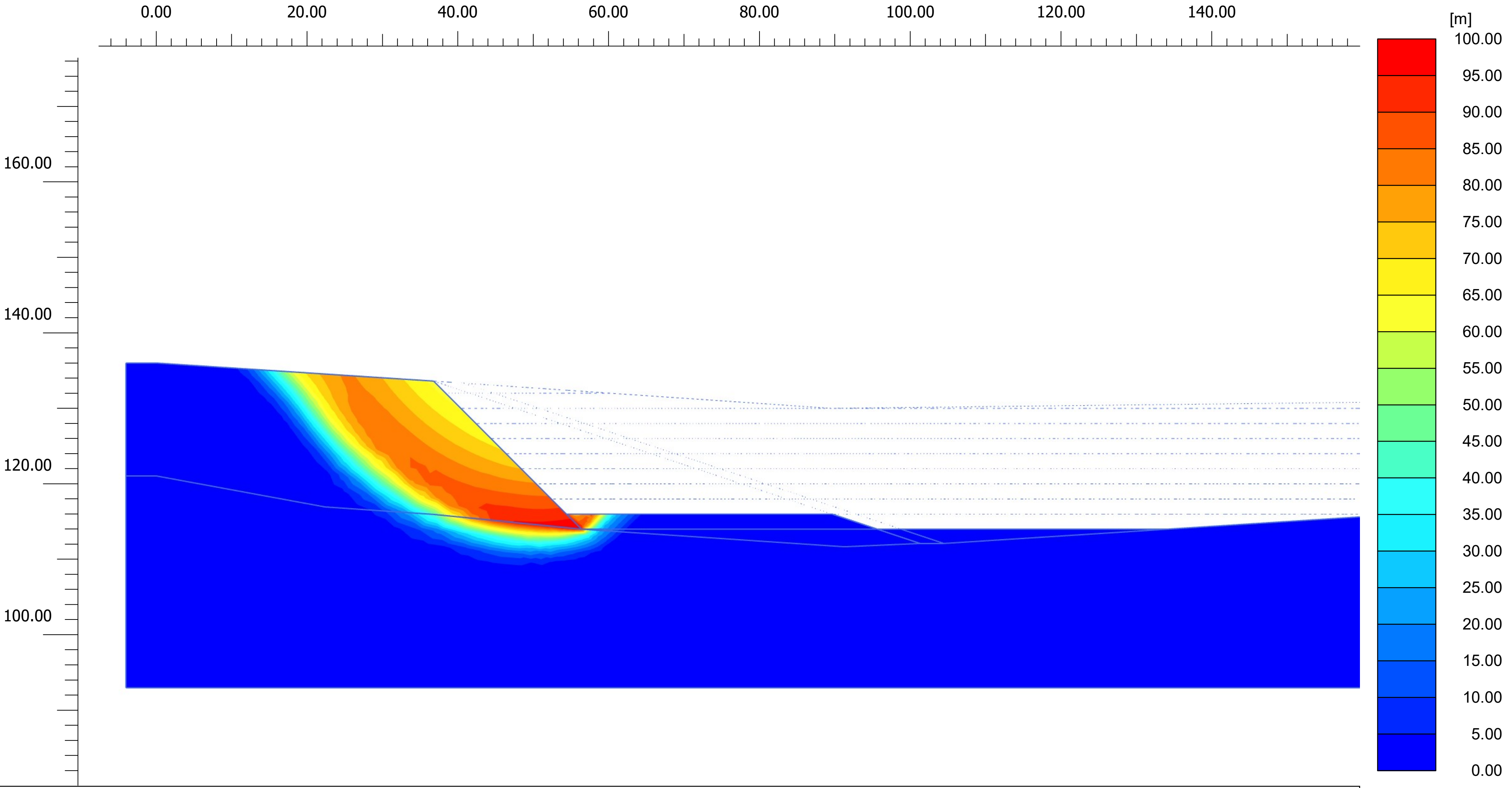
Forces

F_X	0.000 kN/m
F_Y	0.000 kN/m

Consolidation

Realised $P_{Excess,Max}$	12.85E3 kN/m^2

Output Version 21.1.0.479



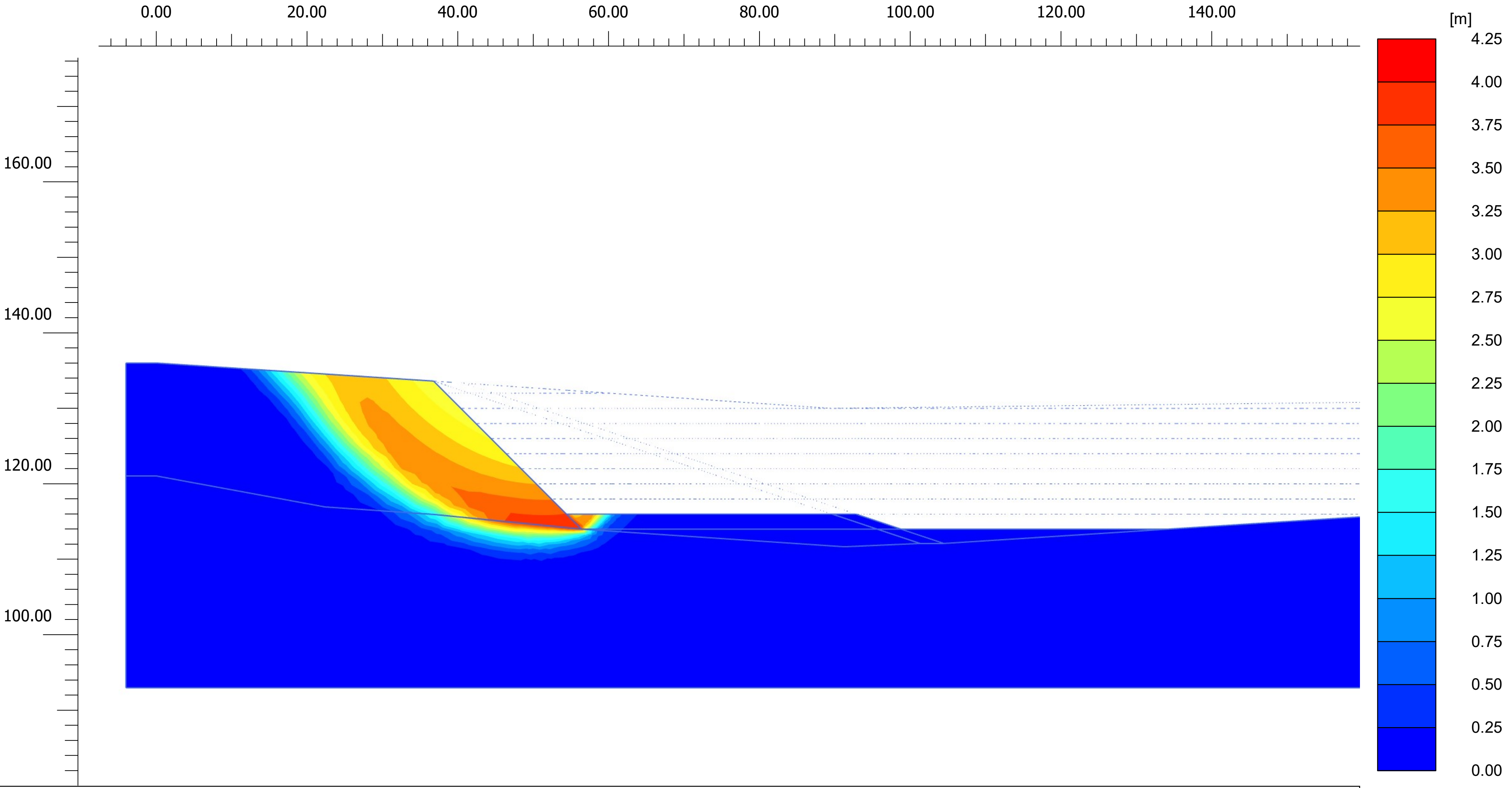
Incremental displacements |Δu| (scaled up 0.0500 times)

Maximum value = 99.27 m (Element 635 at Node 17086)

sirius Environmental	*Project description* Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 3155	*Company* Sirius Environmental Ltd

Step info				
Phase	BL2S [Phase_64]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	4.193E-12			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.04547E-3	ΣM_{sf}	1.437
Time	Increment	0.000	End time	1895
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7308
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	3656 kN/m^2			

Output Version 21.1.0.479



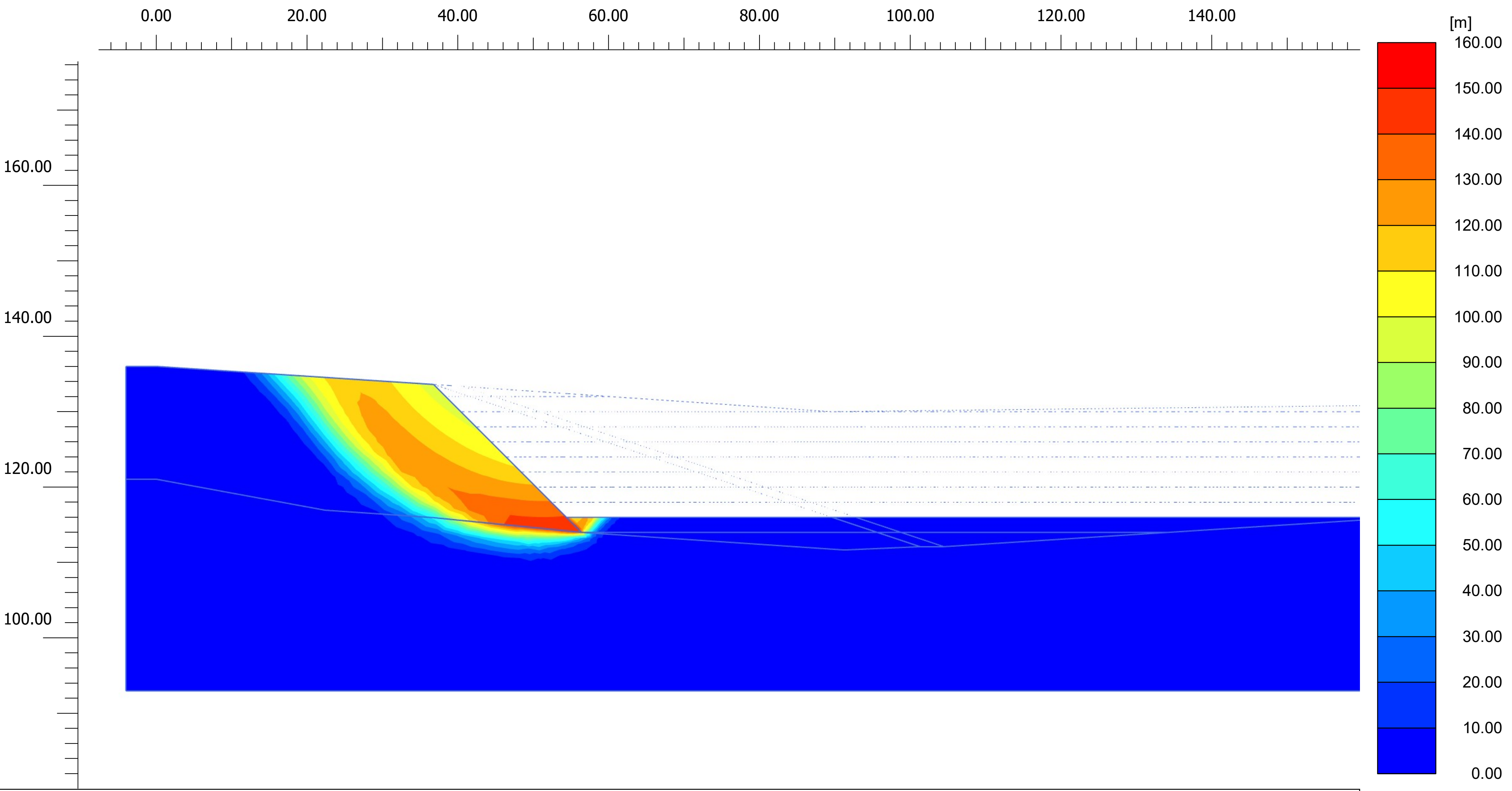
Incremental displacements |Δu| (scaled up 5.00 times)

Maximum value = 4.004 m (Element 635 at Node 17086)

Sirius Environmental	*Project description* Husbands Bosworth			*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 3055	*Company* Sirius Environmental Ltd	

Step info				
Phase	ECLL2S [Phase_63]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	0.05059E-6			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	2.351E-6	ΣM_{sf}	1.441
Time	Increment	0.000	End time	1900
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7313
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	2401 kN/m^2			

Output Version 21.1.0.479



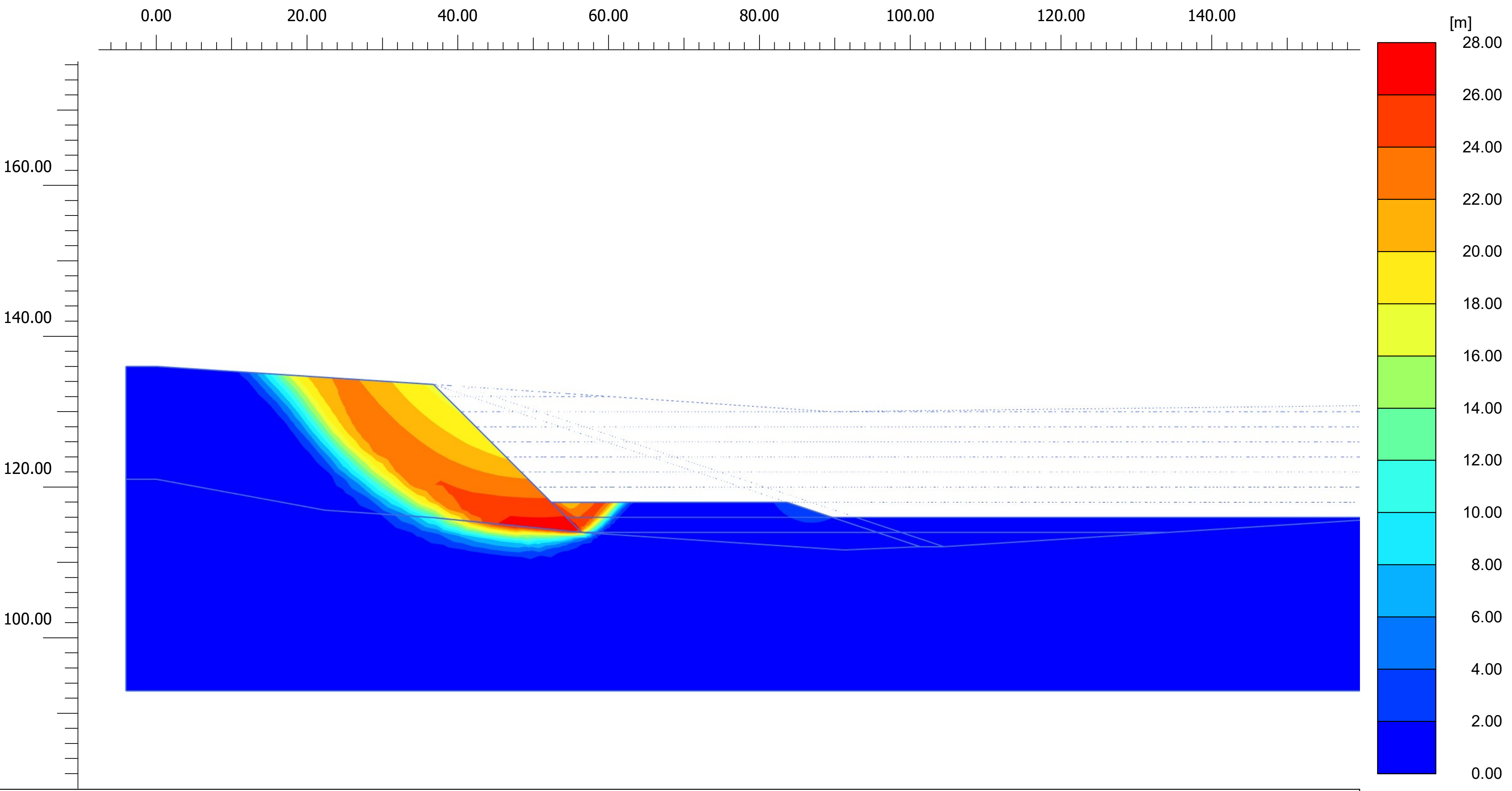
Incremental displacements |Δu| (scaled up 0.0500 times)

Maximum value = 149.9 m (Element 635 at Node 17086)

Project description		*Date*
Husbands Bosworth		28/04/2022
Project filename	*Step*	*Company*
Husbands Bosworth No Drain ...	2955	Sirius Environmental Ltd

Step info				
Phase	WL2S [Phase_62]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	0.1602E-9			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.2058E-3	ΣM_{sf}	1.429
Time	Increment	0.000	End time	1990
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7405
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	5786 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 0.500 times)

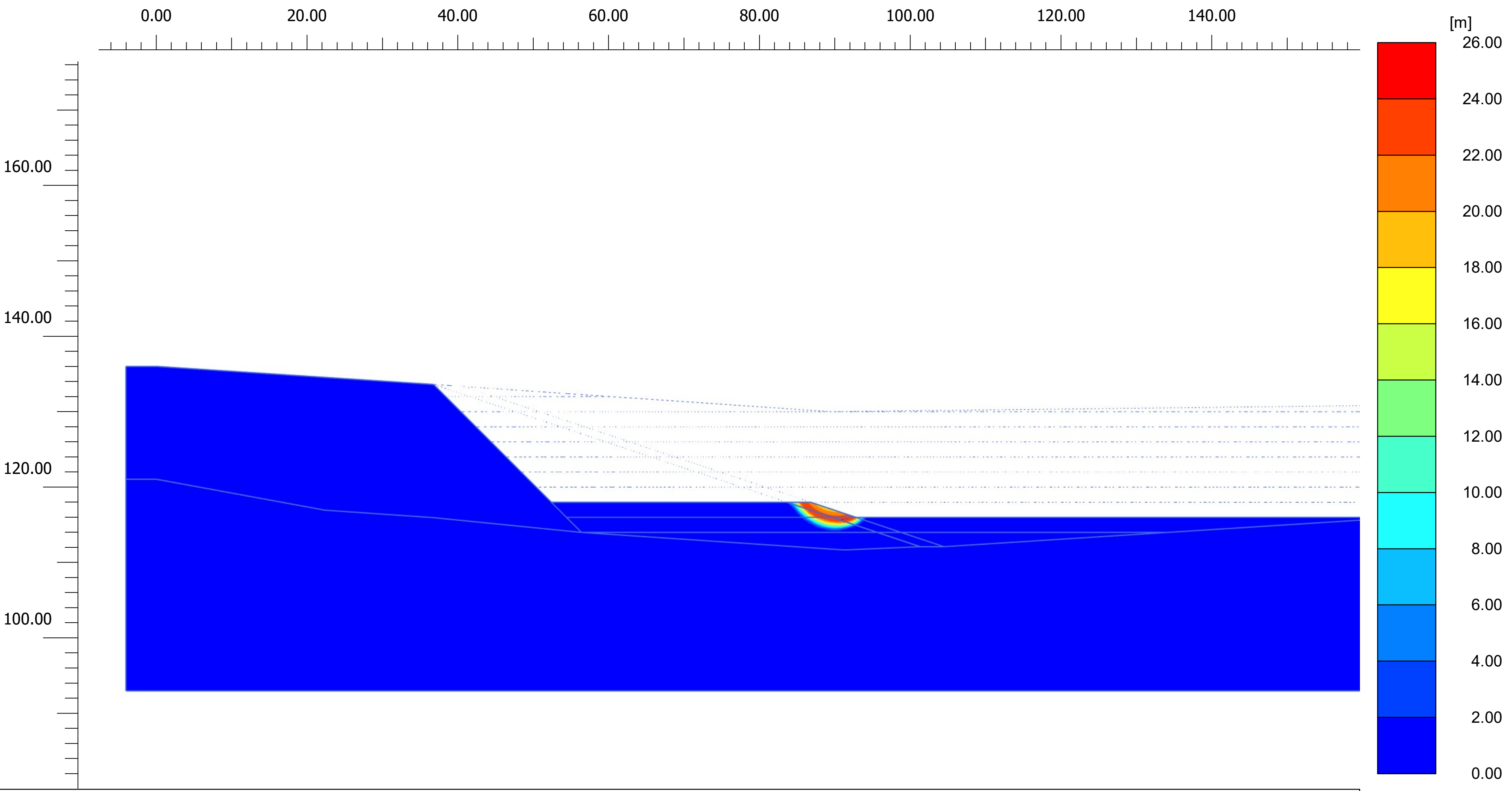
Maximum value = 27.43 m (Element 635 at Node 17087)

Project description		*Date*
Husbands Bosworth		28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 2855	*Company* Sirius Environmental Ltd

Sirius Environmental

Step info				
Phase	BL3S [Phase_61]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	9.191E-9			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.3200E-3	ΣM_{sf}	1.551
Time	Increment	0.000	End time	2000
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7461
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	9092 kN/m^2			

Output Version 21.1.0.479



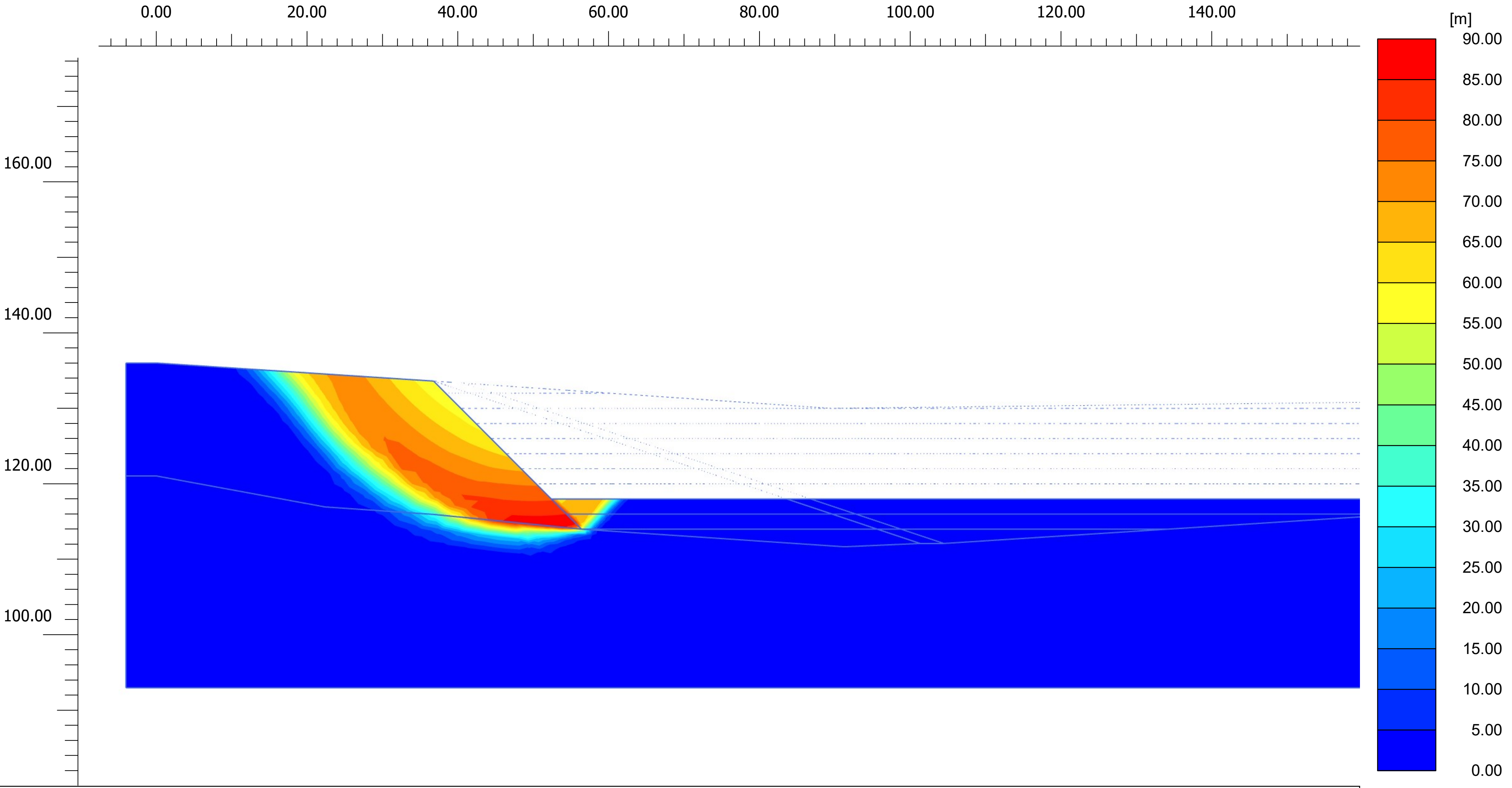
Incremental displacements |Δu| (scaled up 0.500 times)

Maximum value = 24.43 m (Element 1861 at Node 13473)

Project description		*Date*
Husbands Bosworth		28/04/2022
Project filename	*Step*	*Company*
Husbands Bosworth No Drain ...	2755	Sirius Environmental Ltd

Step info				
Phase	ECLL3S [Phase_60]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	0.01070E-6			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.3188E-3	ΣM_{sf}	1.489
Time	Increment	0.000	End time	2005
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7467
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	859.5 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 0.100 times)

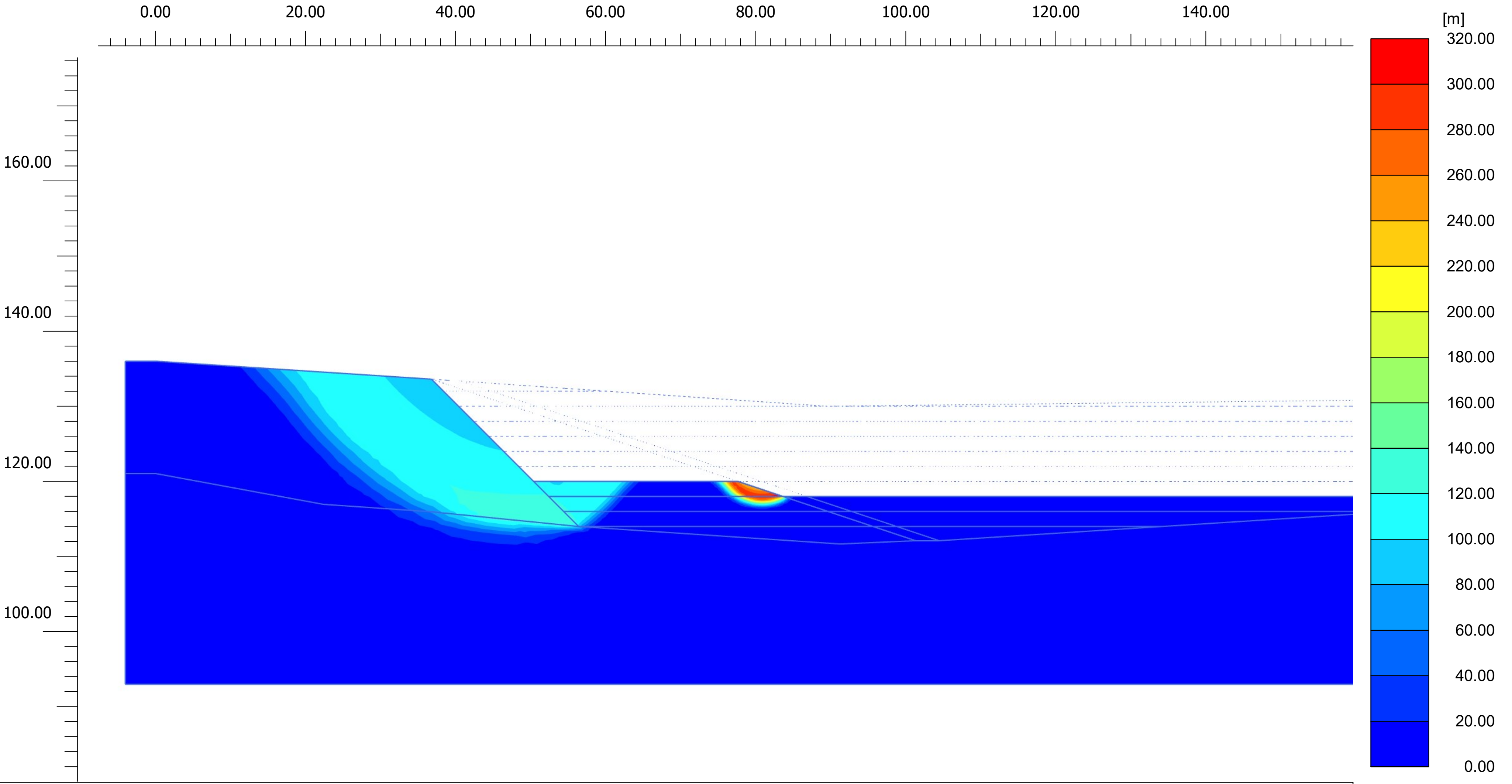
Maximum value = 88.68 m (Element 614 at Node 17191)

Project description		*Date*
Husbands Bosworth		28/04/2022

Project filename	*Step*	*Company*
Husbands Bosworth No Drain ...	2655	Sirius Environmental Ltd

Step info				
Phase	WL3S [Phase_59]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	0.9349E-9			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.1750E-3	ΣM_{sf}	1.543
Time	Increment	0.000	End time	2187
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7693
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	15.64E3 kN/m^2			

Output Version 21.1.0.479



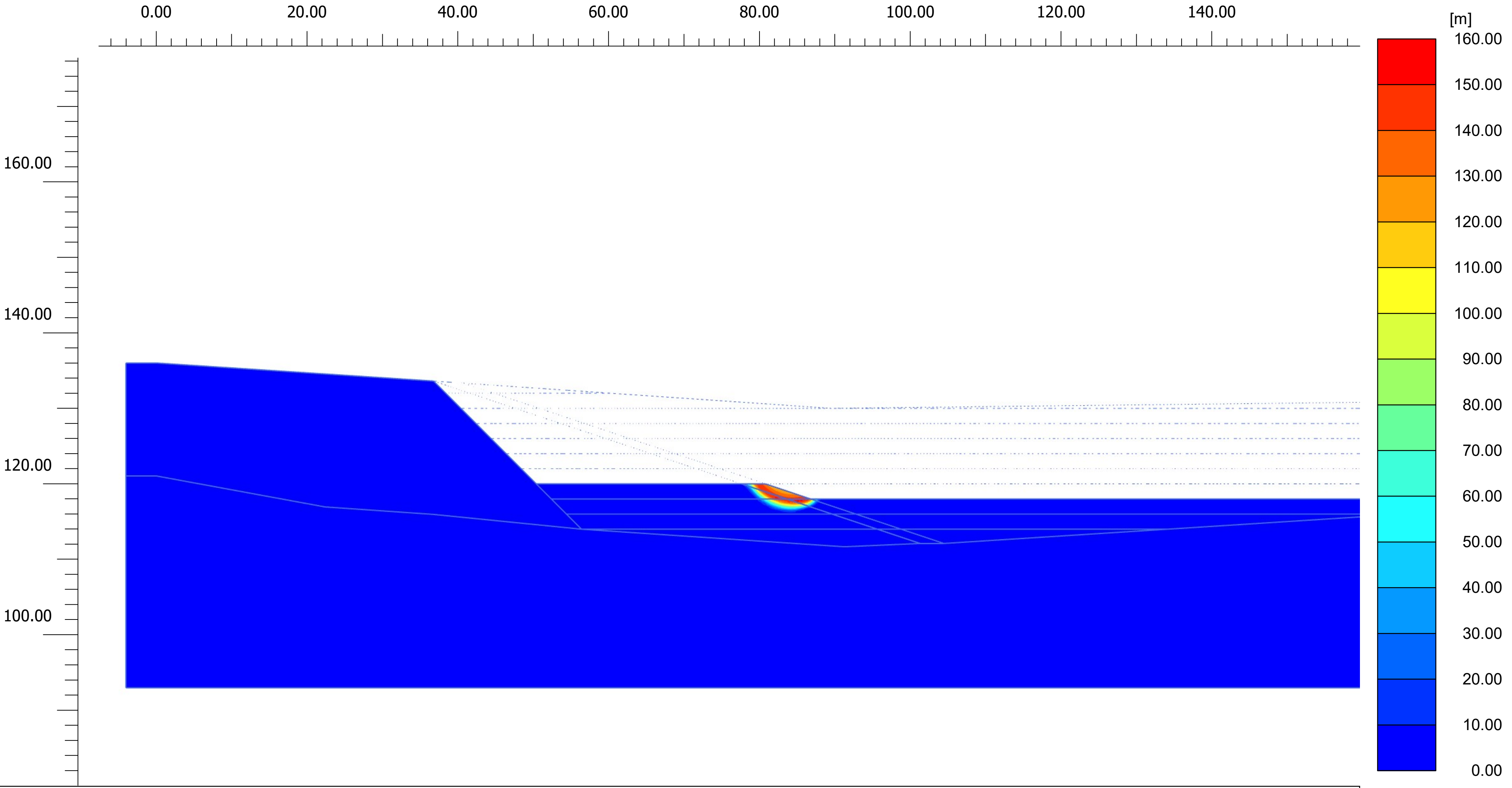
Incremental displacements |Δu| (scaled up 0.0500 times)

Maximum value = 304.4 m (Element 1701 at Node 15065)

Project description		*Date*
Husbands Bosworth		28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 258	*Company* Sirius Environmental Ltd

Step info				
Phase	BL4S [Phase_58]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	0.1986E-9			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.03112E-3	ΣM_{sf}	1.728
Time	Increment	0.000	End time	2197
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7742
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	6500 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 0.0500 times)

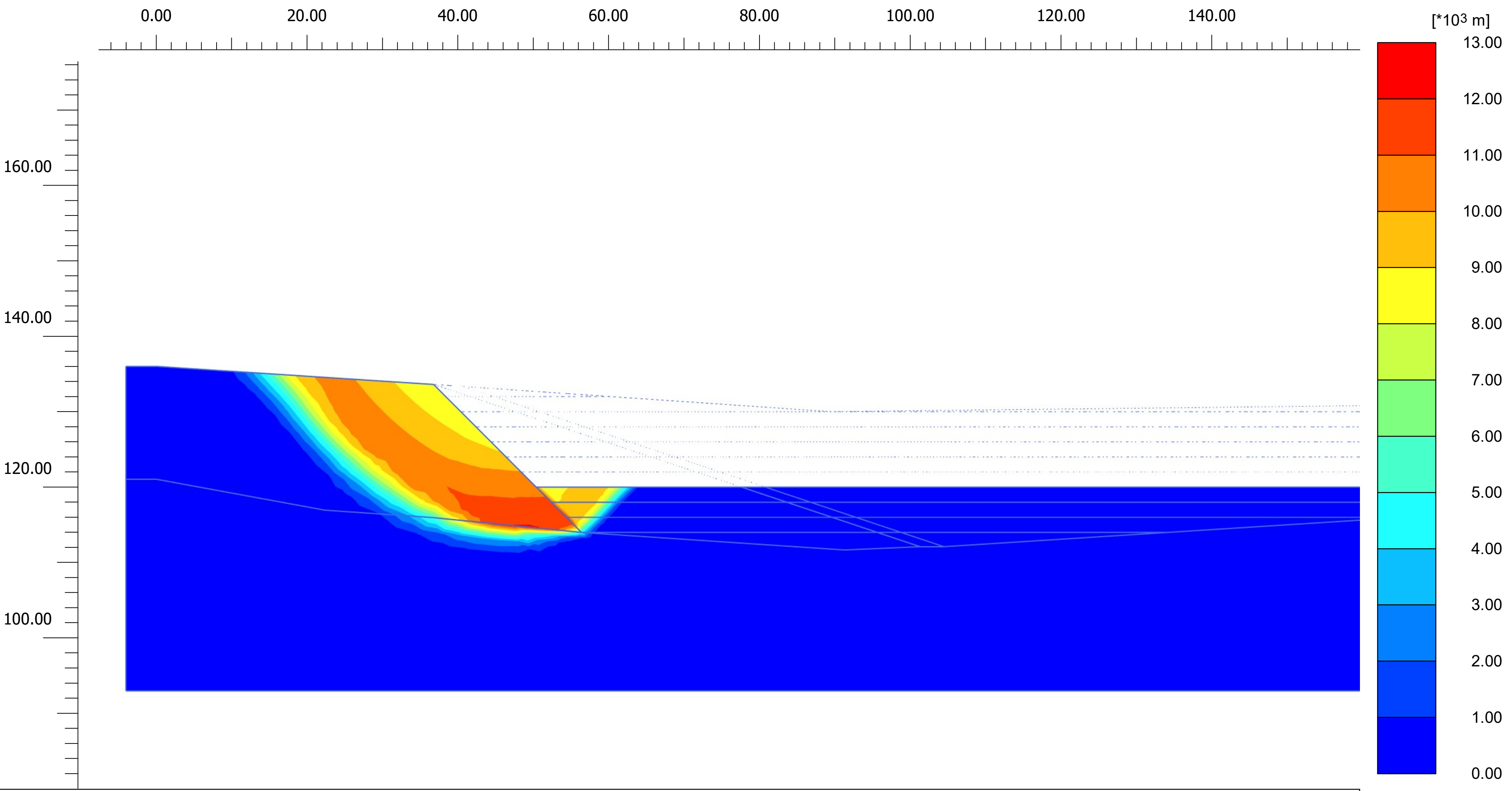
Maximum value = 153.1 m (Element 1671 at Node 14772)

Project description		Date
Husbands Bosworth		28/04/2022

Project filename	Step	Company
Husbands Bosworth No Drain ...	158	Sirius Environmental Ltd

Step info				
Phase	ECLL4S [Phase_57]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	0.6577E-9			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.02936E-3	ΣM_{sf}	1.513
Time	Increment	0.000	End time	2202
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.7748
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	2142 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 0.500*10⁻³ times)

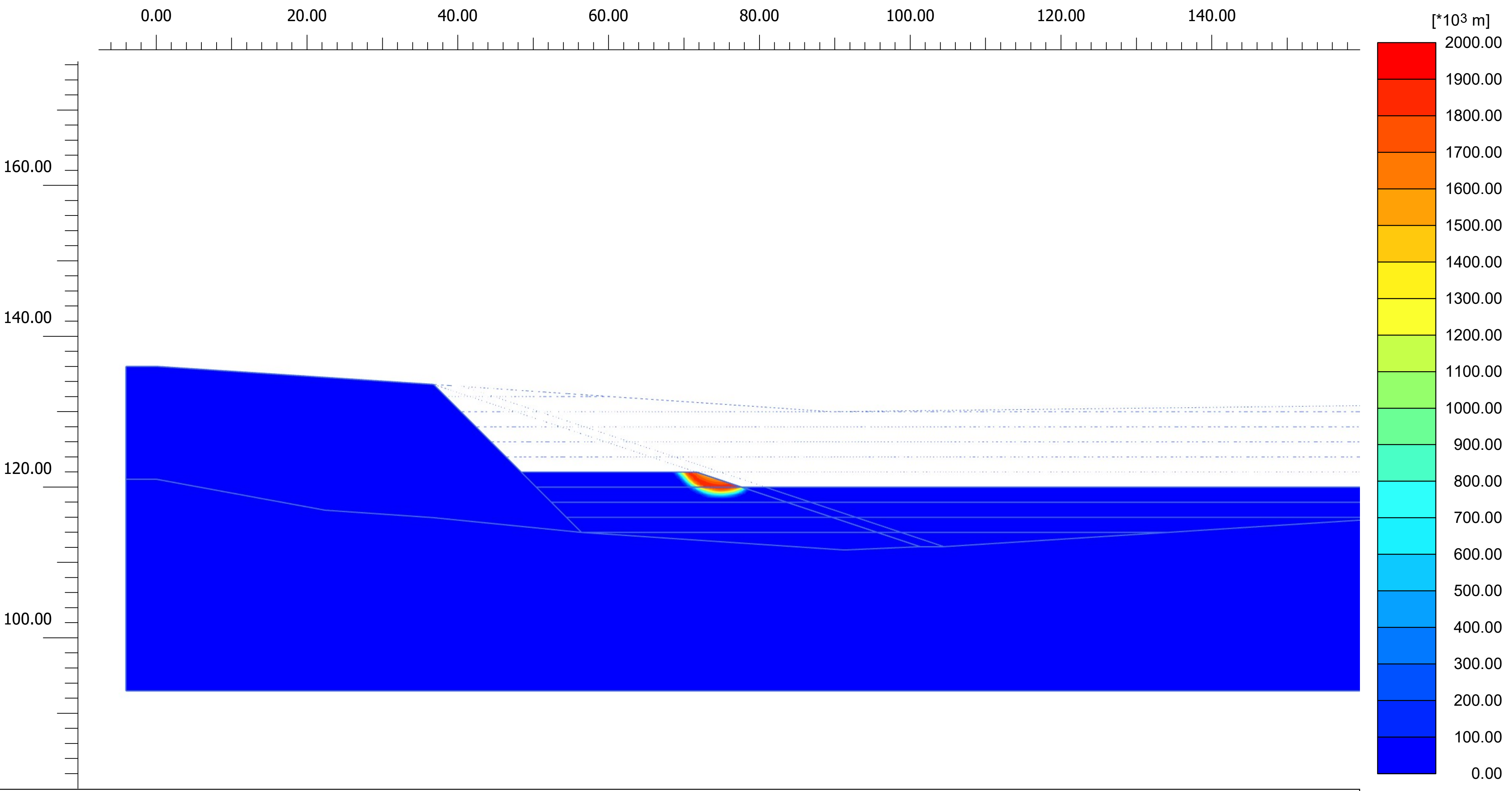
Maximum value = 12.08*10³ m (Element 614 at Node 17187)

Project description	Date
Husbands Bosworth	28/04/2022

Project filename	Step	Company
Husbands Bosworth No Drain ...	2551	Sirius Environmental Ltd

Step info				
Phase	WL4S [Phase_56]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	0.1690E-12			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.2414E-3	ΣM_{sf}	1.722
Time	Increment	0.000	End time	2385
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8052
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	17.05E3 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up $5.00*10^{-6}$ times)

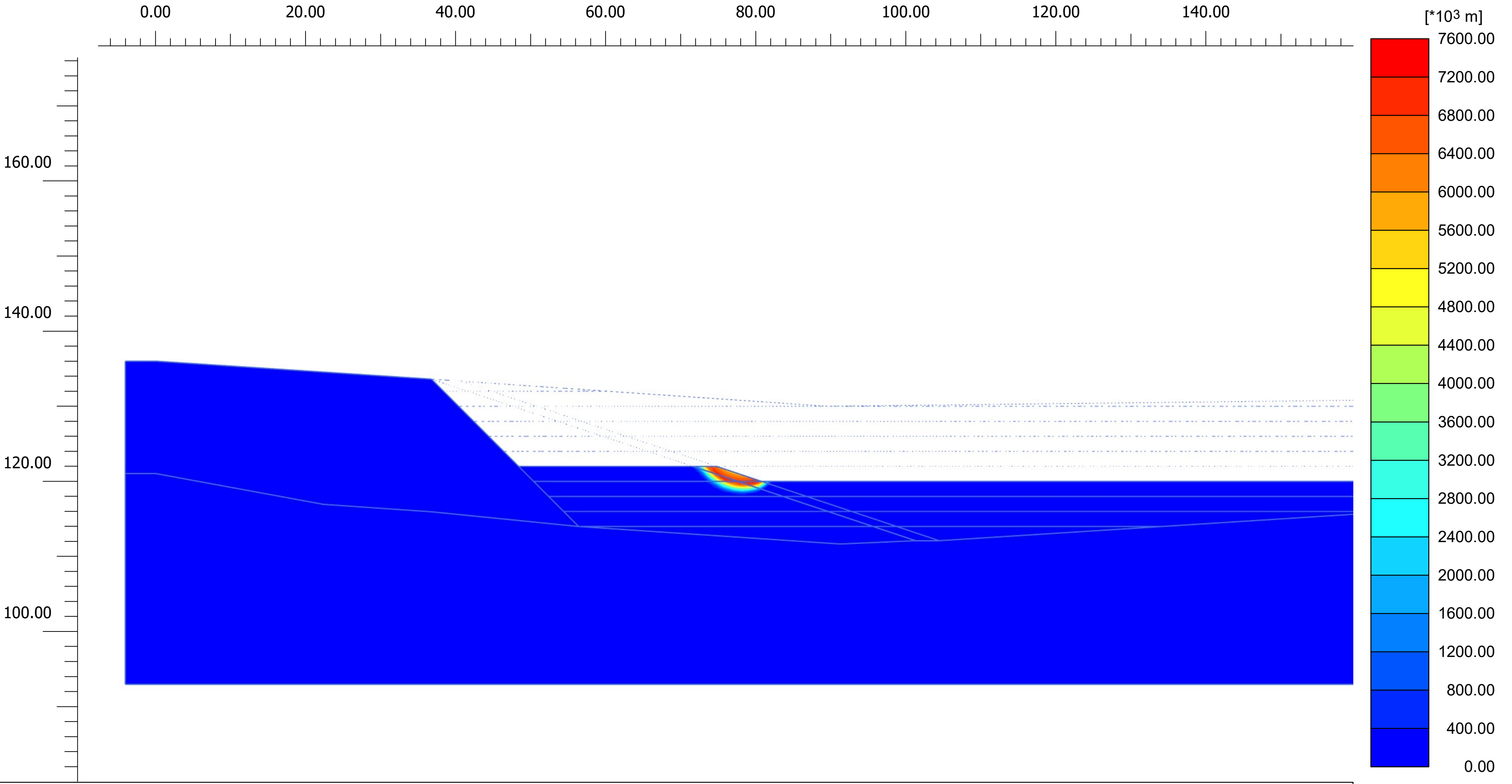
Maximum value = $1.929*10^{6}$ m (Element 1482 at Node 16511)

Project description			*Date*
Husbands Bosworth			28/04/2022
Project filename	*Step*	*Company*	
Husbands Bosworth No Drain ...	2451	Sirius Environmental Ltd	

Sirius Environmental

Step info				
Phase	BL5S [Phase_55]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	0.1958E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.05762E-3	ΣM_{sf}	1.598
Time	Increment	0.000	End time	2395
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8095
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	186.0 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up $1.00*10^{-6}$ times)

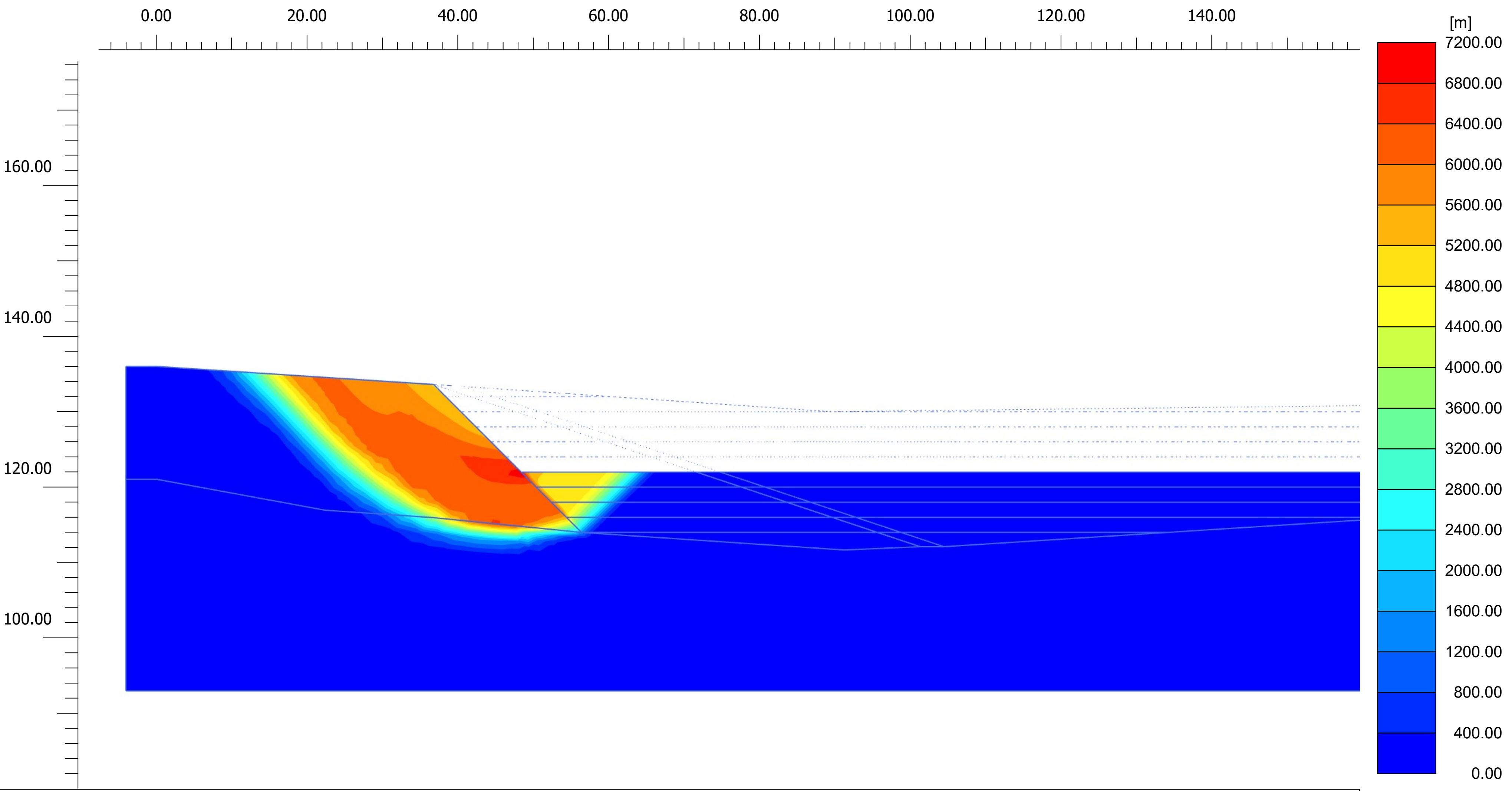
Maximum value = $7.242*10^{6}$ m (Element 1485 at Node 15809)

Project description		Date
Husbands Bosworth		28/04/2022

Project filename	Step	Company
Husbands Bosworth No Drain ...	2351	Sirius Environmental Ltd

Step info				
Phase	ECLL5S [Phase_54]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-0.1124E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.2187E-3	ΣM_{sf}	1.517
Time	Increment	0.000	End time	2400
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8100
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	147.5 kN/m^2			

Output Version 21.1.0.479



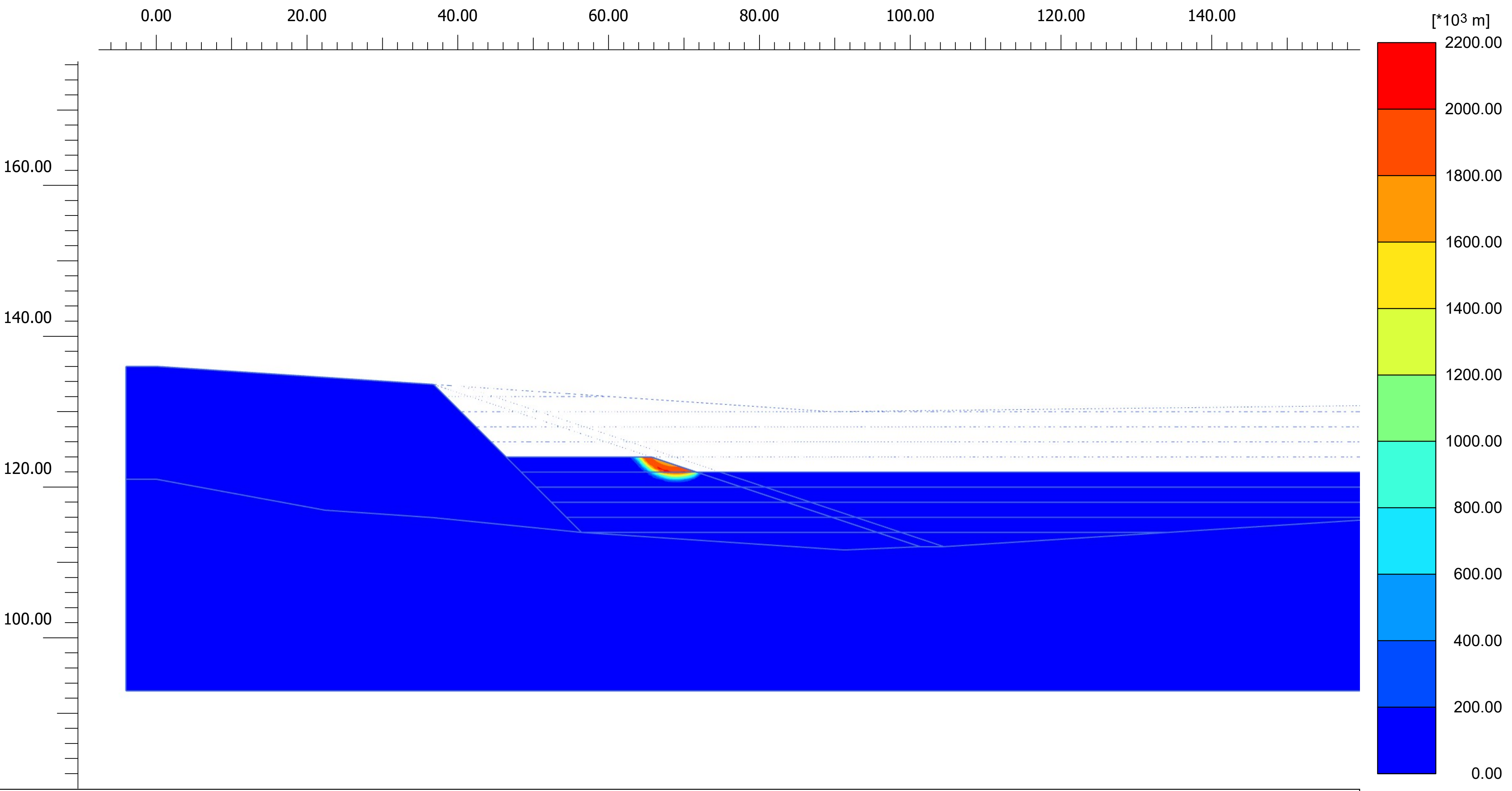
Incremental displacements |Δu| (scaled up $1.00*10^{-3}$ times)

Maximum value = 6942 m (Element 603 at Node 18125)

Project description Husbands Bosworth			*Date* 28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 2251	*Company* Sirius Environmental Ltd	

Step info				
Phase	WL5S [Phase_53]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-1.147E-12			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.08891E-3	ΣM_{sf}	1.987
Time	Increment	0.000	End time	2582
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8443
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	12.78E3 kN/m^2			

Output Version 21.1.0.479



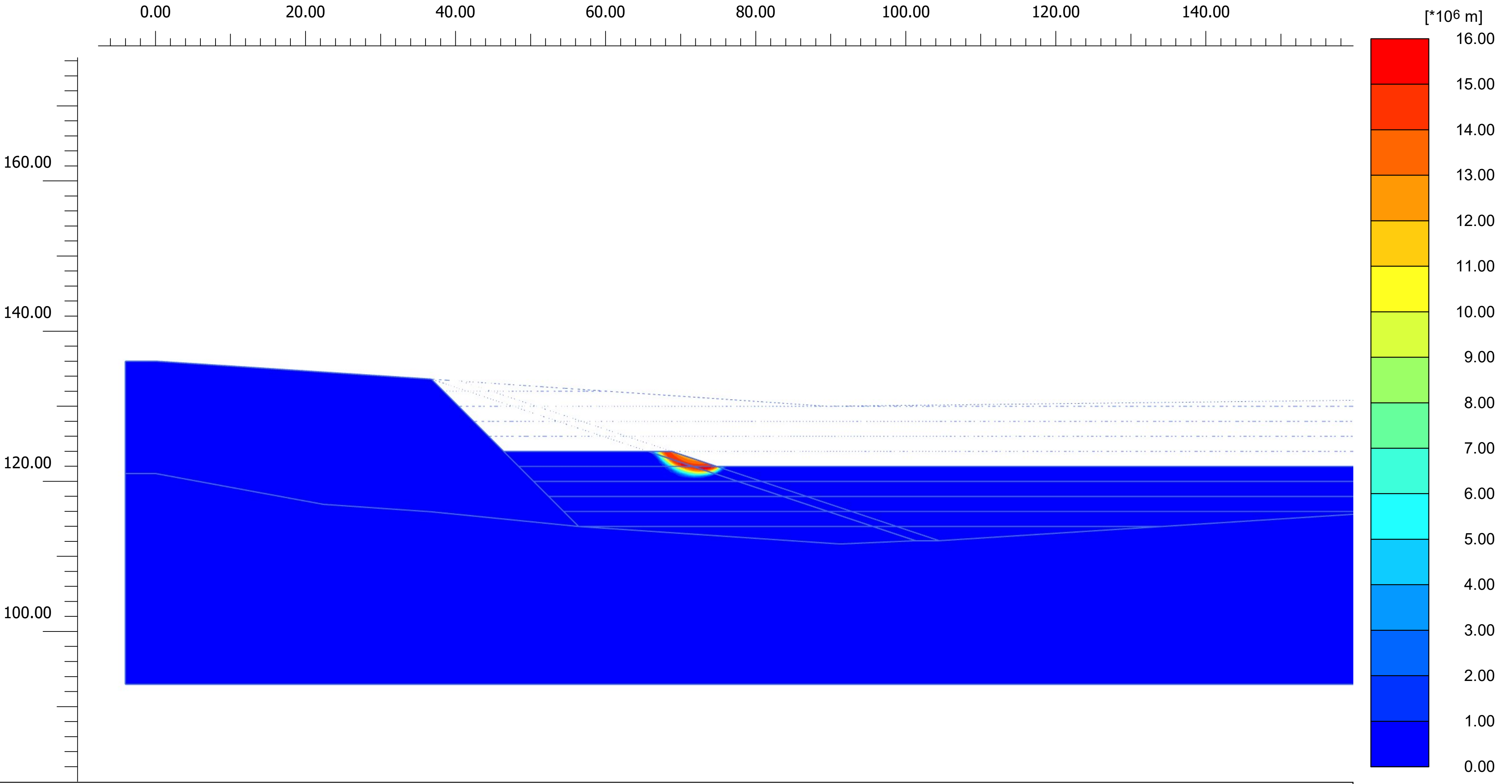
Incremental displacements |Δu| (scaled up $5.00*10^{-6}$ times)

Maximum value = $2.048*10^{6}$ m (Element 1148 at Node 17815)

Project description	Husbands Bosworth		*Date* 28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 2151	*Company* Sirius Environmental Ltd	

Step info				
Phase	BL6S [Phase_52]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	-0.4135E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.5243E-3	ΣM_{sf}	1.640
Time	Increment	0.000	End time	2592
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8479
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	185.9 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up $0.500*10^{-6}$ times)

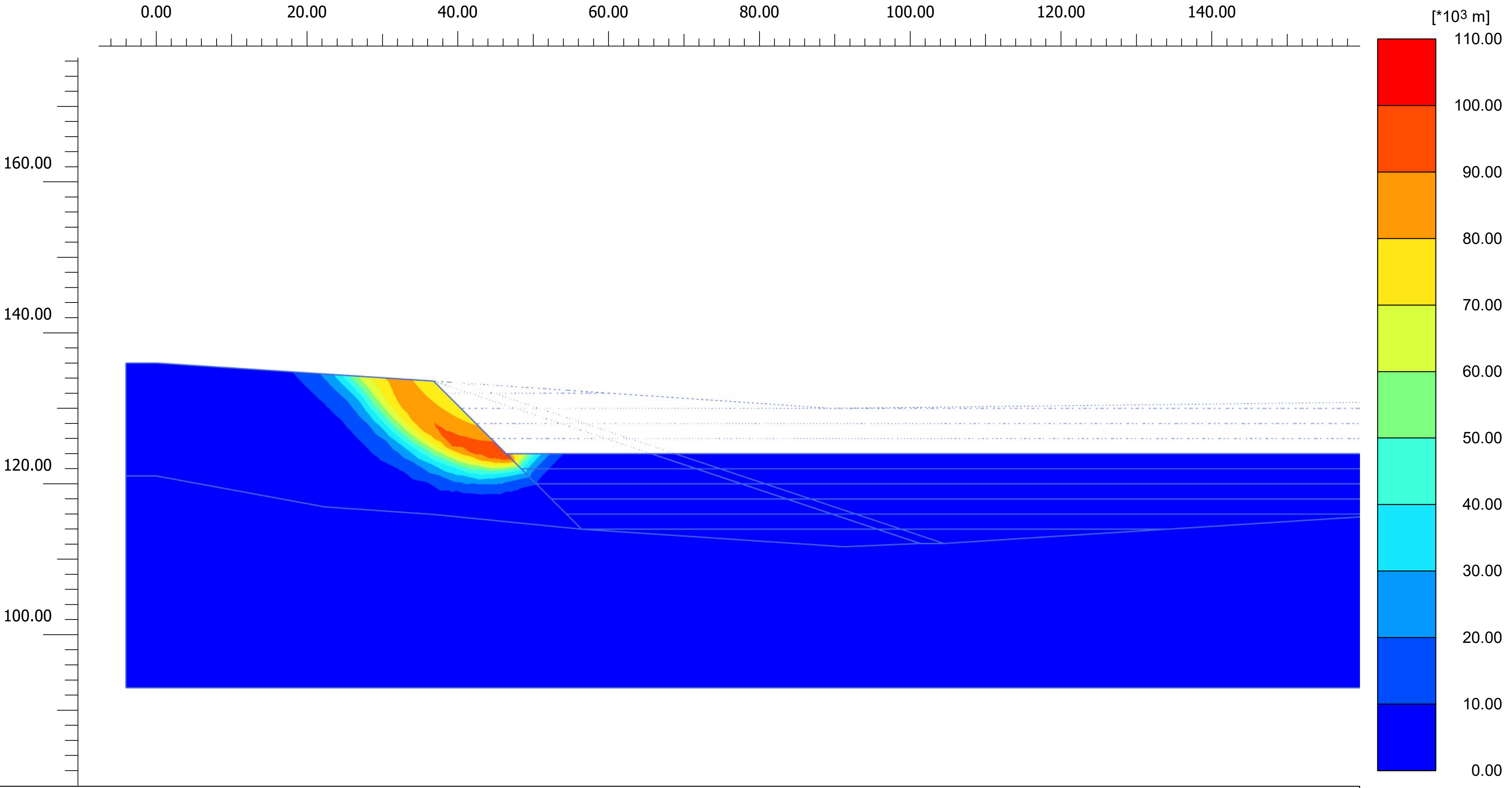
Maximum value = $15.53*10^{6}$ m (Element 1153 at Node 17383)

Project description	*Date*
Husbands Bosworth	28/04/2022

Project filename	*Step*	*Company*
Husbands Bosworth No Drain ...	2051	Sirius Environmental Ltd

Step info				
Phase	ECLL6S [Phase_51]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-0.2392E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.09523E-3	ΣM_{sf}	1.514
Time	Increment	0.000	End time	2597
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8484
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	135.6 kN/m^2			

Output Version 21.1.0.479



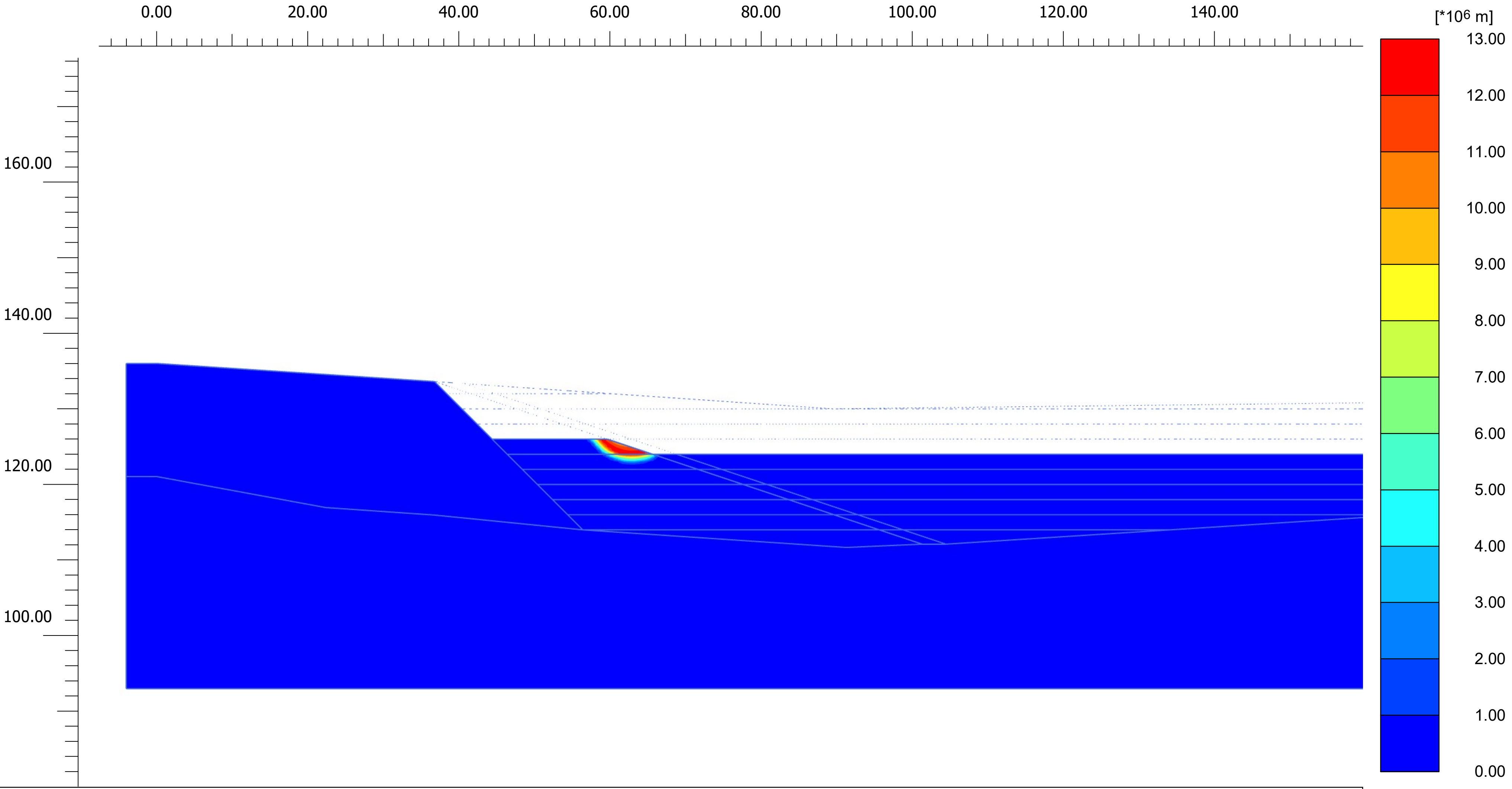
Incremental displacements |Δu| (scaled up 0.0500*10^{-3} times)

Maximum value = 100.4*10^{3} m (Element 626 at Node 18141)

Sirius Environmental	*Project description* Husbands Bosworth			*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 1951	*Company* Sirius Environmental Ltd	

Step info				
Phase	WL6S [Phase_50]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	0.04968E-12			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.01330E-3	ΣM_{sf}	2.321
Time	Increment	0.000	End time	2780
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8847
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	30.52E3 kN/m^2			

Output Version 21.1.0.479



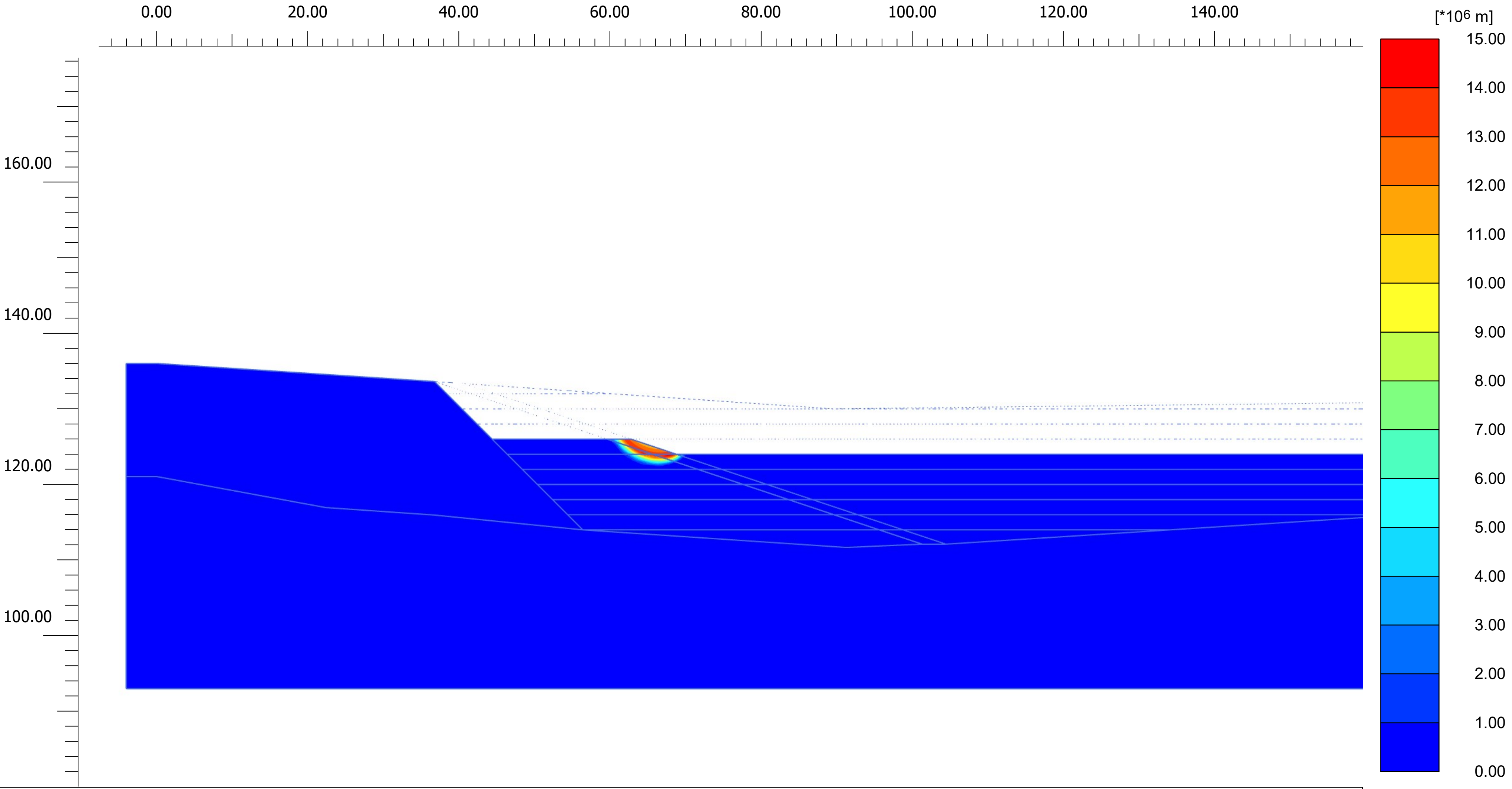
Incremental displacements |Δu| (scaled up 0.500*10^-6 times)

Maximum value = 12.91*10^6 m (Element 860 at Node 18963)

Sirius Environmental	*Project description* Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 1851	*Company* Sirius Environmental Ltd

Step info				
Phase	BL7S [Phase_49]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	-0.3926E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.7547E-3	ΣM_{sf}	1.670
Time	Increment	0.000	End time	2790
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8877
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	224.5 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up $0.500*10^{-6}$ times)

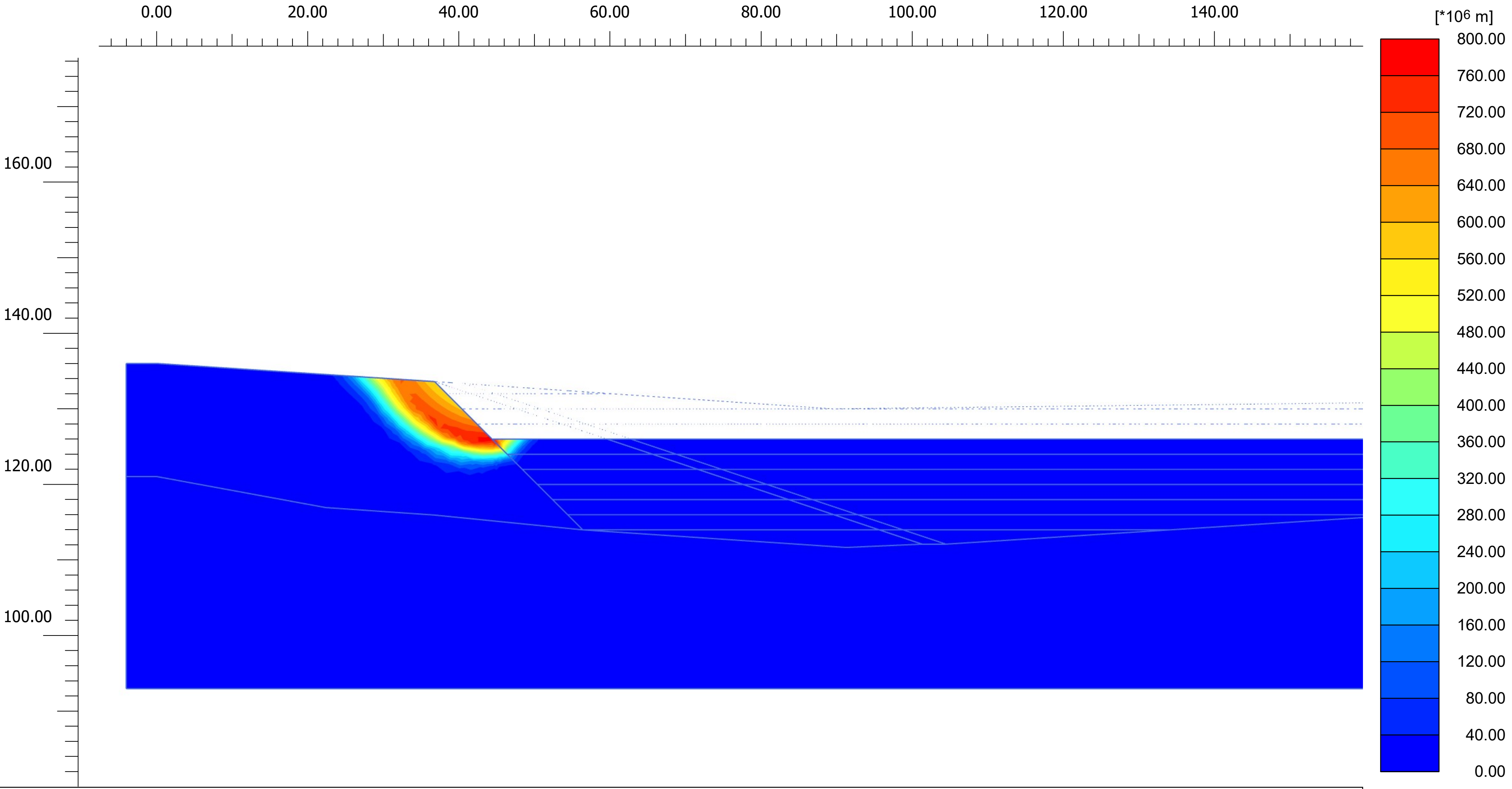
Maximum value = $14.19*10^{6}$ m (Element 865 at Node 18563)

Project description		Date
Husbands Bosworth		28/04/2022

Project filename	Step	Company
Husbands Bosworth No Drain ...	1751	Sirius Environmental Ltd

Step info				
Phase	ECLL7S [Phase_48]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	0.8105E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-1.851E-3	ΣM_{sf}	1.531
Time	Increment	0.000	End time	2795
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.8882
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	131.4 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 0.0100*10^{-6} times)

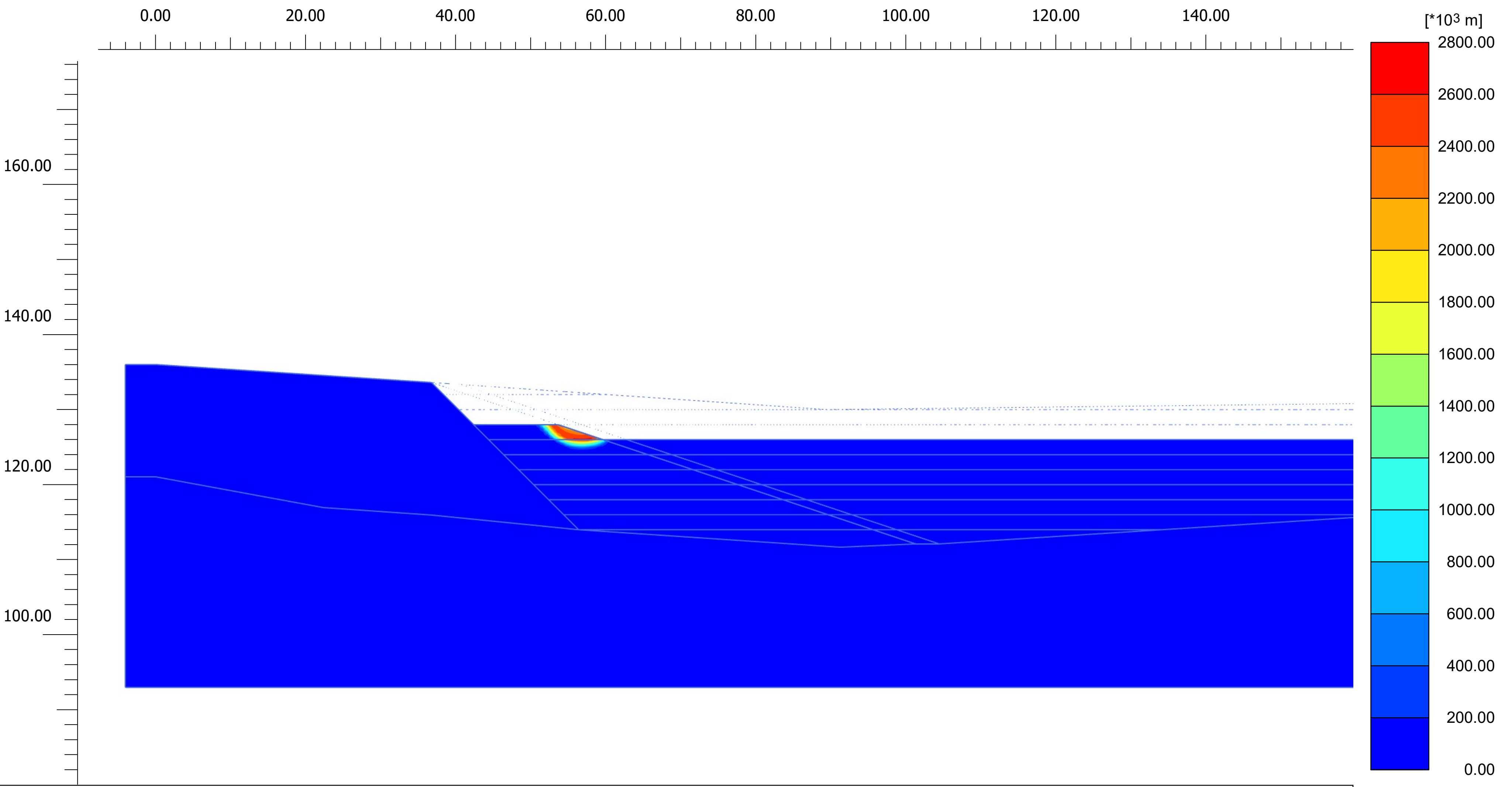
Maximum value = 789.7*10^{6} m (Element 618 at Node 18221)

Project description		*Date*
Husbands Bosworth		28/04/2022

Project filename	*Step*	*Company*
Husbands Bosworth No Drain ...	1651	Sirius Environmental Ltd

Step info				
Phase	WL7S [Phase_47]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	0.03156E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.1449E-3	ΣM_{sf}	2.618
Time	Increment	0.000	End time	2977
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9228
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	7403 kN/m^2			

Output Version 21.1.0.479



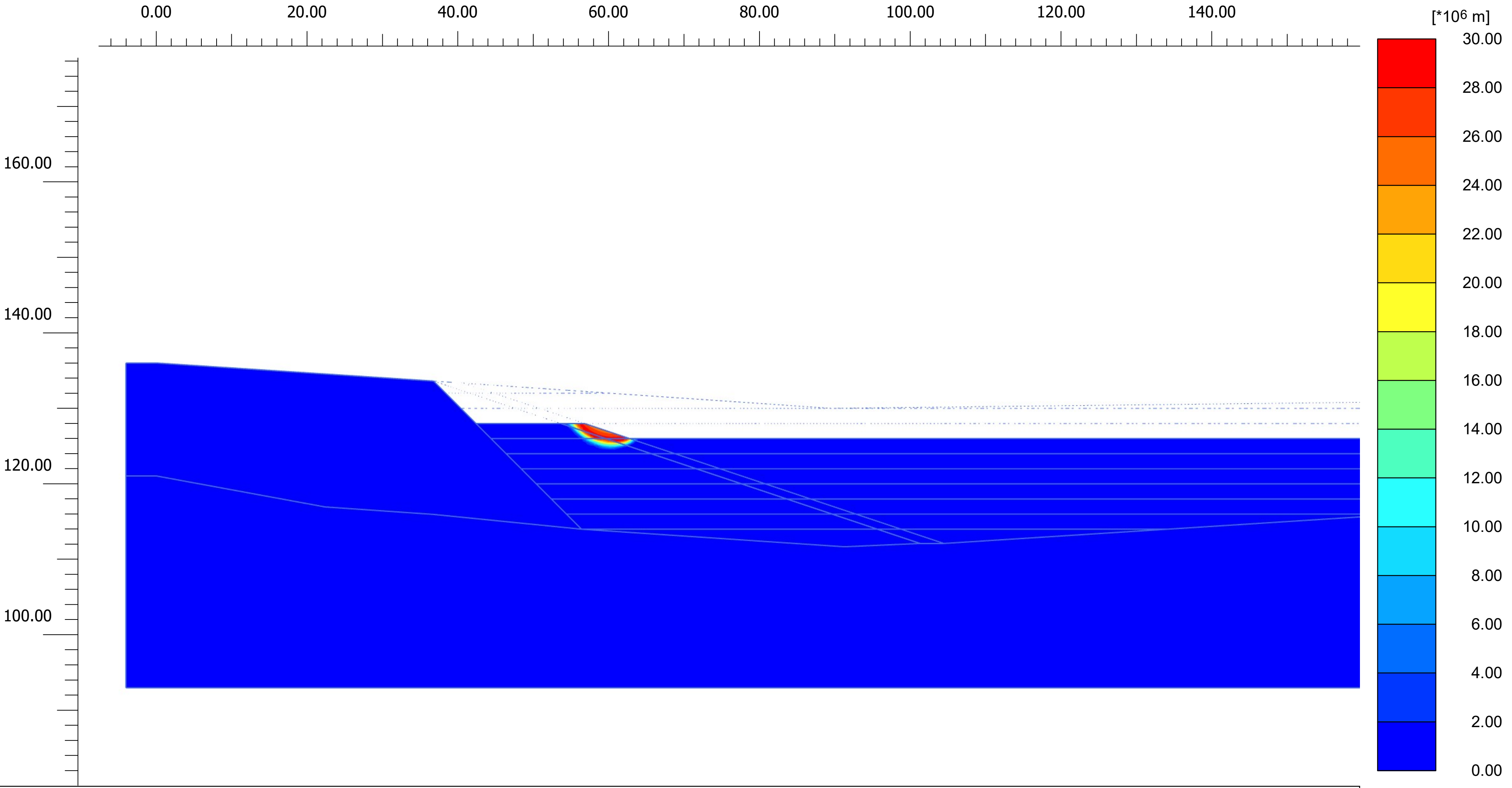
Incremental displacements |Δu| (scaled up $5.00*10^{-6}$ times)

Maximum value = $2.666*10^{6}$ m (Element 588 at Node 19032)

Sirius Environmental	*Project description* Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 1551	*Company* Sirius Environmental Ltd

Step info				
Phase	BL8S [Phase_46]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	0.08680E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.1745E-3	ΣM_{sf}	1.690
Time	Increment	0.000	End time	2987
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9251
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	259.7 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 0.500*10^{-6} times)

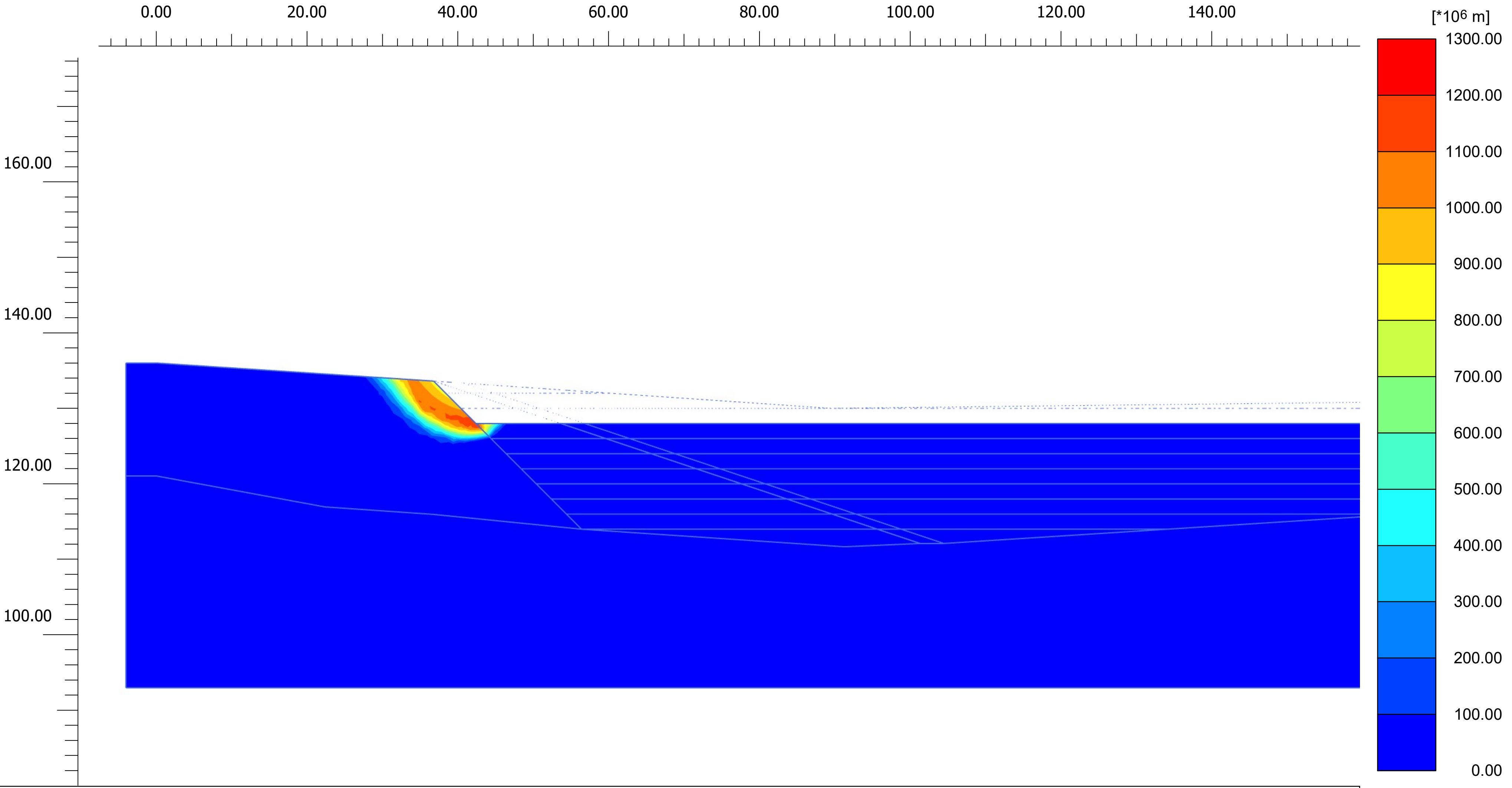
Maximum value = 29.83*10^{6} m (Element 589 at Node 19039)

Project description		Date
Husbands Bosworth		28/04/2022

Project filename	Step	Company
Husbands Bosworth No Drain ...	1451	Sirius Environmental Ltd

Step info				
Phase	ECLL8S [Phase_45]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-0.3405E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.05714E-3	ΣM_{sf}	1.567
Time	Increment	0.000	End time	2992
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9256
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	143.5 kN/m^2			

Output Version 21.1.0.479



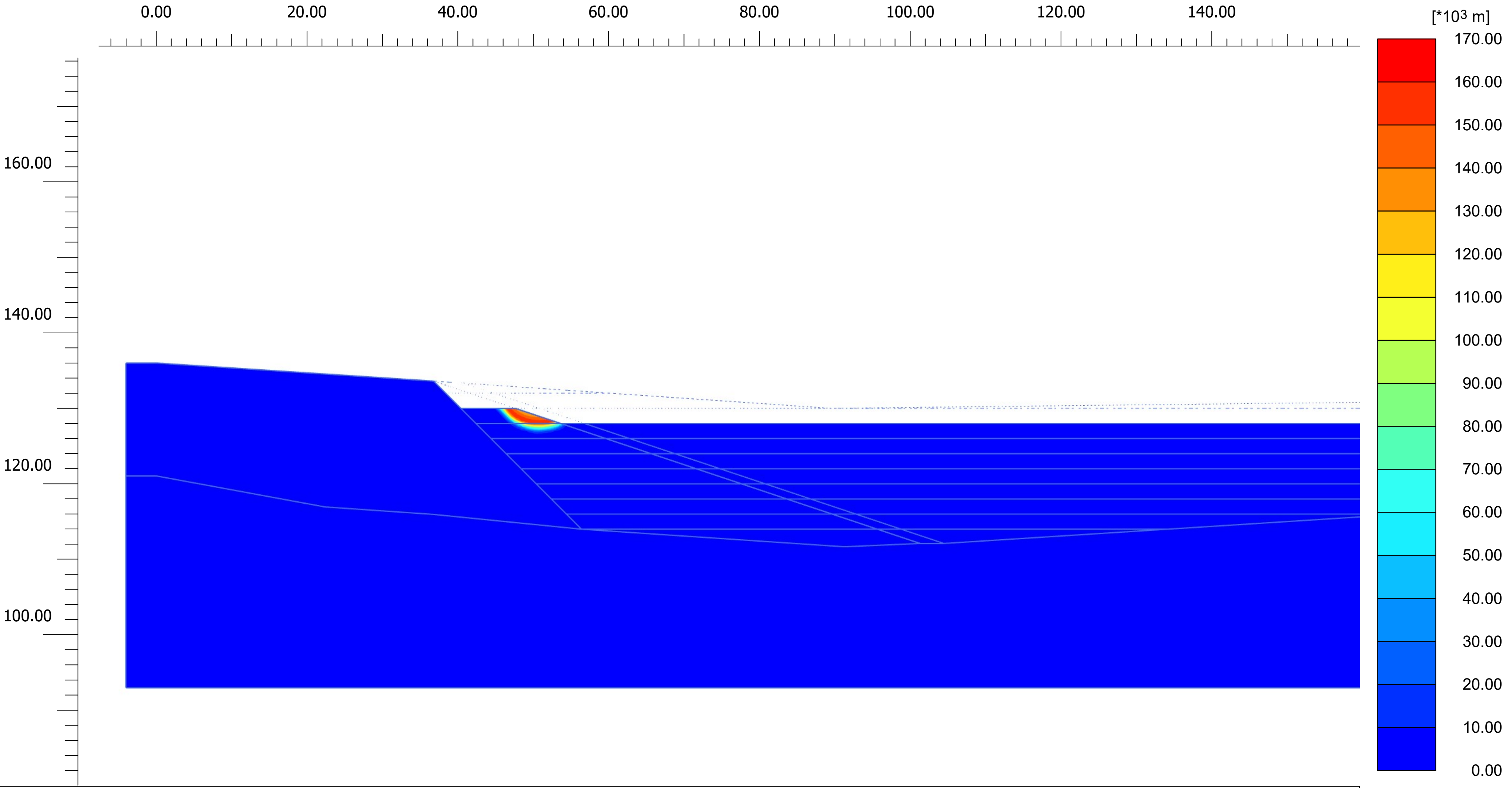
Incremental displacements |Δu| (scaled up $5.00*10^{-9}$ times)

Maximum value = $1.204*10^{9}$ m (Element 575 at Node 18237)

Project description Husbands Bosworth			*Date* 28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 1351	*Company* Sirius Environmental Ltd	

Step info				
Phase	WL8S [Phase_44]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-0.03328E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.7609E-3	ΣM_{sf}	3.154
Time	Increment	0.000	End time	3175
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9573
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	1009 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 0.0500*10⁻³ times)

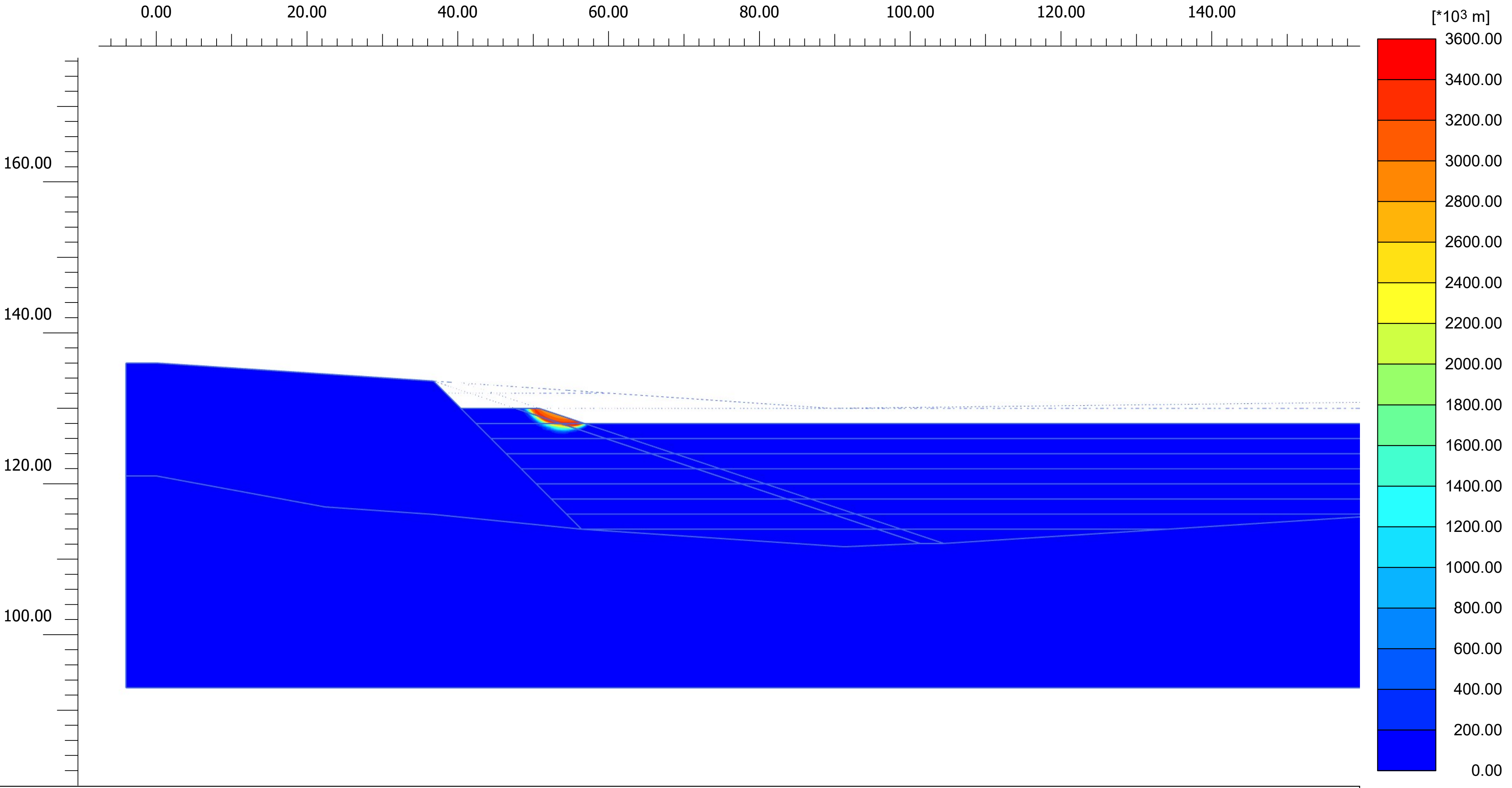
Maximum value = 161.1*10³ m (Element 375 at Node 19233)

Project description Husbands Bosworth			*Date* 28/04/2022
Project filename Husbands Bosworth No Drain ...	*Step* 1251	*Company* Sirius Environmental Ltd	

Sirius Environmental

Step info				
Phase	BL9S [Phase_43]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-4.317E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.2647E-3	ΣM_{sf}	1.705
Time	Increment	0.000	End time	3185
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9588
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	282.9 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 2.00*10⁻⁶ times)

Maximum value = 3.416*10⁶ m (Element 206 at Node 19719)

Project description	Date
Husbands Bosworth	28/04/2022

Project filename	Step	Company
Husbands Bosworth No Drain ...	1151	Sirius Environmental Ltd

Step info

Phase	ECLL9S [Phase_42]
Step	Initial
Calulation mode	Classical mode
Step type	Safety
Updated mesh	False
Solver type	Picos
Kernel type	64 bit
Extrapolation factor	2.000
Relative stiffness	0.2521E-15

Multipliers

Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	1.716E-3	ΣM_{sf}	1.569
Time	Increment	0.000	End time	3190

Staged construction

Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9594
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000

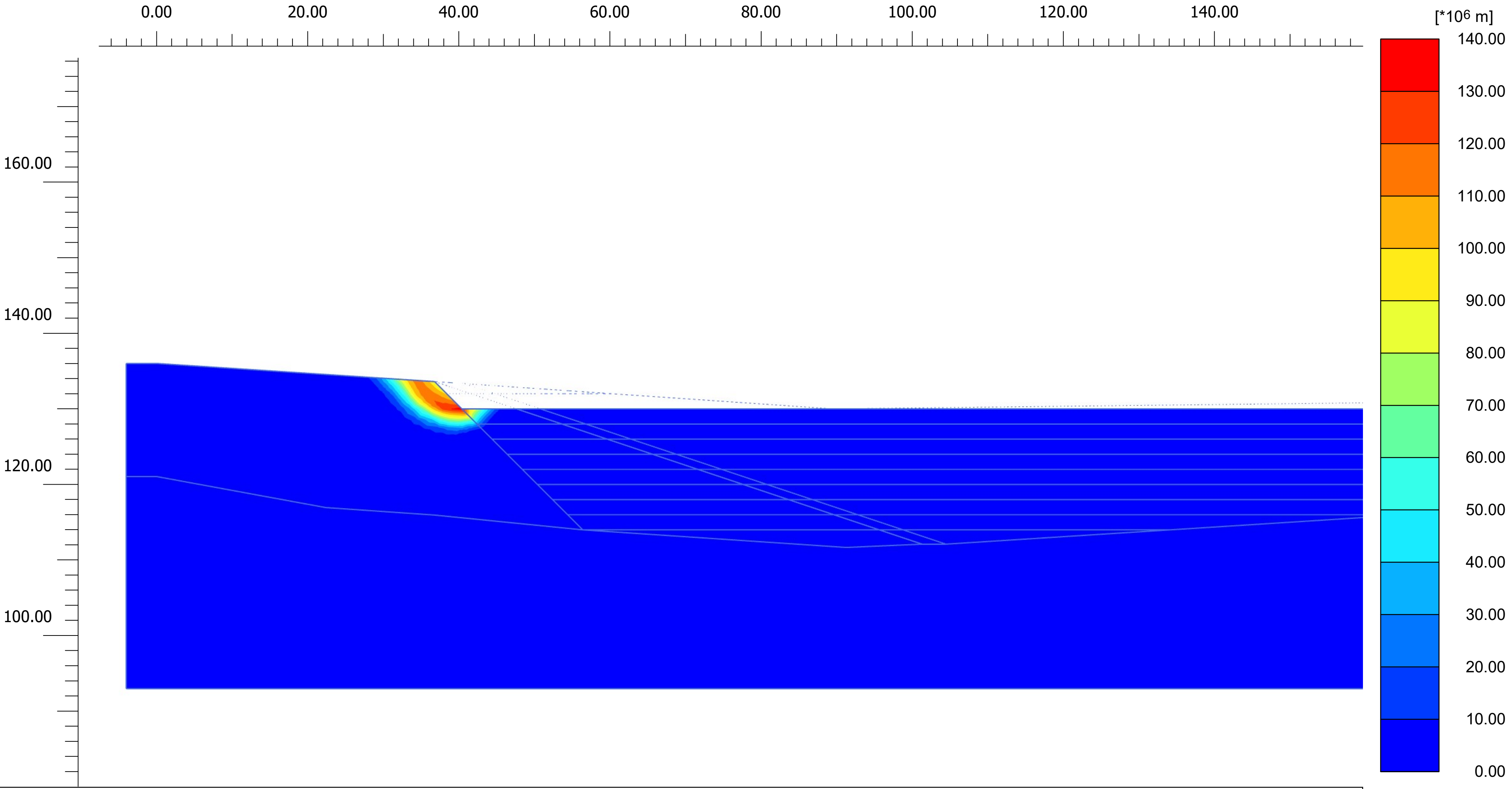
Forces

F_X	0.000 kN/m
F_Y	0.000 kN/m

Consolidation

Realised $P_{Excess,Max}$	234.0 kN/m^2

Output Version 21.1.0.479



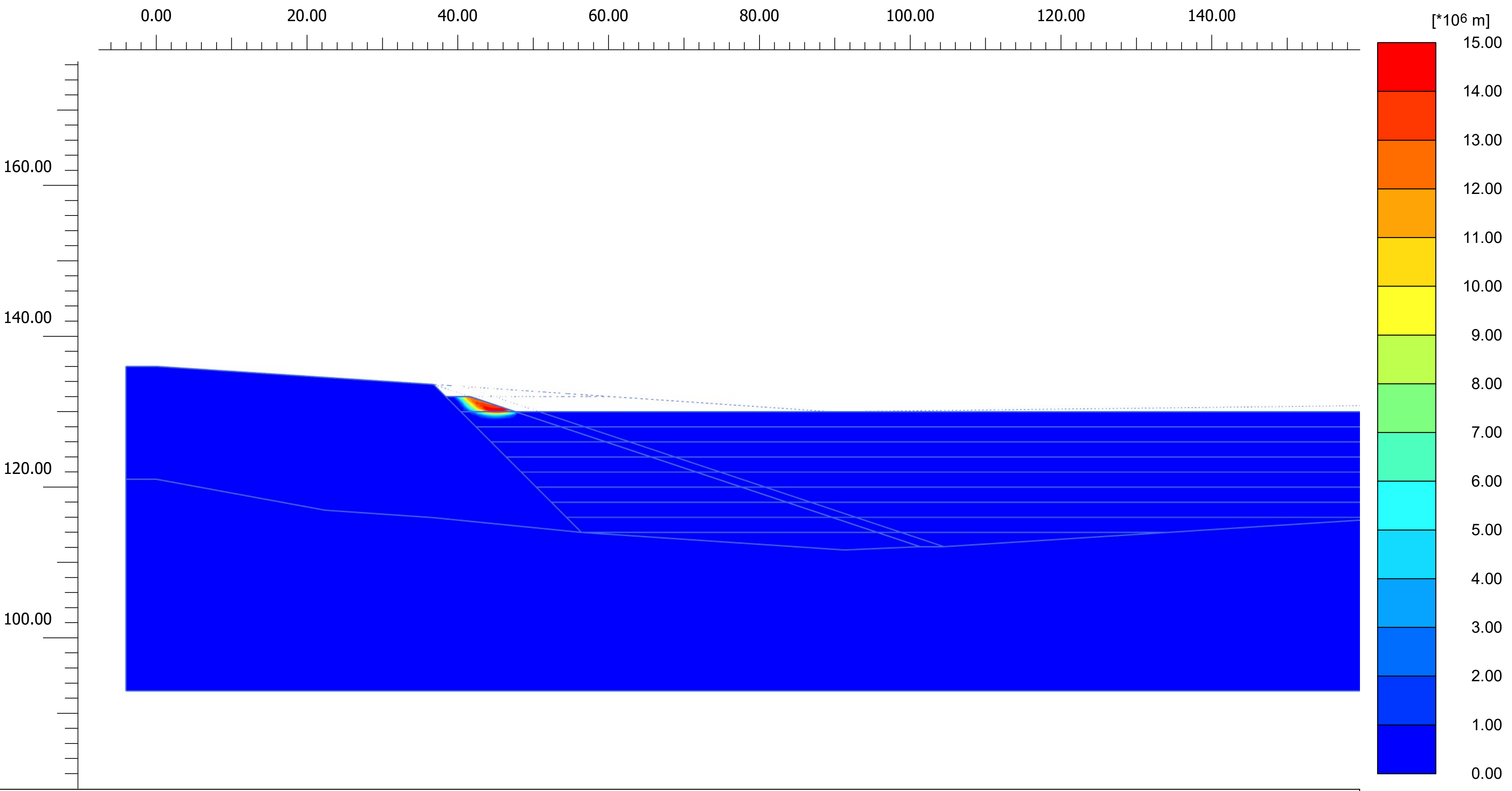
Incremental displacements |Δu| (scaled up 0.0500*10-6 times)

Maximum value = 136.0*10^6 m (Element 370 at Node 18311)

Sirius Environmental	*Project description* Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 1051	*Company* Sirius Environmental Ltd

Step info				
Phase	WL9S [Phase_41]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-0.04298E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	1.355E-3	ΣM_{sf}	4.167
Time	Increment	0.000	End time	3372
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9872
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	2014 kN/m^2			

Output Version 21.1.0.479



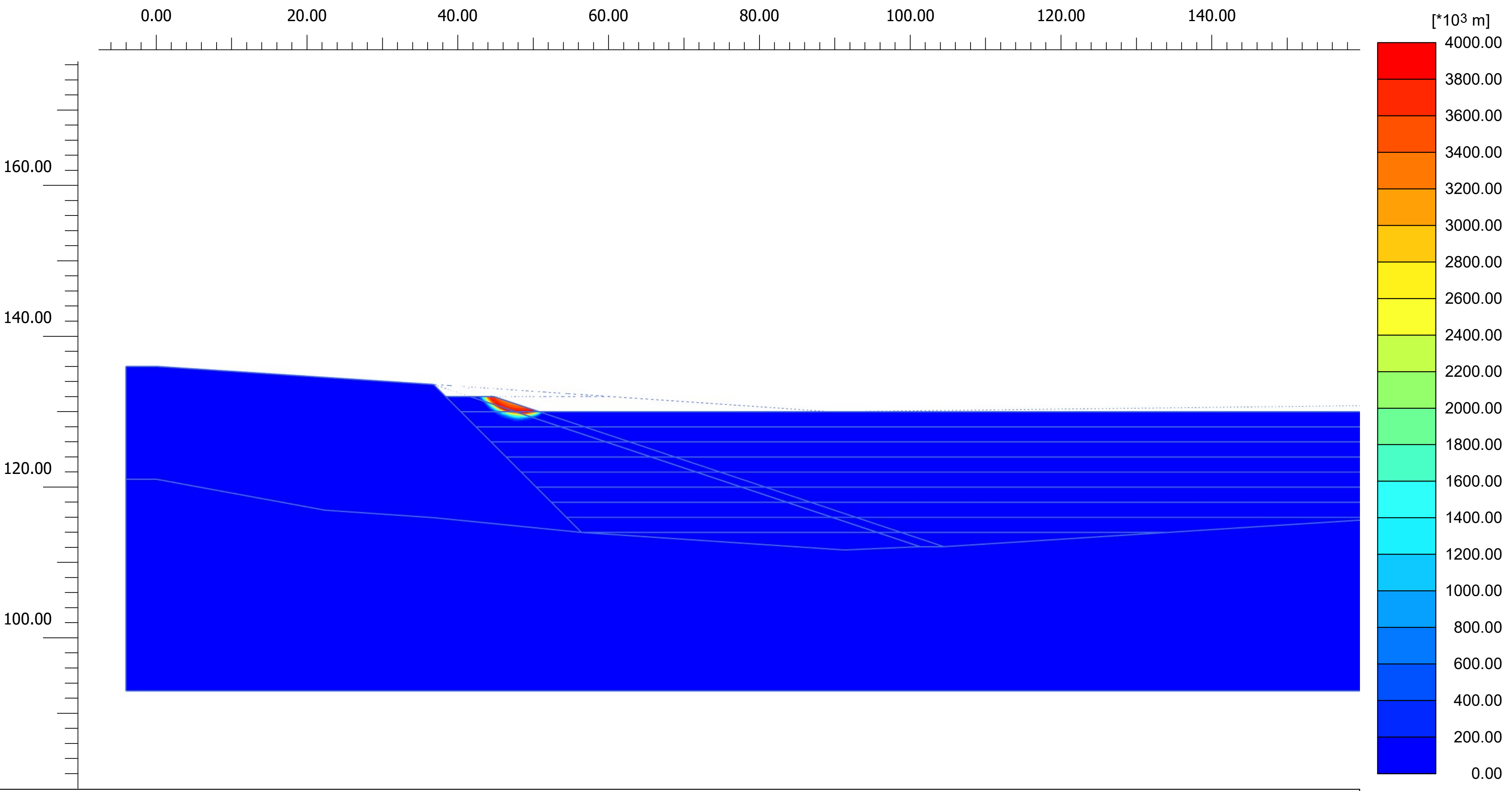
Incremental displacements |Δu| (scaled up 0.500*10^{-6} times)

Maximum value = 14.88*10^{6} m (Element 43 at Node 18646)

	Project description Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 951	*Company* Sirius Environmental Ltd

Step info				
Phase	BL10S [Phase_40]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-0.4848E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.04324E-3	ΣM_{sf}	1.863
Time	Increment	0.000	End time	3382
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9881
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	273.2 kN/m^2			

Output Version 21.1.0.479



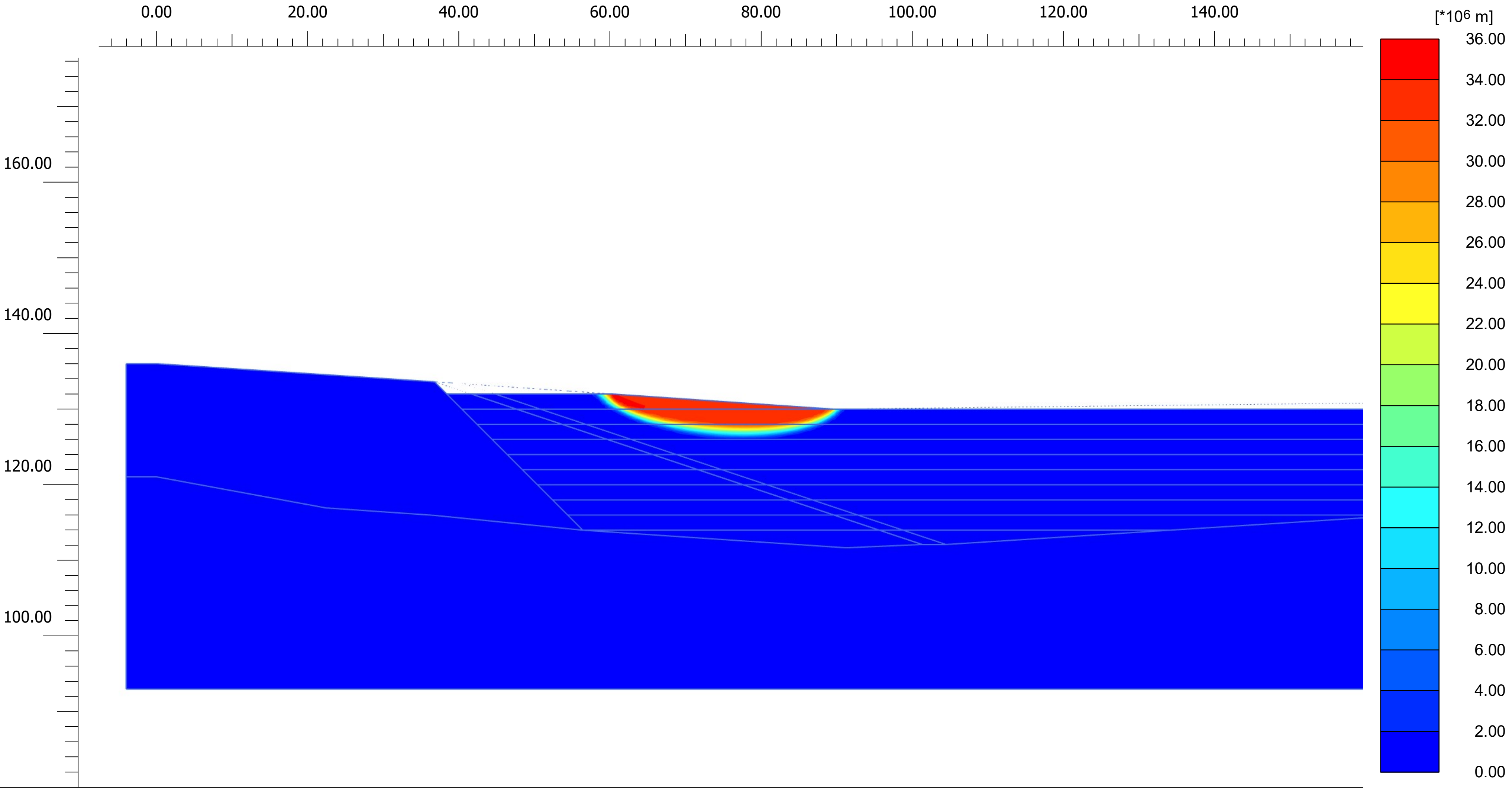
Incremental displacements |Δu| (scaled up $2.00*10^{-6}$ times)

Maximum value = $3.926*10^{6}$ m (Element 39 at Node 19535)

sirius Environmental	*Project description* Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 851	*Company* Sirius Environmental Ltd

Step info				
Phase	ECLL10S [Phase_39]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-0.9471E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	3.377E-3	ΣM_{sf}	1.612
Time	Increment	0.000	End time	3387
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9887
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	234.6 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up $0.200*10^{-6}$ times)

Maximum value = $35.51*10^{6}$ m (Element 48 at Node 20014)

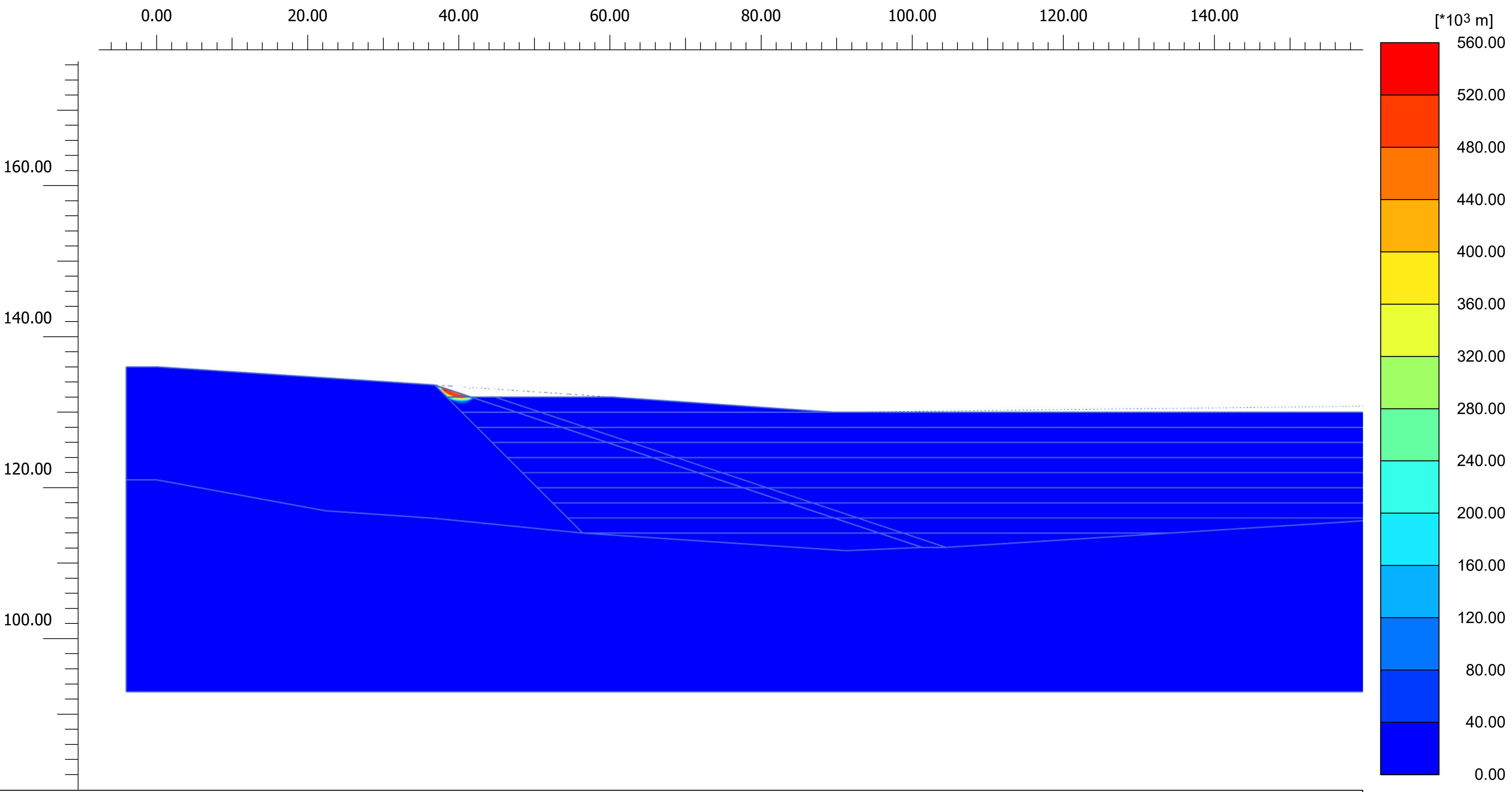
Project description	Date
Husbands Bosworth	28/04/2022

Project filename	Step	Company
Husbands Bosworth No Drain ...	751	Sirius Environmental Ltd

sirius Environmental

Step info				
Phase	WL10S [Phase_38]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	-0.01421E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.1731E-3	ΣM_{sf}	4.103
Time	Increment	0.000	End time	3457
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9933
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	313.7 kN/m^2			

Output Version 21.1.0.479



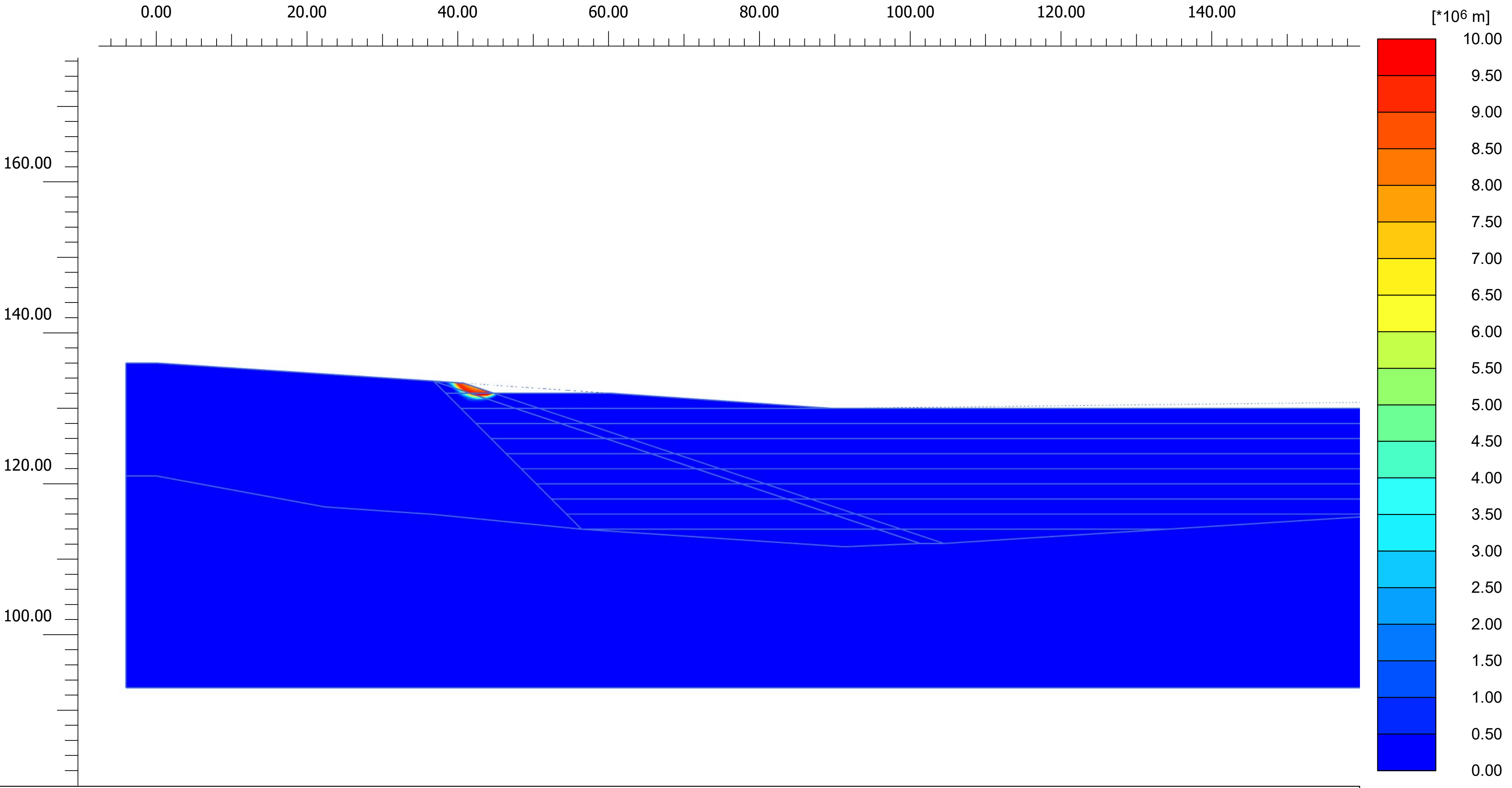
Incremental displacements |Δu| (scaled up 0.0200*10^{-3} times)

Maximum value = 535.1*10^{3} m (Element 9 at Node 17582)

sirius Environmental	*Project description* Husbands Bosworth			*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 651	*Company* Sirius Environmental Ltd	

Step info				
Phase	BL11S [Phase_37]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	1.000			
Relative stiffness	0.5253E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-1.614E-3	ΣM_{sf}	2.823
Time	Increment	0.000	End time	3462
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9935
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	310.7 kN/m^2			

Output Version 21.1.0.479



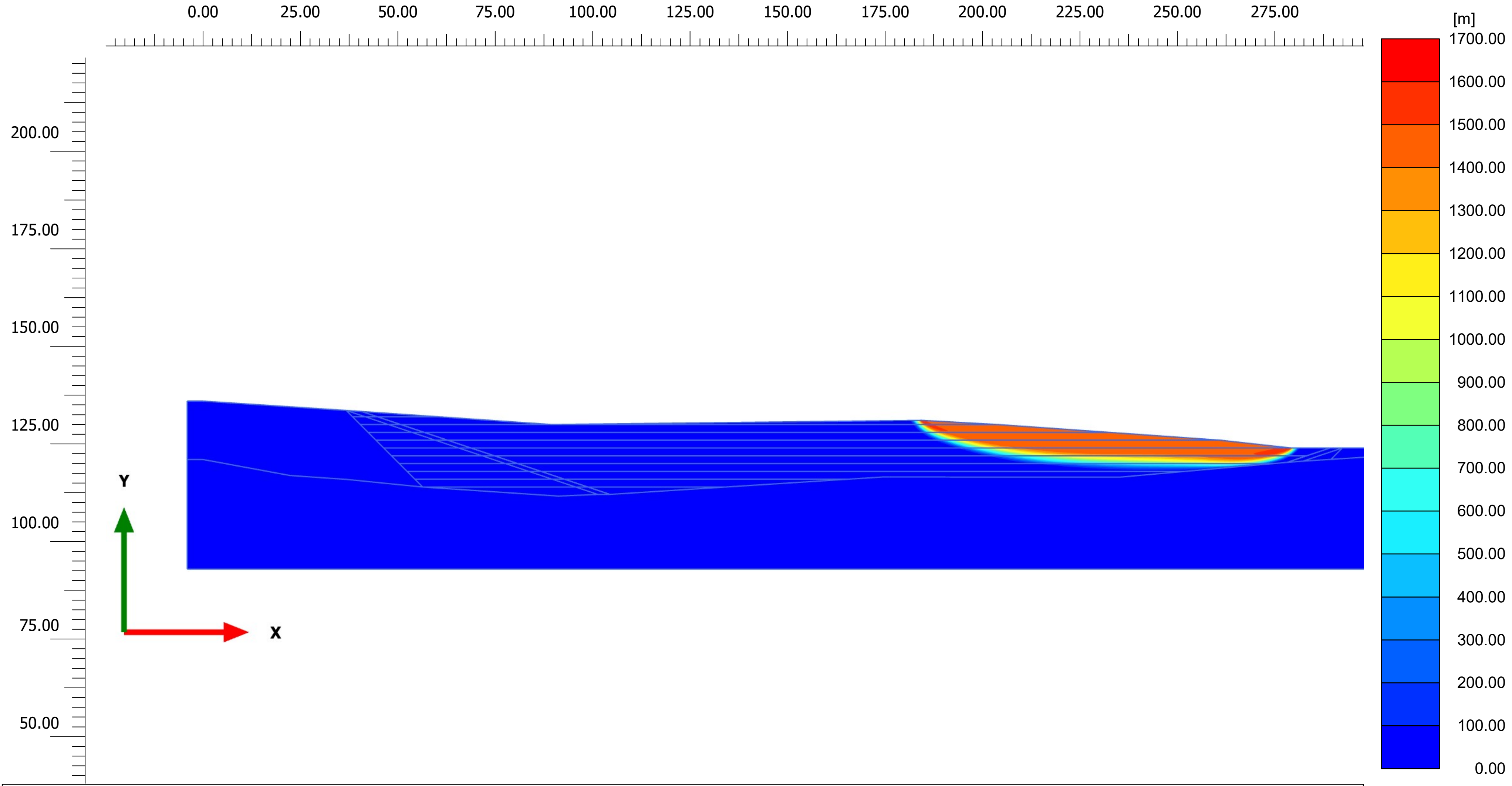
Incremental displacements |Δu| (scaled up $0.500*10^{-6}$ times)

Maximum value = $9.924*10^{6}$ m (Element 4 at Node 18391)

Sirius Environmental	Project description Husbands Bosworth		Date 28/04/2022
	Project filename Husbands Bosworth No Drain ...	Step 551	Company Sirius Environmental Ltd

Step info				
Phase	ECLL11S [Phase_36]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	0.5000			
Relative stiffness	0.05530E-15			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	0.1682E-3	ΣM_{sf}	1.990
Time	Increment	0.000	End time	3464
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	0.9939
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	298.2 kN/m^2			

Output Version 21.1.0.479



Incremental displacements |Δu| (scaled up 5.00*10^{-3} times)

Maximum value = 1614 m (Element 652 at Node 562)

sirius Environmental	*Project description* Husbands Bosworth		*Date* 28/04/2022
	Project filename Husbands Bosworth No Drain ...	*Step* 451	*Company* Sirius Environmental Ltd

Step info				
Phase	WL11S [Phase_35]			
Step	Initial			
Calulation mode	Classical mode			
Step type	Safety			
Updated mesh	False			
Solver type	Picos			
Kernel type	64 bit			
Extrapolation factor	2.000			
Relative stiffness	2.607E-12			
Multipliers				
Soil weight			ΣM_{Weight}	1.000
Strength reduction factor	M_{sf}	-0.3705E-3	ΣM_{sf}	4.484
Time	Increment	0.000	End time	3554
Staged construction				
Active proportion total area	M_{Area}	0.000	ΣM_{Area}	1.000
Active proportion of stage	M_{Stage}	0.000	ΣM_{Stage}	0.000
Forces				
F_X	0.000 kN/m			
F_Y	0.000 kN/m			
Consolidation				
Realised $P_{Excess,Max}$	4295 kN/m^2			